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World Bank Financed Hubei Yichang Three Gorges Modern Logistics Center Infrastructure Project

Environmental and Social Impact Assessment Report

(For Appraisal)

Central-Southern Safety & Environment Technology Institute Co. Ltd.

July, 2016

Name of the Project	World Bank Financed Hubei Yichang Three Gorges Modern Logistics Center Infrastructure Project
Assessed by	Central-Southern Safety & Environment Technology Institute Co. Ltd.
Legal representative	QIAN Bin
Task Team leader	LIU Zhe
Vice-Task Team Leader	SHE Jian
Team Member	KOU Xueyong, LUO Feng, ZHANG Qi
Reviewed and Approved by:	ZHANG Bin

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1 Introduction

1.1 Background

Located in the southwestern Hubei Province, in the middle reaches of Yangtze River, Yichang Municipal has a total population of 4.15 million. The built area of the city is 150 km^2 and has a population of 1.55 million. In 2014, the GDP of this city reached 47.578 billion USD and its public revenue reached 4.123 billion USD. Playing a vital role in the strategy of developing the economic belt along Yangtze River, Yichang Municipal is famous for the transshipment over the Three Gorges Dam and aims to build a logistics center that provides convenient transportation to ports, highways, railways and airports, i.e. to create a logistic corridor between eastern and western China.

The "World Bank Financed Hubei Yichang Three Gorges Modern Logistics Center Infrastructure Project" proposed by Yichang Municipal Party Committee and Government is listed in the "World Bank 2015-2017 Three-Year-Loan Programme Projects List". The total investment of the project is estimated to reach 506.28 million USD and with 200 million USD loan from the World Bank. The development objective of the project is to promote the logistics services and multi-modal transportation along the Yangtze River in Yichang Municipal. The project consists of five components, namely Baiyang Port Operation Area, Baiyang Logistics Park, Road infrastructure, Three Gorges Modern Logistics Information Center and Project management and institutional capacity improvement, including totally 17 sub-components.

Entrusted by Yichang Transportation Investment Co., Ltd., Central-Southern Safety & Environment Technology Institute Co. Ltd. (hereby the EA Consultant) undertaken the Environmental and the social impact assessment of the proposed Project. The EA Consultant visited the site and attended the relevant meeting with PMO and the consultants several times from June 2015. Through on-site survey, about the EA Consultant collected baseline data of the natural environment, identified the sensitive receptors, review the relevant development plans and documents. Based on the EA Guidelines of the China, this project is required to do the additional environmental quality monitoring. Meanwhile, Wuhan Central Quality Test Co., Ltd. (hereinafter referred to as CQT) was entrusted to investigate the groundwater, atmospheric environment, and acoustic environment and pollution sources in the site. This *Environmental Assessment Report* was finished in July 2016.

1.2 Regulatory and legal framework

1.2.1 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) *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;

4) *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;

5) *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;

6) *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;

7) *Water Law of the People's Republic of China*, revised on August 29, 2002, coming into force on October 1, 2002;

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

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

10) Law of the People's Republic of China on the Protection of Wildlife, coming into force on March 1, 1989;

11) *Law of the People's Republic of China on Ports*, June 2003;

12) *Fisheries Law of the People's Republic of China*, October 2000;

13) *Law of the People's Republic of China on Flood Control*, January 1998;

14) *Regulations on the Administration of Construction Project Environmental Protection*, coming into force on November 18, 1998;

15) *Detailed Implementing Rules for the Atmospheric Pollution Prevention and Control Law of the People's Republic of China*, coming into force on July 1, 1991;

16) *Detailed Implementing Rules for the Water Pollution Prevention and Control Law of the People's Republic of China*, coming into force on March 30, 2000;

17) *Regulation on the Implementation of the Water and Soil Conservation Law of the People's Republic of China*, coming into force on August 1, 1993;

18) *Regulation on the Implementation of the Land Administration Law of the People's Republic of China*, coming into force on January 1, 1999;

19) *Regulations of the People's Republic of China on Nature Reserves*, coming into force on December 1, 1994;

20) *Regulation of the People's Republic of China on the Administration of Navigable Waterways*, coming into force on June 3, 1988;

21) *Regulations of the People's Republic of China on the Protection of Basic Farmland*, coming into force on December 27, 1998;

22) *Regulation on Protecting Highway Safety*, coming into force on July 1, 2011;

23) *Regulations of Hubei Province on Administration of Environmental Protection*, coming into force on December 2, 1994;

24) *Ports Administration Measures of Hubei Province*, July 2006;

25) *Regulations of Hubei Province on the Prevention and Control of Atmospheric Pollution* (adopted by the Thirty-one Conference of the Standing Committee of the Eighth People's Congress of Hubei Province on December 3, 1997; revised by the Tenth Conference of the Standing Committee of the Tenth People's Congress of Hubei Province on July 30, 2004);

26) *Regulations of Hubei Province on the Prevention and Control of Water Pollution* (adopted by the Second Conference of the Standing Committee of the Twelfth People's

Congress of Hubei Province on January 22, 2014).

1.2.2 Administration regulations

1) *Regulations for Prevention and Control of Inland Water Pollution from Ships*, issued in 2006, revised in 2015

2) *Catalogue for Guiding Industrial Restructuring (Version 2011)* (Order No. 21 of the National Development and Reform Commission), coming into force on May 1, 2013;

3) *Provisions on the Administration of the Prevention and Control of Pollution in Protected Areas for Drinking Water Sources*, Order No.16 of the Ministry of Environmental Protection;

4) *Measures for the Disclosure of Environmental Information by Enterprises and Public Institutions*, Order No.31 of the Ministry of Environmental Protection, coming into force on January 1, 2015;

5) *Measures for the Investigation and Handling of Environmental Emergencies*, Order No.32 of the Ministry of Environmental Protection, coming into force on March 1, 2015;

6) *Classified Administration Catalogue of Environmental Impact Assessments for Construction Projects*, Order No.33 of the Ministry of Environmental Protection, coming into force on June 1, 2015;

7) *Measures for the Administration of Environmental Emergency Responses*, Order No.34 of the Ministry of Environmental Protection, coming into force on June 5, 2015;

8) *Measures for Public Participation in Environmental Protection*, Order No.35 of the Ministry of Environmental Protection, coming into force on September 1, 2015;

9) *Notice of the Ministry of Environmental Protection on Further Strengthening Environmental Impact Assessment Administration and Preventing Environmental Risks* (No.77 [2012] of the Ministry of Environmental Protection);

10) *Notice of the State Council on Issuing the Plan of National Principal Function Zones* (No. 46 [2010] of the State Council)

11) *Regulations on Formulation, Review and Approval of Soil and Water Conservancy Plan of Projects* (July 8, 2005, Order 24 of the Ministry of Water Resources, revised;

12) *Outline for National Ecological Environment Protection*, November 26, 2000;

13) *Notice on Strengthening the Administration of Hazardous Chemicals* (No. 296 [1999] of the State Environmental Protection Administration) (the State Environmental Protection Administration was renamed Ministry of Environmental Protection in 2008);

14) *Notice on Further Strengthening the Environmental Impact Assessment for Highway and Waterway Transportation Planning* (No. 49 [2012] of the Ministry of Environmental Protection);

15) *Guiding Opinions on Conducting the Pilot Program of Compulsory Liability Insurance for Environmental Pollution* (No. 10 [2013] of the Ministry of Environmental Protection);

16) *Opinions on Strengthening Environmental Protection and Administration in Major National Ecological Function Zones* (No. 16 [2013] of the Ministry of Environmental Protection);

17) *Notice on Strengthening Environmental Impact Assessment for Industrial Park*

Planning (No. 14 [2011] of the Ministry of Environmental Protection);

18) *Notice on Strengthening Environmental Impact Assessment for Protection of Aquatic Organisms* (HF No. 86 [2013] of the Ministry of Environmental Protection)

19) *Guiding Opinions on Promoting Public Participation in Environmental Protection* (No. [2014] 48, General Office of Ministry of Environmental Protection;

20) *Notice on Issuing Guidebook of Government Information Disclosure on Environmental Impact Assessment,* General Office of Ministry of Environmental Protection, November 14, 2013;

21) *Notice on Issuing the Interim Measures for Public Participation in Environmental Protection* (No. 28 [2006] of the State Environmental Protection Administration);

22) *Notice on Issuing the Measures for Recordation Administration of Environmental Emergency Response Plan of Enterprises and Public Institutions (for trial implementation)* (No. 4 [2015] of the Ministry of Environmental Protection);

23) *Notice of the Ministry of Environmental Protection on Better Strengthening Risk Prevention and Tightening up Environmental Impact Assessment Administration* (No. 98 [2012] of the Ministry of Environmental Protection);

24) *Notice of the Ministry of Environmental Protection on Issuing the Interim Measures for Review and Management of Total Emission Control Targets of Major Pollutants in Construction Projects* (No. 197 [2014] of the Ministry of Environmental Protection);

25) *Notice on Promulgating the List of the First Group of Alien Invasive Species of China* (No. 11 [2003] of the State Environmental Protection Administration);

26) *Notice on Promulgating the List of the Second Group of Alien Invasive Species of China* (No. 4 [2010] of the Ministry of Environmental Protection);

27) *Notice of the Ministry of Commerce, Ministry of Public Security, Ministry of Construction and Ministry of Communications on Prohibiting Cast-in-situ Concrete at Urban Area of Cities within Prescribed Time Limit* (No.341 [2003] of the Ministry of Commerce and the National Development and Reform Commission);

28) *Notice of the General Office of the People's Government of Hubei Province on Issuing the Measures for Classified Review and Approval of Environmental Impact Assessment Documents for Construction Projects* (No. 25 [2012] of the General Office of the People's Government of Hubei Province);

29) *Notice on Further Adjusting the Power for Classified Review and Approval of the Environmental Impact Assessment of Construction Projects* (No. 11 [2015] of the Department of Environmental Protection of Hubei Province);

30) *Notice of the General Office of the People's Government of Hubei Province on Forwarding the Provisions of the Department of Environmental Protection of Hubei Province on "Environmental Function Categories of Surface Water in Hubei Province"* (No. 10 [2000] of the General Office of the People's Government of Hubei Province);

31) *Interim Methods for the Monitoring and Management of Ecological Construction Projects for Water and Soil Conservation* (No. 79 of the Construction and Management Department of the Ministry of Water Resources)

32) *Detailed Implementation Rules of Yichang Municipal on the Prevention and Control of Urban Environmental Pollution from Noises*;

33) *Interim Measures of Yichang Municipal on the Management of Smoke and Dust Control Areas* (1989)

34) *Provisions of Yichang Municipal on Pollution Prevention and Control for Protection of Urban Drinking Water Sources* (1995).

1.2.3 Technical specifications

1) *Technical Guidelines for Environmental Impact Assessment – General Provisions* (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 – Groundwater Environment* (HJ610-2011);

5) *Technical Guidelines for Environmental Impact Assessment – Acoustic Environment* (HJ/T2.4-2009);

6) *Technical Guidelines for Environmental Impact Assessment – Ecological Impact* (HJ19—2011);

7) *Technical Guidelines for Environmental Impact Assessment of Construction Projects* (HJ/T169-2004);

8) *Norms of Environmental Impact Assessment for Inland Navigation Construction Projects* (JTJ227-2001);

9) *Norms of Environmental Impact Assessment for Port Construction Projects* (JTS105-1-2001);

10) *Technical Guidelines for the Disposition of Solid Wastes* (HJ2035-2013);

11) *Technical Guidelines for the Prevention and Control of Urban Pollution from Raised Dusts* (HJT393-2007);

12) *Technical Guidelines for the Evaluation of Biological Environment* (HJT192-2006);

13) *Measurement and Calculation Methods of Urban Air Pollutants from Vehicle Emission* (HJ/T180-2005);

1.2.4 Project-related plannings

1) *Master plan of Yichang Navigation Hub*, September 2007;

2) *Three Gorges Hub Port Development Plan (2013-2020)*;

3) *The Twelfth Five-Year Plan for the Modern Logistics Development of Hubei Province*;

4) *Outline of the Twelfth Five-Year Plan for the National Economic and Social Development of Yichang Municipal;*

5) The Twelfth Five-Year Plan for the Water Transportation Development of Yichang Municipal;

6) The Twelfth Five-Year Plan for Overall Transportation Development of Yichang Municipal;

7) *The Twelfth Five-Year Plan for the Modern Logistics Development of Hubei Province (2011-2015)*;

8) *Overall Urban Planning of Yichang Municipal (2011-2030)*;

9) *Master plan for Land Use of Yichang Municipal (2006-2020)*;

10) *Development Plan for Three Gorges Modern Logistics Center (2010-2020)*;

11) *Planning of the Integrated Transport Corridor at Yangtze River Economic Belt (2014-2020)*;

12) *Special Plan for the Adjustment of Yichang Navigation Hub within Main Urban Area*;

13) *Special Plan for the Adjustment of Yichang Navigation Hub within Main Urban Area (2010-2020)*;

1.2.5 Project documents

1) *Letter of Entrustment* by Yichang Transportation Investment Co., Ltd on the Environmental Impact Assessment, November, 2015;

2) *World Bank Financed Hubei Yichang Three Gorges Modern Logistics Center Infrastructure Project Proposal*, T.Y. Lin International, September, 2015;

3) *Response to the World Bank-Funded Hubei Yichang Three Gorges Modern Logistics Center Infrastructure Project Proposal* by Yichang Municipal Development and Reform Commission (Y.F.G. S.P. [2015] 320), on September 13, 2015;

4) *Environmental Impact Report of Yichang Navigation Hub*, Communications Planning and Design Institute, December, 2008;

5) *Feasibility Study Report on the World Bank-Funded Hubei Yichang Three Gorges Modern Logistics Center Infrastructure Project Proposal (Draft)*, T.Y. Lin International, October, 2015;

6) *Feasibility Study Report on the World Bank-Funded Hubei Yichang Three Gorges Modern Logistics Center Infrastructure Project Proposal (Revised Version)*, T.Y. Lin International, June, 2016.

1.2.6 World Bank's safeguard policies

Applicable safeguard policies:

1) Environmental Assessment (OP/BP4.01,1999.1),
2) Natural Habitats (OP4.04, 2001.6).
3) Physical Cultural Resources (OP4.11,1999.8);
4) Involuntary Resettlement (OP4.12, 2001.12)
5) Good Practice Handbook Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets;
6) Environmental, Health, and Safety Guidelines, for Shipping,
7) Environmental, Health, and Safety Guidelines, for Ports, Harbors, and Terminals;
8) Environmental, Health, and Safety General Guidelines;
9) Disclosure of Information (BP17.50, 1993.9).

1.3 Function zoning and applicable standards

Upon initial environmental investigation of project site, and considering the project requirements and the requirement of *Environmental Quality Standard for Noise (GB3096-2008), Technical specifications to determinate the suitable areas for environmental noise of urban area* (GB/T15190-94), and *Notice on Noises of Road and Railway (Light Rail),* the EIA standards are formulated as following:

1.3.1 Ambient air

(1) Quality standard

The quality of the ambient air is Class II, and applies to the requirement of *Ambient Air Quality Standard* (GB3095-2012), Class II, as specified in Table 1.3 - 1.

Table 1.3-1 *Ambient Air Quality Standard* (GB3095-2012)

Pollutant	Sampling time	Class II Standard Value (mg/Nm^3)	Class I Standard Value(mg/Nm^3)
NO_2	per day	0.08	0.08
	per hour	0.2	0.2
SO_2	per day	0.15	0.05
	per hour	0.5	0.15
TSP	per day	0.30	0.12
PM_{10}	per hour	0.15	0.05

(2) Emission standard

The air emission standard applies to *Integrated Emission Standard of Air Pollutants* (GB16297-1996), Class II, as specified in Table 1.3-2. The emission of automobile exhaust applies to *Limits and measurement methods for emission from light-duty vehicles* (China V) (GB18352.5-2013) and *Limits and measurement methods for exhaust pollutants from compression ignition and gas fueled positive ignition engines of vehicles (III, IV, V)* (GB17691-2005).

Table 1.3-2 Integrated Emission Standards of Air Pollutants (GB16297-1996)

Pollutant	Max acceptable emission concentration (mg/m^3)	Max acceptable emission rate (kg/h)		Limit for fugitive emission concentration (mg/m^3)
		Height of exhaust funnel (m)	Class II	
Particulate matter	120	15	3.5	1.0 at boundary
		20	5.9	
		30	23	

Table 1.3-3 Limits on Emission of China 4 and China 5 standards

Pollutant	China V	China IV
NO_X g/km	0.18	0.25

Pollutant	China V	China IV
HC+NO_Xg/km	0.23	0.3
Particulate matter concentration g/km	0.0045	0.025
Particulate matter number (PN) g/km (PN is a new item of China 5)	6.0×10^{11}	-

Explanation: currently Hubei implements China 4 Standard, and China 5 standard will be implemented in January 2017

1.3.2 Acoustic environment

1) Baseline analysis

For roads along the villages, *Environmental Quality Standard for Noise (GB3096-2008) Class I shall apply;* for residential area within 40 m of existing national roads, Class 4a shall apply; for residential area beyond 40 m of existing national roads, Class II shall apply.

2) Impact analysis

For areas near the Yangtze River, certain area within Yangtze River shipping lanes, and for residential area within 40m of National Highway 318, Class 4a shall apply; for residential area beyond 40m, Class II shall apply; for areas bordering the Logistics Park, *Emission Standard for Industrial Enterprises Noise at Boundary* (GB12348-2008) Class III shall apply; for sensitive points outside boundary, Class II shall apply. Refer to 1.3-4~1.3-6 for standard values.

Table 1.3-4 Environmental Quality Standards for Noise (GB3096-2008), dB(A)

Class	Day time	Night time	Applicable area
2	60	50	Residential area
3	65	55	Industrial area
4a	70	55	Certain areas along major roads

During construction, *Emission standard of environment noise for boundary of construction site* (GB12523-2011) shall apply (See Table 1.3 -5).

Table 1.3-5 Emission Standards for construction site Noise at Boundary (GB12523-2011), dB(A)

Noise limits	
Day time	Night time
70	55

Table 1.3-6 Emission Standards for Industrial Enterprises Noise at Boundary (GB12348-2008), dB(A)

Class	Daytime	Nighttime	Applicable area
2	60	50	Residential area
3	65	55	Industrial area
4a	70	55	Certain areas along major roads

1.3.3 Water environment

(1) Environmental quality standards

According to Document E.Z.B [2000] No. 10, the quality of the water body of Zhijiang Section of Yangtze River is Class III. The standard values are shown in Table 1.3 - 7.

Table 1.3-7 Environment Quality Standard of Surface Water (GB3838-2002), mg/L (except for pH)

No.	Item	Ⅲ
1	pH	6 ~ 9
2	BOD_5 ≤	4
3	DO≥	5
4	COD≤	6
5	TP (P value) ≤	0.2
6	NH_3-N	1.0
7	Oil≤	0.05

(2) Discharge standard of pollutants

a) Industrial and domestic wastewater

The domestic wastewater produced during project implementation will be used for fertilizing farmlands after being disposed in septic tank; industrial wastewater produced during project implementation will be recycled after oil segregation and precipitation; wastewater generated during project operation will be discharged to sewage plants through urban sewage pipelines. *Integrated Waste Water Discharge Standard (GB8978-1996)* Class III shall apply for waste water discharge. Standard values are listed in Table 1.3-8.

Table 1.3-8 Integrated Waste Water Discharge Standard (GB8978-1996)

Standard No.	Title	Class	Pollutants	Standard value (mg/L)
GB8978-1996	*Integrated Waste Water Discharge Standard (GB8978-1996)*	Class III	pH	6 ~ 9
			SS	400
			BOD_5	300
			COD	500
			Oil	20
			Animal and vegetable oil	100
			NH3-N	/
			LAS	20

b) Waste water discharged by vessels arrived at the port

For the waste water discharge of vessels arrived at the port, *Effluent Standard of Pollutants from Ship* (GB3552-83) shall apply. Standard values are shown in Table 1.3-9.

Table 1.3-9 Effluent Standards of Pollutants from Ship (GB3552-83) Unit: mg/L

No.	Item	Discharge concentration and regulations

No.	Item	Discharge concentration and regulations
1	Oily water from vessels	Oil ≤15
2	BOD	BOD_5≤50
3	SS	SS≤150
4	Food or other wastes	Shall not be discharged in water

1.4 Evaluation factors and scope

1.4.1 Identification of environmental impact

The key factors and types of impacts of this project are identified based on project scale, implementation technologies, and types, distribution and control measures of pollutants, as shown in Table 1.4-1.

Table 1.4-1 Identification of environmental impacts

Evaluation period	Evaluation factor		Indexes					Remark
			Possibility	Degree	Duration	Scope	Reversibility	
Construction phase	Natural environment	Surface water	－－	－	－	－	Reversible	a) "+": positive impact; "—": negative impact; "□": no impact b) Description of impacts "+": possibility: small; degree: small, duration: short; scope: small; "++": possibility: large; degree: large, duration: long; scope: large; " — ": possibility: small; degree: small, duration: short; scope: small; " — — " possibility: large; degree: large, duration: long; scope: large;
		Ambient air	－－	－	－－	－	Reversible	
		Noise	－－	－	－－	－	Reversible	
		Land resources	－	－－	－－	－－	Irreversible	
	Ecological environment	Terrestrial organisms	－–	－–	－–	－–	Irreversible	
		Aquatic animals and plants	－－	－－	－	－	Reversible	
	Social environment	Transportation	－	－	－	－		
		Socio-economy	++	+	+	++		
		Job Opportunities	++	+	+	+		
Operation phase	Natural environment	Surface water	－－	－－	－－	－－	Reversible	
		Ambient air	－－	－	－－	－－	Reversible	
		Noise	－－	－	－	－	Reversible	
	Ecological environment	Land resources	□	□	□	□		
		Terrestrial organisms	－－	－－	－－	－－	Reversible	
	Social environment	Aquatic animals and plants	++	++	++	++		
		Transportation	++	++	++	++		
		Socio-economy	++	++	++	++		

1.4.2 Screening of evaluation factors

The environmental impact evaluation factors are identified based on environment baseline research and identification of environmental impacts of the project as well as contrast study with similar projects. The pollution factors and evaluations factors are shown in Table 1.4-2.

Table 1.4-2 Identification of pollution factors and evaluation factors

Evaluation period	Environmental elements	Pollution factor	Evaluation factor
Construction period	Air	TSP, NO_2, SO_2	TSP
	Water	SS, COD, BOD_5, NH_3-N, oil	SS, COD, BOD_5, NH_3-N, oil
	Noise	Transportation or mechanical noises	L_{eq}(Equivalent continuous A-weighted sound level)
	Solid waste	Construction wastes and domestic wastes	Construction wastes and domestic wastes
	Ecological environment	Vegetation and aquatic ecosystem	Vegetation and aquatic ecosystem
Operation period	Air	TSP, PM_{10}, NO_2, SO_2	TSP, PM_{10}, NO_2, SO_2
	Water	River regime, hydrology, flood control, COD, oil	River regime, hydrology, flood control, COD, oil
	Noise	Transportation or mechanical noises	L_{eq}(Equivalent continuous A-weighted sound level)
	Solid waste	Ship waste, land-based domestic and industrial waste, hazardous wastes	Ship waste, domestic waste, hazardous waste
	Ecological environment	Impact on aquatic ecosystem	Aquatic ecosystem
	Environmental emergency accident	Oil leakageing	Oil

1.4.3 Evaluation factors

See Table 1.4-3 for evaluation scope.

Table 1.4-3 Evaluation scope

Evaluation factor	Evaluation scope
Surface water	Water area of 5.0 km from Berth 13# downstream
Air	Circular area with D10% as radius or 2.5km as radius, centering Baiyang Port Land-based Operation Area
Noise	Sensitive receptors between 1- 200m outside project boundary
Acoustic environment	Land area is project area and a scope of 300m outside project area; evaluation scope of water area and surface water
Environmental risks	Water area of 5.0 km from Berth 13# downstream
Social environment	Area directly impacted by the project

1.5 Relationship with relevant planning

1.5.1 Urban Master Planning of Yichang Municipality (2011- 2030)

According to the requirements of *Urban Master Planning of Yichang Municipality (2011-2030)* revised in 2011, the Three Gorges Pivotal Port is a comprehensive port for industrial output, Three Gorges tourism, and access to the sea in the western direction. It has functions of materials loading, unloading as well as storage, transshipment over dams and multi-modal transport, Port development zone, industrial output, tourism, etc. According to function zoning and layout, there are 6 port areas in the along the Yangtze River in Yichang Municipal, i.e. Zhongxingshan Port District, Zigui Port District, Major urban port district, Changyang Port District, Yidu Port District, Zhijiang Port District.

Major urban port district provides industrial and living services, and its major operation area includes Taipingxi Operation Area, Baiyang- Yunchi Operation Area. The Yunchi - Baiyang Operation Area will be mainly responsible for logistics transshipment, and also an important multi-purpose Port Operation Area. Transhipment over dam is mainly conducted in Taipingxi

Operation Area, Baiyang - Yunchi Operation Area, Tianjiahe Operation Area, Maoping Operation Area, Honghuatao Operation, and Zhicheng Operation Area. Moreover, Baiyang - Yunchi Operation Area, Tianjiahe Operation Area, Zhicheng Operation Area and Qixingtai Operation Area will be mainly for industrial output; Baiyang - Yunchi Operation Area, Tianjiahe Operation Area and Zhicheng Operation Area will be mainly for access to sea.

1.5.2 Development Planning for Three Gorges Modern Logistics Center (2010 - 2020)

To accelerate the construction of Yangtze River Waterway Shipping System, enhance the transportation capacity and efficiency, and faster up the construction of Three Gorges Logistics Center, the *Development Planning for Three Gorges Modern Logistics Center (2010—2020)* is formulated by Comprehensive Transportation Institute,National Development and Reform Commission. The Center aims to promote Three Gorges Navigation Hub and shipping capacity, so as to enhance the shipping capacity of the Yangtze River Waterway Shipping System and become a vital regional logistics hub of the country.

It plans to build up 9 comprehensive logistics parks including Yunchi- Baiyang Logistics Park, urban distribution center, and transportation infrastructure system. The Project is located in the Baiyang Logistics Park and Baiyang Port Operation Area in the Baiyang Industrial Park, Yichang Hi-Tech Industries Development Zone. Based on the transportation advantages, and Baiyang Port Operation Area will play a vital role as regional logistics hubs, and they will also promote the construction of Yichang Three Gorges Modern Logistics Center.

1.5.3 The Twelfth Five-Year Plan for Developing Hubei Modern Logistics

The *Twelfth Five-Year Plan* for Developing Hubei Modern Logistics (2011-2015) is formulated by Hubei Provincial Development & Reform Committee to guide the development of Hubei's modern logistics. A comprehensive network of "Logistics Circle (Belt) - Key Logistics Cities - Logistics Nodes - Logistics Center" will be built during the twelfth five years. Wuhan Logistic Circle (Belt) centers at Wuhan City and radiates to neighboring cities. It includes the Eco-cultural Tourism Circle in Western Hubei centering the two sub-center cities of Hubei - Yichang Municipal and Xiangyang, which radiates to the western and surrounding areas of Hubei Province; it also includes the Yangtze River Logistics Belt that radiates the surrounding areas of Yangtze River. In short, Wuhan is a national logistics node, while Xiangyang and Yichang are the regional logistics nodes and the other 14 cities are key logistics nodes.

The planning requires Yichang Municipal to take full advantage of its shipping and transportation advantages to develop itself into a regional logistics center that integrates railway, waterway, highway and airway transportation, so as to provide efficient logistics services, particularly for industries such as the agricultural product and by product processing, power sector, chemical industry, food, medicine, equipment manufacturing, tourism, etc., and realize segmented transportation as well as direct transportation. This project will effectively promote the transshipment over the Three Gorges Dam. The Baiyang Logistics Center will become a pivotal logistics node of Yichang Municipal.

1.5.4 Master planning of Yichang Navigation Hub and special planning on adjustment to Major urban port district

(1) Master planning of Yichang Navigation Hub

Yichang Navigation Hub is a major inland port of China, and a vital transportation hub in the middle and upper reaches of Yangtze River for exchange of goods of Yichang City and the neighboring cities. It also plays a vital role for the economic and social development as well

as water tourism of the city. Yichang Navigation Hub will actively develop freight transport, and promote services of logistics, bonded warehousing services and trade, etc., to develop itself into a modernized multi-purpose port and the portside region into an industrial park.

Currently Yichang has plans out 72 port line along Yangtze River and its major branches, with a total length of 104,780 m, of which 32,960 m has already been in use.

Yichang Navigation Hub will develop into six port districts: Major urban port district, Zigui port district, Xingshan port district, Yidu port district, Zhijiang port district, and Changyang port district. Among them, Major urban port district is the main body of Yichang Navigation Hub, and it contributes to the export-oriented economic development, riverside industrial development, urban construction and resources development of Yichang City and neighbouring cities. It also provides transshipment services over the Three Gorges Dam. Major urban port district mainly undertakes transportation of trade containers, non-metal ores, mineral building materials, manufactured goods, passengers. The major urban district includes Taipingxi working area, Binjiang working area, Linjiangping working area, Gulaobei working area, and Yunchi working area. Zigui port district is located in Zigui County, along the reservoir area of Three Gorges Project, and it mainly provides services for transshipment of the reservoir area, such as transportation of passengers, miscellaneous accessories and ro-ro cargo. Xingshan port area is located in the backwater area of Xiangxi River of the reservoir area of Three Gorges, and it mainly provides transportation services of passengers, Phosphate, coal, cement, hazardous goods and miscellaneous accessories. The proposed Baiyang Port is under the Main Urban Ports District. It is located in the Baiyang Industrial Park. Its function is mainly a container transferring hub. The industrial park includes port operation, logistics and storage, and trade and commerce subareas etc. Supported by the Yichang-to-Zhangjiajie Express Way, State Road G318 and Ziyun Railway, the park can provide integrated services for port loading/unloading, logistics, storage and processing. Yidu port district is located in the right bank of Yangtze River of Yidu city, and mainly provides transportation services of coal, non-metal ores and other bulk goods. Changyang port district is located along Qingjiang in Changyang County, and it mainly transports coal, cement and passengers. Moreover, Yichang Navigation Hub also outlines several wharfs to provide services for tourism in counties and villages to promote tourism development.

(2) Special planning on adjustment to Major urban port district of Yichang Navigation Hub (2010-2020)

In order to better meet needs of economic and social development of Yichang Municipal, support development of industrial park, portside industry layout and urban construction, Yichang Administration for Port and Waterway led the preparation of *Special Planning on Adjustment to Major urban port district of Yichang Navigation Hub* (2010-2020). This planning makes partial adjustment to planning and layout of operation areas and working points in Major urban port district from such two major aspects as utilization of shoreline resources and overall arrangement of port district in accordance with new reality of economic and social development of Yichang Municipal and its new requirements on construction and development of Major urban port district under the premise of not exerting substantive impact on nature and function of Yichang Navigation Hub, division and functional orientation of various port districts that are described in reply to *Master plan of Yichang Navigation Hub*.

In order to support development of Baiyang Industrial Park, the riverbank of upper section of Baiyang, namely the riverbank from the location which is 600 meters in upper reaches of Yangjiazui to the location which is 600 meters in lower reaches of Yangjiazui, and the riverbank of lower section of Baiyang, namely the riverbank from the location which is 1000

meters in upper reaches of Guixihu to the location which is about 2,500 meters in lower reaches of Kubaxi, are increased as riverbank of port.

1.6 Comparison and gap analysis with World Bank standards

All the applicable domestic laws, regulations, technical standards, specifications, and related documents of this project have been listed and explained in section 1.2. The differences between domestic EIA system and that of the World Bank policies have been well studied[1] by others. Due to limits in project schedule and budget, we will only focus on the Chinese laws and standards that are most important and relevant to this project and those that have not yet been compared against WB policies and standards.

1.6.1 Regulations on Prevention and Control of Pollution of Inland Waterway

The domestic regulation applicable regarding ports and ships environmental management is the *Management Regulations on Prevention and Control of Pollution of Inland Waters Environment from Ships*. It was first issued as an order (Order No. 11, 2015) from the Ministry of Transportation (MOT). As the original order cannot cope with the new situation, MOT revised it and approved it in the 25th session of ministry meeting on December 15, 2015. It became effective on May 1, 2016. The main contents related to the project are as follows:

(1) Objectives of the regulations

To prevent and control the pollution of inland waters from ships and their operational activities, and protect the environment of inland waters;

(2) Managing authorities

The Ministry of Communications is in charge of the management of the nationwide prevention and control of the pollution of inland waters from ships and their operational activities.

The National Maritime Administration is responsible for supervision and management of the nationwide prevention and control of pollution of inland waters from ships and their operational activities.

The maritime administrative institutions are specifically responsible for the supervision and management of the prevention and control of the pollution of inland waters from ships and their operational activities within the jurisdictional area in accordance with their respective duties and powers.

(3) Responsibilities of the operating and management bodies

Ports, wharves, loading and unloading stations as well as units engaged in ship building, repairing and dismantling overwater, salvage and other operating activities shall be equipped with corresponding facilities which remain in sound conditions for pollution prevention and control with relevant national norms and standards (such as ***Port Construction Project Environmental Impact Assessment Specification*** **(JTJ105-2011),** ***Regulations on the Prevention of Environmental Pollution by Ship Scrapping, Port Engineering Environmental Protection Design Specification*** **(JTS149-1-2007),** *Management Regulations*

1. X. Ren, Implementation of Environ Impact Assessment in China, *Journal of Environ Assessment Policy and Management* (Eng), Imperial Colleague Press, No.3, V15, 2013

on the Prevention of Environmental Pollution from Scrapping, Supervision and Management Regulations on Ship Disassembling of the Ministry of Communications of People's Republic of China). The units with the same port, harbor district, operation area or adjacent port can realize the unified deployment of the facilities, installations and equipment for pollution prevention and control by building defense mechanisms.

Ports, wharfs and loading/unloading stations should receive ship pollutants generated in the process of the production and operation of the wharfing ships.

Operators of ports, wharfs and loading/unloading stations as well as related operating units should formulate emergency plan on the prevention and control of the pollution of inland waters from ships and their operational activities, and organize at least one emergency drill every year and keep record.

According to Article 10, the maritime administrative institutions should be consulted in advance and issue navigational notices (warnings) for units that establish special protected waters. The units that have established special protected waters shall also equip facilities for receiving and disposing ship pollutants.

The ships that sail, berth and operate in special protected waters shall comply with the provisions and standards relating to anti-pollution in special protected waters.

(4) Emission and reception of ship pollutants

Article 13: the ships that sail, berth and operate in inland waters shall not discharge pollutants into inland waters against the laws, administrative regulations, norms, standards and regulations of the Ministry of Communications. The ship pollutants that do not meet the emission regulations shall be received and disposed by the ports, wharfs, loading and unloading stations or qualified units.

Ships shall be prohibited from discharging noxious liquid substances and residues or ballast water, tank washings or other mixtures containing such substances into inward waters.

Ships shall be prohibited from using incinerator in inland waters.

Ships shall be prohibited from using soil leakage dispersant in inland waters.

Article 15: Litter Notices should be set up in ships with a length of and over 12m to inform the crew and passengers about waste management requirements.

Ships of and over 100 tonnage as well as ships that carry 15 and above staffs on single voyage more than two kilometers or voyage time more than 15 minutes shall hold *Ships Waste Management Plan* and *Ships Waste Record Book* endorsed by the maritime administrative institutions, and the waste collection and disposal process shall be recorded in *Ships Waste Record Book* according to the facts and specifications. *Ships Waste Record Book* should be readily available for inspection, and retained on board for 2 years after use.

The waste collection and disposal process of ships besides the second provision in the article should be recorded in the Log Book.

Article 16: The discharge of waste from ships to inland waters is prohibited. Ships shall be equipped with waste storage containers or carrying bags with a lid and without leakage or spill, and the waste generated shall be classified, collected and stored according to the *Ships Waste Management Plan*.

When a ship discharges wastes containing toxic and hazardous substances or other dangerous ingredients into port reception facilities or commissions the reception by ships pollutant

receiving unit, the name, nature and quantity of the materials contained in such waste shall be provided in advance.

Article 17: When ships sail on inland waters, the use of sound equipment shall be subject to the specifications, and comply with requirements on the prevention and control of noise pollution.

Article 18: The fuel used by ships should comply with the relevant laws, regulations and standards. Use of clean energy is encouraged in ships.

Ships shall not discharge exhaust gas generated during operation of the power plant and volatile organic compounds generated from ships to the atmosphere that exceed standard limits.

Article 19: Ships waste, ballast water, sewage and other ships pollutants from infected areas shall not be received and disposed until they pass the quarantine inspection.

Article 20: Ship pollutants receiving unit shall issue pollutants reception and disposal documents after the reception of pollutants, and transfer the ship pollutants received to the relevant units ashore for disposal in accordance with the regulations.

Contents such as the name of the operation parties, the start and end time of the operation, location, and types and quantity of pollutants shall be indicated on the ship pollutants reception documents, which shall be confirmed by the signature of the ship party. The ship pollutants reception documents and relevant record book shall be kept together for future reference.

(5) Emergency disposal of ship pollution

Ship pollution emergency disposal is provided in the fifth chapter:

Article 32: The maritime administrative institutions shall cooperate with the local people's government to formulate the ship pollution emergency plans and carry out emergency disposal.

Article 33: When the pollution accidents occur on the ship, the ship party should immediately report the facts to the nearest maritime administrative institution, and start pollution emergency plan or program as well as take appropriate measures to control and eliminate the pollution. After the initial report, the ship party should also provide a supplementary report in accordance with the progress of the pollution accidents.

The maritime administrative institution shall immediately verify the situation after receiving the report, and report to its superior maritime administrative institution and the local people's government at or above the county level according to the provisions. The maritime administrative institution and relevant units shall carry out appropriate emergency disposal according to the division of responsibilities under the unified leadership and command of the local people's government.

(6) Annex

Article 54: If the provisions related to the prevention and control of pollution from ships in border waters are inconsistent with the international conventions and agreements China has concluded or acceded, the latter shall apply.

1.6.2 The World Bank regulations

The World Bank policies and standards regarding ports and navigations are reflected in the EHS guidelines discussed below.

(**1) EHS guidelines for ports, harbors and wharfs**

"**EHS guidelines for ports, harbors and wharfs**" applies to the commercial ports and wharfs for freight and passenger transport, which mainly contains two important problems: environmental problems and occupational health and safety.

1) Environmental problems

The environmental problems in the construction and operation of ports and wharfs include:

Dredged materials management, biodiversity, atmospheric emissions, general waste reception, waste water, noise, solid waste management, hazardous materials and oil management

2) Occupational health and safety

The occupational health and safety problems in the construction and scrap of the ports are as same as the majority of large infrastructure and industrial facilities, the prevention and control of which can be seen in the "General EHS Guidelines". The occupational health and safety problems related to port operations include: physical hazards, chemical hazards, enclosure space, exposure to organic and inorganic dust, and exposure to noise.

(2) EHS guidelines for shipping

"**EHS guidelines for shipping**" includes the information about ships during the operation and decommissioning, which mainly contains two problems: environmental problems and occupational health and safety.

1) Environmental problems

The environmental problems in the construction and operation of ports and wharfs include:

Dredged materials management, biodiversity, atmospheric emissions, general waste reception, waste water, noise, solid waste management, hazardous materials and oil management

2) Occupational health and safety

Occupational health and safety problems include: bad accommodation and workplace of the staff, physical hazards, narrow space, chemical hazards (including fire and explosion risk) and security issues.

1.6.3 Gap analysis

Management Regulations on Prevention and Control of Pollution of Inland Waters Environment from Ships are stipulated from the perspective of the managers, which are macroscopic. And they mainly manage wastewater, solid waste and accidents, without a mention of the workers' health and safety management. They emphasize the track record; the management time is mainly the operation period; and they include pollution control of the operations of both the ships and wharfs.

On the other hand, World Bank Guidelines both emphasize environmental problems and human health and safety. As for environmental problems, they mainly stipulate and explain from the operability of environmental elements, and put more emphasis on the main responsibility of the operating ship, while the operation subjects such as the wharfs shall also set up the appropriate facilities to meet the environmental needs of the parked ships. The management cycle includes both the construction and operation period, and the whole process is managed.

Both Regulations and World Bank guidelines encourage the centralized disposal of waste water and waste ashore, reflecting the large-scale, centralized, economy-oriented, efficiency-oriented principles.

Both attach great importance to accident risk management and emphasize the importance of prevention. Specifically, World Bank guidelines emphasize regular exercising, while the *Regulations* emphasize the emergency management and regional coordination of the administrative departments.

Regulations are catching up with the international conventions, particularly in the management of waste water, waste gas and solid waste. The Annex clearly states: If the provisions related to the prevention and control of pollution from ships in border waters are inconsistent with the international conventions and agreements China has concluded or acceded, the latter shall apply.

The instruction described in the preface of the Guidelines:

When applying EHS Guidelines, the problems should be flexibly handled in accordance with the hazards and risks identified in each project on the basis of the results of the environmental assessment, and the specific variables of the site (for example, the specific circumstances and the absorption capacity of the environment of the host country) and other factors of the project should be taken into account. Whether the specific technical recommendations are applicable should be decided by the professional opinions of qualified and experienced personnel.

When national standards differ from the standards and measures specified in EHS Guidelines, the more demanding one shall prevail. If it is believed that it's suitable to adopt less demanding targets and measures compared to the provisions in the EHS Guidelines according to the specific circumstances of the project, detailed demonstration on the proposed alternative solution is needed in the environmental assessment of the site. The demonstration should demonstrate that the revised targets can protect human health and the environment.

EHS Guidelines indicate that the ports are different from the traditional industries in that there are few fixed sewage emission sources (wastewater and rainwater) in the port, so that most of the waste gas and water are difficult to be continuously monitored. Please refer to the General EHS Guidelines for the emission quality of sanitary wastewater and rainwater. 1. As for the combustion source associated with steam and power generation activities, if its capacity is equal to or less than 50 MW thermal powers, then its emission standard is contained in the "General EHS Guidelines". If its capacity is large, then its emission standard is contained in the "Thermal Power EHS Guidelines". Please refer to the "General EHS Guidelines" for guidance on how to determine the environmental impact based on the total release of waste gas.

1.6.4 Comparison with General EHS Guidelines

Both the World Bank and China adopt the principle of implementing stricter applicable standards in the application of environmental regulations and standards. The project must comply with the requirements of both domestic and foreign standards, so that it is necessary to compare and analyze the two sets of regulations and standards.

1.6.4.1 Air-related standards

The evaluation cycle of ambient air quality in the "Ambient Air Quality Standard" (GB3095-2012) and the "General Guidelines" are different (for example, hourly average, daily average and annual average), so that the data can't be compared and analyzed one by one. The division of the "Ambient Air Quality Standard" (GB3095-2012) is clearer. Some of the locations of the project are within nature reserves, scenic spots, forest parks and other special protected areas, which regard the protection of the ecology as the main object, therefore, the primary standard of "Ambient Air Quality Standard"(GB3095-2012) should be

implemented here, the overall concentration limit of which is even stricter than that of the ambient air quality guidelines of the World Health Organization (WHO); the surrounding villages and residential area of the project area regard the protection of human health as the main object, and the secondary standard of the "Ambient Air Quality Standard" (GB3095-2012) should be implemented here according to the executive standard, some of whose indicators are generally less demanded than those of the ambient air quality requirements of the WHO, but are in line with the requirements of the local ambient air function zoning. If high standard is adopted anywhere, from the perspective of economy, substantial financial and material resources are required, and from the perspective of technique, it's difficult to implement. Ambient air is a regional problem, so it's not so operable to implement area control only in this project. Therefore, the implementation of the "Ambient Air Quality Standard" (GB3095-2012) in the ambient air quality of the project can meet the air quality requirements in the project area.

As the construction and operation of the project have little impact on the ambient air and the pollutants are mostly discharged randomly, the disorganized emission targets in the *Air Pollutant Emission Standards* (GB16297-1996) are more representative and targeted. However, the emission standards of the unorganized emission of air are not provided in the "General Guidelines". Compared with the emission standards of small combustion facilities, the emission standards of "Air Pollutant Emission Standards" (GB16297-1996) are stricter, so that "Air Pollutant Emission Standards" (GB16297-1996) can be implemented in the air pollutant emissions in the project.

1.6.4.2 **Water-related standards**

Compared with the EHS Guidelines, *Surface Water Environmental Quality Standards* (GB3838-2002) and *Groundwater Environmental Quality Standards* (GB/T14848-93) divide different quality standards for different water bodies, which are more targeted, and a variety of water quality indicators are quantified for monitoring and evaluation, so that *Surface Water Environmental Quality Standards* (GB3838-2002) and *Groundwater Environmental Quality Standards* (GB/T14848-93) are implemented in the water environmental quality of the project.

Compared with the sewage disposal discharge standards in the "EHS General Guidelines", the targets in the "Pollutant Emission Standards for Municipal Wastewater Disposal Plant" (GB18918-2002) are stricter. The targets are divided into primary A and B at the same time, which are more targeted. The sewage disposal plant takeover standard is implemented in the project, which is not comparable and is more conform to the requirements of the region.

1.6.4.3 **Noise-related standards**

Compared with EHS General Guidelines, *Acoustic Environmental Quality Standards* (GB3096-2008) is more detailed and specific; meanwhile, the class 0, 1, 2 standards implemented in the project are stricter compared with general EHS Guidelines, and class 4a standard is only implemented in special areas like both sides of the main lines, which is more in line with the local conditions. Therefore, the "Acoustic Environmental Quality Standards "(GB3096-2008) is implemented in the sound quality of the project.

Compared with the EHS General Guidelines, *Environmental Noise Emission Standards for Construction Site* (GB12523-2011) is more specific to implement in the construction site.

2 Project Description

2.1 General introduction

World Bank Financed Hubei Yichang Three Gorges Modern Logistics Center Infrastructure Project is located in Baiyang Industrial Park, Yichang Hi-tech Industry Development Zone. The project consists of the following components: Baiyang Port Operation Area, Baiyang Logistics Park, Road Infrastructure, Three Gorges Modern Logistics Information Center and Project Management & Organizations Capacity Building. The project area is in Baiyang Town, Zhijiang City, which is to the east of the central urban area of Yichang Municipal and on the northern bank of Yangtze River. The project has total investment of 3.019 billion RMB, including 200 million USD of World Bank load which is equivalent to 1.27 billion RMB (at exchange rate of 1:6.35) and is 42% of total investment, 851.2 million RMB of capital fund, which is 28% of total investment, and 898 million RMB of loan from domestic bank, which is 30% of total investment. Figure 2.1-1 shows the location of the project.

The planned project duration is expected 4 years from July, 2016 to December, 2020 in the feasibility study report, as detailed in Table 2.1-1. Meanwhile, the project schedule will be specified and updated on the Bank's implementation Stage. The location map is shown in the Figure 2.1-1, and the communication map is shown in the Figure 2.1-2.

Table 2.1-1 Project Schedule

Project component	Schedule
Infrastructure of Port and Operations Area	38 months from July, 2016 to August, 2019
Infrastructure of Logistics Park	42 months from December, 2016 to May, 2020
Road Infrastructure	18 months from July, 2016 to December, 2017
Three Gorges Modern Logistics Information Center	16 months from December, 2018 to March, 2020
Project Management & Organizations Capability Building	48 months from January, 2017 to December, 2020

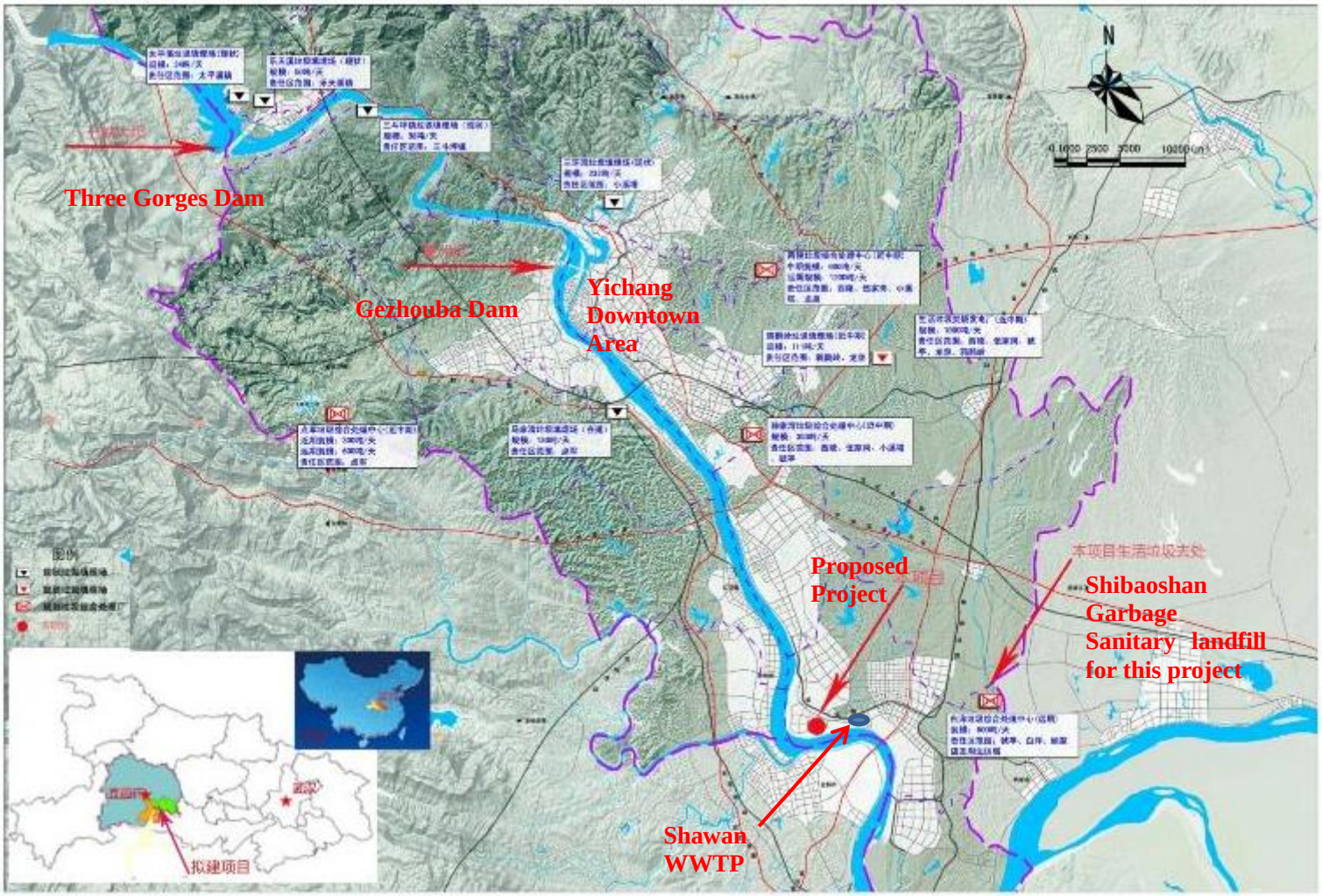


Figure 2.1-1 Location of the Proposed Project and its relationship with Three Gorge Dam and Yichang City

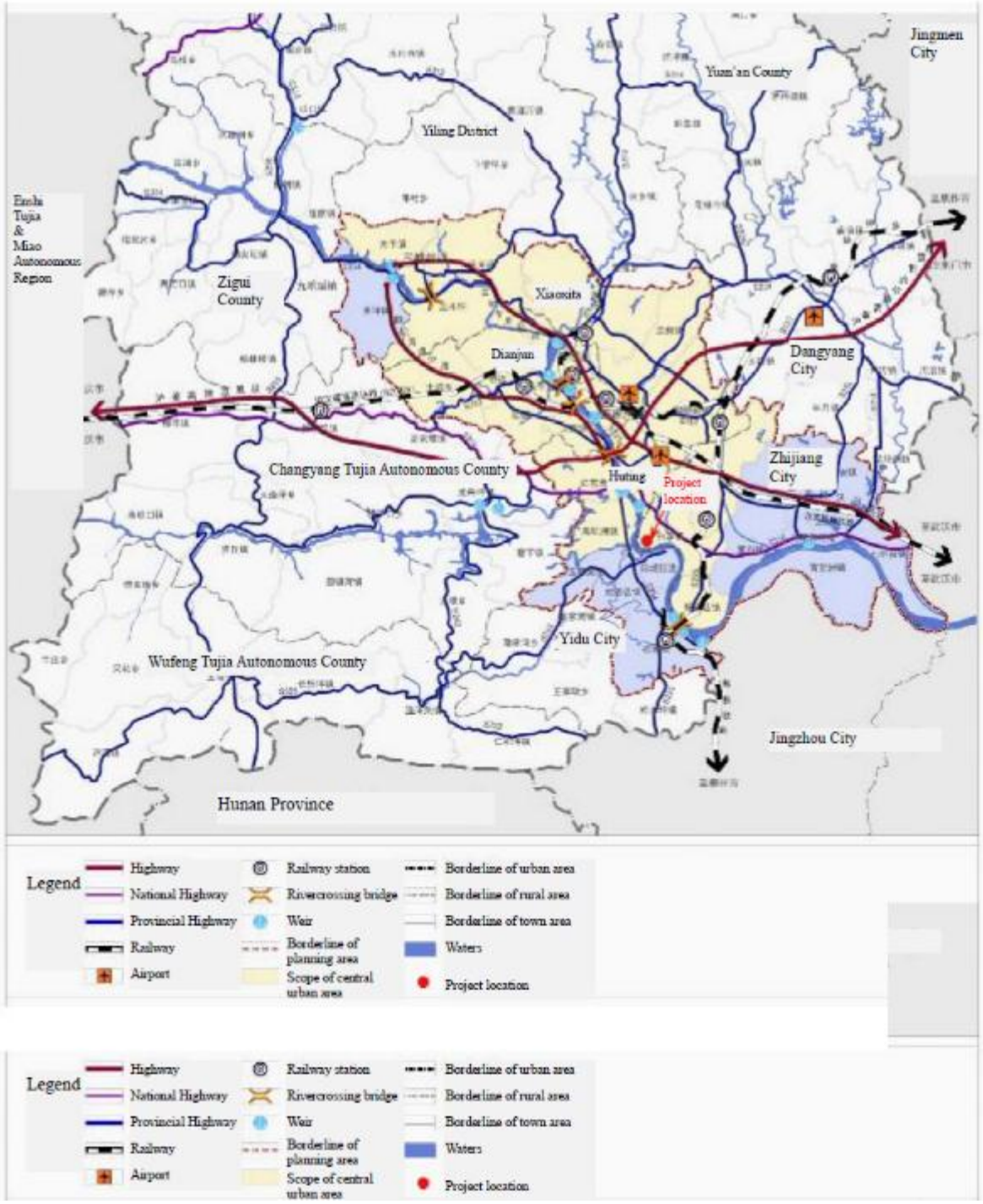


Figure 2.1-2 Transportation network surrounding the project

2.2 Project components

The project mainly consists of 5 components (Baiyang Port Operation Area, Baiyang Logistics Park, Road Infrastructure, Three Gorges Modern Logistics Information Center, and Project Management & Organizations Capability Building) and 17 sub-components. The project area covers a total area of 158.61 hm^2.

Details of the components are listed in Table 2.2-1; for plane layout of the project area, see Chapter III Scheme Comparison and Selection.

Table 2.2-1 List of project components

No.	Component	Contents
A. Baiyang Port Operation Area		
A1	Water area	Two high-piled beam-slab wharves, two floating wharves, and two inclined wharves will be built in the water area in this project. The **high-piled beam-slab wharves** shall have dimensions of 216×28m and 102×28m respectively; the **floating wharves** shall be equipped with 90×16m steel barges in the front, and the **inclined wharves** shall be equipped with 65×16m steel barges in the front.
A2	Land area	One 3000-tonner **heavy lift cargo berth**, four **bulk berths**, and two **multi-purpose berths** will be built, which will stretch for 1036m along the riverbank; the total land area of the port zone will be 44.9hm^2 (including the levee); The port is designed with cargo handling capacity of 7 million tons per year (including general cargo handling capacity of 1.2 million tons per year, bulk cargo handling capacity of 5 million tons per year, and container handling capacity of 80,000 TEU (equivalent to 0.8 million tons) per year); appropriate loading and unloading equipment shall be provided; container yard, road, production facilities and auxiliary production facilities shall be built.
B. Baiyang Logistics Park		
B1	Mixed-use logistics area	It is located behind Baiyang Port Operation Area and covers an area of 518 mu (1 mu = 0.0667 hectare). It includes: urban freight distribution area, food storage area, staging area, parking area, intelligent freight distribution center (third-party or fourth-party logistics enterprises), integrated management and logistics information center, living service area, and auxiliary operation area.
B2	Trade and logistics area A	It covers an area of 357 mu and includes: storage area, circulating and processing area, exhibition and trade area, auxiliary operation area, and storage yard.
B3	Trade and logistics area B	It covers an area of 473mu and includes: storage area, circulating and processing area, auxiliary operation area, and storage yard.
C.Road Infrastructure		
C1	External Road	**Shawan Road Overpass:** It starts from the north of Songgang Second Road, goes up and overpasses Baiyang Avenue toward the north, and ends at the entrance road in the east side of Ziyun Railway Marshaling Yard. It is an urban secondary trunk road with total length of 675m; the overpass is an aerial construction, with width of 17m and two-way four lanes, and total length of 280m; the minimum radius of horizontal curve of the overpass is 120m, the maximum longitudinal gradient of the section is 4.8%, and the minimum clearance is 5m.
C2	Internal Road	**Guihu Road:** It is in south-north direction and starts at Shawan Road and ends at Baiyang Avenue. It is an urban secondary trunk road with width of 30m, two-way four lanes, and total length of 1,126m. Integrated pipeline network infrastructures such as road drainage, lighting, and communication facilities are involved.
		Songgang Second Road: It is in east-west direction and starts at Guihu Road and ends at Shawan Road. It is an urban secondary trunk road with width of 30m, two-way six lanes, and total length of 900m. Integrated pipeline network infrastructures such as road drainage, lighting, and communication facilities are involved.

No.	Component	Contents
C3	Transport facilities	Detailed design of intersections inside the park, construction of parking facilities inside the park, construction of commuting system in the park, and traffic management in the park.
D.Three Gorges Modern Logistics Information Center		
D1	Business application system	Office automation system, comprehensive park supervision service, integrated logistics information service, business information service, regional logistics big data analysis platform
D2	Host and storage system	Computation server, data server, storage system, disaster recovery backup system, virtualized resource platform, network communication etc.
D3	Central Apparatus Room	Host room, space, cabinet system, power supply system, firefighting system etc.
E. Project Management & Organizations Capability Building		

2.3 Construction schemes and process

2.3.1 Baiyang Port Operation Area

2.3.1.1 Designed capacity and cargo categories

The designed capacity and cargo categories of Baiyang Port Operation Area are shown in Table 2.3-1.

Table 2.3-1 Cargo categories and transport capacity

No.	Cargo category	Unit	Amount	Remark
1	Container	10,000 TEU/year	8	
2	Steel, iron and miscellaneous items	10T/year	120	
3	Bulk cargo (sand and stone, pottery clay, sandstone for glass)	10T/year	260	Import
4	Bulk cargo (phosphate ore, limestone)	**10T**/year	240	Export (food and fertilizer, white wine, yeast)
5	Total	10T/year	700	

2.3.1.2 Technological process

(1) Technological scheme

The proposed project new construction of seven 3,000-tonner berths, including two bulk import berths, two bulk export berths, one general & heavy cargo berth, and two multi-purpose berths. Supporting facilities such as bulk cargo storage yard, general cargo storage yard, and container storage yard are provided behind the wharves. General cargo warehouse and container freight station are both built in the transfer logistics park at the back.

Main technological schemes for loading and unloading are as follows:

a. Wharf and back land area at #7 berth

#7 berth is a general & heavy cargo berth and the wharf is of vertical structure. The wharf platform is equipped with 2 40t-30m gantry cranes. Gantry cranes will be used for handling

steel and iron, building materials, and mechanical equipment less than 40t, and crane ship will be rented for handling mechanical equipment at 40 t ~ 80 t. Tractor and flatbed truck will be used for horizontal transport of general cargo. Horizontal transport vehicle for mechanical equipment above 40 t shall be provided by the owner of the cargo.

Technological process flow:

Steel, iron and general cargo (general & heavy cargo berth): ship ←→ gantry crane ←→ tractor, flatbed truck ←→ wheel-mounted crane, goliath crane ←→ steel, iron, and general cargo storage yard

Bulk cargo (export berth): out of port → dump truck → storage yard → single bucket loader → fixed receiving hopper → fixed belt conveyor system → arc track loader → ship

Bulk cargo (import berth): ship → floating crane →fixed receiving hopper → fixed belt conveyor system → mobile belt conveyor system → fixed belt conveyor system → mobile belt conveyor system → storage yard → single bucket loader → dump truck → out of port

Container (multi-purpose berth): ship ←→ quay crane, multi-purpose gantry crane ←→ container tractor, semitrailer ←→ container straddle carrier ←→ container straddle carrier ←→ container yard outside the embankment

Steel (multi-purpose berth): ship ←→ multi-purpose gantry crane ←→ tractor, flatbed truck ←→ wheel-mounted crane ←→ general cargo storage yard

General cargo (multi-purpose berth): ship ←→ gantry crane ←→ tractor, flatbed truck ←→ wheel-mounted crane ←→ general cargo storage yard

General cargo (multi-purpose berth): ship ←→ gantry crane ←→ tractor, flatbed truck ←→ forklift truck ←→ warehouse at transfer logistics area

2.3.1.3 Hydraulic structure

(1) #7 berth (general & heavy cargo)

It consists of a wharf platform, a transformer platform and an approach bridge. The wharf platform is 102 m long in total and 28 m wide, and the space between framed bents is 8m. It is divided into two structural sections and has cantilever beam joint structure.

An approach bridge is built behind the pile platform to connect with the land area. The elevation at the top of the approach bridge outside the embankment is 50.50m and is flush with the wharf surface; it is 32.5m long and 12m wide, and has overhead framed bent structure.

(2) #8 and #9 berth (bulk cargo export berth)

Both berths are floating wharf structure and both wharf structures are basically the same. They consist of a barge, a steel approach bridge and a transfer station platform, and the plane dimension of both barges is 90×16m; a 48×4m steel approach bridge is built at the back of each berth to connect to the abutment of the transfer station.

(3) #10 and #11 berth (bulk cargo import berth)

Both berths consist of a real ramp, a barge, and a steel approach bridge. The plane

dimension of the barge is 65×16m. a 13×4m steel approach bridge is built in the back to connect with the real ramp at each berth. The two ramps are parallel and are located along the bank, extending to the downstream with an angle of about 11 degrees with the embankment; the horizontal projection of the two ramps is respectively 130m and 140m; both ramps are 9m wide, with a gradient of 1:10.

(4) #12 and #13 berth (multi-purpose berth)

Both berths consist of a wharf platform, a transformer platform, and two approach bridges. The wharf platform is 216m long in total and 28m wide; the elevation at the top of the approach bridge outside the embankment is 50.50m and is flush with the wharf surface; it is 26.8m long, the upstream approach bridge is 15m wide and the downstream approach bridge is 12m wide. The wharf, transformer platform and approach bridge structure are the same with #7 berth.

2.3.1.4 Land area, road, and storage yard

(1) Land area

Elevation of land area is 48.5m and earthwork is needed.

(2) Road

Road in the port is in ring. Gangqu Avenue is 24.5~36m wide, and road in the port area is 7m~12m wide.

(3) Storage yard

Storage yards in the port are mainly heavy container yard, empty container yard, general cargo container yard, bulk cargo yard, general cargo yard, and parking lot. All the yards use structure of interlocking block.

2.3.1.5 Information and communication

Information and communication include wired communication (automatic telephone) system, wireless communication system, and ship-bank communication system.

2.3.1.6 Water supply and drainage and fire control

(1) Water supply source

Water supply source: domestic water for the port area, water on the ships, and water for firefighting are from urban tap water, and the water quality meets the current Standards for Drinking Water Quality (GB5749-2006).

(2) Water consumption

Water consumption is shown in Table 2.3-2~2.3-4.

Table 2.3-2 Maximum daily tap water consumption of #7 ~ #11 berth and their land area

NO.	Item	Standard water consumption	Water consumption	Remark
1	Ship water supply	60m³/ship·d	240m^3	Kh=1.2, T=24h
		70m³/ship·d	70 m^3	Kh=1.2, T=24h

NO.	Item	Standard water consumption	Water consumption	Remark
2	Domestic water of staff	50L/person·d	20.3 m^3	Kh=2.0, T=24h
3	Water for production	Machine maintenance and vehicle washing	6 m^3	Kh=1.2, T=6h
4	Unforeseen water demand	(①+②+③+④+⑤) ×0.25	84 m^3	
5	Maximum daily water consumption	①+②+③+④+⑤+⑥	420.3 m^3/d	
6	Maximum hourly water consumption		18.8 m^3/h	
7	Water consumption for one firefighting event		310 m^3	1 fire hazard at one time

Table 2.3-3 Maximum daily miscellaneous water consumption of #7~#11 berths and their land area

NO.	Item	Standard water consumption	Water consumption	Remark
1	High-pressure spraying water for bulk storage yard	4.0L/ (m^2·d)	222 m^3	Kh=1, T=8h
2	Spraying water for transfer station	8.64m^3/h	86.4 m^3	Kh=1, T=10h
3	Spraying water for road	0.5L/ (m^2·d)	16.9 m^3	Kh=1, T=4h
4	Water for afforestation	2.0L/ (m^2·d)	16.7 m^3	Kh=1, T=2h
5	Unforeseen water demand	(①+②+③+④) ×0.25	85.5 m^3	
6	Maximum daily water consumption	①+②+③+④+⑤	427.5 m^3/d	
7	Maximum hourly water consumption		48.9m3/h	

Table 2.3-4 Maximum daily tap water consumption of #12~#13 berths and their land area

NO.	Item	Standard water consumption	Water consumption	Remark
1	High-pressure spraying water for bulk storage yard	4.0L/ (m^2·d)	222 m^3	Kh=1，T=8h
2	Spraying water for transfer station	8.64m^3/h	86.4 m^3	Kh=1，T=10h
3	Spraying water for road	0.5L/ (m^2·d)	16.9 m^3	Kh=1，T=4h
4	Water for afforestation	2.0L/ (m^2·d)	16.7 m^3	Kh=1，T=2h
5	Unforeseen water demand	(①+②+③+④) ×0.25	85.5 m^3	
6	Maximum daily water consumption	①+②+③+④+⑤	427.5 m^3/d	
7	Maximum hourly water consumption		48.9 m^3/h	

(3) Water supply system

Two water supply pipeline systems are provided for #7 and #11 berths and their land area in the port area: one is for domestic water + water on ship + water for production use + water for outdoor firefighting, and the other is for environmental protection water for the bulk storage yard. Water for afforestation and road spraying is supplied by environmental protection sprinkler, which is usually refilled with water from the environmental protection recycling water pond and is refilled with water from miscellaneous water pipeline when the recycling water pond is insufficient of water.

The water pipeline for domestic water + water on ships + water for production use + water for outdoor firefighting is in ring form, and is buried along the road in the port area. The main pipe diameter is DN150. Domestic water for single building is supplied from branch water supply pipeline from the ring like water supply pipeline of the port area. The water pipeline for environmental protection water in the bulk storage yard has pipe diameter of DN150-DN100, and is allocated along the periphery of the bulk storage yard.

(4) Water drainage

Rainwater and sewage are drained separately in the port area.

i). Rainwater drainage system

The land area of #7~#11 berth is divided into 3 drainage sections, the living auxiliary area and steel storage yard, bulk storage yard, and steel storage yard out of the embankment. Buried pipeline system is provided in the living auxiliary area and steel storage yard within the embankment, and the rainwater collected runs into the rainwater drainage pipeline; the outlet pipe diameter is D700; initial rainwater (first 15 minutes) in the bulk storage yard is collected by open drain and discharged to the storage pond, and is used as spraying water after precipitation in the storage pond (refer to Chapter 11 EMP); later rainwater is discharged into the municipal rainwater pipeline via the transfer valve; the diameter of the overflow pipe is D800. Rainwater in the steel storage yard outside the embankment is directly converged into the open drain in the land area of the Baiyang Operations Area Preliminary Project. Land area of #12~#13 berth is 1 drainage section, both equipped with buried pipeline system; the outlet pipe diameter is D1200. Rainwater is elevated by the drainage pump and is discharged into the open drain in the east of the port area.

ii). Sewage system

Domestic sewage: sewage and wastewater are discharged together from individual structures in the port area. The maximum domestic sewage discharged from Berth 7-11 in this port area amounts to 40.3 m^3 per day. No domestic sewage is discharged from the land area of Berth 12-13. Domestic sewage will be treated in septic tanks before it is discharged into the municipal sewerage pipeline network as planned.

Production sewage and wastewater: the production wastewater produced in the port area comes primarily from the water used for flushing roads. Such wastewater is lightly contaminated and its major pollutant is SS (Suspended Solids). First flush rainwater settling basins have been built in front of the drainage outlets of storage yards in order to collect first flush rainwater and production wastewater at the yards, so that such rainwater and wastewater can be treated in the settling basins and then reused to flush the yards.

Bilge oil water produced comes primarily from the machine repair wastewater and the water used for flushing containers. After desalting and treated by oil-water separator, oil

content is 10 ~ 20 mg/L, which reaches the Class III standard in the Table 4 of *Integrated Wastewater Discharge Standards (GB8978-1996)*. Then it enters the sewage network of the port area and then transported to Shawan Wastewater Treatment Plant for treatment.

(5) Fire control

An urban fire station will be built about 3km from the site selected for the project to support fire control for the project. Fire control for this port area falls within the jurisdiction of the fire station. The DN200 pipes are installed indoors and outdoors at the start of the Baiyang Port Operation Area project. Water for fire control can be provided outdoors on land for the berths7-11 of this project. In addition, automatic fire pumps are installed indoors, which can serve as indoor fire hydrants for firefighting in case of fire occurring on the projects berths 7-11. Starting at Shawan Road along which the land area of berths 12-13 is located, the DN 400 pipes are laid out to form a municipal pipe network, through which water used for fire control for this project can be provided.

2.3.1.7 **Production and ancillary buildings**

See table 2.3-5 for information of production and ancillary buildings

Table 2.3-5 Production and ancillary buildings

No.	Item	Floor area (m^2)	Number of floors, a building's height or its eave height (m)
1	Transfer Station G2-Z01	145	2 floors，10.7m
2	Transfer Station G2-Z02	110	2floors，12.8m
3	Weighbridge Room G2-1-4	17*4=68	
4	Gatehouse G2-3-5	17*3=51	1floor，3.6m
5	Substation G2-A	155	1floor，3.6m
6	Substation G2-B	155	1floor，5.4m
7	Substation G2-C	133	1floor，5.4m
8	General distribution substation G2	165	1floor，5.4m
9	Office Occupancy G2	3214	5 floors，19.2m
10	Tool Library G2	333	1floor，7.5m
11	Mobile Machine Shop G2	311	1floor，7.5m
12	Dongdamen	485	1floor，12m
13	Substation G2-E	130	1floor，5.4m
	Total	5455	

2.3.1.8 **Major technical and economic indicators**

See table 2.3-6 for the major technical and economic indicators of Baiyang Port Operation Area

Table 2.3-6 Major technical and economic indicators of Baiyang Port Operation Area

No.	Item		Unit	Quantity	Notes
1	Designed throughput		10,000 t/y	700	
	Of which	Bulk cargo export	10,000t/y	240	
		Bulk cargo import	10,000t/y	260	
		Sundry iron & steel products/parts	10,000t/y	120	
		Containers	10,000TEU	8	1TEU=10t
2	Designed throughput		10,000t/y	765	
3	Number of berths (3000t)		Number	7	
4	Length of the coastline covered		m	1036	
5	Area of the land		mu	674	
6	Loaded container yard		m^2	43280	
7	Empty container yard		m^2	10950	
8	Sundries, container yard		m^2	/	
9	Bulk cargo storage yard		m^2	63247	
10	Sundry cargo storage yard		m^2	46368	
11	Area of roads		m^2	69641	
12	Parking lot		m^2	18838	
13	Supporting areas		m^2	8829	
14	Personnel quota in the port area		Number	506	

2.3.2 Construction plan for Baiyang Logistics Park

Baiyang Logistics Park consists of the integrated logistics zone, commerce & logistics area A, and commerce & logistics area B. See table 2.3-7 for details.

Table 2.3-7 Functional areas of Baiyang Logistics Park

	Functional area	Functional subarea	Floor area (m^2)	Planned floor area (mu)
Baiyang Logistics Park	Integrated Logistics Zone (493mu of planned area)	Foodstuff Warehouse Area	19497	84
		Transit Express Shipment	11600	86
		Urban Distribution Center	15075	75
		General Management and Logistics Information center	32100	67
		Intelligent Freight Distribution Center	21000	90
		Parking Lot	——	27

	Functional area	Functional subarea	Floor area (m^2)	Planned floor area (mu)
		Supporting Area	1650	25
		Life Supporting Area	22954	39
	Commerce & Logistics Area A (272 mu of planned area)	Warehouse Area	22188	83
		Distribution/Processing Zone	12376	46
		Storage Yard	——	91
		Exhibition/Trade Area	——	24
		Supporting Area	——	8
		Parking Lot	——	20
	Commerce & Logistics Area B (384 mu of planned area)	Warehouse Area	16668	62
		Distribution/Processing Zone	25211	94
		Storage Yard	——	199
		Supporting Area	——	9
		Parking Lot	——	20
Total (except for the roads in the Park)			——	1149

2.3.2.1 **Production process**

(1) Integrated logistics zone

The integrated logistics zone includes two distribution centers, four foodstuff warehouses, two express cargo yards, and other supporting facilities for production and living. See map 2.3-1 for the layout of integrated logistics zone.

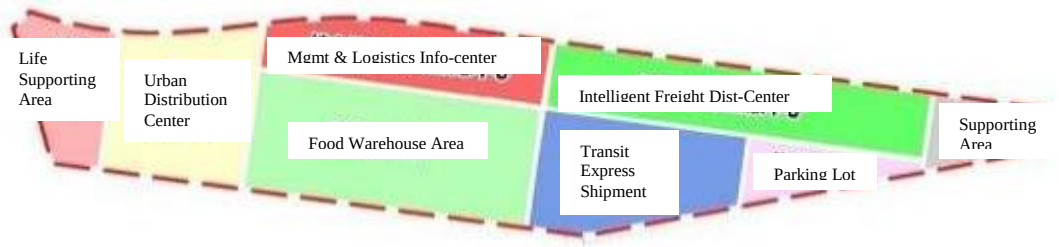
i). Distribution center Distribution Center W1-1, with a size of 162m×18m×2, has two continuous spans. This center is equipped with four 16t-16.5m bridge cranes; under each span there are two bridge cranes. In addition, forklifts also operate in the center. Vehicles may drive into the center where cargos can be loaded onto or unloaded from these vehicles. Distribution Center W1-2, with a size of 168m×48m, has a cargo loading platform on its two sides. Both this center and its platform are 1.35m higher than outdoor ground. A gangway connection is installed on the platform for loading and unloading cargos. Vehicles are parked vertically to the platform. Forklifts are used in this center.

ii). Foodstuff warehouse: Each of Foodstuff Warehouse1-1 and Foodstuff Warehouse1-2 is 180m×24m and has a cargo loading platform on one side. Each of Foodstuff Warehouse1-3 and Foodstuff Warehouse1-4 is 180m×36m and has a cargo loading platform on two sides. Both foodstuff warehouses and their platforms are 1.35m higher than outdoor ground. A gangway connection is installed on the platform for loading and unloading cargos. Vehicles are parked vertically to the platform. Forklifts are used in the warehouses.

iii). Express cargo yard: Express cargo yard W1-1 is equipped with a 16t wheel-mounted crane and express cargo yard W1-2 is equipped with a 30t wheel-mounted crane.

iv). Production supporting facilities: Workshop W1 and Tool Library W1 are jointly constructed with a size of (60+30) m×18m. The workshop and the tool library share one

5t-16.5m electric mono-beam crane.



Map 2.3-1 Layout of the integrated logistics zone

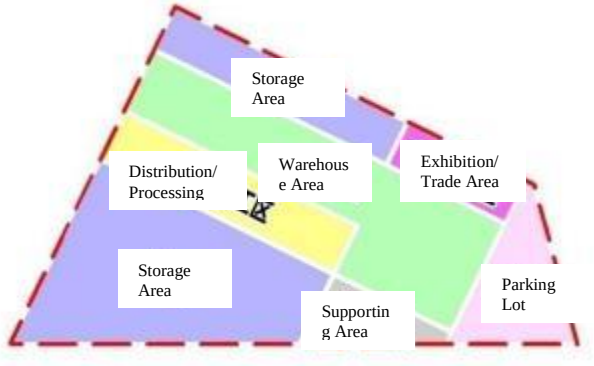
(2) Commerce & logistics area A

In the commerce & logistics area A there are four warehouses, seven storage yards, and two machine shops, as well as parking lots and ancillary buildings. See map 2.3-2 for the layout of commerce & logistics area A.

i. Warehouse: Both Warehouse W2-1 (144m×21m×2) and Warehouse W2-2 (144m×21m×2) have two continuous spans. Each of the two warehouses is equipped with four 32t-19.5m bridge cranes; under each span there are two bridge cranes. Both Warehouse W2-3 (132m×21m×2) and Warehouse W2-4 (132m×21m×2) have two continuous spans. Each of the two warehouses is equipped with four 32t-19.5m bridge cranes; under each span there are two bridge cranes. All four warehouses, equipped with forklifts, allow for vehicles loading and unloading cargos.

ii. Storage yard: Storage yards W2-1 – 7 are all equipped with wheel-mounted cranes.

iii.Machine shop: Both Machine Shop W2-1 (144m×21m×2) and Machine Shop W2-2 (144m×21m×2) have two continuous spans. Each of the two machine shops is equipped with forklifts and four 32t-19.5m bridge cranes; under each span there are two bridge cranes. Both machine shops allow for vehicles loading and unloading cargos.



Map 2.3-2 Layout of commerce & logistics area A

(1) Commerce & logistics area B

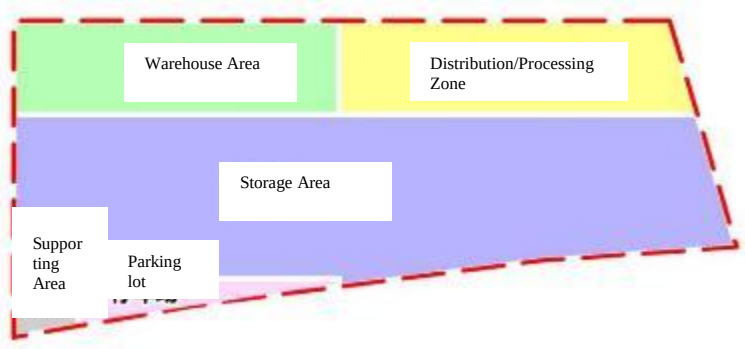
In the commerce & logistics area B there are two warehouses, two machine shops, and twelve storage yards, as well as parking lots and ancillary buildings. See map 2.3-3 for the layout of commerce & logistics area B.

a. **Warehouse**: Warehouse 3-1 and Warehouse 3-2 are both 168m×42m. Each of the two warehouses has

a cargo loading platform on two sides. Both the warehouses and their platforms are 1.35m higher than outdoor ground. A gangway connection is installed on the platform for loading and unloading cargos. Vehicles are parked vertically to the platform. Forklifts are used in the warehouses.

b. **Machine shop**: Both Machine Shop W3-1 and Machine Shop W3-2 have three continuous spans. Machine Shop W3-1 is 132m×24m×3 and Machine Shop W3-2 is 216m×24m×3. Under each span of each machine shop there are two 16t-22.5m bridge cranes. Both machine shops allow for vehicles loading and unloading cargos.

c. **Storage yard**: Storage yards W3-1 – 12 are all equipped with rail-mounted gantry cranes and wheel-mounted cranes.



Map 2.3-3 Layout of commerce & logistics area B

d. Auxiliary production facilities: Build W1- maintenance shop, W1 - tool and raw material warehouse of size at (60+30) m×18m, both worked by 1 set of single electric crane beam of 5t-16.5m.

e. Parts warehouse: W3-1 #, 2 # parts warehouse's main dimensions is 168m × 42m. Its both sides have loading and unloading platforms. The floor of its inside and the platform are 1.35m above the outdoor terrace. The platform has plates for loading and unloading. The vehicle will be wharfed vertically on the platform. Forklift will operate inside of the warehouse.

f. Processing plant: W3-1#, 2# processing plant shall be arranged in 3-span mode. The dimension for warehouse W3-1# is 132mx 24m x 3m. The dimension warehouse W3-2# is to 216m x 24m x 3m. The span of each plant is equipped with 2 bridge cranes (16t-22.5m). Vehicles for loading and unloading operations in the plant shall also be considered. The processing only involves physical processing and deformation, which does not involve painting, coating or cleaning

2.3.2.2 Land formation, roads and storage yards

(1) Land formation

In consideration of the topographic & geologic conditions of the site and the factor of investment, land formation uses backfilling method with earth materials from mountain cutting. The site shall be cleared before backfilling. After backfilling, the backfilled earth shall be compacted by layers by vibrating compactor, 300mm thick for each layer, to reach the compactness of 93%~96%. Then, the structural layer of storage yard and roads are constructed. The backfill materials are the earth generated when cutting into a mountain and leveling the site in Baiyang Industrial Park.

(2) Roads

Roads are made in ring shape. Trunk roads in the port are 24.5 ~ 36m wide and common roads are 7m ~ 12m wide.

(3) Storage yards

Storage yards mainly include heavy container yard, empty container yard, break bulk yard and parking lot. All yards and sites are interlocking blocks.

2.3.2.3 **Power supply and lighting**

(1) Electricity heating will be used instead of fire furnaces.

(2) Lighting

Outdoor illuminance standard is 15Lx for break bulk yard and 20Lx for container yard. The following lighting equipment is provided: 25m high 24×400W sodium lamps at yards, 9m high LED 135W lamps on main roads, and 15m high 6×400W sodium lamps at parking lot and main crossroads.

Offices shall be provided with three-band fluorescent lamps, with illuminance standard 300Lx; warehouses and workshops shall be provided with high-power energy-saving lamps, with illuminance standard 100Lx.

Three-band fluorescent lamps shall be provided with illuminance standard 200Lx at the high/low-voltage distribution room of power substation and with illuminance standard 300Lx at control room.

2.3.2.4 **Water supply & drainage and fire control**

(1) Water supply source

The logistics park provides watering cart to wet roads and irrigate green space and the water for this purpose comes from the settled initial rainwater collected from storage yards, and also from tap water if the settled rainwater is not enough. The tap water quality meets the requirement of the existing Sanitary Standard for Drinking Water (GB5749-2006).

The tap water source is the DN800-DN400 municipal water pipeline under surrounding municipal roads. DN250 pipes will be used to draw water from different sections of the municipal water pipeline. At pipe connection points, the permanent pressure shall be not below 0.55MPa and the permanent flow shall be not below 73L/s.

(2) Water consumption

Water consumption in this component mainly includes domestic water, water for industrial production and water for roads and green space, as shown in Table 2.3-8.

Table 2.3-8 Tap water consumption of the logistics park

No.	Category	Water consumption criteria	Daily water consumption (m^3/d)
1	Domestic water (including the canteen)	150L per person each day for those who live at the logistics park; 50L per person each day for those who don't live at the logistics park	136

No.	Category	Water consumption criteria	Daily water consumption (m^3/d)
2	Roads and green space	$3L/d \cdot m^2$	300
3	Unforeseen water consumption and water leakage		87
4	Maximum daily water consumption		523
5	Maximum water consumption in one hour		$64m^3/h$
6	Water consumption for fire control each time	$1314m^3$ each time	Warehouses

(3) Water supply system

There are two water supply pipeline systems: one for automatic sprinkler + indoor fire hydrants in high rise buildings, with main pipes arranged in ring shape, pipe diameter DN250, and the other at outdoor for other purposes, arranged in ring ship along roads, diameter of main pipe: DN250-DN150.

(4) Water drainage

Rainwater and wastewater are separated outside, while all domestic sewage and wastewater inside one building flow through the same pipeline.

a) Rainwater system

Rainwater flows into the storm water drainage pipeline through gutter inlets and finally is discharged into open channels.

b) Wastewater system

Domestic sewage system: in one building, domestic sewage and wastewater are discharged through the same pipeline. After treated in septic tank, domestic sewage is discharged into the municipal sewage pipe network.

Industrial wastewater system: the industrial wastewater in the logistics park mainly comes from road surface flushing water and other lightly polluted water, and the major pollutant is SS. Settling pond is set before drainage outlet at storage yards to collect initial rainwater and industrial wastewater. The settled water will be recycled for floor flushing at storage yards.

The industrial wastewater produced by machine maintenance workshop is treated at oil trap and then discharged into the sewage pipe of the logistics park and finally into the municipal sewage pipe network.

(5) Fire control

DN800–DN400 municipal ring water supply pipelines are to be constructed near the site of the project, which can serve as the water source of this project.

Bilge oil water produced comes primarily from the wastewater used for machine repair and cleaning. After desilting and treated by oil-water separator, the wastewater enters the sewage network of the port area and then transported to Shawan Wastewater Treatment Plant for treatment.

2.3.3 Construction scheme

2.3.3.1 Bridge works

The bridge over Shawan Road starts from stake no. K0+199 and ends at stake no. K0+467, with a total length of 268m, including 8 spans: (4×30+35+40+35+30)m as a whole. The section from P5 to P6 piers extends across Baiyang Avenue, with net clearance not smaller than 5.0m. With a net width of 17.0m, the bridge uses uniform cross-section pre-stressed concrete continuous beam structure. Refer to Figure 2.3-4 for vertical view of the bridge and refer to Figure 2.3-5 for sectional view of the bridge.

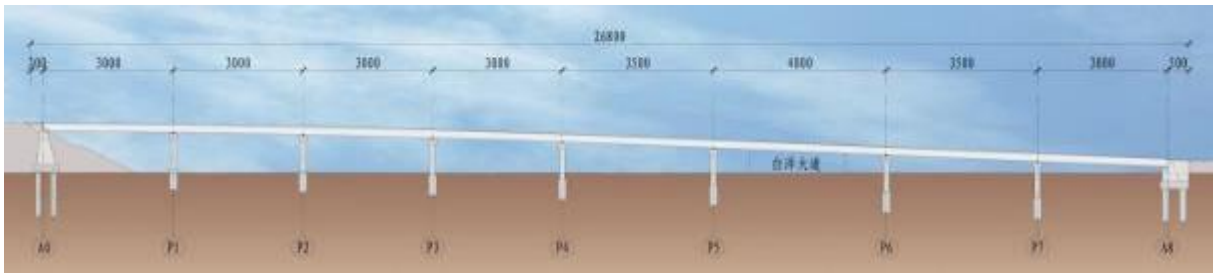


Figure 2.3-4 Vertical view of the bridge

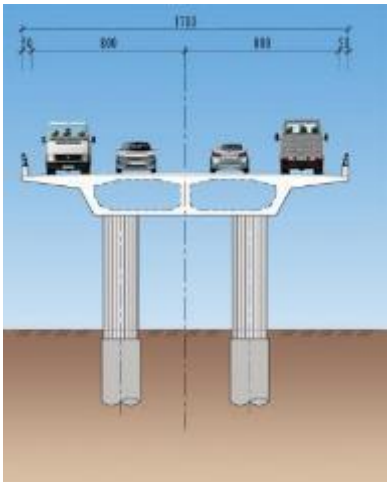


Figure 2.3-5 Sectional view of the bridge

2.3.3.2 Road works

Standard cross-section of Guihu Road: 7.5m (sidewalk) + 16m (carriageways) + 7.5m (sidewalk) =30m; Standard cross-section of Songgang Road: 3m (sidewalk) + 24m (carriageways) + 3m (sidewalk) = 30m.

2.3.3.3 Forecast of traffic volume

According to the *Feasibility Study Report* of this project, long-term (Year 2023) forecast of road traffic volume is conducted as shown in Table 2.3-9.

Table 2.3-9 Traffic volume of roads (unit: pcu/d)

No.	Roads	Traffic volume		
		Short term	Medium term	Long term
1	Guihu Road	156	200	298
2	Second Songgang Road	576	735	1097

No.	Roads	Traffic volume		
		Short term	Medium term	Long term
3	National Highway 318	2477	3161	4718
4	Bridge over Shawan Road	303	387	578
Ratio of large, medium and small vehicles=22:33:45				

Remarks: the calculation is based on the *Feasibility Study Report*.

2.3.3.4 Pipeline works

Pipeline works include water supply & drainage pipeline, communication pipeline, power pipeline and gas pipeline on Second Songgang Road and Guihu Road.

2.4 Sensitive receptors

2.4.1 Sensitive receptors for surface water protection

Information about water intakes near the site of this project, including water intake quantity and distance from wharf, are given in Table 2.4-1 and Figure 2.4-1.

Table 2.4-1 Sensitive receptors for surface water protection

Water intakes	Distance from wharf	Water intake quantity	Purposes	Remarks	Protected area
Baiyang Town Water Supply Plant	1.5km downstream from berth 11	5,000t/d	Domestic water	It exists now, but plans to be cancelled	Grade-I protected area: 1000m upstream and 100m downstream; Grade-II protected area: 3000 m upstream and 300m downstream
Tianjiahe Water Supply Plant	3.8km downstream from berth 11	250,000t/d	Domestic & industrial water	To be constructed	
Requirements	For grade-I protected surface waters as drinking water source, the limit of basic indicators of water quality shall be not below the class-II criteria of GB 3838-2002 and the limit of additional and special indicators shall meet the requirements of this standard; for grade-II protected surface waters as drinking water source, the limit of basic indicators of water quality shall be not below the class-III criteria of GB 3838-2002 and if flowing into Grade-I protected area, the water quality must meet the criteria of grade-I protected area; for the surface waters as drinking water source planned to be protected areas, the water flowing into grade-II protected area shall meet the criteria of grade-II protected area.				

This project is within the grade-II protected area of Baiyang Town Water Plant as drinking water source. In accordance with the *Explanation of the Construction Management Office of Baiyang Industrial Park, Yichang High-tech Zone on the Construction of Supporting Facilities of Baiyang Port and Baiyang Logistics Park*, the office decides to cancel Baiyang Town Water Plant and incorporate it into Xiaoting Water Plant before December 2011. Now the two plants operate as one and the water intake of Baiyang Town Water Plant is used as backup water source.

2.4.2 Atmospheric and acoustic sensitive receptors

Some residents of Yazishan Village and Guixihu Village are within the boundary lines of the proposed project, and they are included in the scope of land acquisition and structure

demolition. The dwellings at Baiyang Town, Guixihu Village, Yazishan Village and Wanfunao Village within the 2,500 m radius and out of the boundary lines of land acquisition are taken as sensitive receptors for atmospheric and acoustic environment protection.

Atmospheric and acoustic sensitive receptors in and near the site of the proposed wharf are shown in Table 2.4-2 and Figure 2.4-1.

Table 2.6-2 Schedule of sensitive acceptors

Environment	**Sensitive receptors**	**Scale**	**Relative location**	**Remarks**
Acoustic environment	Guixihu Village, Baiyang Town	10 households, about 30 persons (mainly 2-3 storey brick-concrete structure buildings)	Locating to the west of the port, about 50m from west boundary wall of the port	Buildings are demolished
	Yazishan Village, Baiyang Town	500 households, about 1670 persons (mainly 2-3 storey brick-concrete structure buildings)	Locating to the north of the port, about 60m from north boundary wall of the port	200 households remain and all others move out
Atmospheric environment	Baiyang Town	300 households, about 980 persons (mainly 2-3 storey brick-concrete structure buildings)	Locating to the east of the port, 1.30km from the site of the project according to the shortest path	
	Guixihu Village, Baiyang Town	600 households, about 2089 persons (mainly 2-3 storey brick-concrete structure buildings)	Locating within the site of this project	Buildings plan to be demolished
	Yazishan Village, Baiyang Town	500 households, about 1670 persons (mainly 2-3 storey brick-concrete structure buildings)	Locating to the north of the port, about 60m from north boundary wall of the port	200 households remain and all others move out
	Wanfunao Village, Baiyang Town	700 households, about 2547 persons (mainly 2-3 storey brick-concrete structure buildings)	Locating to the west of the port, about 1.00km from west boundary wall of the port	

2.4.3 Ecological sensitive receptors

According to our investigation, the wharf of this project locates at the periphery of the Chinese sturgeon protection area (refer to Figure 2.6-3 *Letter on Explaining the Issues Concerning Site Selection of the World Bank Financed Hubei Yichang Three Gorges Modern Logistics Center Infrastructure Project*). The ecological sensitive receptor is the Chinese sturgeon protection area in Yichang section of Yangtze River, which is a provincial level natural reserve as shown in Figure 2.6-2. More details are provided in section 6.4.3.

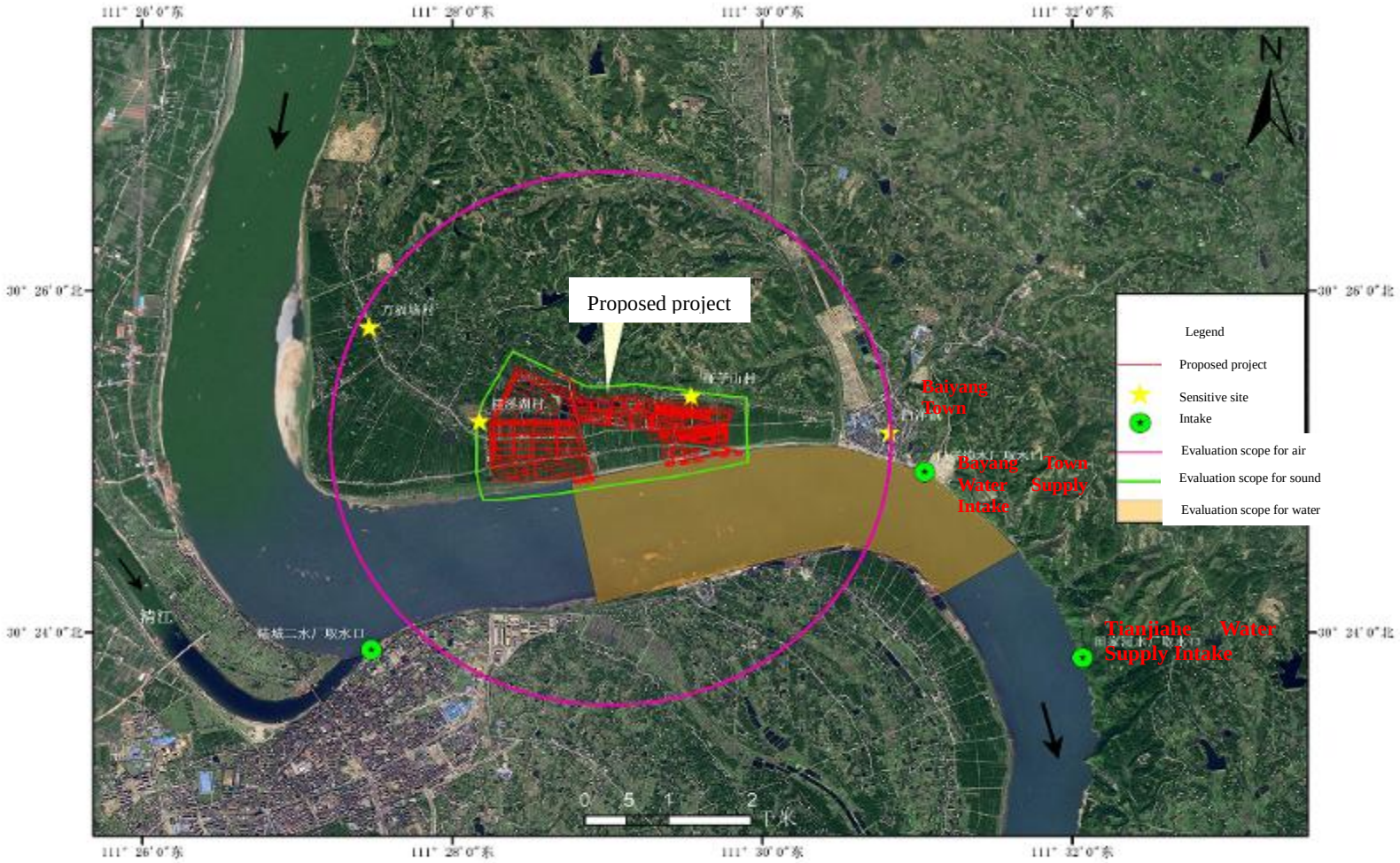


Figure 2.4-1 Atmospheric and acoustic sensitive receptors

2.5 Associated facilities

The wastewater produced during this project will be treated by Shawan Wastewater Treatment Plant about 200 m away from the project site. Solid waste will be disposed in the urban solid waste management system. Details are as follows:

2.5.1 Bayang Town Shawan Wastewater Treatment Plant

Bayang Town Shawan Wastewater Treatment Plant locates at one side of the Yangtze River to the east of Baiyang port and to the south of Baiyang Avenue. The construction content of Phase I includes the main works of the plant with a capacity of 50,000m^3/day and the 14010m sewage collection pipeline. This plant uses the improved A^2/O biological pond system to serve an area of 21.37 km^2 and a population of 74,000, with a total investment of 201.2008 million Yuan.

Construction of this plant was approved by Yichang Municipal Environmental Protection Bureau by issuing the document No. 248 of [2012]. Phase-I works have been completed. Since surrounding enterprises haven't started business, no sewage needs to be treated, so the plant hasn't been officially put into operation. The capacity of this plant can dispose all the wastewater produced from the Project. The location and service area of the plant are shown in Figure 2.4-1.

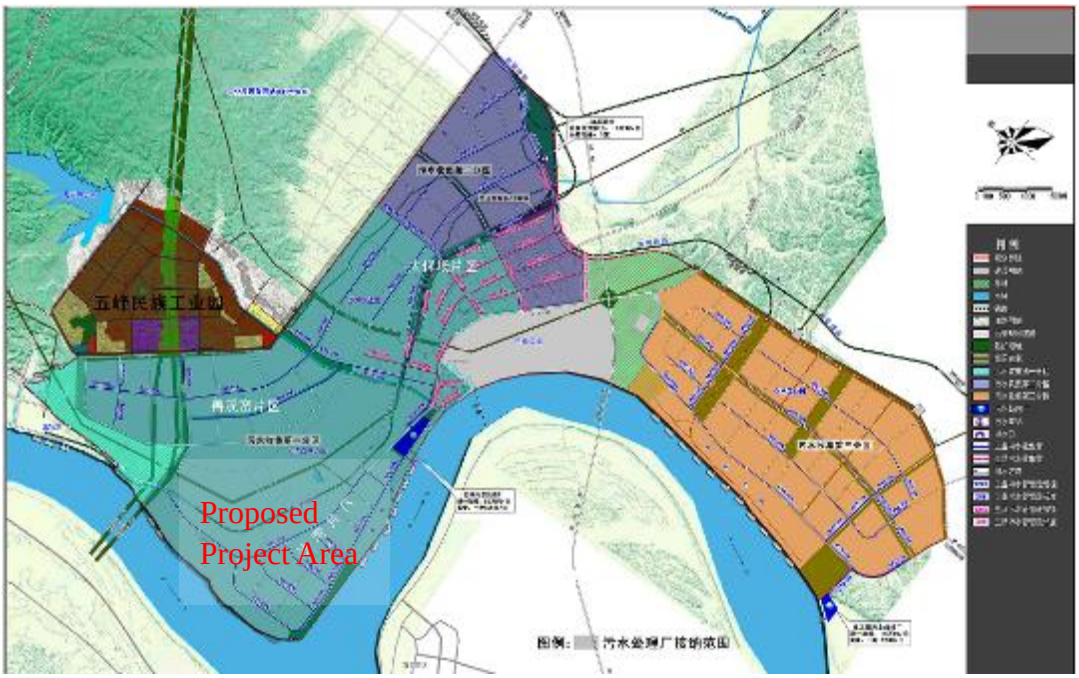


Figure 2.5-1 Location and service area of Shawan Wastewater Treatment Plant (dark blue on the right up corner of the project area)

2.5.2 Landfill

The solid waste generated from this Project will be transfer to the Shibaoshan sanitary Landfill which started operation in 2009. The Shibaoshan Landfill is located 15 km away to the south-east of the proposed project site, as illustrated in Figure2.1-1. This landfill covers an area of 380 mu and has a total storage capacity of $183\times10^4m^3$ and daily capacity of 250t/d. It is a Class III sanitary landfill. The planed service period is 15 years from 2005 to

2020.

For drainage in the landfill, rain & wastewater are separated. The leachate is sent to leachate treatment station (2.5 mu; MBR process (external ultrafiltration membrane) +NF +RO; treatment capacity 100 m³/d; Class I discharge standard of the Pollution Control Standards for Sanitary Landfill (GB16889-2008)). The bottom lining is using thin membrane for seepage control. Landfill gas is guided through stone cages (planed collection for future use). The service scope and capacity shall meet the demand of garbage for areas such as the main urban zone of Zhujiang City, Jiangkou District, Yaojiagang District, and general industrial waste from Yaojiagang Industrial Park, Zhijiang City Industrial Park. Currently, all the environmental protection facilities are in good condition. No complaints have been received. Since May 1, 2016, the landfill's service area has covered the Baiyang district. The status of landfill is shown in Figure 2.5-2.

	
Landfill	Layered backfilling
	
Compaction	Landfill site
	

Leachate treatment

Figure 2.5-2 Landfill

2.6 Linked projects

Infrastructures linked to this project mainly include Baiyang port Phase I and upgrade of about 3.0km of National Highway 318.

2.6.1 Baiyang port Phase I

According to our investigation, Baiyang Port operation area preliminary works (Baiyang Port operation area phase I) is being constructed at some segments of the shoreline. The environmental assessment report for Baiyang Port operation area Phase I was approved by the Provincial Environmental Protection Department in November 2011. Now, water related works and main works of Baiyang Port operation area Phase I have been largely completed. In the construction process, the environmental assessment requirements were obeyed, the quality of surrounding surface waters meets the class-III surface water criteria according to the monitoring results, and no complaint was received from residents or firms. Baiyang Port operation area Phase I is expected to be fully completed in the middle of 2016. The project proposed in this report will not occupy the shoreline of Baiyang Port operation area Phase I and the land area behind the shoreline, and will almost bring no impact to Baiyang Port operation area Phase I. The use of shoreline conforms to the *Master plan of Yichang Navigation Hub* and the *Special Plan for the Adjustment of Major urban port district of Yichang Navigation Hub*.

Borrow pit and dump pit: the borrow pit is located in Wanfunao Village. The earthwork reserve of the village is 4 million m³. The soil borrowed in Phase I is about 2.072 million m³ (see Annex 4). As there is no waste soil in the project, so there is no dump pit.

Rehabilitation of borrow pit: as the soil is not solely used by the Baiyang Port Project, the soil in the borrow pit just undergoes natural rehabilitation (soil erosion is not handled properly). According to *Law of The People's Republic of China on Water and Soil Conservatio*n, the construction implementating companies shall be accountable for treatment of soil erosion caused by project construction. Therefore, Phase-I borrow pit shall undertake ecological restoration as required by local water and soil conservation departments. See Figure 2.6-1 for the borrow pit.

Figure 2.6-1 Ecological rehabilitation of borrow pit in Wanfunao Village

2.6.2 Sections of National Highway 318 Upgrade

National Highway 318 passes outside the north boundary of the WB project area. Its section connecting the project site to the nearby express way nearby is about 3 km. The section of 3km is being upgraded into a four-lane road (15 m) from a two-lane road (9 m).

The design standard of the road is Class I. Its design speed is 80km/h. The subgrade width is 21.5m. About the width: intermediate zone (double yellow line with a spacing of 0.5m); lane width: 2 x 2 x 3,75 m; hard road shoulder: 2 x 2.0m; soil shoulder: 2 x 0.75m. Both sides of the subgrade shall consider drainage.

The reconstruction of 318 section has completed its environmental impact report and it is approved by provincial environmental protection bureau. The main part has been completed. The construction process meets relevant requirements in environmental impact assessment. Local environmental protection and construction department have not received any complaints from local residents (according to the inquiry of local environmental protection and construction department). Up to summer 2016, most of the road sections are open to traffic. A small portion of the road needs to lay asphalt, and ancillary works such as greening, street lights, and isolation belt have not been fully implemented. There is no dump pit for this activity. The ecological rehabilitation of the borrow pit is ordinary. See Figure 2.6-2 for some details.

Asphalt not laid yet

Already open to traffic

Borrow pit (located in k57+900, about 3.0 km from the Project)

Figure 2.6-2 Condition of road sections linked to National Highway 318

3 Environmental and Social Baseline

3.1 Environmental Baseline

The project is located in the east of the urban area of Yichang Municipal, and is about 35km away from the central urban area of Yichang in the west and borders on Yangtze River in the south (see Figure 2.1-1).

3.1.1 Topography

Yichang's topography is complicated and elevation differs greatly. Mountainous area in the west accounts for 69% of total area of the whole city, which mainly covers Xingshan County, Zigui County, Changyang County, Wufeng County and west Yiling District. Most mountains are at an elevation of around 1,000 meters. Quite a few mountains are at an elevation of above 2,000 meters. Xiannv Mountain in Xingshan County has an elevation of 2,427 m and is the highest one in the city. There are many gorges in the mountainous area. Some mountains are magnificent with steep cliffs reaching to the cloud. Some gorges are deep, beautiful, and full of twists and turns. Such gorges exist in the basins of Yangtze River, Qing River, Xiangxi River, and Huangbo River, for example, Xiling Gorge, one of the world-famous Three Gorges of Yangtze River. The hilly area in central Yichang is a transitional zone between the mountainous area and the plain area, which consists of low hills or stretches of high terraces with gentle slopes that have been weathered, denudated or dissected for a long time; the hilly area has an elevation of 100m ~ 500m and incline of 5 degrees ~ 25 degrees, and accounts for 21% of total area of the city. It covers Yuan'an County, Yidu City, east Yiling County and north Dangyang City. The plain area in east Yichang is located in the west end of Jianghan Plain with an elevation of below 100m. Yanglin Lake in Zhijiang City has an elevation of 35m and is the lowest point in the city. The plain area accounts for 10% of total area of the city, and covers Zhijiang City, southeast Dangyang City, southwest part of the urban area of Yichang, and the area on the banks of Yangtze River, Qingjiang River, and Juzhang River in Yidu City and Yuan'an County. Besides, there are many karsts in the city, which are mainly in the mountainous area and hilly area of Wufeng County, Changyang County, Xingshan County, Zigui County, and Yidu City. The karsts vary a lot. Many places have strange mountains, beautiful rocks, intriguing caves, and clear waters, and are good tourism destinations.

3.1.2 Climate

Yichang is located in the transitional zone between the middle subtropics and the northern subtropics and has humid subtropical monsoon climate. It has four distinct seasons, with wet season overlapping with hot season and dry season overlapping with cold season. The annual average precipitation here is 1,215.6 mm. Average temperature is 16.9°C, extreme maximum temperature is 41.4°C (in July), and extreme minimum temperature is -9.8°C (in January). The total of daily average temperature above 10°C is over 5200°C, and the total number of days when daily average temperature is above 10°C is above 250. The frost-free period is 250~300 days. Annual average radiation quantity is 100.7 kals per square centimeter. Annual average sunshine duration is 1,538~1,883 hours, and the sunshine rate is 40%.

3.1.3 Surface water

Surface water in the region where the logistics center is located is mainly the water in

Yangtze River.

Yangtze River is the main water source and pollutant-receiving water of Zhijiang City. Zhijiang section of Yangtze River has abundant water with good water quality, and it has enormous environmental capacity. According to hydrological statistic data for many years, its annual average flow rate is 14,300 m^3/s; the maximum flow rate in wet season is 70,800 m^3/s, the average flow rate is 29,600 m^3/s, and the minimum flow rate in dry season is 2,770 m^3/s; its annual average sand output is 526 million tons. After the Three Gorges Project is completed, the annual average flow at the Yichang monitoring station is supposed to change; yet it is reported in literature that under the normal reservoir regulation mode, the water level change is not big and is within the variation range of natural average water level.

3.1.4 Soil and minerals

The soil type detected is suitable for a wide range of plants and is very favorable for agriculture and forestry.

There is a large amount of argil, cobbles (including various rare stones), river sand and building material resources in the area.

3.2 Ambient air quality monitoring and evaluation

(1) Monitoring points

For location and description of the points, see Table 3.2-1 and Figure 3.2-1

Table 3.2-1 List of air monitoring points

No.	Name of the point	Position coordinates	Description
1#	Yazishan Village, Baiyang Town	N: 30.42274°, E: 111.48913°	60 m north of the project site
2#	Guixihu Village, Baiyang Town	N: 30.42179°, E: 111.47193°	Inside the project site
3#	Baiyang Town	N: 30.41974°, E: 111.51280°	1,700 m east of the project site
4#	Wanfunao Village, Baiyang Town	N: 30.43063°, E: 30.43063°	1,600 m northwest of the project site

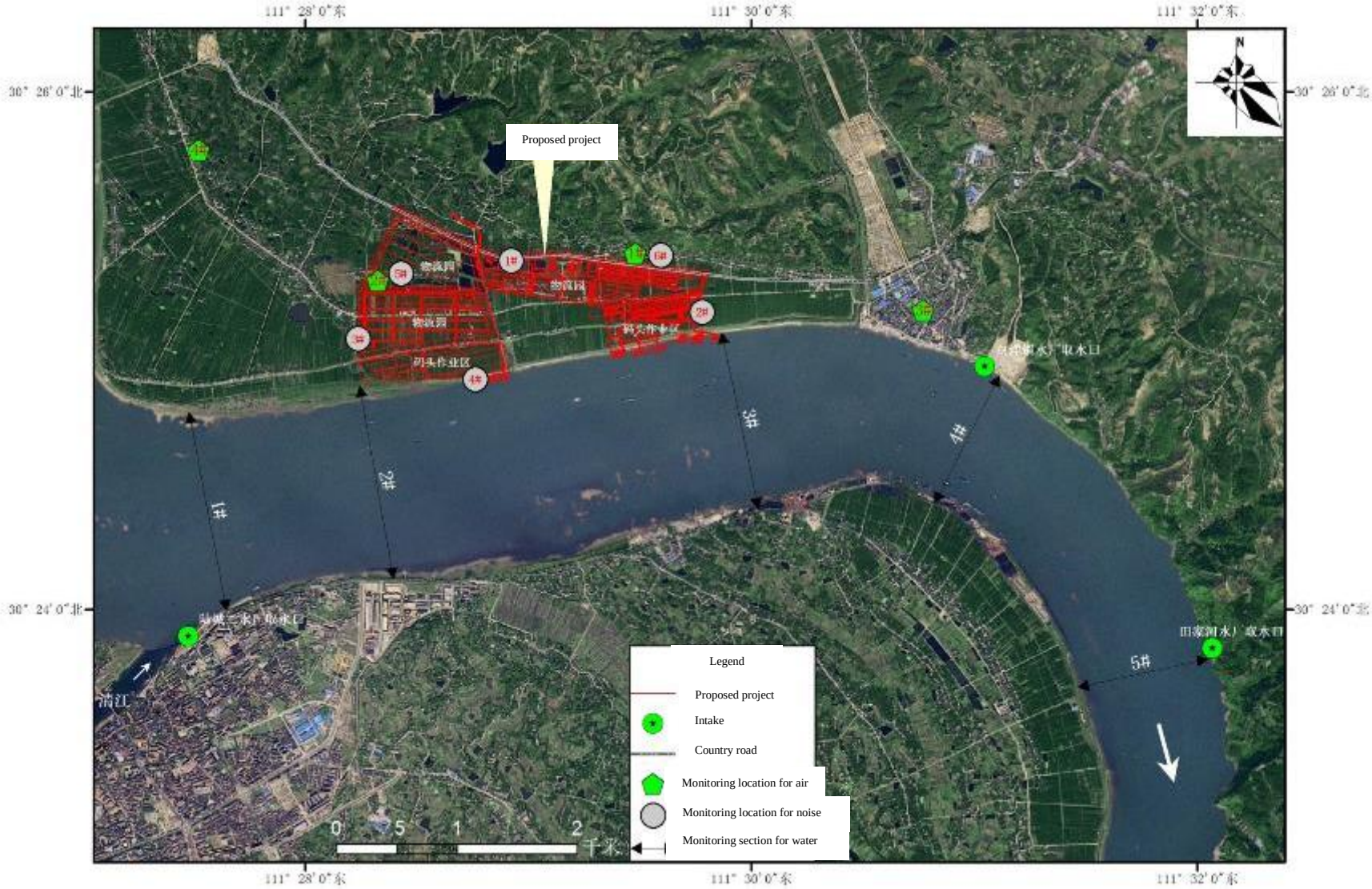


Figure 3.2-1 Location of the monitoring points

(2) Monitoring items and analysis method

The monitoring items are SO_2, NO_2, PM10, and TSP. For SO_2 and NO_2, hourly value and daily average value shall be measured; and for PM10 and TSP, daily average value shall be measured. Methods of ambient air quality monitoring and analysis are shown in table 3.2-2.

Table 3.2-2 List of ambient air quality monitoring and analysis methods

Monitoring item	Analysis method	Reference of method
PM_{10}	Gravimetric method	HJ 618-2011
TSP	Gravimetric method	GB/T15432-1995
SO_2	Formaldehyde absorbing – pararosaniline spectrophotometry	HJ482-2009
NO_2	N-(1-naphthyl) ethylene diamine dihydrochloride spectrophotometric method	HJ 479-2009

(3) Monitoring frequency

First phase monitoring was conducted in November, 2015 for 7 consecutive days, November 18~24, 2015. Daily average value of TSP and PM10 was measured and samples were collected 24 hours every day; Hourly value and daily average value of SO_2 and NO_2 were measured, and samples were collected 4 times a day for the measurement of the hourly value respectively at 02:00, 08:00, 14:00, and 20:00; for the measurement of daily average concentration of PM10, SO_2, and NO_2, samples were collected continuously for 20 h each day. For the measurement of the daily average concentration of TSP, samples were collected for 24 h each day.

(4) Evaluation method

Single factor index method is adopted.

The formula is: Pi＝Ci/Si

In the formula: the single quality index of a certain pollutant

Ci- the measured concentration of the pollutant, mg/m^3;

Si-the evaluation standard limit of the pollutant,, $mg/m^{3.}$

(5) Statistical analysis

Based on the monitoring data of the consecutive 7 days obtained at the monitoring points, the statistical analysis result is made into Table 3.2-3 and 3.2-4 according to the statistical requirement of Guidelines for Environmental Impact Assessment-Atmospheric Environment (HJ 2.2-2008).

Table 3.2-3 Statistics of Hourly Concentration of Pollutants in Ambient Air

No.	Sampling place	Monitoring item	Level II standard value of hourly concentration (mg/Nm^3)	Variation range of hourly concentration (mg/Nm^3)	Maximum hourly concentration (mg/Nm^3)	Average hourly concentration (mg/Nm^3)	Ratio of maximum concentration to standard value (%)	Meet the standard or not	Over-limit rate %

No.	Sampling place	Monitoring item	Level II standard value of hourly concentration (mg/Nm^3)	Variation range of hourly concentration (mg/Nm^3)	Maximum hourly concentration (mg/Nm^3)	Average hourly concentration (mg/Nm^3)	Ratio of maximum concentration to standard value (%)	Meet the standard or not	Over-limit rate %
1#	Yazishan Village	SO_2	0.50	0.011~0.033	0.033	0.021	6.6	Yes	0
		NO_2	0.20	0.014~0.038	0.038	0.026	19	Yes	0
2#	Guixihu Village	SO_2	0.50	0.013~0.029	0.029	0.019	5.8	Yes	0
		NO_2	0.20	0.018~0.031	0.031	0.024	15.5	Yes	0
3#	Baiyang Town	SO_2	0.50	0.011~0.057	0.057	0.024	11.4	Yes	0
		NO_2	0.20	0.013~0.027	0.027	0.022	13.5	Yes	0
4#	Wanfunao Village	SO_2	0.50	0.009~0.028	0.028	0.019	5.6	Yes	0
		NO_2	0.20	0.017~0.034	0.034	0.023	17	Yes	0

Table 3.2-4 Statistics of Daily Concentration of Pollutants in Ambient Air

No.	Sampling place	Monitoring item	Level II standard value of daily concentration (mg/Nm^3)	Variation range of daily concentration (mg/Nm^3)	Max. daily concentration (mg/Nm^3)	Average concentration (mg/Nm^3)	Ratio of max. concentration to standard value (%)	Meet the standard or not	Over-limit rate %
1#	Yazishan Village Guixihu Village	SO_2	0.15	0.016~0.028	0.028	0.021	18.67	Yes	0
		NO_2	0.08	0.016~0.034	0.034	0.026	42.5	Yes	0
		PM_{10}	0.15	0.041~0.113	0.113	0.064	75.3	Yes	0
		TSP	0.30	0.055~0.15	0.15	0.085	50	Yes	0
2#	Baiyang Town Wanfunao Village	SO_2	0.15	0.015~0.024	0.024	0.019	16	Yes	0
		NO_2	0.08	0.019~0.027	0.027	0.024	33.75	Yes	0
		PM_{10}	0.15	0.032~0.102	0.102	0.064	68	Yes	0
		TSP	0.30	0.043~0.133	0.133	0.087	44.3	Yes	0
3#	Yazishan Village Guixihu Village	SO_2	0.15	0.014~0.048	0.048	0.025	32	Yes	0
		NO_2	0.08	0.019~0.023	0.023	0.021	28.75	Yes	0
		PM_{10}	0.15	0.038~0.104	0.104	0.064	69.3	Yes	0
		TSP	0.30	0.051~0.136	0.136	0.089	48.3	Yes	0
4#	Baiyang Town	SO_2	0.15	0.014~0.022	0.022	0.019	14.67	Yes	0
		NO_2	0.08	0.020~0.032	0.032	0.024	40	Yes	0
		PM_{10}	0.15	0.035~0.109	0.109	0.064	72.7	Yes	0
		TSP	0.30	0.048~0.145	0.145	0.088	48.3	Yes	0

According to the monitoring data, the daily average concentration and hourly average concentration of SO_2 and NO_2 and the daily average concentration of PM10 and TSP have all met the level II standard of *Ambient Air Quality Standards* (GB3095-2012).

3.3 Acoustic environment quality monitoring and evaluation

(1) Monitoring points and items

6 monitoring points are set up for monitoring of environmental noise, and the monitoring range covers the whole project area. The 1# ~ 4# monitoring points are set at the boundary of the project site. 1# and 4# monitoring points are respectively set near the National Highway 318 and the Yangtze River channel, and adopt class 4a standard; 5# and 6# monitoring points are set at residential area and adopt class 2 standard; noise monitoring section is set at 6# monitoring point. For arrangement of the monitoring points, see Table 3.3-1 and Figure 3.2-1.

Table 3.3-1 List of the environmental sound monitoring points

No.	Location of monitoring point	Standard adopted
1#	North of the project site	Class 4a, 70dB (A) at daytime and 55 dB (A) at night
2#	East of the project site	Class 2, 60dB (A) at daytime and 50 dB (A) at night
3#	West of the project site	Class 2, 60dB (A) at daytime and 50 dB (A) at night
4#	South of the project site	Class 4a, 70dB (A) at daytime and 55 dB (A) at night
5#	Guixihu Village	Class 2, 60dB (A) at daytime and 50 dB (A) at night
6#	Yazishan Village	Class 2, 60dB (A) at daytime and 50 dB (A) at night

The equivalent continuous A-weighted sound level at daytime and at night is measured.

(2) Time and frequency

CQT conducted continuous monitoring for 2 days from November 19 to November 20, 2015 at each noise monitoring point both at daytime and at night. Daytime: 06:00~22:00; night: 22:00~06:00 (the next day).

(3) Monitoring method

Principles and methods for the setting of noise monitoring points as well as noise monitoring and data processing shall be subject to Environmental Quality Standard for Noise (GB3096 - 2008), Emission Standard for Industrial Enterprises Noise at Boundary (GB12348-2008) and Technical Guidelines for Environmental Impact Assessment – Acoustic Environment (HJ/T2.4-2009).

(4) Monitoring result

Noise monitoring result is shown in Table 3.3-2

Table 3.3-2 Acoustic environment monitoring results

No.	Location of monitoring points	Main sound source	Monitoring date	Day time	Night	Excess of standard		Evaluation Standard
						Daytime	Night	
1#	North of the project site	Traffic noise	Nov. 19	63.1	57.0	/	+2	Class 4a
			Nov. 20	62.4	57.8	/	+2.8	
2#	East of the project site	Community noise	Nov. 19	48.9	44.2	/	/	Class 2
			Nov. 20	48.5	44.1	/	/	
3#	West of the project site	Comm	Nov. 19	48.9	44.7	/	/	Class 2

No.	Location of monitoring points		Main sound source	Monitoring date	Day time	Night	Excess of standard		Evaluation Standard
							Daytime	Night	
			unity noise	Nov. 20	47.6	45.2	/	/	
4#	South of the project site		Traffic noise	Nov. 19	49.4	44.5	/	/	Class 4a
				Nov. 20	47.6	45.1	/	/	
5#	Guixihu Village		Community noise	Nov. 19	46.7	44.0	/	/	Class 2
				Nov. 20	45.7	44.0	/	/	
6#	Yazishan Village	20 m away from the highway	Traffic noise, community noise	Nov. 19	59.5	53.5	/	/	Class 4a
				Nov. 20	58.5	53.1	/	/	
		40 m away from the highway		Nov. 19	58.6	52.4	/	/	Class 4a
				Nov. 20	56.5	52.4	/	/	
		60 m away from the highway		Nov. 19	56.9	51.0	/	+1.0	Class 2
				Nov. 20	55.3	51.0	/	+1.0	
		120 m away from the highway		Nov. 19	54.1	49.5	/	/	Class 2
				Nov. 20	54.6	48.9	/	/	

According to Table 3.3-2, the north boundary of the project site is close to the National Highway 318 which is under construction, and the daytime noise there conforms to the standard, while the night noise exceeds the standard level for 2~2.8 dB (A); Noise at the east, west, and south boundary of the project site all conforms to the standard; at noise sensitive point Guixihu Village, noise at daytime and at night both conforms to class 2 standard; Yazishan Village is 60 away from the road, and the daytime noise there conforms to the standard, while the night noise exceeds the standard by 1.0 dB (A), mainly due to the noise from the National Highway 318.

3.4 Monitoring and evaluation of surface water environment

(1) Section setting

Water environment quality monitoring section is set for this project according to the principles and methods for setting of sampling section and sampling point in river water quality monitoring specified in the *Technical Guidelines for Environmental Impact Assessment – Surface Water Environment (HJ/T2.3-93)* and based on the location of the construction project and the location of the water intakes upstream and downstream the project site.

The proposed project is beside the Zhijiang section of Yangtze River. 5 monitoring sections are set, and their locations as shown in Table 3.4-1.

Table 3.4-1 Water quality monitoring sections of the proposed project area

No.	Monitoring section
1#	1,800m downstream the wharf (intake of Lucheng Second Water Plant)
2#	Upper boundary of the wharf
3#	Lower boundary of the wharf
4#	1,500m downstream the wharf (intake of Baiyang Town Water Plant)
5#	3,800m downstream the wharf (intake of Tianjiahe Water Plant)

(2) Monitoring item and methods

There are 9 monitoring items: pH, water temperature, dissolved oxygen (DO), chemical oxygen demand (COD), permanganate index, five-day biochemical oxygen demand (BOD5), suspended solids (SS), NH3-N, and petroleum. Collection, storage, and transport of water samples shall be subject to Regulation for Water Environmental Monitoring (SL219-98), and sample analyzing methods shall be subject to national standard. Analyzing methods of the monitoring items are shown in Table 3.4-2

Table 3.4-2 Water quality monitoring items and analyzing method

Monitoring item	Analyzing method and basis	Detection limit	Main instruments used
pH	Portable pH meter method	0.1 pH unit	FE20 pH meter
Water temperature	Thermometer method GB/T13195－1991	0.1℃ 0.1℃	—
DO	Electrochemical Probe method HJ 506-2009	0.2	HQ30d dissolved oxygen meter
Petroleum	Infrared spectrophotometry HJ637-2012	0.01	F2000-IK Infrared photometric oil content analyzer
SS	Gravimetric method GB11901-89	—	All-glass nuclepore membrane filter
NH3-N	Nessler's reagent colorimetric method HJ535-2009	0.025	Ultraviolet-visible spectrophotometer (TU1900)
COD	Potassium dichromate titration method GB/T11914－1989	5	Burette
BOD5	Dilution and inoculation method HJ505-2009	0.5	HQ30d dissolved oxygen meter
Permanganate index	Titrimetric method GB 11892-89	0.5 mg/L	Burette

(3) Monitoring time and frequency

Phase I monitoring was carried out for 2 days from November 18 to November 19, 2015 and samples were collected once each day.

(4) Monitoring results

Result of surface water quality monitoring is shown in Table 3.4-3.

Table 3.4-3 Water quality monitoring result

Unit: mg/L, no dimension for pH

Item		pH	SS	COD	BOD_5	NH_3-N	Petroleum	Permanganate index	DO
1,800m upstream the wharf	Nov. 18	7.04	5	10	2.2	0.798	ND	3.0	8.13
	Nov. 19	7.06	5	10	2.3	0.786	ND	2.8	8.14
Boundary upstream the wharf	Nov. 18	7.10	6	10	1.3	0.706	ND	2.4	8.12
	Nov. 19	7.15	5	12	1.4	0.616	ND	1.8	8.14
Boundary downstream the wharf	Nov. 18	7.08	5	10	1.6	0.724	ND	2.7	8.36
	Nov. 19	7.03	5	11	1.9	0.536	ND	2.2	8.38
1,500m	Nov. 18	7.21	5	10	2.0	0.394	ND	2.2	8.61

Item		pH	SS	COD	BOD_5	NH_3-N	Petroleum	Permanganate index	DO
downstream the wharf	Nov. 19	7.28	5	9	1.2	0.430	ND	2.0	8.65
3,800m downstream the wharf	Nov. 18	7.17	6	7	2.6	0.210	ND	2.2	8.46
	Nov. 19	7.14	6	11	2.6	0.272	ND	2.2	8.49

Note: "ND" refers to "not detected".

(5) Evaluation method

Based on the water quality monitoring items and monitoring result, single-factor pollution index method is adopted for water quality evaluation. The value of P_i is used to evaluate the water environment quality of the monitored area. Average value in the section is used for evaluation. The calculation formula is as follows:

$P_i = C_i / B_i$

In which,

P_i——the environment quality index of the factor *i*

C_i——the monitoring result of the factor *i*, mg/L

B_i——the evaluation standard of the factor *i*, mg/L.

The evaluation formula of pH is:

$P_i=(7.0-C_i) / (7.0-C_{sd})$ $(C_i \leq 7.0)$

$P_i=(C_i-7.0) / (C_{su}-7.0)$ $(C_i \geq 7.0)$

In which: C_{sd}——the lower limit stipulated by the evaluation standard;

C_{su}——the upper limit stipulated by the evaluation standard;

Other symbols have the same meaning with before.

$$S_{DO,j}=\frac{\left|DO_f-DO_j\right|}{DO_f-DO_s} \qquad DO_j \geq DO_s;$$

$$S_{DO,j}=10-9\frac{DO_j}{DO_s} \qquad DO_j<DO_s.$$

Standard index of DO is:

In which, $S_{DO,j}$——the standard index of single water quality parameter DO at the point j;

$DO_f = 468/(31.6+T)$ The saturated DO when water temperature is T°C

DOs——standard value of DO, mg/L;

DOj——monitored value of DO, mg/L.

(6) Evaluation result

Evaluation result is shown in Table 3.4-4.

Table 3.4-4 Water quality evaluation result of the surface water monitoring section

Section	Item	pH	SS	COD	BOD_5	NH_3-N	Oil	Permanganate index	DO
1#	Monitoring result	7.04 ~ 7.06	5	10	2.2 ~ 2.3	0.798 ~ 0.786	Not detected	2.8 ~ 3.0	8.13 ~ 8.14
	Evaluation standards (C)	6 ~ 9	30	≤20	≤4	≤1.0	≤0.05	≤6	≥5
	P_i	0.02 ~ 0.03	0.17	0.50	0.55 ~ 0.58	0.798 ~ 0.786	0	0.47 ~ 0.50	0.292 ~ 0.294
	Times of ultra standard	—	—	—	—	—	—	—	—
	Over-limit rate	0	0	0	0	0	0	0	0
2#	Monitoring result	7.10 ~ 7.15	5 ~ 6	10 ~ 12	1.3 ~ 1.4	0.706 ~ 0.616	Not detected	1.8 ~ 2.4	8.12 ~ 8.14
	Evaluation standards (C)	6 ~ 9	30	≤20	≤4	≤1.0	≤0.05	≤6	≥5
	P_i	0.05 ~ 0.08	017 ~ 0.20	0.50 ~ 0.60	0.33 ~ 0.35	0.706 ~ 0.616	0.2	0.30 ~ 0.40	0.292 ~ 0.297
	Times of ultra standard	—	—	—	—	—	—	—	—
	Over-limit rate	0	0	0	0	0	0	0	0
3#	Monitoring result	7.03 ~ 7.08	5	10 ~ 11	1.6 ~ 1.9	0.536 ~ 0.724	Not detected	2.2 ~ 2.7	8.36 ~ 8.38
	Evaluation standards (C)	6 ~ 9	30	≤20	≤4	≤1.0	≤0.05	≤6	≥5
	P_i	0.02 ~ 0.04	0.17	0.50 ~ 0.55	0.40 ~ 0.48	0.536 ~ 0.724	0.2	0.37 ~ 0.45	0.238 ~ 0.242
	Times of ultra standard	—	—	—	—	—	—	—	—
	Over-limit rate	0	0	0	0	0	0	0	0
4#	Monitoring result	7.21 ~ 7.28	5	9 ~ 10	1.2 ~ 2.0	0.394 ~ 0.430	Not detected	2.0 ~ 2.2	8.61 ~ 8.65
	Evaluation standards (C)	6 ~ 9	30	≤20	≤4	≤1.0	≤0.05	≤6	≥5
	P_i	0.11 ~ 0.14	0.17	0.45 ~ 0.50	0.30 ~ 0.50	0.394 ~ 0.430	0.2	0.33 ~ 0.37	0.177 ~ 0.186
	Times of ultra standard	—	—	—	—	—	—	—	—
	Over-limit rate	0	0	0	0	0	0	0	0
5#	Monitoring result	7.14 ~ 7.17	6	7 ~ 11	2.6	0.210 ~ 0.272	Not detected	2.2	8.46 ~ 8.49
	Evaluation standards (C)	6 ~ 9	30	≤20	≤4	≤1.0	≤0.05	≤6	≥5
	P_i	0.07 ~	0.20	0.35 ~ 0.55	0.65	0.210 ~ 0.272	0.2	0.37	0.213 ~ 0.219

Section	Item	pH	SS	COD	BOD_5	NH_3-N	Oil	Permanganate index	DO
		0.09							
	Times of ultra standard	—	—	—	—	—	—	—	—
	Over-limit rate	0	0	0	0	0	0	0	0

Section	Item	pH	SS	COD	BOD_5	NH_3-N	Petroleum	Permanganate index	DO
1#	Monitoring result	7.04 ~ 7.06	5	10	2.2 ~ 2.3	0.798 ~ 0.786	ND	2.8 ~ 3.0	8.13 ~ 8.14
	Evaluation standard (class III)	6 ~ 9	30	≤20	≤4	≤1.0	≤0.05	≤6	≥5
	P_i	0.02 ~ 0.03	0.17	0.50	0.55 ~ 0.58	0.798 ~ 0.786	0	0.47 ~ 0.50	0.292 ~ 0.294
	Maximum over standard multiple	—	—	—	—	—	—	—	—
	Over standard rate	0	0	0	0	0	0	0	0
2#	Monitoring result	7.10 ~ 7.15	5 ~ 6	10 ~ 12	1.3 ~ 1.4	0.706 ~ 0.616	ND	1.8 ~ 2.4	8.12 ~ 8.14
	Evaluation standard (class III)	6 ~ 9	30	≤20	≤4	≤1.0	≤0.05	≤6	≥5
	P_i	0.05 ~ 0.08	017 ~ 0.20	0.50 ~ 0.60	0.33 ~ 0.35	0.706 ~ 0.616	0.2	0.30 ~ 0.40	0.292 ~ 0.297
	Maximum over standard multiple	—	—	—	—	—	—	—	—
	Over standard rate	0	0	0	0	0	0	0	0
3#	Monitoring result	7.03 ~ 7.08	5	10 ~ 11	1.6 ~ 1.9	0.536 ~ 0.724	ND	2.2 ~ 2.7	8.36 ~ 8.38
	Evaluation standard (class III)	6 ~ 9	30	≤20	≤4	≤1.0	≤0.05	≤6	≥5
	P_i	0.02 ~ 0.04	0.17	0.50 ~ 0.55	0.40 ~ 0.48	0.536 ~ 0.724	0.2	0.37 ~ 0.45	0.238 ~ 0.242
	Maximum over standard multiple	—	—	—	—	—	—	—	—
	Over standard rate	0	0	0	0	0	0	0	0
4#	Monitoring result	7.21 ~ 7.28	5	9 ~ 10	1.2 ~ 2.0	0.394 ~ 0.430	ND	2.0 ~ 2.2	8.61 ~ 8.65
	Evaluation standard (class III)	6 ~ 9	30	≤20	≤4	≤1.0	≤0.05	≤6	≥5
	P_i	0.11 ~ 0.14	0.17	0.45 ~ 0.50	0.30 ~ 0.50	0.394 ~ 0.430	0.2	0.33 ~ 0.37	0.177 ~ 0.186
	Maximum over standard multiple	—	—	—	—	—	—	—	—

Section	Item	pH	SS	COD	BOD_5	NH_3-N	Petroleum	Permanganate index	DO
	Over standard rate	0	0	0	0	0	0	0	0
5#	Monitoring result	7.14 ~ 7.17	6	7 ~ 11	2.6	0.210 ~ 0.272	ND	2.2	8.46 ~ 8.49
	Evaluation standard (class III)	6 ~ 9	30	≤20	≤4	≤1.0	≤0.05	≤6	≥5
	P_i	0.07 ~ 0.09	0.20	0.35 ~ 0.55	0.65	0.210 ~ 0.272	0.2	0.37	0.213 ~ 0.219
	Maximum over standard multiple	—	—	—	—	—	—	—	—
	Over standard rate	0	0	0	0	0	0	0	0

According to Table 3.4-4, for the three monitoring sections at the proposed project area, the evaluation indexes of pH, SS, Permanganate index, COD, DO, BOD5, petroleum and NH_3-N are all smaller than 1, which shows that the water quality of this section of Yangtze River meets the class III standard specified in the Environmental Quality Standards for Surface Water (GB3838-2002).

3.5 Ecological baseline

The current land in the area is mainly agricultural land with a small part of waste grassland, water and construction land. The area is now under large scale development, the previous status of some part of the land is being changed, and the ecology of the area is being changed gradually from traditional agricultural ecology to urban ecology. This survey involves data referencing, field investigation and interviewing. Sampling method is used for survey of terrestrial vegetation; survey of terrestrial animals is carried out based on interviewing and data collection; and presentation of aquatic ecology is based on existing data. Field investigation was carried out three times in May, June, and November, 2015, and the investigation place was the project area and the surrounding area.

Since land development is intensive and terrestrial vegetation change is enormous, plot sampling method is used for the survey. As the surrounding area is similar to the area, there is no big change in the terrestrial species. And since the main factor that may interfere with aquatic species is the dam that has been built for many years, there is no big change in the aquatic species this year, and the presentation of aquatic ecology is based on the data on aquatic species of the river section of the recent years.

Data collection, site investigation and face-to-face interviews are used for project survey. For terrestrial vegetation, simple investigation is used. For terrestrial animals, field visits and data collection are used. For aquatic ecosystem, data collection is used. Field survey is conducted for 3 times in June, May and November of 2015. The survey sites include project areas and its surrounding areas.

The intensity in land development will result in changes in land cover, so we conducted field survey to get relevant information. However, as the changes in aquatic ecosystem are very little, we use aquatic data in recent years as a reference for status description.

3.5.1 Terrestrial ecology

3.5.1.1 Flora

The project area contains northern subtropical broad-leaved evergreen forests, eastern-China (humid) broad-leaved evergreen forests, mid-subtropical broad-leaved evergreen forests, and mixed forests of mid-subtropical broad-leaved evergreen trees and deciduous trees, and is the cultivation area for paddy rice and citrus.

Current major vegetation in the project area is agricultural vegetation that mainly consists of citrus and dry land crops as well as a small number of planted trees and natural shrubs. Common herbs also grow around the vegetation.

(1) Vegetation types of the project area

The natural vegetation classification system in China's Vegetation defines different forms of vegetation. After plot sampling survey, we have known the composition and structure and communities of dominant species among the vegetation in the area as well as the ecological environment and geographical distribution of the communities, and have found 9 natural vegetation forms of 3 natural vegetation types. The distribution of all vegetation forms is as shown in Table 3.5-1.

Table 3.5-1 Vegetation types in the project area

	Vegetation type group	**Vegetation type**	**Form**		**Distribution**
Natural vegetation	Shrubs and herbs	I. Shrubs	Broussonetia papyrifera	Form.*Broussonetia papyifera*	Widely distributed beside roads and cottages
			Rubus coreanus Miq	Form.*Rubus coreanus Miq*	Around farmland
			Clerodendrum bungei	Form.*Clerodendrum bungei* Sterd.	At some river banks
		II. Herbs	Imperata cylindrica	Form.*Imperata cylindrica (Linn.) Beauv.*	Beside river embankment
			Cynodon dactylon	Form. *Cynodon dactylon*	Widely distributed beside river banks
			Artemisia princeps	Form. *Artemisia princeps*	Widely distributed beside river banks
	Marsh and aquatic vegetation	III. aquatic vegetation	Typha orientalis	Form.*Typha orientalis Presl.*	In pond or swamp
			Nelumbo nucifera	Form.*Nelumbo nucifera*	In pond
			Phragmites australis	Form. *Phragmites australis*	In pond or swamp
Artificial vegetation	Planted forests		Metasequoia	Form.*Metasequoia glyptostroboides Hu & W. C. Cheng*、*Melia azedarach L.*	Around cottages
			Populus euramevicana	Form.*Populus euramevicana*	Beside cottages and roads

	Vegetation type group	Vegetation type	Form		Distribution
			Citrus reticulata	Form. *Citrus reticulata*	Widely distributed between fields
Agricultura vegetation	Crops		Cash crops	Oilseed rape etc.	Distributed between fields
			Grain crops	Maize, paddy rice, buckwheat	Distributed between fields (buckwheat is less populated)
			Vegetables	Canavalia gladiata, Raphanus sativus, Brassica pekinensis, Lactuca sativa, Brassica campestris ssp chinensis, Brassica chinensis, Allium sativum, Allium fistulosum, Ipomoea aquatica Forsk, Capsicum annuum, Vigna unguiculata etc.	Widely distributed in villages

(2) Distribution of key protected plants and old trees

According to the field survey, no national key non-commercial forests, forest parks, or scenic spots are involved in the project area, and no rare old trees are found.

3.5.1.2 **Survey of terrestrial animals**

Based on field survey and interviewing, we have referred to Revised Checklist of Chinese Amphibia & Reptilia (Zhao Ermi, Zhang Xuewen etc., 2000), A Checklist on the Classification and Distribution of the Birds of China (Second Edition) (Zheng Guangmei, 2011), Atlas of Amphibians of China (Fei Liang, 1999), Atlas of Reptiles of China (China Wildlife Conservation Association, 2002), Atlas of Birds of China (Qian Yanwen, 1995), Complete Catalog of Vertebrates of China (Liu Mingyu, Xie Yuhao, Ji Daming, Gao Zhongxin, Li Sizhong, Gao Wei etc., 2000), Atlas of Key Protected Wildlife in Hubei Province (Chen Wei, 1996), and relevant data of the project area, and have comprehensively concluded the animal resources in the project affected area.

We use quantitative rating to indicate the abundance of each animal species: if the population of an animal species in unit area accounts for over 10% of the total number of all surveyed animals, the quantitative rating of such animal species is "+++", which means that such species is a dominant species in the area; if the population of an animal species in unit area accounts for 1~10% of the total number of all surveyed animals, the quantitative rating of such animal species is "++", which means that such species is a common species in the area; if the population of an animal species in unit area accounts for below 1% of the total number of all surveyed animals, the quantitative rating of such animal species is "+", which means that such species is a rare species in the area. The standard for quantitative rating is shown in Table 3.5-2.

Table 3.5-2 Standard for Quantitative Rating of Animal Resources

Status of species	Symbol	Standard
Dominant species	+++	Population of the species in unit area accounts for over 10% of the total number of all surveyed animals
Common species	++	Population of the species in unit area accounts for 1~10% of the total number of all surveyed animals
Rare species	+	Population of the species in unit area accounts for below 1% of the total number of all surveyed animals or is only 1

According to the field survey and relevant data, at present there are various terrestrial

vertebrates living in the project affected area. For distribution and quantity of such species, see Table 3.5-3.

Table 3.5-3 Quantity of terrestrial vertebrates in the project affected area

Class	Order	Family	Species
Amphibia	1	2	5
Reptilia	2	5	9
Aves	3	13	21
Mammalia	5	6	10
Total	17	26	45

Note: Classification is based on Revised Checklist of Chinese Amphibia & Reptilia (Zhao Ermi, Zhang Xuewen etc., 2000)

(I) Amphibias

There are 5 species in 2 families of 1 order of amphibias in the project area, which are all protected animals of Hubei Province. Table 3.5-4 lists the amphibias in the project area.

Table 3.5-4 List of amphibias in the project area

Family	Species	Living environment	Fauna	Population	Protection level
I. ANURA					
(I) Bufonidae	1. *Bufo gargarizans*	Near water sources or in dark and damp grass	Polytopic species	+++	Provincial level
(II) Ranidae	2. *Rata guentheri*	Ponds, water ditches or rivulet, or in nearby grass. Its spawning season is from March to June.	Oriental species	++	Provincial level
	3. *Rata limnocharis*	Ponds, damp fields or nearby fields and wet places.	Oriental species	++	Provincial level
	4. *Rana nigromaculata*	Damp fields, brooks, ditches, lakes and ponds	Polytopic species	+++	Provincial level
	5. *Rana plancyi*	Damp fields	Polytopic species	++	Provincial level

Note: Classification is based on Revised Checklist of Chinese Amphibia & Reptilia (Zhao Ermi, Zhang Xuewen etc., 2000)

(II) Reptilias

Through field survey and interviewing in June and November, 2015 and by referring to the published literature on the project area, we have concluded the types, quantity and distribution of reptilias in the project area as follows:

There are 9 species in 5 families of 2 orders of reptilias in the project area (see Table 3.5-5 for the list). There are 5 species of colubridae, which is the most and accounts for 55% of all species; other species account for 44.5%. no national key protected wildlife is found in the area. Three species of key protected wildlife of Hubei Province live there: Elaphe carinata, E. taeniura, and Zaocys dhumnades.

Table 3.5-5 List of reptilias in the project affected area

LATIN NAME OF THE SPECIES		LIVING ENVIRONMENT	FAUNA	POPULATION	PROTECTION LEVEL
I. TESTUDI NATA					
(I) Bataguridae					
(1)	*Chinemys reevesii*	Rivers, lakes, ponds, rivulets or in wet grass on the bank.	Polytopic species	+	Not listed
(II) Trionychidae					
(2)	*Pelodiscus sinensis*	Rivers, lakes and ponds.	Polytopic species	+	Not listed
II. SQUAMATA					
Lacertilia					
(III) Gekkonidae					
(3)	*Gekko japonicus*	It inhabits in tree cavities, under rocks or in the gaps between walls and it is nocturnal.	Oriental species	+	Not listed
(IV) Scincidae					
(4)	*Eumeces chinensis*	It inhabits in trees and grass in the mountains and plains.	Oriental species	+	Not listed
Serpentes					
(V) Colubridae					
(5)	*Dinodon rufozonatum*	It inhabits in mountain forests and plains, waterside, wall foundation and caves.	Palaearctic species	++	Not listed
(6)	*Elaphe carinata*	It inhabits in forests and shrubs in hills and mountains and nearby fields.	Polytopic species	+++	Provincial level
(7)	*E. rufodorsata*	It is semi-aquatic nonpoisonous snake and inhabits in rivers, ditches, wet fields, ponds and nearby.	Palaearctic species	+	Not listed
(8)	*E. taeniura*	It inhabits near human houses and also appears in grassland, fields, and hills.	Polytopic species	+	Provincial level
(9)	*Zaocys dhumnades*	It inhabits in the fields, in grass beside roads or waterside in hilly areas.	Oriental species	++	Provincial level

Note: Classification is based on Revised Checklist of Chinese Amphibia & Reptilia (Zhao Ermi, Zhang Xuewen etc., 2000)

(2) Ecotype

Based on the ecological habits of the reptilias, the reptilias in the project area have the following 4 ecotypes:

i). House-inhabited type: 1 species, Gekko japonicas. It mainly lives in residential area and nearby shrubs in the project area and has close relation with human activities.

ii). Shrub and rock gap inhabited type: 2 species, Eumeces chinensis and Dinodon rufozonatum. They are widely distributed in the project area and mainly appear in grass and shrubs beside roads, and have close relation with human activities.

iii). Water-inhabited type: 2 speicies, Pelodiscus sinensis and Chinemys reevesii. They are mainly distributed along the banks of Yantgze River in the project area.

iv). Forest waterside inhabited type: 4 species of snake, Elaphe carinata, E. rufodorsata, E. taeniura, and Zaocys dhumnades. They are mainly distributed in the shrubs near water in the project area.

(3) Fauna

Based on the fauna types, the above 9 species of reptilias are divided into 3 catogeries: 3 species are oriental species, accounting for 33.3%; 4 species are polytopic species, accounting for 44.4%; and 2 species are palaearctic species, accounting for 22.2%.

(4) Introduction to the main species

Elaphe carinata: it inhabits in mountains, plains and hills, and appears in river bank, pond bank, reservoir and other places near water. There are a large number of elaphe carinata in the plains in the project area.

Dinodon rufozonatum: It inhabits in mountain forests and plains, waterside, wall foundation and caves. It is widely distributed in the project area.

Zaocys dhumnades: it inhabits in middle and lower mountains, and usally appears near fields, rivers and ditches, and sometimes is also found in villages. It moves fast and is quick in action. It is docile and mainly feeds on batrachian, lizards, fishes, mouses and so on. There are a large number of zaocys dhumnades in the plains in the project area.

(III) Aves

Through extensive field survey and interviewing and by referring to relevant literature on the project area, we have concluded the types, quantity and distribution of aves in the project area as follows:

(1) Species, quantity and distribution

There are 21 species in 13 families of 9 orders of aves in the project area and surrounding area (see Table 3.5-6 for the list). There are 8 species of gruiformes, which is the most and accounts for 38.1% of all species. There is no national key protected species of aves in the area. Eleven species of key protected aves of Hubei Province live there: Phalacrocorax carbo, Egretta garzetta, E.i.intermedia, Ardea cinerea, Anas platyrhynchos, Phasianus colchicus, S. chinensis, Hirundo rustica, Corvus macrorhynchos, Pica pica, and Garrulax canorus.

Table 3.5-6 List of species of aves in the project area

Latin name	Living environment	Resident/ Migratory	Fauna	Popula-tion	Protection level
I. PODICIPEDIFORMES					
(I) Podicipedidae					
1. *Podicepsr uficollis*	Lakes, rivers, reservoirs and ponds where there are reeds or waterweeds.	Resident	Polytopic	++	Not listed
II. PELECANIFORMES					
(II) Phalacrocoracidae					
2. *Phalacrocorax carbo*	Rivers, lakes, ponds, reservoirs, estuaries and marshland.	Resident	Polytopic	++	Provincial
III. CICONIDFORMES					

(III) Ardeidae					
3. *Egretta garzetta*	Shallow waters, such as paddy fields, ponds, rivers & lakes, reservoirs and streams	Summer visitor	Oriental	+++	Provincial
4. *E.i.intermedia*	Streams, paddy fields, ponds	Winter visitor	Polytopic	++	Provincial
5. *Ardeacinerea*	Inhabiting at shallow waters, such as marshlands, beaches, and rivers & lakes, building nests at a centralized place	Resident	Oriental	+++	Provincial
6. *Ardeapurpurea*	Shallow waters, such as marshlands, rivers and reservoirs	Summer visitor	Palaearctic	+	Not listed
IV. GRUIFORMES					
(IV) Rallidae					
7. *Amaurornisphoeicurus*	Marshlands, ponds, paddy fields, places near a stream, and shrubs near water	Summer visitor	Palaearctic	++	Not listed
V. ANSERIFORMES					
(V) Anatidae					
8. *Anasplatyrhynchos*	Lakes, rivers, ponds, marshlands etc.	Winter visitor	Palaearctic	+	Provincial
9. *Anascreca*	Rivers, lakes, marshlands	Winter visitor	Palaearctic	+	Not listed
10. *Anaspoecilorhyncha*	Rivers, lakes, sandbars, marshlands	Summer visitor	Oriental	++	Not listed
VI. GALLIFORMES					
(VI) Phasianidae					
11. *Phasianus colchicus*	Shrub grasslands, bamboo forest, dry lands	Resident	Polytopic	+	Provincial
VII. CHARADRIIFORMES					
(VII) Sternidae					
12. *Chlidoniashybrida*	Marshlands, river & lake banks, and paddy fields	Summer visitor	Polytopic	++	Not listed
VIII. COLUMBIFORMES					
(VIII) Columbidae					
13. *S. chinensis*	Inhabiting in woods at hilly and mountainous area, at wild field with lots of trees, and near farmlands, usually appearing in small groups in fall	Resident	Oriental	+	Provincial
IX. PASSERIFORMES					
(IX) Hirundinidae					
14. *Hirundorus*	Flying over farmland, especially flying in groups and preying on insects over the just ploughed lands, building nests on walls and under eave.	Summer visitor	Palaearctic	++	Provincial
(X) Motacillidae					

15. *Motacillacinerea*	Various environments near water	Winter visitor	Polytopic	++	Not listed
16. *Motacillaalba*	Farmlands, grasslands, barren slopes and road sides near water, never in woods	Resident	Polytopic	++	Not listed
17. *Anthusspinoletta*	Low mountains & hills, plains at the foot of mountain, marshlands, and grasslands & farmlands on both banks of a river	Winter visitor	Polytopic	+	Not listed
(XI) Corvidae					
18. *Corvus macrorhynchos*	Inhabiting at plains, hills and mountainous areas, usually appearing in groups at farmlands, near villages and at river beaches.	Resident	Palaearctic	+	Provincial
19. *Pica pica*	Mountain forest periphery, farmlands and villages.	Resident	Polytopic	++	Provincial
(XII) Timaliidae					
20. *Garrulax canorus*	Shrubs and pygmy forests at hilly and mountainous areas, bamboo forests and yards near town or village	Resident	Oriental	+bu+	Provincial
(XIII) Passeridae					
21. *Passer montanu*	Mountain villages, valleys, river banks and farmlands	Resident	Polytopic	+++	Note listed

Note: the classification is made in accordance with the *A Checklist on the Classification and Distribution of the Birds of China (2nd Edition)* (By Zheng Guangmei, 2011).

(IV) Mammals

On the basis of outdoor survey, interviews and relevant literature, a complete investigation about the species, quantities and distribution of mammals in the target area of ecological assessment was conducted, getting results in below:

There are totally 5 orders, 6 families and 10 species (see details in Table 3.5-7). Two species, Lepus sinensis and Mustela kathiah, are Hubei provincial-level protected animals.

Table 3.5-7 List of mammal species in the target area

Specific name	**Living environment**	**Fauna**	**Population**	**Protection level**
I、INSECTIVORA				
(1) Erinaceidae				
1. *Erinaceus europaeus*	Living in various environments, usually building nests at tree roots, on fallen trees, in stone cracks and in shrubs	Palaearctic	++	Not listed
(2) Soricidae				
2. *Anourosorex squamipes*	Forest lands, grasslands, farmlands and villages	Oriental	+	Not listed
II.CHIROPTERA				
(3) Hipposiderid				
3. *Pipistrellus*	Near residences	Oriental	++	Not listed

Specific name	Living environment	Fauna	Population	Protection level
abramus				
III.LAGOMORPHA				
(4) Leporidae				
4. *Lepus capensis*	Mainly at farmlands or in the shrubs and grasses on both sides of channels near farmland, in shrubs on hills, and at the periphery of forestry	Oriental	++	Not listed
5. *L. sinensis*	At shallow grass slope and shrub land at the foot of mountain, and near farmlands	Oriental	+	Provincial
IV.RODENTIA				
(5) Muridae				
6. *Rattus .norvegeicus*	Widely distributed	Oriental	+++	Not listed
7. *R. niviventer*	Forest lands, shrubs, crop areas, stone cracks, and grasslands near water	Oriental	+	Not listed
8. Mus musculus	Villages	Polytopic	+++	Not listed
V.CARNIVORA				
(6) Mustelidae				
9. *Mustela sibirica*	Inhibiting in various environments, mainly forest periphery, shrubs, marshlands, valleys, hills and plains	Polytopic	++	Not listed
10. *M. kathiah*	Mainly at mountain forests, grasslands, low mountains & hills, farmlands and villages	Oriental	++	Provincial

Note: the classification is made in accordance with the *A Complete Collection of Vertebrates* (Editor in chief: Liu Mingyu, 2000).

(V) Key protected terrestrial animals

In the target area of ecological assessment, there is no national key protected terrestrial animals, but there are 21 Hubei provincial-level protected animals, as shown in Table 3.5-8.

Table 3.5-8 List of key protected terrestrial animals in the target area

Species	Living environment	Protection level	Population	Distribution in target area
1.Bufo gargarizans	Streams & gullies, shrub grasslands, villages	Provincial	+++	Near to paddy fields
2.Hylarana guentheri	In ponds, ditches or rivers, or in the grass nearby	Provincial	++	
3.Pelophylax nigromaculata	Paddy fields, streams & gullies, lakes and marshes	Provincial	++	
4.Fejervarya multistriata	Paddy fields, marshes and vegetable fields	Provincial	+	
5.Rana plancyi	Paddy fields, taro fields, or water bamboo fields	Provincial	+	
5.Elaphe carinata	Shrubs, rivers, ponds	Provincial	+++	Near to shrubs and grasslands
6. *E. taeniura*	Shrubs	Provincial	+	
7.Zaocys dhumnades	Shrubs	Provincial	++	
8.Phalacrocorax carbo	Rivers, lakes, ponds, reservoirs, estuaries and marshes	Provincial	++	Rivers

Species	Living environment	Protection level	Population	Distribution in target area
9. Egretta garzetta	Streams, paddy fields, ponds	Provincial	+++	Rivers, paddy fields
10. E.i.intermedia	Streams, paddy fields, ponds	Provincial	++	Rivers, paddy fields
11.Ardea cinerea	Streams, paddy fields, ponds	Provincial	++	Paddy fields
12.Anas platyrhynchos	Lakes, rivers, ponds, marshes and other waters	Provincial	+	Rivers
13.Phasianus coichicus	Shrub grasslands, bamboo forests, dry lands	Provincial	+	Dry lands, shrub grasslands
14.S.chinensis	Open grounds, sparse woods	Provincial	++	Villages
15.Pica pica	Mountain forest periphery, farmlands or villages	Provincial	+	Shrubs, farmlands
16.Hirundo rustica	Villages	Provincial	+++	Near to villages
18.Corvus macrorhynchos	Inhabiting at plains, hills and mountainous areas; usually appearing in groups near farmlands and villages and at river beaches	Provincial	+	Near to villages
19.Garrulax canorus	Shrubs at hilly and mountainous areas, bamboo forests and yards near town or village	Provincial	++	Shrub grasslands, yards
20. *L. sinensis*	At shallow grass slopes or shrubs, or near farmlands	Provincial	+	Shrub grasslands, farmlands
21. *M. kathiah*	Mountain forests, grasslands, low mountains & hills, and places near to villages and farmlands	Provincial	++	Near to farmlands and villages

(VI) Assessment of terrestrial animal resources

The target area is rural area, most of which are plains and hills. The density of population is not large and the topographic relief is not obvious. Ground vegetation is mostly artificial. It's not a good place for wild animals. So the diversity of terrestrial animals is not sufficient. In the target area, the amphibians include 1 order, 2 families and 5 species, the reptiles include 2 orders, 5 families and 9 species, the birds include 9 orders, 13 families and 21 species, and the mammals include 5 orders, 6 families and 10 species.

In the target area, there is no national-level protected animals, but there are 21 Hubei provincial-level protected animals,

3.5.2 Aquatic environment

As the wharf of project is located in Yangtze River section as stated in *Environmental Impact Report for Jingjiang River Reach Regulation Project (2012)* . At the same time, the aquatic ecological environment of the river reach in recent years sees little change (for example, its upper reaches see no new dam). We believe that the status quo of aquatic ecosystem mentioned in environmental impact report can represent the current situation of aquatic ecosystem of the project. Therefore, we adopt it in this section.

Environmental Impact Report for Jingjiang River Reach Regulation Project is carried out by the Ministry of Water Resources/Water Engineering Ecologic Institute of Chinese Academy of Sciences. The surveys for the status quo of aquatic ecosystem include site reconnaissance, data collection and site visit. The survey is conducted on April 9 - 23, 2011 and July 6 - 30, 2011. The survey for larval resources of fishes is conducted from June 16 to July 15 in 2011 (prosperous period of natural reproduction for four Chinese carps).

3.5.2.1 **Phytoplanktons**

(1) Species of phytoplanktons

We conducted two investigations in April (dry season) and July (wet season) of 2011 in the target area. The investigation results include 7 phyla and 48 genera, covering totally 125 phytoplankton species, of which 75 species belong to bacillariophyta, accounting for 60.00%, 28 species belong to chlorophyta, accounting for 22.40%, 16 species belong to cyanophyta, accounting for 12.80%, one species belongs to euglenophyta and one species belongs to chrysophyta, accounting for 0.80% respectively, and two species belong to pyrroptata and two species belong to rhodophyta, accounting for 1.60% respectively.

In the target area, the quantity of phytoplankton species in bacillariophyta is the largest, followed by chlorophyta and cyanophyta. The common species include melosira, fragilaria, synedra, cymbella, navicula, diatoma, gomphonema, and phormidium etc.

(2) Standing crops of phytoplanktons

Investigation results show that in the target area, the average density of phytoplanktons is 287656 ind./L, of which the average density of bacillariophyta is 245016 ind./L, accounting for 85.18%, the average density of chlorophyta is 32933ind./L, accounting for 12.45%, that of cyanophyta is 7627 ind./L, accounting for 2.65%, that of euglenophyta is 1387ind./L, accounting for 0.48%, that of pyrroptata is 390 ind./L, accounting for 0.14%, and that of chrysophyta is 1092ind./L, accounting for 0.38%.

According to investigation results, the average biomass of phytoplanktons in the target area is 0.5876mg./L, of which the average biomass of bacillariophyta is 0.3632 mg./L, accounting for 61.80%, the average biomass of chlorophyta is 0.1615mg./L, accounting for 27.48%, that of cyanophyta is 0.0449 mg./L, accounting for 7.63%, that of chrysophyta is 0.0185mg./L, accounting for 3.15%, that of euglenophyta is 0.0035 mg./L, accoutning for 0.60%, and that of pyrroptata is 0.0195mg./L, accounting for 3.32%.

(3) Diversity of algae

Biodiversity is an important indicator of the structure of species in an ecological system. It not only reflects the level of organization of the biocenosis but also shows the essential nature of the biocenosis from the relation between structure and function. Biodiversity index is ecologically significant because it reflects the richness and evenness of the species in an ecological system.

By using Shannon-Wiener index formula, the diversity index of phytoplanktons at cross sections of Zhijiang section of Yangtze River is calculated as shown in Table 3.5-9.

Table 3.5-9 Diversity indexes of phytoplanktons at cross sections of Zhijiang section of Yangtze River

Time	Items	Quantity
April	Qualitative measurement of species	39
	Quantitative measurement of species	26
	Diversity index	3.56
July	Qualitative measurement of species	52
	Quantitative measurement of species	22
	Diversity index	3.45

Diversity index is designed to reflect the richness and evenness of species in an ecological

system. Investigation results show a high diversity index of phytoplanktons at cross sections of Zhijiang section of Yangtze River in the target area. This demonstrates that the target area has rich and even phytoplankton species.

Algae diversity has something to do with water quality. Shannon-Weiner index is used to assess water quality, as shown in Table 3.5-10.

Table 3.5-10 Algae diversity index and water quality assessment

Diversity index	0	0＜H≤1	1＜H≤2	2＜H≤3	3＜H
Degree of pollution	Severe pollution	Heavy pollution	Moderate pollution	Light pollution	Clean

Shannon-Wiener index is used to assess the water quality in the target area. Investigation results show that the algae diversity index at cross sections of Zhijiang section is larger than 3, which demonstrates that the quality of waters in the target area is clean.

3.5.2.2 **Zooplankton**

(1) Species of zooplankton

In the target area, there are totally 32 genera and 65 species of zooplankton (refer to Table 3.5-11), including 28 protozoa species at most, accounting for 43.08%, 19 rotifer species, accounting for 29.23%, 8 cladocera species, accounting for 12.31%, and at least 10 copepod species, accounting for 15.38%. Common protozoa species include arcella hemisphaerica and C. orbicularis, common rotifer species include brachionus calyciflorus pallas, keratella cochlearis and polyarthra trigla, common cladocera species include daphnia hyaline and bosmina coregoni, and common copepod species include sinocalanus dorrii and cyclops strenuuss.

Table 3.5-11 Number of zooplankton species in the target area

Species		Protozoa	Rotifer	Cladocera	Copepod	Total
Zhijiang section	April	17	13	7	5	42
	July	21	8	4	9	42
	Total	28	19	8	10	65

(2) Standing crops of zooplankton

1) Density

As shown in Table 3.5-12, the average density of zooplankton in the target area (Zhijiang section of Yangtze River) is 213.97ind./L, of which the average density of protozoa is 198.5ind./L, accounting for 92.77%, that of rotifer is 15.00ind./L, accounting for 7.01%, that of cladocera is 0.13 ind./L, accounting for 0.06%, and that of copepod is 0.335ind./L, accounting for 0.0.16%. The average density of zooplankton at this section is 255.81ind./L in April and 172.12ind./L in July, higher than the former.

Table 3.5-12 Density of zooplankton in the target area, unit: ind./L

Species		**Protozoa**	**Rotifer**	**Cladocera**	**Copepod**	**Total**
Zhijiang section	April	225	30	0.23	0.58	255.81
	July	172	0	0.03	0.09	172.12
	Average	198.5	15	0.13	0.335	213.97

2) Biomass

As shown in Table 3.5-13, the average biomass of zooplankton in the target area (Zhijiang section of Yangtze River) is 0.0369mg/L, of which average biomass of rotifer is 0.018mg/L, accounting for 48.78%, the highest among the four categories, followed by protozoa (0.0099mg/L, accounting for 26.834%), copepod (0.0064mg/Lm, accounting for 17.34%) and cladocera (0.0026mg/L, accounting for 7.05%) in order.

Table 3.5-13 Biomass of zooplankton in the target area, unit: mg/L

Species		Protozoa	Rotifer	Cladocera	Copepod	Total
Zhijiang section	April	0.0113	0.0360	0.0046	0.0110	0.0629
	July	0.0086	0.0000	0.0006	0.0017	0.0109
	Average	0.0099	0.0180	0.0026	0.0064	0.0369

3) Diversity analysis of zooplankton

By using Shannon-Weiner index formula, the diversity index of zooplankton at Zhijiang section is calculated as shown in Table 3.5-14, Diversity index is designed to reflect the richness and evenness of species in the ecological system. Investigation results show that the diversity index of zooplankton in the target area is 1.21 in April and 0.58 in July, both of which are at low level.

Table 3.5-14 Shannon-Weiner diversity index of zooplankton at Zhijiang section

Items		**Zhijiang section**
April	Diversity index	1.21
	Quantitative measurement	6
July	Diversity index	0.58
	Quantitative measurement	6

3.5.2.3 **Zoobenthos**

(1) Species of zoobenthos

In the target area, there are totally 26 species of zoobenthos, including 2 annelid species, accounting for 7.69%, 10 mollusk species, accounting for 38.46%, and 14 arthropod species, accounting for 53.85%. Dominant species include limnoperna lacustris, corbicula fluminea, procladius, palaemonidae, palaemonetes sinensis and freshwater shrimps.

Most of zoobenthos inhabit at near-shore beaches and backwaters where water flows slowly. In main course of river, water flows fast, so size of zoobenthos is small. Since hydrological conditions are similar throughout the target area, species of zoobenthos have mostly the same structure and there is no significant difference in horizontal distribution of species, just a little richer in dry season than in wet season.

In Yangtze River, most of zoobenthos appear at near-shore beaches and shallow waters and river branches where water flows slowly. In main course of river, water flows fast, so size of zoobenthos is small.

(2) Standing crops of zoobenthos

Standing crops of zoobenthos in the target area are shown in Table 3.5-15. We can see from the table that the density of zoobenthos is 10ind./m^2, of which the highest component is

arthropod, followed by mollusk and the lowest component is annelid, and that the biomass of zoobenthos is 3.24g/m^2, of which the highest component is mollusk, followed by arthropod, and the lowest component is annelid.

Table 3.5-15 Standing crops of zoobenthos

Cross sections of river		Density (ind./m^2)				Biomass (g/m^2)			
		Annelid	Mollusk	Arthropod	Total	Annelid	Mollusk	Arthropod	Total
Zhijiang section	April	0	5	16	21	0	3.43	0.8	4.23
	July	0	3	4	7	0	1.25	0.99	2.24

(3) Diversity index of zoobenthos

Diversity index of zoobenthos at Zhijiang section is 2.4 in April and 2.1 in July, both of which are at ordinary level, as shown in Table 3.5-16.

Dominant species of zoobenthos in the target area include limnoperna lacustris, corbicula fluminea, procladius, palaemonidae, palaemonetes sinensis and freshwater shrimps. Most of them inhabit at near-shore beaches and backwaters. There are few at main course of river and deep waters.

Table 3.5-16 Diversity index of zoobenthos

Indicators	Zhijiang section	
	April	July
Qualitative measurement	14	9
Quantitative measurement	6	5
Diversity index	2.4	2.1

(4) Assessment of zoobenthos

In the target area, there are now 35 species of zoobenthos, of which the mollusk, arthropod and annelid take up 65.71%, 20.00% and 14.29% respectively. Dominant species include bellamya quadrata, semisulcospira cancellata bonson, limnoperna lacustris, corbicula fluminea, corbicula nitens, E.annandalei, E.modestus and palaemonetes sinensis etc. The average density of zoobenthos is 27.11ind./m^2, of which the mollusk, arthropod and annelid take up 4.28%, 61.16% and 34.56% respectively. The average biomass of zoobenthos is 1.2g/m^2, of which the mollusk, arthropod and annelid take up 82.54%, 10.32% and 7.14% respectively.

There are rich species of zoobenthos in Zhijiang section of Yangtze River, including very few dirty resistant species, and some aerobic ephemeroptera species were detected in some positions. All these demonstrate that the water quality is good at this section of Yangtze River.

3.5.2.4 **Fish resources**

(1) Living environment for fishes

a) Spawning ground of four major Chinese carps

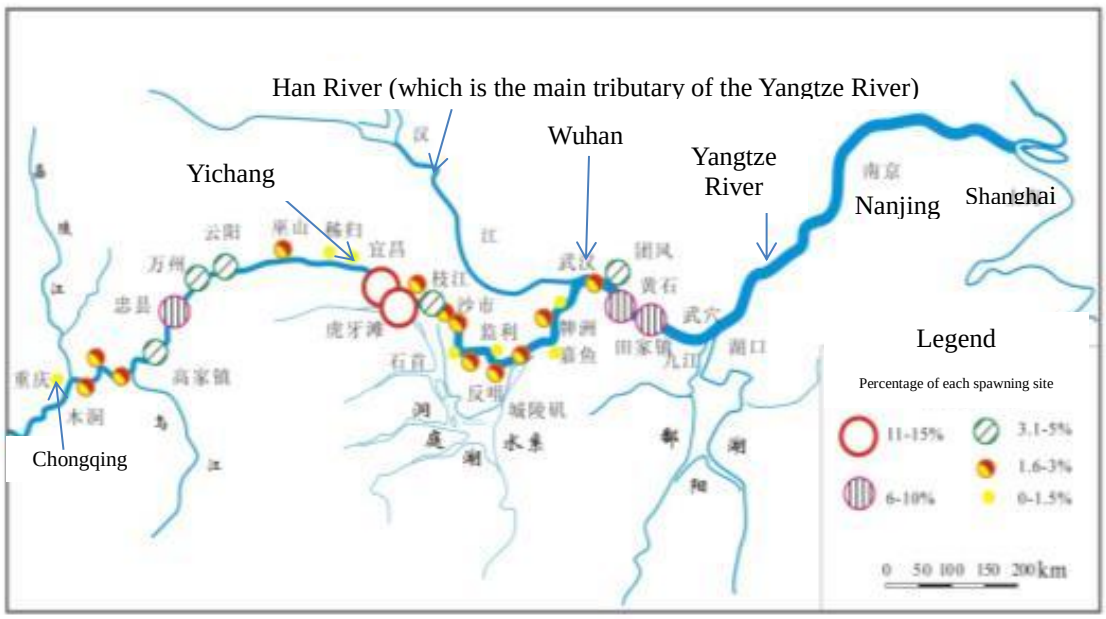
The environmental requirements for spawning of the fishes producing pelagic eggs such as four major Chinese carps include proper water temperature, river swelling as a stimulus and proper hydrological conditions. River swelling actually represents a series of hydrological changes, such as increased flow, rise of water level, increased speed, and becoming less

transparent and disorder.

Spawning grounds for the fishes producing pelagic eggs such as four major Chinese carps are usually featured with tortuous and complex river channel, a strip of land extending into river center, or sandbars at river center. These features result in complicated hydrological conditions, such as change of water speed and disorder of water flow, and water waves and whirlpools are generated to provide the best conditions for spawning of the fishes producing pelagic eggs. Sperms fuse with eggs when moving up and down with water flow. Proper hydrological conditions at spawning season will stimulate parent fishes to spawn at the spawning grounds.

According to the survey in 1980s, there are 19 spawning grounds for four major Chinese carps (grass carp, black carp, silver carp and bighead carp) in the section from Yichang to Wuxue of Yangtze River (as shown in Figure 3.5-1).

After Three Gorges Reservoir was used for water storage, Yangtze River Fisheries Research Institute and Institute of Hydrology, MWR & CAS had continuous monitoring on the fishes producing pelagic eggs in the middle reaches of Yangtze River and found 11 spawning grounds of four major Chinese carps in the 300km section from Yichang to Chenglingji of Yangtze River (as shown in Figure 3.5-1). During 2003~2006, the amount of eggs produced by fishes with pelagic eggs was approximately 42.7% at the middle reaches of Yangtze River. The fish eggs mainly sourced in Yichang, Yidu, Jiangkou, Shishou and Tiaoguan, indicating that there are many spawning grounds distributed in this section and they are moving downstream.



1980s

After Three Gorges Reservoir was used for water storage

Figure 3.5-1 Spawning grounds of four major Chinese carps at the middle and lower reaches of Yangtze River

b) Feeding or nursing ground

Location of feeding or nursing ground of fishes usually depends on their foods. The fishes preying on planktons, such as silver carp and bighead carp, usually feed themselves or juveniles at clean lakes connected to river. Due to water storage in Three Gorges Reservoir, the water area downstream from the dam has clean and transparent water and has become feeding ground for the fishes preying on planktons. The fishes preying on aquatic vascular plants, e.g. grass carp, and the fishes preying on snails and mussels, e.g. black carp, also get fed mainly at lakes connected to river.

c) Overwintering ground

In winter, water level falls and fishes spend winter mainly in deep waters of river.

(2) Biological conditions of major aquatic animals

Refer to section 3.6.

(3) Species of fish in the target area

In the target area, there are 10 orders, 23 families, 77 genera and totally 123 species of fish, including cypriniformes (54 genera and 83 species and subspecies), siluriformes, perciformes, acipenseriformes, clupeiformes, cyprinodontiformes, synbranchiformes, beloniformes, salmoniformes, anguilliformes and tetraodontiformes. Family cyprinidae includes 46 genera and 69 species. In addition, giant salamander and finless porpoise were seen in the target area.

In general, the environment of the project area is good, in spite of local destruction of ecological environment due to large-scale development or construction.

3.6 Chinese Sturgeon Nature Reserve

The project area is 3km away outside the boundary of the provincial level Chinese Sturgeon Nature Reserve, as shown in Figure 3.6-1.

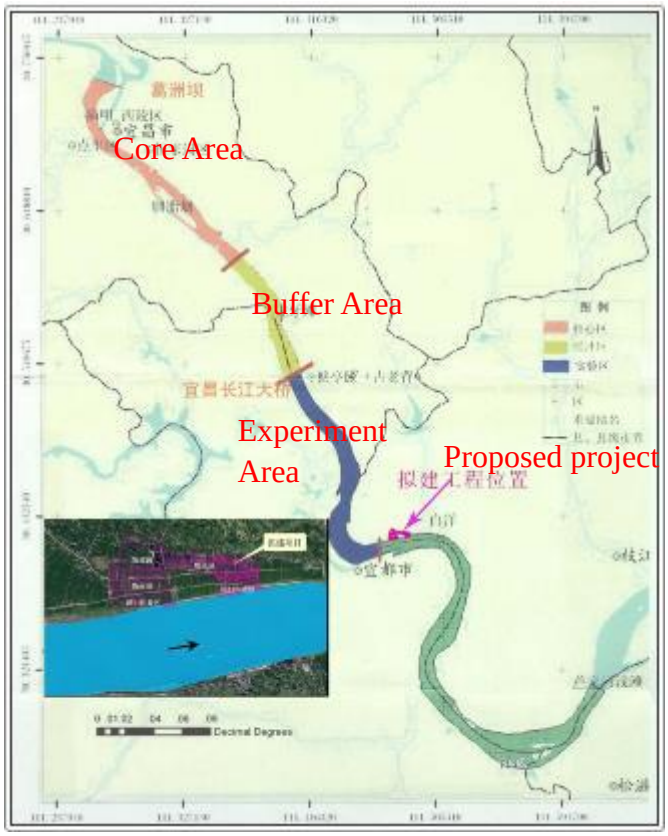


Figure 3.6-1 Relationship between the Project and Chinese Sturgeon Nature Reserve

3.6.1 Chinese sturgeon

(1) Introduction

Chinese sturgeon is one kind of anadromous fish, of important significance for research. They inhabit along coasts of China and Japan and migrate to lower section of Jinsha River at the upper reaches of Yangtze River (3,050 km from Yangtze estuary) or upper section of Pear River for propagation. Yangtze River Chinese sturgeon spawn from middle of October to middle of November, and Pearl River Chinese sturgeon spawn during March to April, so they are different ecological groups. Today, the size of spawning stock of Chinese sturgeons in Pearl River is decreasing sharply. Before 1980, the size of spawning stock of Chinese sturgeons in Yangtze River was larger than 2000 each year, but 400~500 Chinese sturgeons were harvested by people each year at the upper reaches of Yangtze River, equivalent to 60,000~80,000kg. After Gezhou Dam Water Control Project was constructed, the channel for Chinese sturgeon migrating upstream along Yangtze River was blocked and a new spawning ground for natural propagation was formed downstream from the dam. Many years' investigation shows that this is now the only spawning ground for Yangtze River Chinese sturgeon, and also the major habitat for spawning stock of Chinese sturgeon.

Since 1983, commercial harvest of Yangtze River Chinese sturgeon has been prohibited. Only several licensed organizations are allowed to harvest Yangtze River Chinese sturgeon for the purpose of artificial spawning or scientific research. In spite of such measures, the population of Yangtze River Chinese sturgeons is decreasing continuously, only less than 1000 currently, because the size of natural propagation at the spawning ground downstream from Gezhou dam is small and artificial release is not enough to make up for the decrease of natural propagation.

To prevent extinction of Chinese sturgeons resulting from the blockage of their channel migrating upstream along Yangtze River by Gezhou Dam project and Three Gorges project, Research Institute of Chinese Sturgeon was established at Yichang in 1982. In the twenty years since its establishment, the institute has released more than 4,490,500 artificially-bred Chinese sturgeons into Yangtze River to effectively make up for the decrease of population of Chinese sturgeon. This activity is still being carried out every year.

(2) Migration period of Chinese sturgeons

The migration period of Chinese sturgeons consist of two periods, i.e. pre-spawning anadromous migration and post-spawning catadromous migration.

1) Time of anadromous migration

The period of anadromous migration of Chinese sturgeons is in the middle of October each year.

2) Time of catadromous migration

The time of **catadromous migration of** adult Chinese sturgeons is in during Feb. – the

middle of April each year.

The larvae and juveniles of Chinese sturgeons begin catadromous migration in the early to middle of Decembereach year. Since the spawning ground is 55km from the project site, and the migration speed each day for larvae and juveniles is the water flow speed, i.e.

0.68m/s (low flow period), it can be seen that the time for the young fishes crossing this river section is less than one hour. Therefore, by a conservative estimate, the time of migration of larvae and juveniles during this period is during the mid to end of December each year.

3.6.2 Other important fishes

***Psephurus gladius* (Martens)**

Psephurus gladius is one kid of ferocious fish swimming in middle and deep waters, listed into China level-1 protected aquatic wild animal. They inhabit in stem stream of Yangtze River, occasionally in large lakes connected to Yangtze River (e.g. Dongting Lake). They feed on other fishes (such as coreius heterokon and bigmouth grenadier anchovy), shrimps and crabs, and spawn in spring.

In the history, adult psephurus gladius were caught mainly at Leibo-Yibin section, Jiangjin section and Chongqing-Wanxian section in Sichuan as well as the Yichang-Yidu section in Hubei. The adults harvested from Leibo-Yibin section were large and sexually mature. This proves that this section was a spawning ground.

After Gezhou Dam Water Control Project was constructed in 1981, the channel for psephurus gladius migrating upstream along Yangtze River was blocked. The population of Psephurus gladius at upper part of Yangtze River receives no replenishment, and through many years' investigation, we get no direct evidence of natural propagation of psephurus gladius at the middle and lower part of Yangtze River. In previous ten years, the population of psephurus gladius decreased obviously. This species may become extinct if without forceful measures. Since natural population of psephurus gladius is very small, it's not a good method to wait for natural restoration.

In December 2005, China Three Gorges Corporation initiated and financed the preliminary research for the project: "Research on Life History and Artificial Propagation Technologies of Psephurus Gladius", with the aim to explore the possibility of artificial domestication and propagation. Since then, a rare fishes rescue & rapid response system was established and many investigations were conducted to explore their major habitats. But till now, no living psephurus gladius has been searched and the artificial domestication and propagation technologies are under exploration.

***Neophocaena phocaenoidesasiaeorientalis*(Pilleri *et* Gihr)**

Category II Nationally Protected Aquatic Wildlife

Neomeris phocaenoides are porpoise and only species of neomeris. Body length of adult neomeris phocaenoides is 120 to 190 cm and the weight ranges from 100 to 220kg. Neomeris phocaenoides are distributed in Western Pacific Ocean, India Ocean, Japan Sean, China's Coastal Waters and other waters from tropical to warm Temperate Zone and are found in Bohai Sea, Yellow Sea, East China Sea, South China Sea and Yangtze River. They usually inhabit in saltwater and freshwater transitional zones and can also live in freshwater like downstream reaches of rivers.They are found even in the Yichang section of the Yangtze River. Neomeris phocaenoides like to go about alone or in pairs and the members in one fish group normally will not be larger than 4 or 5. However, there is also record that 87 neomeris phocaneoides go about together. Neomeris phocaneoides usually breed in Spring and their delivery takes longer time. April and May are usually the peak period for them to breed. Body length of new born neomeris phocaneoides is about 70 cm and neomeris phocaneoides usually bear one child for one pregnancy. They have wide feeding

habits with fish as the main food source and eat shrimps and cephalopods.

Currently, number of neomeris phocaneoides in Changjiang River is not more than 2000 and is decreasing constantly. Changes in natural environment, water level drawdown, deterioration of water quality, siltation of rivers and lakes and reduction of food sources threaten the breeding and growth of neomeris phocaneoides. Sailing and heavy fishing devastate the parent and young neomeris phocaneoides, causing sharp decrease in number of neomeries phocaneoides. Developing studies on artificial domestication and breeding, releasing young neomeries phocaneoides to enhance the sources and ensuring reproduction of neomeries phocaneoides for generations are of significant importance.

***Myxocyprinus asiaticus* (Bleeker)**

Category II Nationally Protected Aquatic Wildlife

The morphological characters of Myxocyprinus asiaticus vary greatly during different growth periods. For instance, as for the relationship of body length and height, fish larvae has a body length of about 1.6 ~ 2.2cm, which is about 4.7 times of its body height. However, as it grows up with a body length of about 12.0 ~ 28.0cm during juvenile period, its body length is about 2.5 times of its body height, i.e. the growth rate of the fish's body height is faster than that of its body length during this period. On the other hand, adult fishes have body length about 58.4 ~ 98.0 cm, about 3.4 times of its body height, i.e. The growth rate of body height slows down during this period.

Myxocyprinus asiaticus spawns during late March and late April, when the water temperature is low. Natural breeding can be detected when the temperature of the river water is about 13°C and 14 ~ 16 °C is the optimal temperature for spawning. The fish usually spawns on the sands and gravels on the riverbed near the beach where the water flow is turbulent. The fish eggs become sticky and the water sellable egg envelope makes it easy to stick to the sands and gravels to grow. The eggs can expand into a size with diameter of 4.0 ~ 4.5 mm after swelling up with water. In water of 13 ~ 15 °C, it takes about 7 ~ 8 days for fertilized eggs to hatch. Newly hatched larvae are unable to swim up and down in the water due to immature organs and they lie at the bottom of the riverbed with intermittent twitching. This takes about 6 ~ 8 days when they can easily be attacked and eaten by predators, resulting in a high mortality rate in this stage.

Myxocyprinus asiaticus feeds on benthic invertebrates such as Ephemeroptera, Odonata, Plecoptera, Trichoptera, Chironomidae and other aquatic insects, as well as some molluscs such as aquatic oligochaete, earthworms, limnoperna fortunei and Corbiculidae, etc. Food intake is large, and the diet composition varies greatly from individuals due to the different types of benthonicanimals living in the habitat environment. For instance, limnoperna fortunei is the major intake of fishes found in Chongqing river section, while Odonata larvae and limnoperna fortunei are the major intake of fishes found in Yichang river section.

Myxocyprinus asiaticus is widely seen in the mainstream and tributaries of the Yangtze system. Catching of Myxocyprinus asiaticus in the mainstream and tributaries (including Jinsha River, Minjiang River, Tuojiang River, Chishui River, Jialing River, Wujiang River, Qingjiang River, and the Han River) of the Yangtze River, and in Dongting Lake, Poyang lake, and other lakes along the Yangtze River has been recorded. The spawning sites were thought to be mostly located in the mainstream in the upper reaches of the Yangtze River between Yibin and Chongqing, as well as in the Minjiang River, Jialing River and other tributaries, especially in the downstream of the Jinsha River.

After Gezhouba Dam is built, the habitat of Myxocyprinus asiaticus is divided into upstream and downstream segments from the dam. According to relevant statistics, in the Yangtze segment upstream from Yichang, the catches of Myxocyprinus asiaticus account for over 13% of the total fish catches in the Minjiang River in 1958; in mid 1970s, the number of Myxocyprinus asiaticus fell sharply, with the catches of Myxocyprinus asiaticus accounting for only 2% of the total fish catches in the Minjiang River; in 1980s, the catches of Myxocyprinus asiaticus account for less than 1% of the total fish catches in the upper reaches of the Yangtze river.

Myxocyprinus asiaticus may naturally spawn in the Yangtze segment both upstream and downstream from Yichang, with the quantity of eggs spawned in the upstream segment being slightly larger. However, the quantity of spawns in general is rather small. No evident habitats of Myxocyprinus asiaticus juveniles have been found in the upper reaches of the Yangtze River.

Acipenser dabryanus (Dabry's sturgeon)

Dabry's sturgeon lives in slow-moving river waters over substrates of sand and mud with humus and benthos or in river bends/bays with pebble dams. This species takes part in a migration, but never leaves fresh water. It grows quickly to reach 0.8-1.0 m in general length and weigh 5-10kg. It falls under the category of animals under the state's first-grade protection.

Dabry's sturgeon falls under osteichthyes, belong to sturgeon family. Its 1.1m long, cylinder-shaped body is blue-gray above and yellowish white on the belly, with five rows of scutes. The head is triangular and the snout is long with the mouth located on the underside. There are two pairs of barbels. The length of a barbel is half the length between the mouth and the end from which a barbel extrudes. Dabry's sturgeon feeds on aquatic plants, invertebrates, and small fish. It takes part in a migration, but never leaves fresh water. Its maximum weight reaches over 15kg. Males mature at 4-7 years old while females mature at 6-8 years old. Dabry's sturgeon is a big fish of commercial importance, but has a small quantity of spawns. It is endemic to the Yangtze River Basin in China. Its population has declined drastically over the past two decades, facing the risk of extinction. Provinces along the upper Yangtze have begun to pay attention to Dabry's sturgeon and take as much effort protecting the species as protecting Chinese sturgeon.

Among rare fish species, few Dabry's sturgeon and Chinese sturgeon has been seen for years. Chinese sturgeon juveniles have been found caught in fishing nets now and then.

3.7 Regional social and economic development

3.7.1 Yichang Municipal social and economic

Yichang Municipal has jurisdiction over five districts, five counties and three cities, i.e. Xiling District, Wujiagang District, Dianjun District, Huting District, Yiling District, Yuan'an County, Xingshan County, Zigui County, Changyang Tujia Autonomous County, Wufeng Tujia Autonomous County, Yidu City, Dangyang City, Zhijiang City. Yichang has 25 counties, 62 towns, and 20 subdistricts, 1367 villager's committee, 9804 villager groups, and 260 resident's committees. By the end of 2009, there are about 4.0137 million registered populations by the end of 2009, and 4.0455 million permanent populations. The newly-born population in 2009 is 30.6 thousand, with a birth rate of 7.62‰, while the deaths is 31.3 thousand people, with a mortality rate of 7.80‰, i.e. natural population

growth rate is -0.18‰. The city has a land area of 21084 km^2, and the area of towns and urban area accounts for about 40.13%. Urban area is 4232 km^2.

In 2014, the gross production of Yichang Municipal amounted to 47.578 billion USD, a growth of 9.8%; the public budget revenue of this city amounted to 27.15 billion Yuan, a growth of 31.6%; the fixed-asset investment amounted to 247.1 billion Yuan, a growth of 22.1%; total retail sales of consumer goods amounted to 96.45 billion Yuan, a growth of 13.3%; import & export value reached 2.7 billion Yuan, a growth of 14.8%; the income of urban residents was 25,025 Yuan, a growth of 9.6%; the income of rural residents was 11,837 Yuan, a growth of 13.2%. Four counties of this city, namely Yidu, Yiling, Zhijiang and Dangyang, were among the economically strongest counties of Hubei, and Yidu was the second county of Hubei which was listed into China Top 100 strongest counties. Eight counties (prefecture level cities or districts) had a public budge revenue exceeding 1 million, among which two counties exceeding 2 billion and two counties exceeding 3 billion; the income of urban residents in nine counties (prefecture-level cities or districts) exceeded 20,000 Yuan; the income of rural residents in eight counties (prefecture-level cities or districts) exceeded 10,000 Yuan.

3.7.2 Cultural relics

There are no cultural relics within the project scope. The latest cultural relics are the ancient tombs of Song Dynasty in Baiyang Town, which is more than 1.0 km away and is separated from the project area by Baiyang Town.

4 Analysis of Alternatives

The purpose of the comparison is to find out the most environmental-friendly schemes from the perspectives of environmental, social and safety impact, mitigation measures, cost of such measures and the requirements of management and training, and provide support for further scheme optimization, so as to reduce the negative impact and the cost of implementing mitigation measures in the future.

4.1 With and without project

The logistics industry of Yichang Municipal is awash with small-sized logistics firms and even individual businesses. These firms and individual businesses usually have incomplete facilities. Few of them own warehouse and storage yard. Most of these logistics service providers provide only single or two types of logistics services, generally focusing on transportation. But most of the vehicles they use in transportation are private vehicles rather than own vehicles, and few of these firms and businesses have park lots for these vehicles. Most of logistics service providers in the market don't grasp advanced logistics operation technology, and the persons providing logistics service have a great space for improvement in logistics services and logistics management.

Most of nodes in the logistic network of Yichang Municipal have the functions of transport, handling, storage & delivery and information services, but compared with the needs of logistics market, the logistics industry of Yichang Municipal has many problems, such as being not professional, lacking supporting facilities, incapable of providing integrated services and insufficient information communication, and also have a lot that need to be improved, including multi-modal transport, swap trailer transport, cold-chain logistics services, information management, process optimization and one-stop service.

(1) Current situation of Yichang Navigation Hub

Yichang Navigation Hub is one of major inland ports in China and also an important transit port in the upper and middle reaches of Yangtze River. Yichang Navigation Hub mainly serves for Yichang Municipal and northwestern Hubei, including transit transport of bulk cargo, such as coals, minerals, fertilizers and cements, and feeder line container transportation. Many of goods at Yichang Navigation Hub are from Sichuan, Chongqing, Henan and Anhui besides Yichang Municipal and northwestern Hubei.

Yichang Navigation Hub consists of six districts, namely Zhucheng, Zigui, Zhijiang, Yidu, Changyang and Xingshan. Most of wharves locate along the trunk line of Yangtze River and some also locate along Xiangxi River, Huangbai River and Qing River. Presently, there are 361wharves and 577 berths, including 306 for bulk cargo, 59 for break bulk cargo, 2 for containers, 9 for ro-ro cargo, 62 for passengers, and 139 for others. The annual cargo handling capacity of Yichang Navigation Hub reaches 66.761 million tons, including 31.835 million tons of bulk cargo, 18.64 million tons of break bulk cargo, 203,000 TEUs, and 2.59 million ro-ro vehicles, and the annual passenger throughout of the port reaches 11.9835 million. Up to 2014, there had been 116 enterprises (or individuals) having business at Yichang Navigation Hub (only one was shut down), with assets totaling over 2.1 billion Yuan, creating more than 3450 jobs, mainly covering coals, phosphate ores (powdered rock phosphate), sand and gravel materials, cement, chemical products and raw materials, fertilizers and raw materials, metallic and non-metallic ores, mechanical parts, agricultural and sideline products, and hardware etc.

(2) Existing environmental problems of Yichang Navigation Hub

Currently the development of Yichang Navigation Hub is still lagging behind and unable to satisfy the transportation demand of local economic development. The following is the major environmental problems to be solved.

1) Part of Yichang Navigation Hub is within Chinese sturgeon protection area and may bring great adverse impact to the protection of Chinese sturgeon;

2) Some wharves for dangerous chemicals locate at water intake, reservoir area or any other area having high requirement for water quality and may bring adverse impact to the water quality protection at Yichang section of Yangtze River; relocation of these wharves is under way;

3) Some wharves locate near the urban area and may bring adverse impacts, e.g. dusts and noise, to the sensitive receptors like residential areas, etc;

4) Collection and disposition of pollutants inside the port shall be improved. Dusts during construction and floating waste on the river make it unsightly to look at.

After implementation of the project, it shall be able to undertake part of the wharf function for upper reaches. It will solve part of its environmental problems, and it is conducive to the efficient use of shoreline resources. It will protect the surface water resources in Yichang section. It is also conducive to realize large-scale and intensive processing of regional pollutants. Meanwhile, with the implementation of the project, the logistics industry will see rapid development, thus bringing far-reaching impact on overall economic development. It will be able to solve the existing logistics problems, and give full play to Yichang Navigation Hub.

If we do not implement this project, it is not conducive to the development of Yichang Navigation Hub, and is not conducive to the rapid development of logistics in Yichang City.

From the perspective of environmental protection, the implementation of the project is conducive to the protection and improvement of regional environment.

4.2 Layout of Baiyang Logistics Park

(1) Bayang Logistics Park

Two plans for the overall arrangement of Baiyang Logistics Park are provided as shown in Figures 4.2-1 & 4.2-2.

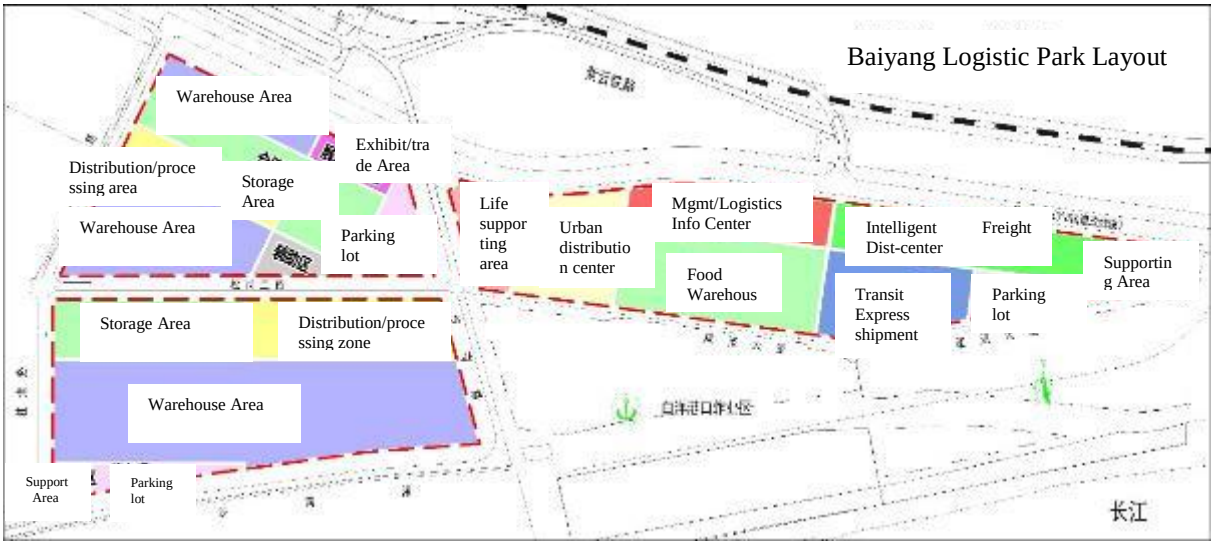


Figure 4.2-1 Scenario I for overall arrangement of Baiyang Logistics Park

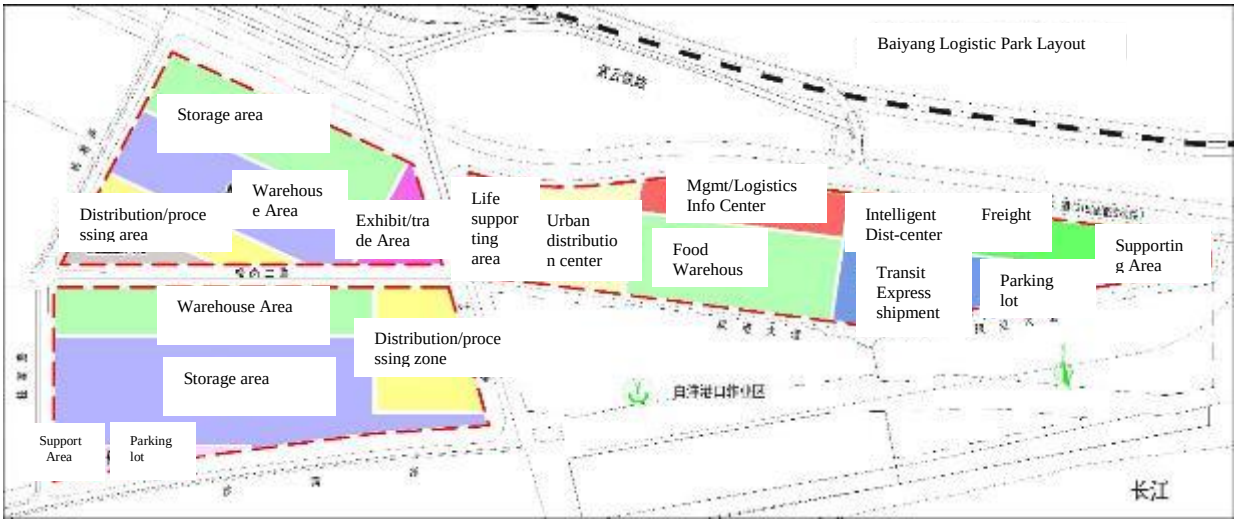


Figure 4. 2-2 Scenario II for overall arrangement of Baiyang Logistics Park

The above mentioned two plans are same in land coverage and surrounding environment, they have similar impacts on acoustic, water and ecological environments, but the big difference is the impacts on atmospheric environment and social environment. Refer to Table 4.2-1.

Table 4.2-1 Comparative analysis of two plans in terms of environmental impacts

Indicators		**Scenario I**	**Scenario II**
Environmental elements	Atmospheric environment	The trade and logistics area and the transit logistics area are better arranged to shorten the travel distance of intermediate machineries and vehicles and decrease exhaust emission.	It's too far and needs more fuels to transport the goods from container area to storage area for devanning, remanding and consolidation.
	Social environ	Three are three entrances/exits at the Second Songgang Road and the parking lot	The arrangement of cargo flows seriously interfere

Indicators		Scenario I	Scenario II
	ment	is near the exhibition & trade area. This is better for arrangement and optimization of cargo flows, brings less interference to the traffic at the Second Songgang Road, and has better social benefits, e.g. saving resources and energy and improving competitiveness of the firms in this area.	with the traffic at the Second Songgang Road and may hinder the development of the firms in this area.
Conclusive recommendation: Scenario I			

In the Scenario I, all functional areas are better arranged to shorten travel distance of intermediate machinery and vehicles in the park. From a long-term perspective, Scenario I will save resources and energy and decrease the environmental impacts during the operation of the logistics park. So, for the purpose of environmental protection, Scenario I is better.

(2) Overall layout of Baiyang Port

According to the FSR, there are two scenarios, of which birth #12 ~ 13 are completely the same, only # 7 ~ 11 Births are different, as shown in Figure 4.2-3, Figure 4.2-4 and Figure 4.2-5.

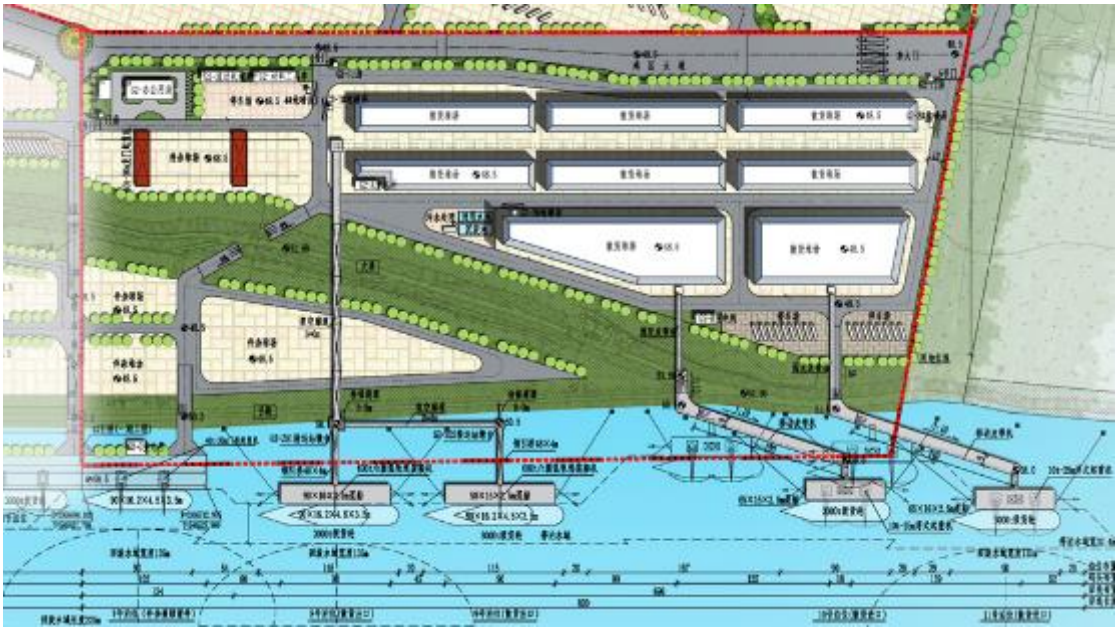


Figure 4.2-3 Layout plan of # 7 ~ # 11 Births (Scenario I)

Figure 4.2-4 Layout plan of #12 & # 13 Births (Scenario I)

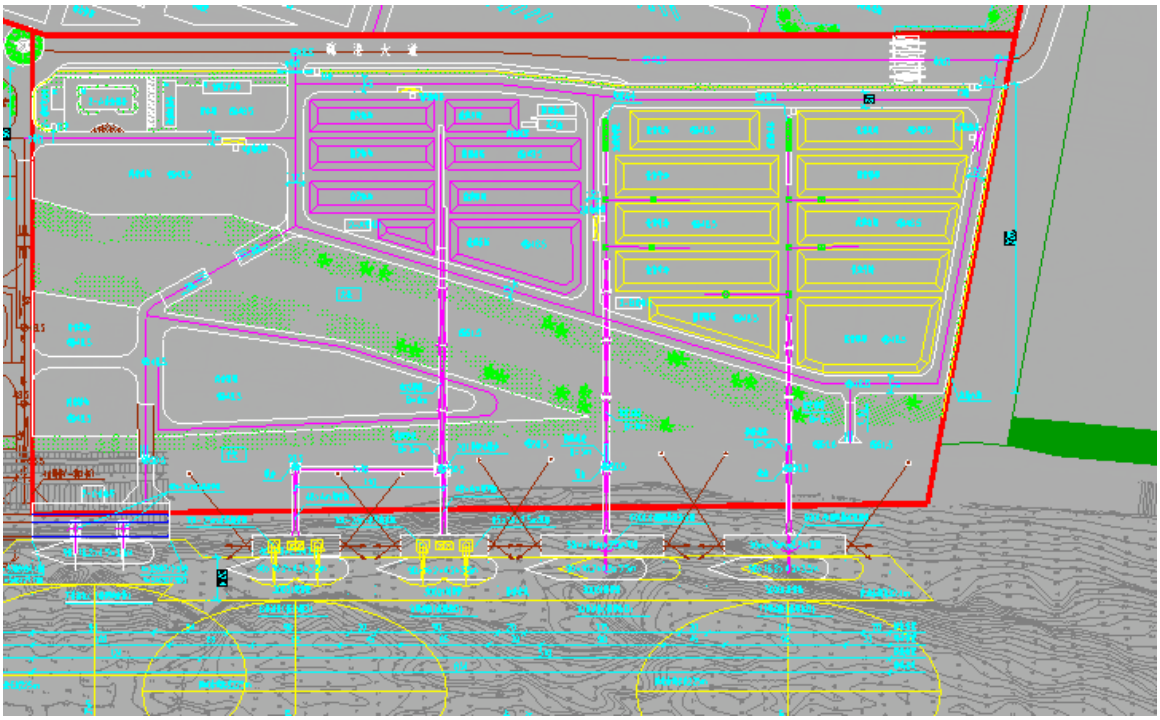


Figure 4.2-5 Layout plan of #7 ~ # 11 Births (Scenario I)

Impact on atmospheric environment: comparing with Scenario II, Scenario I allow mobile machinery and vehicles to move more smoothly in storage yard, and Scenario I brings convenience to work scheduling and horizontal transportation; with less fuel consumption and less exhaust emission.

Impact on water environment: in Scenario II, the hydraulic structure of the # 10 & # 11 berths adopts floating landing stage and the abutment uses cast-in-situ bored piles, so the construction process is apt to affect the groundwater and the drilling mud is apt to pollute the surface water.

For the purpose of environmental protection, we agree to Scenario I proposed by the *Feasibility Study Report* by considering the arrangement of storage yard and the hydraulic structure of the wharf.

4.3 Comparison of different technology for bulk handling

According to popular practices in China, two methods are used for horizontal transportation of bulk cargo, i.e. dump truck and flatbed trailer with hopper, and fixed belt conveyor, with advantages and disadvantages as shown in table 4.4-1.

Table 4.4-1 Main advantages and disadvantages of two handling methods

Advantages & disadvantages Handling methods	Contents		Advantages	Disadvantages
Scenario I	Loading & unloading	Arc track ship loader (export); Floating crane + grab bucket (import)	1. Bulk cargos are handled by using professional high-tech machineries and transported with belt conveyor to improve the work efficiency and the utilization of storage yard. 2. Belt conveyor allows airtight transportation to avoid raised dusts and scattered materials to keep the site clean.	1. Substantial investment is needed for equipment. 2. Mobile machineries are used to load bulk cargo and transport them out from storage yard. 3. The fixed belt conveyor and fixed funnel interfere with the loading of bulk cargo on board.
	Bulk yard	Single bucket loader (export); Stacker (import)		
	Horizontal transportation	Fixed funnel + fixed belt conveyor (export); fixed belt conveyor system + mobile belt conveyor system (import)		
Scenario II	Loading & unloading	Floating crane + grab bucket	1. The technology used has been practically proven and is appropriate to loading/unloading of bulk cargo on/from ship (or on/from vehicles in storage yard). 2. Investment in equipment is not large.	1. More mobile machineries are used and they need more repairing and maintenance. 2. Handling efficiency of bulk cargo is low. 3. Materials may be scattered from dump truck to cause serious dust pollution. 4. Dump truck burn fuel and emit exhaust to cause atmospheric pollution.
	Bulk yard	Dump truck + single bucket loader		
	Horizontal transportation	Dump truck and flatbed trailer with hopper		

In Scenario I, most of the equipment used for handling of bulk cargo are electricity-driven professional machinery with merits of energy saving and environmental protection and bulk cargos are unloaded from ship and transported to other places by machinery. By using this method, the utilization of storage yard is improved, the dust pollution is decreased to the greatest extent, but the investment in equipment is very large. In Scenario II, the bulk cargo handling technology has been practically proven and most of the equipment used is mobile

machinery that is more widely used, but this method causes raised dusts and exhaust emission. By considering the investment and wharf structure, we agree to Scenario I recommended by the *Feasibility Study Report*.

4.4 Comparison of different rainwater treatment methods

Usually, rainwater is separated from waste water to prevent the increase of workload of waste water treatment facilities, and rainwater shall be divided into initial rainwater and later rainwater by content of pollutants. The initial rainwater on the ground contains large quantity of SS pollutants (since the goods stored in the wharf is mostly sands, steel, food that are oil-free, this treatment system does not incorporate oil-removing measures), while the later ground surface flushing water is similar to the rain, which can be flow to the rain system, and the form the surface water finally.

(1) Common practice in most ports

In most ports in China, rainwater flows into surface waters without being divided into initial rainwater and later rainwater. In this case, some pollutants on the ground are carried away by rainwater and enter into surface waters to cause water pollution.

(2) Rainwater treatment method in this project

The initial water is collected into the settling pond through drainage ditches and the settled rainwater is used to wet ground surface to prevent dusts, and later rainwater are discharged to storm water drainage system and then pumped into the open channel in east of the port.

In conclusion, the rainwater treatment method used in this project is better for surface water protection.

4.5 Comparison of different waste collection methods

1. Methods taken for this project

The project has two methods of waste collection: building up waste transfer stations and collecting waste together with Baiyang Town, and transporting the waste to landfill.

The *Standard for Setting of Environmental Sanitation Facilities* stipulates that a waste collection station may be built when the daily quantity of wastes produced by the population in the served area is larger than 4 tons. Given that 1kg wastes are produced by one person each day and the total population is about 1200, the daily waste production is far below 4 tons, so the waste transfer station is not recommended. According to the *Master plan of Baiyang Industrial Park of Yichang Municipal*, waste transfer stations are planned along Ziyun Railway and National Highway 318 at Baiyang Town.

2. Waste collection and treatment method (at the logistics center)

The wastes produced during project construction, such as rubbles, ashes, slags and waste woods, shall be collected and removed by the construction company and these wastes can’t be dumped at waste transfer station. Domestic garbage can be thrown into nearby trash cans, but if the quantity is large, they shall be transported directly to the waste transfer station out of the site of the project. The cleaning workers shall collect the garbage in trash can and transport them to the waste transfer station.

Currently, various cargo wharves of Yichang Navigation Hub just leave the treatment of ship garbage to the ship themselves. Generally, generally there are no treatment facilities on the riverbank.

International good practices in EHS Guidelines: As the nature of operation and type of ship differ, the type and quantity of solid and liquid wastes may also differ. The waste generated by the port may include packaging of goods and the inert solid waste disposed by Administrative Office, as well as harmful or hazardous waste relevant to vessel maintenance (such as waste lubricant and degreasing solvent for engine) Waste generated by ships may include inert materials such as oily sludge and food packaging, as well as food wastes.

We propose to adopt the international good practice, which is also recommended by Ministry of Transportation (see section 1.6- Inland Water Environment Management Rules for Pollution from Ships, PRC). The waste generated by ships shall be brought ashore for further treatment. See Chapter 11- EMP for details on prevention, reduction and control measures.

4.6 Comparison of different oily water treatment methods

(1) Bilge oil water treated on board and then discharged

According to the *Provisions of the People's Republic of China on Prevention and Control of Inland Water Environment Pollution from Ships*, the vessels sailing into the port is not allowed to discharge bilge oil water into the water area of the port. If it is indeed necessary, the vessels shall first report to the maritime authority in written form, and after getting approval, the vessels can discharge bilge oil water into the designated area.

Mechanical separation technology (separation by gravity and coalescence - separation) was widely used by transport ships to dispose bilge oil water at early time in China. It is quite effective for disposing oil slick but ineffective for emulsified oil. Moreover, during actual operation, it cannot meet the requirements of the *Effluent Standard for Pollutants from Ship (GB3552-83)* and *the No. 107(49) International Convention for the Prevention of Pollution from Ships* by Resolution of Maritime Environment Protection Committee (included in the *EHS Guidelines for Ports, Harbors, and Terminals*). Meanwhile, the *Effluent Standard for Pollutants from Ship (GB3552-83)* was formulated at very early time and the effluent standard for petroleum pollutants is too loose, and its discharge limit for bilge oil content is 15mg/L, equal to that of Class I standard of *Integrated Water Discharge Standard* (15mg/L) and much higher than that of Class I type B standard of *Discharge Standard of Pollutants for Municipal Wastewater Treatment Plant* (3mg/L), so it is not sufficient for surface water protection.

(2) Treatment by receiving vessel

According to the investigation of marine department, the oil sewage in vessels are received by a special ship. The receiving vessel is able to collect oil sewage with high oil content. After that, the oil collected is recycled ashore for further treatment. The recycle price is able to meet the operating expenses of the receiving vessel. Of course, there are some of special vessel which directly processes the oil waste by mechanical separation technology. As the treatment technology is too simple, and now the receiving vessel does not handle the oil waste by them. However, there are also some new-type vessels with membrane technology or adsorption systems, which is able to ensure that the discharged water will meet relevant provisions in MEPEC.107. (49).

(3) International good practices

1) *EHS Guidelines of Shipping Industry* by WB

In accordance with MARPOL and national regulations, port operators shall provide collection, storage and transportation services for the oil sewage produced during its stay in port. The ship operator shall ensure the handling capacity of the oil sewage facilities and its type is suitable:

Oily waste and oil sewage should be collected using a barge, a vehicle or a central collection system and a storage tank. Collect capacity of oily waste should be determined based on the relevant provisions of MARPOL;

In accordance with recommendations of general *EHS Guidelines*, the sewage discharged from the vessel shall be collected to be treated on-site or in other places.

Small boats for harbor service should be equipped with recycled toilet or chemical toilet for onshore treatment.

2) *EHS Guidelines of Port* by WB

The discharged water from ships may contain oil or hazardous substances, which may cause damage to the environment. It is recommended the following measures shall be taken to prevent, reduce and control the pollution of discharged water:

If the ship is not equipped with certified oil-water separator (OWS), then all oily residue and sludge shall be send to the reception facilities on port for treatment. If certified oil-water separator is equipped, then the above mentioned waste can be discharged into the sea after proper treatment. Other water management measures also include: To install an alarm system which is able to automatically detect and treat the sewage discharged from the oil-water separator when the oil concentration reaches 15×10−6/106.

(3) Conclusion of the comparative analysis

According to *Provisions of the Prevention and Control Measures of Water Pollution from Ships in Inland Waters of PRC*, the oil sewage of the project shall be treated in two ways: the bilge oil water shall be treated by receiving vessel or receiving treatment onshore. Since the logistics park plans to build up a rainwater storage tank, it is recommended to build up treatment facilities for bilge oil water within the logistics park. It can both be used for treating the oil-containing wastewater within the park (such as wastewater used for cleaning machines and containers and workshop maintenance), and also used for treating bilge oil water from ships, therefore it can guarantee that such bilge oil water is not discharged into inland waters.

Based on above analysis, this treatment method is more feasible than the self-treatment method. It is also in line with *Regulations on Prevention and Control Measures of Pollution of Inland Waters from Ships of PRC* and international good practices.

5 Assessment of Environmental Impacts during Construction

The impacts of the project on the environment during construction have been analyzed based upon both the project's characteristics and the project area's environment. The project's environmental impacts during construction include the impacts on the surface water, the atmospheric, and the ecological environments, as well as noise, and solid waste pollution.

The wharf stands along the deep-water stretch of the Yangtze River bank so there is no dredge this part of the river. Piling is the main construction activity on hydraulic engineering.

5.1 Impacts on water environment

The sewage during construction primarily comes from domestic wastewater (produced by construction workers) and industrial wastewater.

(1) Wharf construction

The project involves construction of two high-piled beam-slab wharves, two floating piers, and two sloped wharves in the water. One of the high-piled beam-slab wharves is 216×28m and the other is 102×28m. A 90×16m steel pontoon is built in front of the floating piers and a 65×16m steel pontoon is built in front of the sloped wharves.

With regard to the high-piled beam-slab wharves, holes are drilled on the spot for steel-pipe piles and cast-in-place pipe piles, which affects surrounding water bodies.

Piling tends to increase the concentration of substances suspended in water bodies, thus affecting the water environment. The scope of piling's impact on the water environment is in the oval shape. According to a survey, where the increase of the concentration of substances suspended in water bodies that is caused by piling exceeds 10mg/L, such increase involves an area of a length of about 100 ~ 250m in the water flow direction and of a width of about 50 ~ 100m vertical to the river bank. The suspended substances produced by piling will not pollute the water in the water conservation areas and the water from the intake of the river's lower reaches.

Holes will be drilled for the cast-in-place piles of an approach span. A part of the pile is underwater. A cofferdam will be built around the underwater part of the pile such that the enclosure is then pumped out and made dry. Therefore, pollution comes primarily from the sewage overflowing from mud circulation pits rather than from piling for the approach span.

When drilling holes for the cast-in-place piles, workers should build a mud pit in the river bank area, pump muddy water into drilled holes from the mud pit, and preserve the walls of drilled holes. The muddy water circulates between the mud pit and drilled holes through a mud pump. After all holes are drilled, mud in the mud pit will be air dried and piled on the spot. This is the most common method used in China at present.

If cast-in-place pile construction coincides with rain, the rainwater may make waste water overflowing from the mud pit. As the concentration of SS in the waste water is high, the waste water will pollute the water body in the Yangtze River part that this project covers.

Therefore, it is suggested that workers build a cofferdam enclosing the mud pit and cover

the mud pit so as to prevent surface runoff and rainwater from flowing into the mud pit and thus prevent waste water from spilling out of the pit. An overflow hole should be arranged at the mud pit and geotextile should be arranged at the overflow hole, so as to reduce the SS pollution caused by the waste water overflowing from the mud pit due to heavy rain.

(2) Analysis of sewage discharge from construction ship

Sewage discharge from construction ships includes bilge oil water and the domestic waste water discharged from a ship. If underwater construction lasts 120 days, based on similar project experiences, bilge oil water is generally discharged at a rate of 0.56t/d, the amount of bilge oil water discharged during construction will reach 67.2t, with 0.84kg of petroleum being separated from bilge oil water. If the domestic sewage discharged from a construction ship averages 150L per person per day, the amount of domestic sewage will reach 9.6t/d.

Construction ships are forbidden from discharging sewage into the Yangtze River. In case that a construction ship has to discharge sewage into the river, it must submit an application of sewage discharge to Yichang Maritime Safety Administration for approval. After the application is approved, ships approved by Yichang Maritime Safety Administration to collect pollutants will be paid to collect and treat pollutants.

(3) Construction wastewater and domestic sewage in land areas

Less industrial and domestic wastewater will be produced during construction in land areas. The main pollutant in industrial wastewater is SS. Settling basins should be built on the construction site so that industrial wastewater can be precipitated and then used to water the construction site to reduce dust, or it can be naturally evaporated or absorbed by soil.

Worker should try their best to avoid flushing construction machinery on the construction site, so as to avoid oily water produced when flushing construction machinery. In case that construction machinery has to be flushed on the construction site, workers should build sewage tanks to collect wastewater produced when flushing construction machinery and transport the wastewater to a pollutant collection ship for treatment.

Based on the project's construction scale and comparing with similar projects, we can safely guess that the number of workers on the construction site at the construction's peak is about 400. If domestic water is consumed at a rate of 100L/d per person and the coefficient of pollutants produced is 90%, the maximum amount of domestic sewage produced will be 36m³/d. Main pollutants are COD, animal and vegetable oil, and SS. In every liter of domestic sewage there are 200~300mg of COD, 50mg of animal and vegetable oil, and 80~100mg of SS. As the amount of domestic sewage is relatively small, such sewage may not severely pollute the environment after it is treated in a septic tank. After construction, the impact of the construction workers' domestic sewage on the environment will vanish.

In conclusion, the sewage and wastewater produced during construction has been properly treated, hardly contaminating surface water.

5.2 Impacts on ambient air

(1) Lime-soil mix and dust pollution

Lime-soil mixers are used during construction. Mixing concrete when it is windy will produce TSP on the construction site. According to a survey of completed similar projects, the station of lime-soil mixers produces TSP at a rate of 8.90mg/m at a distance of 50m

downwind; the station of lime-soil mixers produces TSP at a rate of 1.65mg/m³ at a distance of 100m downwind. The amount of TSP produced by the station of lime-soil mixers at a distance of 150m downwind meets the Ambient Air Quality Standard (GB3095-2012) Class II. TSP produced during other operation phases can generally be controlled within 50-200m from the construction site. The amount of TSP produced beyond 50-200m from the construction site meets the Ambient Air Quality Standard (GB3095-2012) Class II.

(2) Dust pollution caused by construction vehicles

During construction, transporting and loading and unloading construction materials will pollute the areas where those materials are transported, loaded and unloaded. The results of dust monitoring during the transport of lime soil on the construction site show that the transport of lime soil produces dust at a rate of 11.625mg/m³ at a distance of 50m downwind; the transport of lime soil produces dust at a rate of 9.694mg/m³ at a distance of 100m downwind; and the transport of lime soil produces dust at a rate of 5.093mg/m³ at a distance of 150m downwind, exceeding the Ambient Air Quality Standard (GB3095-2012) Class II. Obviously, dust produced by construction vehicles severely pollutes the areas where construction materials are transported. In conclusion, we must not ignore dust pollution caused when lime and soil are being mixed and when construction materials are being transported. We should take measures to reduce dust pollution.

Yazishan Village will undergo the largest impact during the construction, which is not far from the project construction area, especially the impact of fugitive dust on villagers visible to naked eyes when water-spraying measures are not taken on the road or the construction operation surface when the wind speed is high and air is dry. Under the condition of reinforcing water spraying on the construction operation surface and the road for transportation, the impact of the project during construction on Yazishan Village can be effectively reduced.

(3) Machinery in operation

Construction machines include heavy duty trucks, excavators, and diesel-powered machines. These machines emit such pollutants as CO, NO_2, and THC. As most of these machines are heavy duty, one such machine emits a large number of pollutants. However, as construction machines are not concentrated in one area and the number of these machines is small, the overall pollution caused by these machines is relatively light. The monitoring results with regard to the construction sites of similar projects show that construction machines produce NO_2 at an average concentration of 130μg/m^3 per hour within 50m of the construction site; and the concentration of NO_2 produced by construction machines within 24 hours is estimated to be 62μg/m^3, meeting the requirements of the *Ambient Air Quality Standard* (GB3095-2012) Class II.

5.3 Acoustic impacts

5.3.1 Applied technical standard

This report lists the noise pollution areas determined based on the stages of construction in accordance with *Emission Standard of Environment Noise for Boundary of Construction Site* (GB12523-2011) so that construction contractors can take a fact-based approach to preventing and reducing noise pollution.

Noise produced by construction machinery can be treated as point source. Because the sound level decreases as it gets further and further away from its source, we estimate the

noise levels at different distances from the noise source by using the following formula:

$$L_p = L_{p0} - 20\lg(r / r_0)$$

In this formula, L*p* represents the estimated noise level dB (A) at a distance of r meters from the sound source; Lp_0 represents the reference value for the noise level dB (A) at a distance of r_0 meters from the sound source.

5.3.2 Noise affected area estimation

By using the above formulas and the information regarding noise produced by the equipment listed in the project analysis, we have estimated the noise levels of individual machines (main sources of noise) at different distances. We also put into operation a concrete mixer, an excavator, and a bulldozer on the same site at the same time, figuring out the superposition of construction noise levels at different distances. See table 5.3-1 for more details.

Table 5.3-1 Construction noise levels (Unit: dB(A)) at different distances

Distance from the noise source(m) / Types of equipment	10	50	100	150	200	250	300	400
Concrete mixer, concrete vibrator	85.0	71.0	65.0	61.5	59.0	57.0	55.5	53.0
Excavator	82.0	68.0	62.0	58.5	56.0	54.0	52.5	50.0
Bulldozer	76.0	64.0	56.0	52.0	50.0	48.0	46.0	44.0
Superposition of the noise levels of the above three machines	87.1	73.3	67.1	63.6	61.1	59.1	57.6	55.1
Pile driver	90.0	76.0	70.0	66.5	64.0	62.0	60.5	58.0

(3) Estimation and analysis

a) According to *Emission Standard of Environment Noise for Boundary of Construction Site*, the maximum level of ambient noise emitted from the construction sites is 70dB(A) during daytime and 55dB(A) during nighttime. According to table 6.4-1, if the noise produced by a concrete mixer or a concrete vibrator is not audible at a distance beyond 55m during daytime and 330m during nighttime, the level of such noise is considered below the allowed maximum level; if the noise produced by a excavator or a bulldozer is not audible at a distance beyond 25m during daytime and 230m during nighttime, the level of such noise is considered below the allowed maximum level; Piling is generally forbidden during night, and if the noise produced by a pile driver is not audible at a distance beyond 100m, the level of such noise is considered below the allowed maximum level.

b) The above estimation shows that when multiple construction machines operate at the same time, the allowed maximum level of noise will increase such that the noise produced by these machines shall not be audible at a distance of more than 60m from the construction site during daytime and 405m from the construction site during nighttime.

c) The noise produced by construction for this project disturbs the Guixihu Village (to the west of the construction site) and Yazishan Village (to the north of the construction site). These two villages are located within 50-60m from the construction site. Therefore, noise produced by construction machines during construction disturbs the residents of the two villages to different degrees. Noise produced during daytime construction exceeds the

maximum level by 3.3-6 dB(A); Noise produced during nighttime construction exceeds the maximum level by 18.3-21dB(A).

5.4 Ecological environment

5.4.1 Impacts on terrestrial ecology

(1) Assessment of impacts on terrestrial plants

This project covers a total area of about 158.61hm^2, most of which is agricultural land. In addition, the project also covers a small number of shrub land, water areas, and construction land. A large amount of agricultural vegetation and a small amount of secondary vegetation are affected by the project.

Project construction affects vegetation in the following aspects:

1) Permanent land occupation will destroy the habitat of vegetation. Once individual organisms lose their habitats, the damage will be irreversible.
2) Vegetation in the project area will be destroyed. According to a survey of biogeography, vegetation directly affected by the project is primarily orangery, cropland, and shrub land.
3) During construction, temporary land use for this project is primarily agricultural land used temporarily as dump, so it will destroy the vegetation in this area.
4) During construction, vegetation will be crushed by machinery or trampled by construction workers.

In short, most of the proposed project area is agricultural land and most of the land requisitioned/occupied for the project is agricultural land. The ecological system of the area close to the construction site is affected by the project to some degree. However, as affected plants are either the common crops or the common species of the plants on which we assessed impacts, and because these common crops and species grow in a large number of environmental conditions, project construction will not cause the species of plants in the project area to die out. Damage to the vegetation in the project area will take a toll on the existing ecological system of the area. However, as the affected area is rather small in comparison to the whole project area and efforts have been taken to afforest the affected area, the damage is not very serious and it will not affect the general stability and completeness of the ecological system in the larger area.

(2) Assessment of impacts on terrestrial animals

During project construction, excavation and infrastructure construction will damage both vegetation and animals' habitats in the affected areas. Most of the affected animals are the amphibians, reptiles, and birds that inhabit cropland and shrubland. Moreover, noise made by construction machinery/equipment and by the transport of earth and construction materials will affect the feeding, living, reproduction, and migration of terrestrial animals inhabiting the areas close to the noise. Construction will completely change the use of land on which impacts are assessed. The impact of construction on some of the terrestrial animals (especially those unable to adapt to human settlement) is irreversible.

As most of the project area is frequented by humans, terrestrial animals in the area are more adaptable to human impact on the environment. Animals living in the area are either able or unable to adapt to the environment. Those who are unable to adapt to the environment has begun migrating to other places. As there are a large number of similar

habitats (farmland, shrubland, ponds, etc.) near the construction site and there is a wide variety of terrestrial animals living in a vast area, the project will not seriously affect the diversity of animals living in the area.

(3) Impacts on agroecological system

Changes in soil structure and texture have rendered the soil unable to be used for agricultural production, thus the agriculture in the project area will be severely affected.

a. Arable land will largely shrink

By analyzing the current land use, we have learned that the increase of construction land comes from farmland. A sharp decrease in the farmland of the planned area is inevitable for large-scale development and construction. Land used for developing industry, public facilities, and transportation comes most from farmland, causing farmland to shrink and its productive potential to dwindle. A decrease in the number of farmlands disrupts ecological balance and the dynamic control of the ecological environment.

b. Farmland's productive potential will dwindle

The planned area will primarily serve logistics. Production and R&D in the area will produce air and water pollutants, contaminating the air, water, and soil, as well as the surrounding farmland, thus the farmland's productive potential will dwindle.

As the economy is growing, farmland used for other purposes will not become less uncommon. In view of the farmland loss, we must increase crop yields in an effort to ensure food security. However, when developing and introducing high-yielding, cost-effective new crop varieties as a way to ensure food security, we must constantly develop and use chemicals. It will not only enable pests to be resistant to pesticides and increase minor pests in a large number, but it will also contaminate water areas, reducing the food on which fish, mollusks, and farmland birds feed, as well as reducing the number of farmland birds. Moreover, the chemicals we constantly develop and use will leave pesticide residues, making the farmland's quality and productivity further drop and in the end leaving high-yielding farmland used for all other purposes but farming.

c. Crop yields will decrease

A total of 2,614 mu (1 mu = 0.0667 hectare) of land (all is collectively owned) will be permanently requisitioned for this project. Of 2,614mu, 1944.50 mu is agricultural land and 184.20 mu is pond, causing an annual loss of 5,321,750 Yuan (calculated at a rate of 2,500 Yuan/mu) to agriculture.

(4) Assessment of impacts on the project area's ecological integrity

The area's ecological integrity is affected by the project as it involves a total area of 158.61hm2, most of which is agricultural land. Construction will change the use of various lands in the project area, affecting the fertility of the project area and its ecological system's stability. As a result, the ecological integrity of the project area will be disrupted. However, such disruption to the ecological integrity of a wider area (e.g. Baiyang Town) is limited.

5.4.2 Impacts on aquatic ecosystem

(1) The categories and scope of impacts on the aquatic ecosystem

The impacts of the project on the aquatic ecosystem primarily occur during construction, including direct and indirect impacts. Riprap works will bury the habitat of benthos, thus

directly affecting the aquatic ecosystem. Underwater construction will increase the concentration of suspended solids (SS) in some water areas, thus indirectly affecting the aquatic ecosystem. See table 5.4-1.

Table 5.4-1 Determination of direct and indirect impacts during construction

Categories of impacts	Affected areas	Factors	Possibilities for restoration	Impacts on organisms
Direct impacts	Dredging	Covering, disruption	Can be restored	All benthos have vanished, but the affected area is relatively small
Indirect impacts	Spread of the increased SS produced during construction	Lower transparency	Can be restored	Some of aquatic organisms die out

(2) Impacts of construction on plankton

Construction, especially underwater construction, will disrupt the riverbed environment increasing solids suspended in water and lowering water transparency. Underwater construction will disrupt plankton's photosynthesis, lower the aquatic productivity in some of the water areas, and disrupt the daily life of animals whose movement depends largely on light changes. Moreover, suspended solids will adhere to the plankton, disrupting their movement and ingestion and even causing them to die, thus the number of plankton in some water areas will decrease.

According to relevant data, an increase of solids suspended in water bodies will jeopardize the survival and reproduction of planktonic copepods. Excessive suspended solids will block the digestive system of planktonic copepods, especially when the concentration of suspended solids reaches 300mg/L and more. Among suspended solids, sticky sludge causes the biggest harm to plankton; soil and fine sediment cause less harm to plankton than sludge.

A decrease in the number of phytoplankton and zooplankton will cause the number of other organisms to drop. A decrease of phytoplankton will lead to a decrease of zooplankton that feed on phytoplankton, and the decrease of plankton will cause fish to decrease as fish feeds on plankton. Likewise, it will be hard for higher-level consumers of fish to find food as the number of organisms at low trophic levels decrease. Obviously, an increase of solids suspended in water bodies will disrupt the food chain in multiple aspects.

According to the test results with regard to the toxic effect on aquatic organisms that is caused by sediment suspended in the dredged waterway to the Yangtze River estuary, when the concentration of suspended sediment reaches 9mg/L, it will cause some of zooplankton to die and disrupt phytoplankton's photosynthesis. However, as the piling (including pile driving and constructing bored pile cast in situ) for this wharf affects an area no wider than 100 m^2, and considering this part of the river is 900 ~ 1200 m wide, disruption caused by construction of this wharf to the Yangtze River is limited. Under the effect of water flow, turbid suspended sediment will be diluted in a short period of time. In addition, construction of the wharf takes a short period of time, so the impacts of suspended solids produced during construction on aquatic organisms will be limited and short-lived.

(3) Impacts on the eggs and larvae of fish

Suspended solids produced during construction will spread within a certain range.

Suspended particles will directly harm the eggs and larvae of aquatic organisms in the Yangtze River. Specifically, suspended particles will hinder the embryonic development of fish and even block the gills of fish, thus suffocating them. Moreover, a large number of suspended particles will reduce the available oxygen in water bodies, thus causing aquatic organisms to die. Hazardous substances in suspended solids will produce secondary pollution to the environment, causing organisms to die. The capacities of different aquatic organisms to survive the suspended solids vary. Generally speaking, the eggs and larvae of fish are much less likely to survive the suspended solids than adult fish. An increase of sediment suspended in water will hinder the growth of the eggs and larvae of fish.

(4) Impacts on fish

Noise produced when workers are drilling holes will startle the fish in the construction area, but it will not injure the fish or cause them to die. However, constant noise will disrupt the routine foraging and migration patterns of some fish. If the noise source is close to a spawning ground, or if the noise occurs during the spawning season, spawning will be disrupted.

During construction of the wharf, suspended solids produced by dredging will increase and thus contaminate water. Suspended solids will highly concentrate and spread within a certain range. A high concentration of suspended solids will make water more turbid and less transparent, which will hinder the growth of natural fish feed and thus reduce fish feed. In addition, a high concentration of suspended particles will suffocate fish, causing fish to die. As these particles are breathed by fish in their gills and adhere to the gill lamella and gill filament, they will not only damage the gill tissues, but also obstruct the airway of fish and even cause fish to suffocate. Moreover, the particles will also hinder the embryonic development of fish.

The capacities of different fish to survive the suspended solids vary. According to relevant experimental data, if the concentration of suspended solids reaches 80,000mg/L, fish can survive only for one day; if the concentration of suspended solids decreases to 6,000mg/l, fish may survive for a week at most; if workers stir the sedimented sludge for a short period of time every day and keep the concentration of suspended solids at 2300mg/l, fish may survive for 3-4 weeks. It is generally believed that fish will not die from the effects of suspended solids if its concentration is lower than 200mg/l and its effects only last for a short period of time, and that adult fish may successfully avoid the effects of suspended solids if its concentration is slightly higher than 10mg/L because adult fish is highly capable of swimming long distance at a relatively fast speed. The impacts of construction on adult fish appear as “dispersion effect”. Underwater construction is arranged to be undertaken in dry seasons. Most parts of the construction area are open or shallow water, so fish tend to swim to deep water. Therefore, construction may change the habitats of the fish originally living in the construction area, but it will not affect the fish in a big way, nor will it significantly reduce the fish in the construction area.

5.4.3 Impacts on soil erosion

Article 4 of ***Provisions on the Administration of Examination and Approval of Preparation and Reporting of Water and Soil Conservation Plans for Development and Construction Projects*** (No. 24 Amendment of the Ministry of Water Resources dated July 8, 2005) lists the following requirements: 1) Where the area of requisitioned land exceeds one hectare, the land owner should compile a relevant report; where the area is less than

one hectare, a report table should be created. 2) Where the volume of excavated/refilled earth exceeds 10,000m^3, a relevant report should be compiled; where the volume of excavated/refilled earth is less than 10,000m^3, a report table should be created.

In November of 2015 the construction contractor commissioned Yichang Friendly Ecological Engineering Consulting Co., Ltd. to compile the *Report on Water and Soil Conservation Plan for the World Bank Financed Hubei Yichang Three Gorges Modern Logistics Center Infrastructure Project*. In January of 2016 Yichang Friendly Ecological Engineering Consulting Co., Ltd. finished the compilation of the *Report on Water and Soil Conservation Plan for the World Bank Financed Hubei Yichang Three Gorges Modern Logistics Center Infrastructure Project*. The report consists of 10 sections, namely general statement, general rules of compilation, project overview, overview of the project area, analysis and assessment of the water and soil conservation regarding the main works, estimation of soil loss, the objectives and measures of soil erosion prevention and treatment, monitor over water and soil conservation, the investment estimation and benefit analysis of water and soil conservation, supporting measures for implementing plans, conclusion and suggestion.

The following content is an extract from the *Report on Water and Soil Conservation Plan for the World Bank Financed Hubei Yichang Three Gorges Modern Logistics Center Infrastructure Project*.

(1) Analysis of causes for soil erosion

The soil of the surface affected by construction tends to become loose. Whenever it heavily rains, the surface may suffer soil erosion. When soil is excavated and refilled for construction of roadbeds, the vegetation growing in the area will suffer and the area's original soil structure will be damaged and form slopes. When it rains, surface runoff may easily form on such slopes. Surface runoff takes away soil particles, thus causing soil erosion. When it rains heavily, debris in the construction area during construction will also cause soil erosion.

Estimation of soil loss covers the construction area where soil erosion is to be prevented and treated.

(2) Area of the affected land and vegetation

The land affected by the project covers an area of 183.12hm2

(3) Estimation of soil loss

1) Equation for estimation

The volume of soil loss due to this project is the volume of soil loss caused by soil disturbance in association with excavation and the damage to original landforms. Different formulas used for different indicators are as follows:

The volume (W_0) of the soil loss based on the original landforms:

$W_0 = \sum P_i F_i T = PFT$

The total volume (W) of the soil loss during production and construction in the project area (the volume of the soil loss based on the total soil erosion area):

$W = \sum P_i A_i F_i T = PAFT$

The increased volume (W_c) of soil loss due to production and construction in the project area:

$W_c = W - W_0$

In the formulars above, P represents the erosion modulus based on the original landforms, t/(km²·a); A represents accelerated erosion coefficient; F represents potential soil erosion area, km²; T represents estimated time span, year.

2) Estimated results

Based on the field survey and according to the *Report on Water and Soil Conservation Plan for the World Bank Financed Hubei Yichang Three Gorges Modern Logistics Center Infrastructure Project*, we have determined the background values of soil erosion based on the original landforms in the area before it is affected by the project and the modulus of soil erosion in the area affected by the project. See table 5.4-2 for the estimated volumes of soil loss in the affected area during construction and natual restoration.

Table 5.4-2 Estimated volumes of soil loss in the area affected by construction

Section	Time span	Background values of soil erosion	Affected area's soil erosion modulus	Area of eroded soil	Time span regarding soil erosion	Original volume of soil loss	Estimated volume of soil loss	Increased volume of soil loss
		t/(km²·a)	t/(km²·a)	hm²	a	t	t	t
Berth 7-11	Construction	1238.81	7000	25.15	3	934.68	5281.5	4346.82
	Natural restoration	1238.81	1500	3.53	1	43.73	52.95	9.22
Berth 12-13	Construction	1185.65	7000	21.33	3	758.70	4479.3	3720.60
	Natural restoration	1185.65	1500	3.1	1	36.76	46.5	9.74
Integrated logistics area	Construction	1262.03	9000	34.53	4	1743.12	12430.8	10687.68
	Natural restoration	1262.03	1500	7.26	1	91.62	108.9	17.28
Commerce& logistics area A	Construction	1343.55	9000	23.81	4	1279.60	8571.6	7292.00
	Natural restoration	1343.55	1500	6.6	1	88.67	99	10.33
Commerce& logistics area B	Construction	1224.04	9000	31.53	4	1543.76	11350.8	9807.04
	Natural restoration	1224.04	1500	6.89	1	84.34	103.35	19.01
Total	Construction			136.35		6259.86	42114.00	35854.14
	Natural restoration			27.38		345.12	410.70	65.58
	Subtotal			163.73		6604.98	42524.70	35919.72

The land affected by this project covers an area of 183.12 hm², of which 180.07hm² is the area of land suffering soil erosion. No imperishable debris is produced by this project. During construction, the volume of soil loss is 42524.70t, and the increased volume of soil loss is 35919.72t. The volume of soil loss reaches its peak during construction; a large

volume of soil is eroded during construction of the integrated logistics area and business & logistics area A and B. Therefore, more efforts should be paid in preventing and treating soil erosion in the integrated logistics area and commerce & logistics area A and B.

5.5 Impacts on solid waste

Solid waste produced during construction comes primarily from domestic garbage and construction waste. Construction waste comes from excavation, housing demolition, and residual soils.

(1) Earthwork

According to the *Report of World Bank Loaned Yichang Three Gorges Logistics Center Infrastructure Project Water and Soil Conservation Scheme,* the main works of this project involves 743,700 m^3 of excavated soil and unformed rock (of 743,700 m^3, 67,900 m^3 is the volume of topsoil stripped; 6,400 m^3 is the volume of the sand, silt, and mud that are dredged from the river bottom; and 669,400 m^3 is the volume of soil used for leveling the ground), 1.27 million m^3 of total fill (including 67,900 m^3 of topsoil refilled and 1.2021 million m^3 of the backfill of soil and unformed rock), and 526,300 m^3 of the soil and unformed rock that are moved to the construction site from elsewhere). No soil and unformed rock is dumped permanently for this project.

For this reason, there will be no soil borrow pit or dump pit for this scenario.According to the provisions of *Letters of Yichang High-tech Zone Baiyang Park Management Office on Soil-Borrow of World Bank Loaned Yichang Three Gorges Logistics Center Project* ([2016] No. 2) , the 526,300 m^3 of waste soil generated by leveling project of Baiyang new-town core area shall be used for soil-fill of the Logistics Center project. The project impact is small if the earthwork project is implemented in accordance with water conservation requirements.

Inappropriate temporary storage or management measures of waste soil during construction may cause water and soil loss and pollute water bodies during rainy season, generate fugitive dust during dry and windy season, which will pollute the atmosphere and affect the health of people around. Therefore, during construction, measures of water and soil conservation shall be strictly implemented by sheltering and prevention.

(2) Domestic garbage from construction

During the busiest construction time, there are about 400 builders working on the construction site. These builders produce about 0.4t of daily domestic garbage, including food residue, plastic wrap, and used batteries. If the garbage is left about, it will damage the landscape and pollute the environment. Randomly piled garbage may stink and draw mosquitoes and mice, jeopardizing the health of builders. The garbage that is left about may produce smelly fluid, contaminating water and soil. As used batteries contain a large amount of heavy metal, they will severely contaminate water and soil if they are not properly disposed of.

Domestic garbage generated by construction workers will be collected and handed over to the environment hygiene department for disposal.

(3) Construction garbage and waste soil

Construction garbage generated from house demolition in the urban section will be promptly cleared away and disposed by the waste soil management department under the authority of urban management bureau. The construction garbage storage location is

determined based on the construction situation in the region, which will be transferred in an extensive range and preferably be backfilled. At present, the residential houses in Baiyang Logistics Park will be demolished in a centralized way about one month after the residents are resettled. The quantity of the construction garbage is 128788.64t, about 80486.7m^3, which will be sorted and recycled by categories. Reinforcements and woods will be collected and sold. Blocks such as concrete and bricks will be crushed for use as filling materials. And all the construction garbage will be recycled.

Domestic garbage produced by workers will be collected and transported to the local environmental hygiene department for disposal. Construction waste produced during housing demolition will be removed and disposed of by the local spoil management department (the spoil management department is affiliated to Urban Management Bureau, while the location of spoil storage is subject to the conditions of regional construction). It is expected that with the above measures being taken, the impacts of solid waste produced during construction on the surroundings of the project area will be limited.

If relevant workers fail to properly pile up or promptly dispose of solid waste during construction, solid waste will directly damage the affected area's vegetation, block irrigation ditches and ponds, and contaminate water. Therefore, relevant parties should tighten control over construction and promptly remove and dispose of solid waste as a way to reduce and prevent effects caused by solid waste.

Seen from Phase 1 project, construction garbage from house demolition and domestic garbage have been well handled. It is anticipated that the solid wastes generated from the construction area in this project can also be effectively handled and produce little impact on surrounding environment after the above measures are taken.

Considering that the hi-tech zone construction scale is becoming larger and larger and it will become difficult to directly recycle the construction garbage inside the site area, it is recommended that Baiyang hi-tech zone follow the practice in urban area in order to reduce the possible environmental impact by establishing temporary construction garbage storage yard in Baiyang hi-tech zone (please refer to Chapter 11 ESMP for the management requirement). The urban management department office of Yichang Hi-tech zone will be responsible for the daily management of construction garbage in a centralized way.

To summarize, we believe that the solid waste during the project construction period can be effectively utilized or disposed and will have little impact on the environment of the project area.

5.6 Impacts on cultural relics

No officially protected historical and cultural sites (aboveground) or unofficially protected historical and religious architectures (such as ancestral hall, ancient dwellings, and ancient tombs) are involved in this project. However, there may be unknown cultural relics discovered underground during construction. If unknown cultural relics are discovered during construction, workers should promptly take measures to protect the relics, including suspending construction, reporting the discovery to the local administration of cultural heritage, unearthing the relics in an effort to better protect it, and resuming construction.

Having taken the above steps, relevant parties can minimize the impacts of this project on cultural relics.

5.7 Impacts on health

None of the proposed project areas are severely plagued by endemic diseases, so relevant parties should take proactive measures to prevent endemic diseases. For example, builders can visit local health departments to learn about endemic diseases and take measures to prevent them under the guidance of the health departments before entering the construction sites. Builders are generally immune to endemic diseases.

People from different regions gather in the construction camp. Their health may be affected by poor hygienic conditions, such as shortage of basic hygienic facilities and tableware sterilization equipment in the camp canteen, latrine pits without any feces bio-safety measures in most camps, drinking water without sterilization treatment at construction camp, poor water quality, severely exceeding bacteriologic indexes of water sample or inappropriate prevention.

There are explicit management regulations regarding construction camps at home, which include management of camp environment and life of personnel living in camp. Based on the foundation of implementing construction camp management, the construction camp of the project will have little impact on the surrounding environment and the living, safety and health of the construction workers of the project can also be effectively safeguarded. The regulations of camp management are described in the construction measures in the environment and social management plan.

For prevention of contagious disease, it focuses on cultivating good hygienic habit of construction workers by educating them with necessary schistosomiasis prevention knowledge and hygienic knowledge. Attention paid to dietetic hygiene and necessary schistosomiasis prevention measures can control the development of contagious disease.

Workers working at a work place with high noise and relatively high concentration of dust should pay attention to health care at work, which will be described in the noise and atmosphere environment protection measures.

6 Assessment of Environmental Impacts during Operation

This chapter is the analysis on the environmental impacts during project operation stage, which will serve as the basis for proposing relative environmental protection measures in the ESMP in order to mitigate the environmental impacts to an acceptable level.

6.1 Impacts on water environment

Waste water produced during the project's operation consists of bilge oil water discharged from a transport ship, domestic sewage produced by seafarers and the staff at the logistics park, waste water produced by machinery, washing water, and first-flush rainwater.

6.1.1 Oil-containing bilge wastewater

According to the *Design Code of Environmental Protection for Ports*, the bilge water production for a vessel of 3,000 tons is 0.81 tons/day. This project has a designed throughput of 7 million tons/year. Assuming the 3000 tons vessels will be used, there will be 8 ships docking at the project wharfs each day. The total bilge production can then be calculated at 2138.4 tons/year. Assuming the oil concentration is 5000 mg/L (the design code recommended oil concentration 2,000-20,000 mg/L. The actual monitored results in domestic ports are approximately 5,000 mg/L), the total amount of oil pollutant is 10,692 kg/year.

Usually ships in actual operation are equipped with oil separation devices, which can reduce the oil concentration so that it can comply with the standard in Pollutant discharge standards from ships (GB3552-83). Some ports also have special waste receiving ships to collect and handle the waste. In Yichang, most of the bilge wastewater are collected and handled by special waste receiving ships. After the oil content is recovered during centralized treatment, the wastewater can be discharged following the Class I standard in the Integrated Wastewater Discharge Standards (GB8978-1996).

According to *Environmental Protection Design Rule of Port Construction Project* issued by Ministry of Transportation on December 20, 2007, the oil sewage of a 3000-t barge is 0.81 t/d. The number of the ships staying the port (considering 700t and 3,000t vessels) is 8 ships/day. Considering berth number, residence time and proportion of oil sewage, the total amount of oil sewage generated in the port is 2138.4 t/year. According to actual measurement, the average oily concentration of the oil sewage is 5, 000 mg/l, so the amount of oil generated is 10, 692 kg/year.

In actual operation, some ships having oily-water separator can handle the oil sewage themselves. Some ships may collect the sewage to send it ashore for centralized treatment. Currently, the 80% of oil sewage is collected by receiving vessels for centralized treatment. After oil-water separation, water meeting the requirement of Category I in *Integrated Water Discharge Standard* can be discharged into the sea.

6.1.2 Domestic wastewater produced from ships

Based on the assumptions that 2,500 ships-times (about 8 boat/day) docking at port, each ship has a staffing size of 20 people, each person consume 150 L water per day and the

wastewater conversion rate is 0.8, the domestic wastewater production can be calculated to be 6,000 t/a.

Domestic wastewater from ships is not allowed to be discharged in the port area and should be transferred to waste receiving ships registered by the maritime affairs authorities for paid treatment service. Generally ships made after mid-90's are all equipped with domestic wastewater treatment devices which can treat the domestic wastewater to a standards that complies with relevant discharge standards. However the actual situation is, according to surveys, most of the ships do not operation their treatment devices; instead, they discharge the domestic wastewater directly into water bodies.

To make sure these wastewaters can be treated effectively, it is needed for the maritime affair authorities to enhance their supervision on the domestic wastewater treatment from ships.

However, according to the requirements of relevant World Bank policies, the wharf areas are generally required to be equipped with wastewater collection facilities so that wastewater can be pumped to wastewater treatment facilities on land and be treated there.

Similar to the case of Yichang Navigation Hub, in many developed countries, domestic wastewater from ships are collected and treated for a certain fee by waste receiving ships approved by the local maritime department, or be collectively treated in the land area. This can guarantee that the domestic wastewater from ships will be properly treated and does not cause pollution to the surface water in the port area.

6.1.3 Washing water and first flush rainwater

Washing water is the water used to flush the wharf's surface; first flush rainwater refers to run-off rainwater at storage yards.

1) The amount of water used to flush the wharf's surface and roads

After cargos are loaded / unloaded on a bulk cargo terminal, there may be a handful of dust left on it. After dusting the terminal, workers should promptly flush its surface and the roads at storage yards. The volume of water used to flush a bulk cargo berth a single time is 4.2m3. Water is used twice a day for flushing a bulk cargo berth and there are four bulk cargo terminals, so the water used annually is 11088 tons.

If SS emissions average 1100mg/L, the amount of SS emitted annually will be 12.2tons.

2) The maximum potential drainage for first flush rainwater

When it rains, first flush rainwater carries a small amount of SS.

The maximum potential drainage for first flush rainwater is determined based on the following formula:

The maximum potential drainage for first flush rainwater=15min rainfall (mm) × area × runoff coefficient

If the amount of 15 min rainfall is 8mm, the runoff coefficient is 0.9, and (based on the feasibility study report) the runoff area is estimated to be 600,000m^2, the maximum potential drainage a single time for first flush rainwater will be 4,320m^3; if the average concentration of SS in the drainage of first flush rainwater is 500mg/L, the maximum amount of SS produced a single time by the drainage for first flush rainwater will be 2,160kg.

3) The drainage for run-off rainwater at a storage yard

The drainage for run-off rainwater at a storage yard= daily rainfall × area of the storage yard × runoff coefficient

If daily rainfall is the lowest value 75mm for this project,（according to the *Environmental Impact Assessment Specification for Port Construction Project*） among daily rainfall maximums in recent 10 years, area of the storage yard is 104,547m^2 (of which 63,247m^2 is the wharf area and 41,300m^2 is the Baiyang Logistics Park area), and runoff coefficient is 0.1(ditto), the one-time drainage for run-off rainwater in the project's storage yard will be 784.1m^3; if the average concentration of SS in the drainage of first flush rainwater is 1,000mg/L (empirical value from the similar project), the maximum amount of SS produced a single time by the drainage for first flush rainwater will be 784.1kg.

When it rains, the maximum drainage a single time for rainwater is about 5,200m^3. The drainage will be collected and transported to a settling basin. After the wastewater is treated in the settling basin, it will be used to water the storage yard, which will not contaminate the water environment of the Yangtze River.

6.1.4 Bilge oil water

Bilge oil water comes primarily from water used to flush workshops, vehicles, and containers.

(1) Water used to flush vehicles

1) Baiyang Port Operation Area

This project is equipped with about 100 vehicles. Generally for similar domestic wharves, 30% of the vehicles need to be flushed on a daily basis and 0.8 ton of water is used for flushing a vehicle, and the amount of water used to flush the vehicles for this project will be 7,920 tons a year, empirical value from the similar project. According to similar monitoring data, the main pollutants in the wastewater produced when vehicles are being flushed are SS and oil. The concentrations of SS and oil in the wastewater are 50mg/L and 200mg/L respectively, and the amounts of SS and oil produced annually are 396 kg and 1,584kg respectively.

2) Baiyang Logistics Park

This project is equipped with 60 vehicles, according to domestic experiences, about 30% of the vehicles need to be flushed on a daily basis and 0.8 ton of water is used for flushing a vehicle, the amount of water used to flush the vehicles for this project will be 5,280 tons a year. According to similar monitoring data, the main pollutants in the wastewater produced when vehicles are being flushed are SS and oil. The concentrations of SS and oil in the wastewater are 50mg/L and 200mg/L respectively, and the amounts of SS and oil produced annually are 264.0kg and 1.06kg respectively.

(2) Water for container washing and rinsing

Throughput of container of this project is 8×104TEU/a. In accordance with the equation as recommended in Environmental Protection Design Specifications of Port Projects (JTS149-1-2007) of the Ministry of Transportation, the daily maximum number of cleaned containers can be calculated according to the following equation:

Nd =D/ Na K

In the equation, Nd—Daily maximum number of cleaned containers (TEU/d)

Na—total number of cleaned containers (TEU) which can be calculated according to 0.05%

to 0.1% of the throughput of container; in this project, we take 0.1%.

D—working days of the year (d);

K—uniformity coefficient of daily number of cleaned containers; in this equation, K=2;

The daily maximum water quantity for container cleaning can be calculated according to the following equation:

Wj＝QNd

In which:

W – Daily maximum water quantity for container cleaning (m3/d);

Q – Water quantity for container cleaning (L/TEU), which shall be in the range of 100～200 L/TEU, we take 200L/TEU for this project

Nd – Daily maximum number of cleaned containers

We can know from the above equation that the daily maximum production of container cleaning sewage is about 0.1m3/d and the annual maximum production of container cleaning sewage is about 33.0m3/a.

We analyzed relevant information of similar projects and found that the pollutants in the sewage generated from cleaning of this type of containers mainly include petroleum, SS and COD and their concentrations are 30mg/L, 300mg/L and 150mg/L. On the basis, we can know that the daily maximum production of container cleaning sewage for petroleum, SS and COD are 0.003kg/d, 0.03kg/d and 0.015kg/d and the annual maximum production of container cleaning sewage for petroleum, SS and COD are 1.0 kg/a, 10.0kg/a and 5.0 kg/a respectively.

(3) Water used to flush machine repair shop

1) Baiyang Port Operation Area

The project is equipped with 100 vehicles (empirical value from the similar project). If the repair rate of equipment used for this project is 5% and the amount of water used for cleaning one piece of equipment is 0.8 tons, the bilge oil water produced when workshops are being flushed will amount to 132 tons a year. The concentration of oil in the wastewater is about 2,000mg/L and the oil separated from the wastewater amounts to 2640.0kg a year.

2) Baiyang Logistics Park

The project is equipped with 60 vehicles (empirical value from the similar project). If the repair rate of equipment used for this project is 5% and the amount of water used for cleaning one piece of equipment is 0.8 tons, the oily wastewater produced when workshops are being flushed will amount to 792 tons a year. The concentration of oil in the wastewater is about 2,000mg/L and the oil separated from the wastewater amounts to 1,584kg a year.

Yichang Transportation Investment Co., Ltd. will build oily sewage treatment facilities in the Baiyang Logistics Park to treat the oily sewage by means of sedimentation, oil separation and oil-water separator. The water with petroleum content 10~20mg/L from oil-water separator can reach the Level 3 standard in the Comprehensive Sewage Discharge Standard and be discharged in the sewage pipeline.

6.1.5 Domestic sewage produced by the logistics center

According to the feasibility study report, the domestic water consumption of the Three Gorges Modern Logistics Center is 156.3 m^3 per day. If the center is active 330 days a year and the coefficient of water discharge is 0.9, the annual water discharge will be 46421.1m^3. If the domestic sewage produced by the center meets the *Integrated Wastewater Discharge Standard* Class III after it is treated in a septic tank, it can be discharged into the urban sewage network in the Park area.

The above analysis indicates that the wastewater produced during the project's operation can be effectively treated and thus it generally will not contaminate the water environment of the Yangtze River.

6.2 Impacts on ambient air

6.2.1 Analysis of cargos dust pollution

Dust at storage yards and the exhaust gas emitted by cargo loading/unloading machines and by vessels arriving in port are fugitive emissions and tend to pollute their nearby areas. Exhaust gas will pollute ambient air in the Baiyang Port Operation Area. Air pollution is caused by particles produced when cargos are being loaded, unloaded, or stockpiled on the wharf. Predictive analytics is used to assess the TSP's impacts on ambient air.

I. Items to be estimated

Dust emission probability and the amount of dust produced when sand and gravel is being loaded, unloaded, or stockpiled on the wharf are affected by weather and the moisture content of bulk cargos. The TSP's pollution on the wharf's surroundings and sensitive spots is estimated when No.8-No.11 berths are being used at the same time. See table 6.2-1 for relevant details.

Table 6.2-1 Factors of estimation

No.	Emission plan	Types of pollution sources	Predictors	Items to be calculated
1	Bulk cargos are being loaded/unloaded on the four berths at the same time	Moisture content 8%	TSP	Ambient air protection targets Maximum measured ground-level TSP concentration

II. Estimation method

The concentration of pollutants in the air is calculated based on the formula SCREEN3 proposed in the *Technical Guidelines for Environmental Impact Assessment-Atmospheric Environment*.

III. Intensities of pollution sources

A wet degusting system is activated whenever bulk cargos are loaded onto or unloaded from a vessel, a vehicle, or a storage yard in the port area. Windbreaks are set up around the storage yard of bulk cargos. See table 6.2-2 for basic information of the intensities of pollution sources with regard to this project.

Table 6.2-2 Intensities of dust emitted when bulk cargos are being loaded/unloaded on the wharf and stockpiled on the storage yard

Category	Area sources (name)	Area sources (length)	Area sources (width)	Angle between due north and an area source	Height of initial emissions from area sources	Emission intensities	
						TSP	PM_{10}
Unit	—	m	m	°	m	mg/s	mg/s
Types of pollution sources	Ores loaded/unloaded on the wharf	90	32	11.5	10	79.6	16.7
	Dust produced by wind erosion at storage yards	180	60	11.5	8	103.22	21.68

IV. Estimated results

(1) Estimation of impacts on the atmospheric environment

Table 6.2-3 Estimations of impacts on the atmospheric environment

At a distance of D(m) downwind from the source of pollution	TSP produced when cargos are being loaded/unloaded on the wharf		PM_{10} produced when cargos are being loaded/unloaded on the wharf		TSP produced when cargos are being stockpiled		PM_{10} produced when cargos are being stockpiled	
	Estimated concentration C_{i1} (mg/m^3)	The proportion of estimated concentration to standard concentration P_{i1} (%)	Estimated concentration C_{i1} (mg/m^3)	The proportion of estimated concentration to standard concentration P_{i1} (%)	Estimated concentration C_{i1} (mg/m^3)	The proportion of estimated concentration to standard concentration P_{i1} (%)	Estimated concentration C_{i1} (mg/m^3)	The proportion of estimated concentration to standard concentration P_{i1} (%)
10	0.03535	3.93	0.00742	1.65	0.02957	3.29	0.00621	1.38
100	0.08040	8.93	0.01687	3.75	0.05192	5.77	0.01091	2.42
200	0.06116	6.8	0.01283	2.85	0.06358	7.06	0.01335	2.97
300	0.03485	3.87	0.00731	1.62	0.04172	4.64	0.00876	1.95
400	0.02228	2.48	0.00468	1.04	0.02770	3.08	0.00582	1.29
500	0.01561	1.73	0.00328	0.73	0.01971	2.19	0.00414	0.92
600	0.01167	1.3	0.00245	0.54	0.01485	1.65	0.00312	0.69
700	0.00915	1.02	0.00192	0.43	0.01169	1.3	0.00246	0.55
800	0.00743	0.82	0.00156	0.35	0.00951	1.06	0.00200	0.44
900	0.00619	0.69	0.00130	0.29	0.00794	0.88	0.00167	0.37
1000	0.00526	0.58	0.00110	0.25	0.00676	0.75	0.00142	0.32
1500	0.00288	0.32	0.00060	0.13	0.00371	0.41	0.00078	0.17
2000	0.00191	0.21	0.00040	0.09	0.00247	0.38	0.00052	0.12
2500	0.00141	0.16	0.00030	0.07	0.00182	0.35	0.00038	0.09
3000	0.00111	0.12	0.00023	0.05	0.00143	0.32	0.00030	0.07

At a distance of D(m) downwind from the source of pollution	TSP produced when cargos are being loaded/unloaded on the wharf		PM_{10} produced when cargos are being loaded/unloaded on the wharf		TSP produced when cargos are being stockpiled		PM_{10} produced when cargos are being stockpiled	
	Estimated concentration C_{i1} (mg/m^3)	The proportion of estimated concentration to standard concentration P_{i1} (%)	Estimated concentration C_{i1} (mg/m^3)	The proportion of estimated concentration to standard concentration P_{i1} (%)	Estimated concentration C_{i1} (mg/m^3)	The proportion of estimated concentration to standard concentration P_{i1} (%)	Estimated concentration C_{i1} (mg/m^3)	The proportion of estimated concentration to standard concentration P_{i1} (%)
3500	0.00090	0.1	0.00019	0.04	0.00117	0.3	0.00025	0.05
4000	0.00076	0.08	0.00016	0.04	0.00099	0.27	0.00021	0.05
4500	0.00066	0.07	0.00014	0.03	0.00085	0.2	0.00018	0.04
5000	0.00058	0.06	0.00012	0.03	0.00075	0.16	0.00016	0.04
Maximum measured ground-level TSP/PM_0 concentration	0.08679	9.64	0.01821	4.05	0.06797	7.55	0.01428	3.17
$D_{10\%}$(m)	/		/		/		/	

Table 6.2-3 shows that Pi_{max}= 9.64%, so the air pollution caused by this project is rated as level 3 pollution. The pollution caused by sand-gravel dust on the atmospheric environment is relatively insignificant.

(2) Estimation regarding the sensitive spots

According to estimation, the shortest distances from the Guixihu Village and the Yazishan Village (the two sensitive sports covered by the assessment for this project) to the storage yard of bulk cargos are 1,700m and 180m respectively; the shortest distances from the Guixihu Village and the Yazishan Village to the wharf area are 2,000m and 600m respectively.

The concentrations of TSP and PM10 that are produced when bulk cargos are being loaded, unloaded, or stockpiled for this project) are relatively low. The proportion of maximum measured ground level TSP concentration to the standard concentration is 9.64%, while the proportion of maximum measured ground level PM10 concentration to the standard concentration is 4.05%. TSP and PM10 primarily affect the berth and storage yard areas. The Guixihu Village and the Yazishan Village, the two sensitive spots closest to the project area, are located in the areas downwind from the project area. According to relevant estimation, loading, unloading, and stockpiling bulk cargos have a rather limited impact on ambient air in the project area.

(3) Determining atmospheric environmental protection zones

The formula proposed in HJ/T2.2-2008 for determining the atmospheric environmental protection zones will be used to determine the atmospheric environmental protection zones from the fugitive emission sources. Calculation based on the proposed formula indicates that air pollutants have not exceeded the standard, so there is no need to set up an

atmospheric environmental protection zone.

6.2.2 Analysis on the impacts of vehicle exhaust

The main pollutants of vehicle exhaust emitted during the project's operation are SO_2, CO, NO_x, and CnHm. Analogy analysis will be used to analyze the impacts on the atmospheric environment throughout the project's operation.

The source of air pollution throughout the project's operation is vehicle exhaust. Vehicle exhaust comes primarily from the gas leaked from the crankcase, fuel volatilization, and emissions from the exhaust funnel. Based on the motor vehicles' pollutant emission factors (Table 6.2-4) proposed in the*Norms of Environmental Impact Assessment for Port Construction Projects*, we calculate that the SO_2, CO, NOx, and CnHm emitted by a motor vehicle average 97.82g/100km, 815.13g/100km, 1340.44g/100km, and 134.04g/100km respectively.

Table 6.2-4 Motor vehicles' pollutant emission factors

Pollutants	Petrol fuel (g/L)	Diesel fuel (g/L)
SO_2	0.295	3.24
CO	169	27
NOx	21.1	44.4
CnHm	33.3	4.44

The traffic flow for this project is estimated to be about 500 vehicles per day. Based on the traffic flow in the port area and the average distance that a vehicle travels in the port area, if vehicles use diesel fuel and the distance a vehicle travels in the port area averages 1.0 km, the SO2, CO, NOx, and CnHm that are emitted daily by the vehicles traveling in the port area are estimated to be 0.49 kg, 4.08kg, 6.70 kg, and 0.67kg respectively. The SO2, CO, NOx, and CnHm that are emitted annually by the transport vehicles traveling in the port area are estimated to be 0.16 ton, 1.35 tons, 2.21 tons, and 0.22 ton respectively.

According to the analogy analysis of similar ports, the average CO emissions within 24 hours range between 1.80 mg/m^3 and 2.7mg/m^3, and the average NO_2 emissions within 24 hours range between 1$\mu g/m^3$ and 60$\mu g/m^3$. Therefore, exhaust emissions conform to the Ambient Air Quality Standard Class II. Moreover, as the project area is rural and as CO and NO_2 emitted by transport vehicles in the port area tend to be below relevant standards throughout the project's operation, the surrounding area will remain unpolluted.

6.2.3 Cargo loading and unloading machines

(1) Exhaust emitted by cargo loading and unloading machines in the Baiyang Port area

Diesel consumption in the Baiyang Port area is 1,000 tons a year. Based on this, the SO2, CO, NOx, and CnHm that are emitted daily by the machines operating in the port area are estimated to be 12.3 kg, 102.2kg, 67.3kg, and 6.70kg respectively. The SO2, CO, NOx, and CnHm that are emitted annually by the machines operating in the port area are estimated to be 4.10 tons, 33.7 tons, 22.2 tons, and 2.22 tons respectively.

(2) Exhaust emitted by cargo loading and unloading machines in the Baiyang Logistics Park area

Energy consumed by the Logistics Park project includes electricity, diesel, and water. Diesel consumption is 500 tons a year. Based on this, the SO2, CO, NOx, and CnHm that are emitted daily by the machines operating in the port area are estimated to be 6.1 kg,

51.1kg, 33.65kg, and 3.35kg respectively. The SO2, CO, NOx, and CnHm that are emitted annually by the machines operating in the port area are estimated to be 2.05tons, 16.9 tons, 11.1 tons, and 1.11 tons respectively.

Emissions from cargo loading and unloading machines and from fugitive emission sources tend to pollute their nearby areas. Exhaust emission will pollute the atmospheric environment within 50 meters from the emission point. The pollution will only be found within the port and operations area and the logistics park area, so generally exhaust emission will not pollute the atmospheric environment throughout the project's operation.

6.2.4 Exhaust emissions from vessels

During a vessel's stay at the port, the vessel relies on its auxiliary engine to power electric lighting. The auxiliary engine emits SO_2 and NO_2 when it is operating. A total of 7 berths with each having a tonnage of three thousand are built through this project.

The tailpipe emission from a vessel is calculated based on the method (fuel consumption for every 1KW·h averages 231g) recommended by the Lloyd's Register of Shipping. If one auxiliary engine on board a vessel operates at 250KW·h and if there are 8 vessels berthing every day, based on the emission factors of SO2, NOx, and other pollutants, the SO2, CO, NOx, and CnHm that are emitted daily from the vessel are estimated to be 20.9kg, 173.7 kg, 286.0kg, and 28.6kg respectively. Berths at the port are active 330 days a year. The SO2, CO, NOx, and CnHm that are emitted annually from the vessel are 6.9 tons, 57.4 tons, 94.4 tons, and 9.4 tons respectively.

Exhaust from the vessels arriving in port is fugitive emissions and it tends to pollute its nearby areas. Exhaust emission will pollute the atmospheric environment within 50 meters from the emission point. The pollution will only be found within the port and operations area, so generally the exhaust will not pollute the atmospheric environment throughout the project's operation. This is also proved by the data monitored at the yard from the environment protection acceptance survey report of the Yichang Navigation Hub Yidu Port Area Shigu Operation Zone Integrated Terminal (the ratio of the actual monitoring data is 10~20% in the emission standard).

Currently China requires using shore power to reduce air pollution and CO_2 emission caused by. According to Regulations on Prevention and Control of Air Pollution of Yichang, since Yichang Navigation Hub requires to ships which enter the port to use shore power, considering the above elements, the waste gas from ships will have less impact on air environment.

6.2.5 Exhaust emissions from machining and warehousing

As machining steel involved in this project is to physically deform steel, dust produced thus is in small amount. As warehouses are used solely for storing cargos, only a small amount of dust is produced in warehouses and that is when cargos are being carried in and out of warehouses. As the dust mentioned above is produced in a small amount within several meters from the operations area, it will not pollute ambient air.

6.3 Impacts on acoustic environment

Noise produced during the project's operation comes primarily from the loading and unloading equipment, stockpiling machines, warehouse/logistics machines, and vehicles. The supporting facilities for the work of the logistics park will generally not cause noise

pollution to the environment outside the park.

A number of villagers residing in the Yazishan Village and Guixihu Village will be relocated as parts of these two villages are requisitioned for this project. As the villagers will be relocated during the project's operation, the two villages will suffer noise pollution. Therefore, efforts should be paid to protect the two villages from noise pollution. The Yazishan Village, along China National Highway 318 (G318) that is under construction, is located to the north of the project's construction site. This assessment has taken into consideration the impacts of both the construction of China National Highway 318 and the noise sources throughout the project's operation on the acoustic environment of the Yazishan Village.

6.3.1 Applied technical guidelines

This environmental impact assessment uses the formulas listed in the *Technical Guidelines for Environmental Impact Assessment-Acoustic Environment* HJ2.4-2009 to measure the ambient noise levels, assessing the effects of the traffic noise and noise produced by machinery and equipment.

6.3.2 Assessment Formulas

(1) Formula for noise at point sources

Based on the characteristics of the noise source, the following formula is used to measure noise levels.

$$L_i = L_0 - 20\lg\frac{r_i}{r_0} - \Delta L$$

In this formula, L_i represents the level of noise at a distance of r_i from the sound source [dB(A)]

L_0 represents the level of noise at a distance of r_0 from the sound source

ΔL represents the noise levels reduced by other factors; in this case ΔL=0

High level noise throughout the project's operation is produced primarily by cargo loading and unloading machines operating on the wharf. Such machines include multi-purpose portal cranes, forklifts, wheel cranes, rail mounted gantry cranes, belt conveyors, and single-scoop loading machines. Based on the field measurement data with regard to similar projects, the noise source intensity of cargo loading/unloading machines used for this project is estimated to range between 67dB and 99 dB.

(2) Formula for traffic noise levels

$$L_{Aeq}i = L_{oi} + 10\lg\frac{N_i}{TV_i} + 10\lg(7.5/r) + 10\lg((\Psi_1 + \Psi_2)/\pi) + \Delta L \quad -16$$

$$L_{Aeq交} = 10\lg\left[10^{0.1L_{Aeq_{大}}} + 10^{0.1L_{Aeq_{中}}} + 10^{0.1L_{Aeq_{小}}}\right]$$

In this formula, $L_{Aeq}i$ represents the equivalent continuous sound level of model i vehicles (in large-, medium-, and small sizes), dB;

$L_{Aeq交}$ represents the equivalent continuous sound level of traffic noise, dB;

L_{oi} represents the average radiated noise levels of model i vehicles at a distance

of 7.5 meters, dB;

N_i represents the traffic flow of model i vehicles per hour, number of vehicles/h;

T represents time during which the equivalent continuous sound level is measured; in this case T=1h;

V_i represents the average driving speed of model i vehicles, km/h;

r represents the distance between the center line of the lane and the spot where noise levels will be measured, m;

Ψ_1 and Ψ_2 respectively represents the field angle and radian between the measuring point to the measured road section;

ΔL represents the correction caused by other factors, dB(A); it can be measured based on the following formula:

$$\Delta L = \Delta L_1 - \Delta L_2 + \Delta L_3$$

$$\Delta L_1 = \Delta L_{坡度} + \Delta L_{路面}$$

$$\Delta L_2 = A_{atm} + A_{gr} + A_{bar} + A_{misc}$$

ΔL_1 represents the correction caused by routes, dB(A) ;

ΔL_{Grade} represents the correction caused by highway longitudinal grades, dB(A) ;

$\Delta L_{Pavement}$ represents the correction caused by highway pavement materials, dB(A) ;

ΔL_2 represents the noise level reduced due to the propagation of acoustic waves, dB(A) ;

ΔL_3 represents the correction caused by emission, dB(A) ;

A_{atm} represents the correction caused by atmospheric absorption, dB(A) ;

A_{gr} represents the correction caused by ground effect, dB(A) ;

A_{bar} represents the noise level reduced due to obstacles, dB(A) ;

A_{misc} represents the correction caused by other effects, dB(A) .

(3) Impacts of aggregate noise

Aggregate noise from various sources will be measured at sensitive spots by using the following formula:

$$L_{TP} = 10 \lg \left[\sum_{i=1}^{n} 10^{0.1 L_{pi}} \right]$$

6.3.3 Technical specifications of noise estimation

(1) Estimation of noise at sensitive spots

The southern part of the project area is close to the Yangtze River waterway and there are two sensitive spots (Guixihu Village and Yazishan Village) of the acoustic environment on which noise effects will be assessed. Noise levels will be estimated at the northern, western, and eastern parts of the project area as well as the Guixihu Village and Yazishan Village.

(2) Estimation of noise produced by machinery

As terminal operations are intermittent and as the vehicles involved in terminal operations travel to and from the wharf, it is difficult to estimate the noise levels in the area. In order to fully reflect the effects of noise produced by machinery in the port area, by taking into consideration both the general layout of the port area and the use of berths and cargo loading/unloading machinery, we choose to estimate noise at the berths in front of the wharf and the storage yards at the back of the wharf as well as noise produced when the machines in warehouses operate simultaneously.

(3) Estimation of noise at sensitive spots

The Yazishan Village suffers both the traffic noise of China National Highway 318 and the noise produced by the machines involved in this project. With regard to China National Highway 318, it has a roadbed of 21.5m; the driving speed is designed to be 80km/h; it is two-way, four-lane; and it has asphalt concrete pavement. See table 2.6-1 for the traffic flow of China National Highway 318.

6.3.4 Estimation and assessment of ambient noise

1. Estimation of noise at boundary

See table 6.3-1and map 6.3-1 for estimations of noise at boundaries of industrial enterprises throughout the project's operation.

Table 6.3-1 Estimations of noise at boundary

Spots	The shortest distance(m) from the sound source	Noise made by multiple machines [dB(A)]	Background noise level [dB(A)]		Estimated noise level [dB(A)]		Assessment standard	Noise level [dB(A)]	
			Daytime	Nighttime	Daytime	Nighttime		Daytime	Nighttime
Boundary in the north	35	43.5	—	—	43.5	43.5	4	Reasonable	Reasonable
Boundary in the west	30	41.0	—	—	41.0	41.0	3	Reasonable	Reasonable
Boundary in the east	40	49.5	—	—	49.5	49.5	3	Reasonable	Reasonable

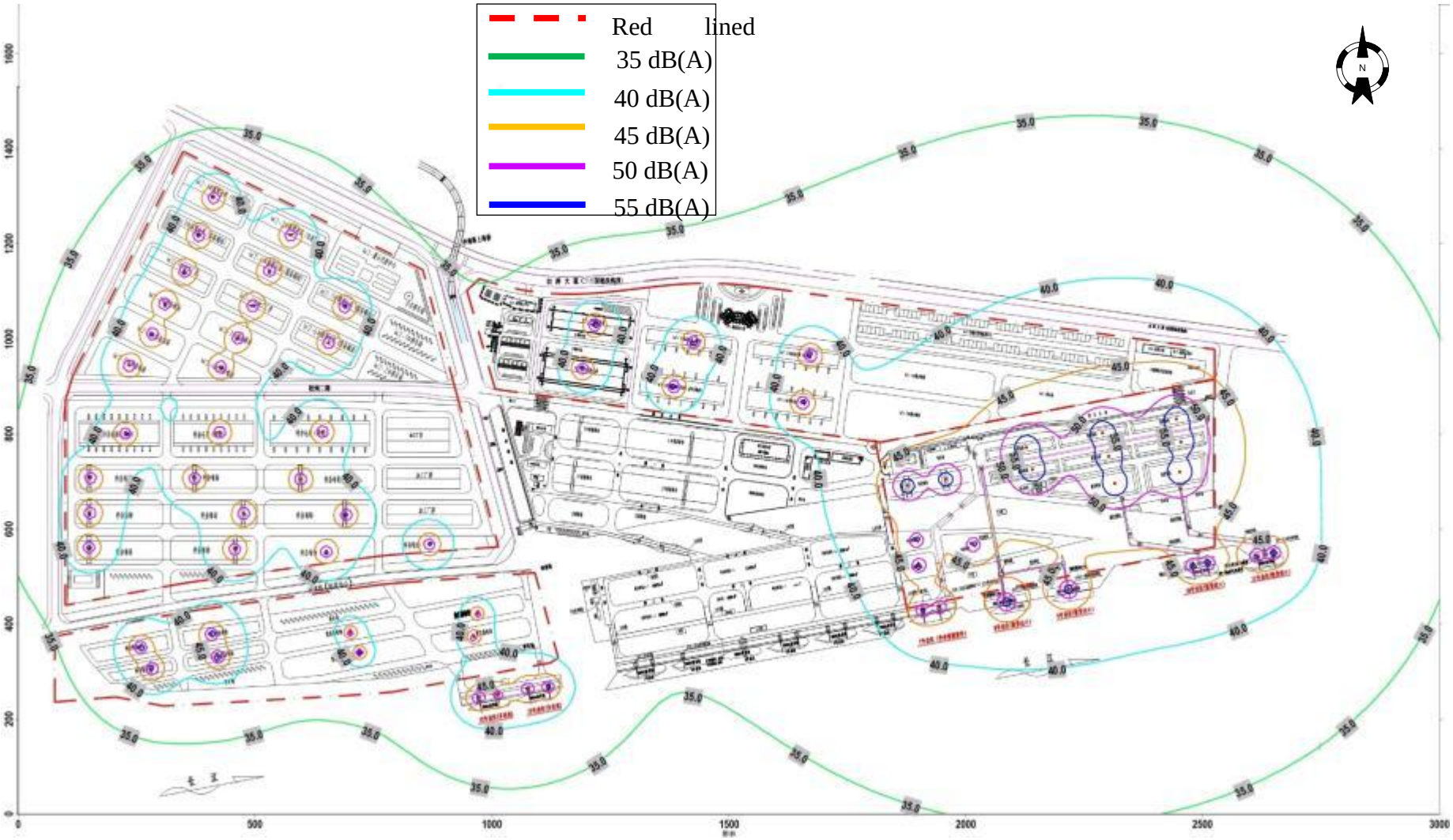
2. Estimation of noise at sensitive spots

The Yazishan Village, a sensitive spot on which noise effects will be assessed, suffers both the traffic noise of China National Highway 318 and the noise produced by the machines

involved in this project. The Guixihu Village suffers the noise produced primarily by the machines involved in this project. According to the *G318 Wancheng Bridge to Yunchi Segment Renovation Project EIA Report*, Baiyang Town's Yazishan Village is located on the newly constructed road section from K50+680 to the terminal and the shortest distance between the Yazishan Village and China National Highway 318 is 60 meters, so the village will suffer the noise coming from China National Highway 318. The medium-term construction of China National Highway 318 makes noise at a level of 59.3dB (A) during daytime and 56.7dB (A) during nighttime; the noise produced by the construction during nighttime exceeds the relevant standard by 6.8dB(A). It is planned to install soundproof windows for residents in the Yazishan village. Relevant estimation indicates that noise at the Guixihu village is below the standard level. See table 6.3-2 for details.

Table 6.3-2 Estimations of noise at sensitive spots (unit: dB(A))

Spots	**Noise produced by multiple machines**	**Noise from China National Highway 318**		**Background noise level**		**Estimated noise level**		**Assessment standard**	**Noise level vs standard**	
		Daytime	**Nighttime**	**Daytime**	**Night time**	**Daytime**	**Nighttime**		**Daytime**	**Nighttime**
Guixihu Village	35	/	/	46.2	44	46.2	44.0	2	-	-



Map 6.3-1 Noise contours

6.4 Impacts on ecological environment

6.4.1 Impacts on terrestrial ecosystems

(1) Assessment of impacts on terrestrial plants

When the project's construction is completed, the vegetation and shrubs on the permanently occupied farmland will be fully destroyed. Structures, pavement and its supporting facilities will be constructed on such farmland, turning it into construction land. However, the land used for the project's construction is relatively small comparing with the land area of Yichang municipality, the composition of species concentrating in the project area has changed insignificantly, and plants will be grown in the project area. Therefore, we can say that despite the impacts of the project on the ecosystem in parts of the project area, such impacts on the ecosystem and vegetation in a wider area are insignificant.

(2) Assessment of impacts on terrestrial animals

When the project is put into operation, the habitats of animals in the project area will be completely destroyed by the change brought about by the project and by such factors as noise pollution, vehicle exhaust, and dust produced at storage yards. A majority of animals will leave their habitats in the project area for new habitats elsewhere.

As the terrestrial animals inhabiting the project area are generally adaptable to human impacts, construction will not cause them to die out, nor will it change their habits. However, a large number of these animals will leave their habitats in the project area as a result of construction.

6.4.2 Impacts on aquatic ecosystems

Impacts to the Yangtze River's aquatic ecosystem during the project's operation come from the following sources: disruption of aquatic animals and their migration routes, domestic sewage produced by people working on land around the port, water used for flushing vehicles and workshops, and wastewater discharge from vessels arriving in port.

(1) Impacts on aquatic organisms

Industrial wastewater and domestic sewage will be treated before they are discharged into a sewage treatment plant in the park area; the domestic sewage from the vessels arriving in port and their bilge oil water are forbidden to discharge into the wharf area, instead, such wastewater will be collected and treated for a certain fee by the vessels approved by the local maritime department. Therefore, the wastewater produced by this project has been effectively treated, which neither contaminates water in the section of the Yangtze River involved in this project nor harms the aquatic ecosystem of this section of the Yangtze River.

(2) Impacts on fish

The implementation of the project affects both water quality and fish habitats.

As the water quality of the section of the Yangtze River involved in this project remains unchanged, the water areas which the food for fish comes from remain generally unchanged.

As some of the wharves are beam-slab structures with high piles, fish can still swim under approach spans and wharves after construction of the wharves is completed. As the area of water blocked by the wharf project accounts for less than 5% of the flow area of the Yangtze River, the impacts on fish that are caused by the decrease in the flow area are

insignificant.

As the wharf project is completed, the number and density of ships will increase significantly, thus ships, particularly their propellers and the noise made by them, will disrupt the distribution patterns of fish in the section of the Yangtze River involved in the project. The waves and noise produced by ships will cause fish inhabiting in important waterways to migrate; propellers may injure or even kill a fish if it fails to promptly dodge the propeller, but such cases are relatively rare. In addition, some fish may become accustomed to the impact on their habitats after some time.

Therefore, it can be said that the impacts on fish that are caused by implementation of the project are acceptable.

(3) Impacts on Asian carps

Affected by the Gezhouba Dam, the spawns of Asian carps have increased in the Yichang section of the Yangtze River. The spawning sites are concentrated in the segment (from Gezhouba Dam to Huyatan) that is about 23km downstream from the dam and 28km upstream of the Yangtze segment. As the project area is relatively far away from the spawning sites, it will not severely disrupt the reproduction of Asian carps.

6.4.3 Impacts on Yichang Chinese Sturgeon Natural Reserve

As the wharves that the Three Gorges logistics center plans to build are located about 3.0km from the outlying area of Yichang Chinese Sturgeon Natural Reserve (see appendix 1), the impact of wharf construction on the habitats of Chinese sturgeons will be insignificant.

(1) Analysis of impacts on the reproduction of Chinese sturgeons

Since the Gezhouba Dam was built in 1981, a new spawning site for the Chinese sturgeons that are confined to the area downstream from the dam has taken shape in the 4km Yangtze segment downstream from the dam. By 2008, the spawning activities of Chinese sturgeons had been found every year on this new site, making it their stable spawning site.

Moreover, in October of 1986 and November of 1987, minor spawning activities were found in Huyatan segment about 25km downstream from Gezhouba Dam, which is their historical occasional spawning site. Impoundment of the Three Gorges Project began in 2003. Having been operating for years, the project has released clear water, increasing the gravel riverbeds downstream from Gezhouba Dam. As a result, the existing, stable spawning site of Chinese sturgeons may expand and move downstream, turning the current “occasional spawning site” into a stable one. However up to 2008, there had been no evidence indicating that Chinese sturgeons had spawned in this segment of the Yangtze River.

The survey since 1996 found that the spawning downstream the Gezhouba dam occurs mostly in two small areas in the main channel between Gezhouba Power Plant and Miaozui segment (approximately 4 km) as illustrated in Figure 6.4-1. It was mainly in the I3-B to II1-B area (upper spawning area) near the outlet of the power plant and the III1-B to IV2-B area (lower spawning area). Each year there was Chinese Sturgeon spotted spawning in the lower spawning area. And the numbers spawning in the lower area were significantly higher than that in the upper area.

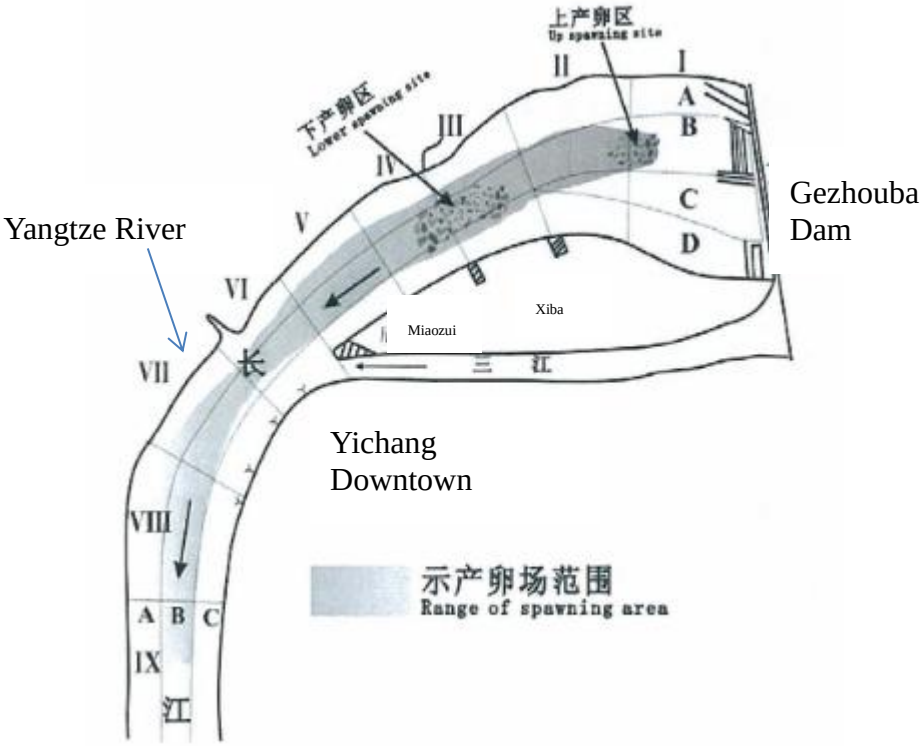


Figure 6.4-1 Schematic diagram of the spawning site for Chinese Sturgeon

The river segment involved in this project is located downstream from the aforementioned spawning site of Chinese sturgeons, about 47km from their stable spawning site and 30km from their historical occasional spawning site. It is estimated that this project will not have any impact on the spawning activities of Chinese sturgeons.

(2) Analysis and estimation of impacts on the migration of Chinese sturgeons

The Chinese Sturgeon Natural Reserve covers approximately 50 km of Yangtze River main channel. It is a typical river ecological system. Due to variance of geotechnical condition, topographic condition, climate condition and ecological habitats, the river ecological system has formed many diversified habitats, which are important to the survival and reproduction of many aquatic organisms including the Chinese Sturgeon.

Yangtze sturgeon is a typical migratory sturgeon species. Chinese sturgeon spawns mainly in the Yangtze River. The spawning season is October to November of each year. Multi-year survey results show that the lower reach of Yangtze River including the Yichang Segment have habits for Chinese Sturgeon. Before the Gezhouba was built, the soon-to-be mature sturgeon in the sea migrates up along the Yangtze River during July and August, until October and November of the next year when they reach the Jinshanjiang segment. After the Gezhouba was built, the migrate route was interrupted. The sturgeons formed new spawning sites downstream from the dam. However the area was limited. The migrate routes is illustrated in Figure 6.4-2.

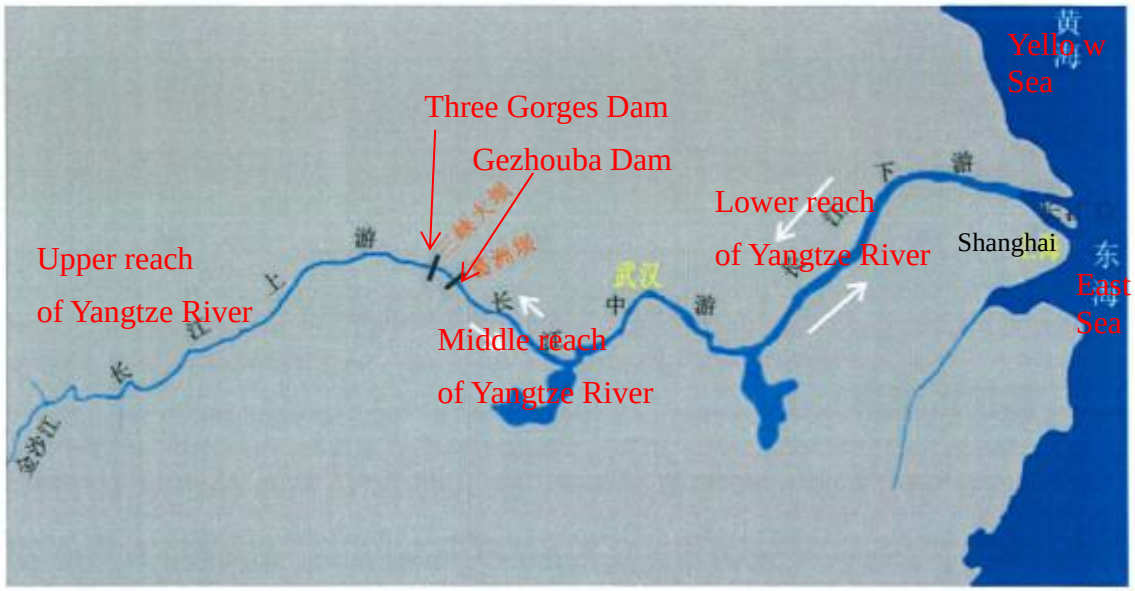


Figure 6.4-2 Migrate routes for Chinese Sturgeon in Yangtze River

The project is located on the passage of Chinese sturgeons' migration from the mid-and lower reaches of the Yangtze River to the stable spawning site downstream from Gezhouba Dam, and the fries' migration passage into sea.

According to the ultrasonic tracking survey conducted by the Yangtze River Fisheries Research Institute in recent years, Chinese sturgeons in the Yangtze River inhabit the area along the river channel and migrate along it, which matches the record made in the 1970s. Based on the direction of this segment's channel and adult sturgeons' habits, it is estimated that adult sturgeons are used to passing through the left bank of the segment (where the project is located). Therefore, the construction noise of the project is estimated to have some impact on the adult sturgeons' migration.

The fries and juveniles of Chinese sturgeons may either migrate with the mainstream of the river channel or swim along the two sides of the channel due to the impact of current. There may be only a few fries migrating along the segment where this project is located, or passing through the space between the foundations of wharves. The project is estimated to have little impact on the migration of the fries and juveniles.

In addition, Chinese sturgeons tend to migrate against the current in the mid-and lower reaches of the Yangtze River to the spawning site downstream from Gezhouba Dam 1-3 days before spawning. Before and after spawning, only a few parent sturgeons stay at the spawning site while most inhabit the segment between Yanzhiba and Gulaobei.

As the proposed wharf of this project is located downstream from this segment, construction of the wharf is estimated to have little impact on the temporary habitat of parent sturgeons.

(3)Analysis of impacts on the spawning of other major fish species

i. Chinese high-fin banded sharks (Myxocyprinus asiaticus)

The spawning sites of Chinese high-fin banded sharks are generally concentrated in the upper reaches of the Yangtze River. Before Gezhouba Dam was built, no spawning sites had been found in the mid-and lower reaches of the Yangtze River. Since construction of

Gezhouba Dam began, the Chinese high-fin banded sharks living downstream from the dam have developed their own spawning sites in some segments of the river. According to the survey conducted between 1985 and 1992, the spawning sites of Chinese high-fin banded sharks living downstream from Gezhouba Dam are generally concentrated in the segments between the Yangtze River hub and Xiaoziyan, Yanzhiba and Huyatan, and Honghuatao and Houjiangtuo. The largest spawning site that is also the closest to the project is located about 8 km upstream from the project. Parent myxocyprinus asiaticus migrate to the segment downstream from Gezhouba Dam during late autumn and early winter. They generally inhabit the deep water of the river. When spring arrives, they grow mature and begin spawning in the river bottom's segment where the flow regime is disrupted by gravels or reefs.

No spawning sites of Chinese high-fin banded sharks have been found in the Yangtze River's segment where the project is located. The spawning site closest to the project segment is located about 8km upstream from the project. Therefore, the project is estimated to have some impact on one or two spawning sites.

ii. Asian carps

Due to Gezhouba Dam, Asian carps' spawning activities in the Yangtze River segment within Yichang have increased. Asian carps' spawning sites are generally concentrated in the segment 23km downstream from Gezhouba Dam (Gezhouba-Huyatan). Asian carps' spawning sites are found in the segment 28km upstream and 22km downstream from the project. Due to the distance, they will not be greatly impacted by the project.

iii. Impacts on Chinese paddlefish (Psephurus gladius) and Dabry's sturgeon (Acipenser dabryanus)

At present, there is a very small number of Chinese paddlefish and Dabry's sturgeons in the Yangtze River. Chinese paddlefish generally inhabit the mainstream of the Yangtze River. Dabry's sturgeons generally inhabit the upper reaches of the Yangtze River and Jinsha River, which fall within Yichang Chinese Sturgeon Natural Reserve. Since 1995, no case of catching adult/juvenile Chinese paddlefish or Dabry's sturgeons has been recorded or reported. Only one adult Chinese paddlefish was found in Nanjing's Yangtze River segment in 2002. As adult Chinese paddlefish and Dabry's sturgeons generally inhabit big rivers and they are good swimmer, they tend to be more adaptable to changes in water quality and more capable of dodging vessels. There are a small number of adult Chinese paddlefish and Dabry's sturgeons inhabiting the natural reserve. Therefore, the area affected by the project is limited and thus the negative impact on these fish's habitat and living is limited. There has been no direct evidence proving if Chinese paddlefish and Dabry's sturgeons can spawn in the segment downstream from Gezhouba Dam. There are spawning sites of Chinese paddlefish and Dabry's sturgeons in the upper reaches of the Yangtze River, where the fish spawn in March and April. Thereafter, their fries and juveniles flow with water and the chance is not high for them to pass through two great dams and reach Yichang.

Therefore, this project has no obvious impact on Chinese paddlefish and Dabry's sturgeons in the natural reserve.

iv. Impact on finless porpoise (Neophocaena phocaenoides)

Yangtze finless porpoise generally inhabits the area where saline water meets fresh water and the lower reaches of rivers. In the Yangtze River, they generally inhabit the lower reaches, concentrating in Tongting Lake, Poyang Lake, and the mainstream of the Yangtze

River.

The challenge facing Yangtze finless porpoise comes primarily from the impact of human activities. The noise and propellers of vessels traveling back and forth frequently pose the worst challenge to finless porpoise. The widely use of unlawful fishing gears and the construction of water conservancy facilities will disrupt their habitats. As some of the wharves in this project are built with high piles, their water area is limited. Moreover, only a few vessels berth at the wharves and the wastewater produced by this project has been properly treated, so the project's impact on Yangtze finless porpoise is insignificant.

The project has a minor impact on the natural reserve and its aquatic organisms. However, construction of wharves in this project covers some water area in the natural reserve, which will increase the number of vessels passing through the natural reserve and relevant human activities. As a result, emergencies may occur. Therefore, the project's long-term impact on the natural reserve and its aquatic organisms should not be ignored.

6.5 Solid waste pollution

6.5.1 Vessels' waste pollution analysis

Domestic waste from the vessels arriving in port is about 75tons a year. Waste from vessels includes seafarers' domestic garbage and maintenance waste. Domestic garbage comes primarily from food residues; chemicals used for cleaning, and used packing bags, bottles, and jars. Maintenance waste comes primarily from garbage on deck, used gauze, paint slag, and used tools. Vessels are forbidden to discharge waste into inland waters. Waste from the vessels arriving in port must be sealed or packed in buckets, collected, and then transported to land for treatment. Waste from the vessels coming from epidemic areas or overseas must be quarantined; in case of any epidemic disease, the vessels must be disinfected. By taking the above measures, we can minimize the negative impact of vessels' solid waste to the port area, ecological environment, and society.

6.5.2 Impacts of solid waste on land

There are 506 full time workers and 1,500 other staff working in the port area. They produce 662 tons of domestic waste a year and 200 tons of production waste a year. The waste includes staff's domestic garbage and production waste. Domestic garbage comes primarily from food residue, chemicals for cleaning, and used packing bags, bottles, and jars. If solid waste on land fails to be cleaned up in a timely manner, it will decay and stink, largely increasing bacteria, mosquitoes, and flies, and causing infectious diseases to spread locally. The stink caused by domestic garbage will disrupt the lives of local residents.

6.5.3 Hazardous waste impact analysis

Hazardous wastes, such as cutting oil and the cotton yarn and rag used for cleaning up the machines and equipment that have oil leakage, is produced 4tons a year during the project's operation. These wastes should be collected and then treated by the local hazardous waste treatment plant.

6.5.4 Impacts on excavated and dumped soil

According to the *Report on Water and Soil Conservation Plan for the World Bank Financed Hubei Yichang Three Gorges Modern Logistics Center Infrastructure Project*, the volume of the soil excavated for the project's main works is 743,700 m^3 (of which, 67,900 m^3 is topsoil stripped, 6,400 m^3 is dredged mud and sand, and 669,400 m^3 is soil used for site formation), the total volume of soil used for refilling excavations is 1.27million m^3 (of

which, 67,900 m^3 is the topsoil backfilled and 1.2021million m^3 is the soil backfilled), and the total volume of soil transferred from elsewhere is 526,300 m^3. There is no permanently dumped soil involved in this project.

As excavations are to be refilled, this plan excludes the sites where soil is excavated and dumped. Based on *Letter on Soil Borrow* for *the World Bank Financed Hubei Yichang Three Gorges Modern Logistics Center Infrastructure Project from Yichang High-tech Zone Baiyang Park Office* (YGBBH [2016] No.2), Yichang High-tech Zone's Baiyang Industrial Park Construction Management Office has determined that 526,300 m^3 of the soil waste produced during the site formation of the core zone of Baiyang New Town will be used to refill excavations for the World Bank Financed Hubei Yichang Three Gorges Modern Logistics Center Infrastructure Project. This has prepared soil for the project and reduced soil erosion and dust. During construction, the earthwork that follows the requirement of water conservancy has little impact on the environment.

6.6 Indirect/ induced impacts

Induced impact refers to indirect impact generated from the project implementation; this section carries out analysis on induced impact as follows:

6.6.1 Impact of regional port integration

At present, the Yichang Yangtze River section is already overdeveloped. Besides, the Chinese sturgeon protection area is exactly where Yichang downtown is located. The existence of a lot of ports is unfavorable to the protection of Chinese sturgeon. In order to change the aforesaid situation, based on the master plan of Yichang Navigation Hub of the Yichang Municipal Government, it is required that the urban area wharfs are consolidated and high standard wharfs are built outside the urban area, one of which is the Baiyang port. There is no explicit schedule regarding the shutdown of the urban area wharfs, so it is difficult to assess its impact. However, for controlling the sand wharfs and illegal sand excavation, the Yichang Municipal Government developed *Yichang Work Plan for Governing Illegal Sand Excavation and Sand Wharf along Yangtze River's Main Stream and Branch.* In some area, the implementation of this plan has already commenced, as illustrated in Figure 6.6-1.The abovementioned plan is not completely induced by Baiyang port, but the port will replace some functions of sand transportation wharf in part and may have indirect impact, both negatively and positively.

(1) Positive impact

Excessive sand excavation usually produces the following hazards: riverbed is excavated, which is easy to cause river bank collapse and impair bridge safety; cause river way blockage and affect safety for flood draining; severely damage ecological environment in the river and cause devastating blow on the organisms in the river; change the original hydrological environment of the river, damage navigation channel and pose severe threat to the shipping safety; severely affect water quality and post severe threat to the drinking water safety for neighboring residents; directly cause water and soil loss leading to arable land erosion and severe damage of land resources.

By fixing the excessive and unorderly sand excavation and integrating resources at wharf to avoid and reduce the above mentioned negative impact, resources utilization rate can be improved to avoid excessive development and protect the ecological shore. Fixing regional wharfs is also favorable to flood prevention, shipping, reduction of water and soil loss,

protection of ecological system of water and land area. The shores of these small wharfs will be restored to original condition, trees and grass will be planted and the concrete revetment will be restored to ecological revetment. These measures are favorable to ecological restoration and of great significance to protecting water quality of Yangtze River, the ecological system of Yangtze River and the main fishes under protection.

(2) Negative impact

The main negative impact generated from banning the sand wharf is social impact, namely, the impact on the livelihood of the workers associated with sand excavation. Meanwhile, impact may also be caused to the production of the enterprises relying on small wharfs in short period. Therefore, Yichang government must develop policies for re-employment and diversion of corresponding personnel in time before shutting down, to reduce the social impact and potential hazard of instability.

6.6.2 Change land use and promote urbanization

The project implementation will change the existing condition of the land use by transforming the original agricultural land into urban construction land, which is helpful for regional urbanization and promotion of urbanization process. Urbanization is favorable for transferring spare labor force and for farmers to get rid of poverty and become better off. The essence of urbanization is to transform farmers into citizens. As more and more farmers come into the city, stable employment in non-agricultural sectors will be realized.

6.6.3 Improve living environment

The implementation of the project will enable further development of local infrastructure. The public service facility system will be further improved. The domestic waste water and garbage from local residents will be collected and disposed in a centralized way. It will become more convenient for travel. All of these will be helpful to improving their living environment and increase the living quality.

Figure 6.6-1 Existing orderless wharfs

7 Environmental Risk Analysis

In accordance with *Notice concerning Risk Evaluation over Hidden Dangers of Major Environmental Pollution Accidents* ((90) H.G.Zi No. 057) of State Environmental Protection Administration, *Notice concerning Strengthening Management over Environmental Impact Evaluation and Preventing Environmental Risks* (H.F.[2005] No. 152), *Technical Guidelines for Environmental Impact Assessment of Construction Projects* (HJ/T169-2004), and *Identification of Major Hazards Installations* (GB18218-2000), as well as the World Bank requirements concerned and health & safety guides, we evaluate the environmental and safety risks, understand the acceptability of environmental risks, put forward the emergency measures and contingency plan and provide information and basis for project design and environment management, so as to reduce hazards and pollutions.

7.1 Identification of main risks

In accordance with relevant national policies, the Project Management Office (PMO) commissioned XXX to prepare a *Report on Safety Pre-evaluation for World Bank Financed Hubei Yichang Three Gorges Modern Logistics Center Infrastructure Project* ("Safety Evaluation" for short) in September of 2015. The report was completed in February of 2016. According to the report, risks can be divided into construction period risks and operation period risks.

7.1.1 Construction period risks

Construction period risks mainly include risks in the prefabrication and installation of components, cast-in-place of concrete, foundation treatment, surface construction, the installation of balustrade, railway ancillary facilities, power equipment, and other equipment, as well as water terminal operation.

Table 7.1-1 Analysis of Construction Period Risks

No.	Operation	Main potential hazards
1	Marine pile driving	Crane accidents, injuries caused by mechanical equipment, drowning, falling (accident), object strikes
2	Erecting and dismantling scaffold	Collapse, falling, object strikes
3	Formwork engineering	Collapse, falling, object strikes
4	Temporary electricity use on the construction site	Electric shock, fire
5	Water terminal operation	Drowning, falling
6	Construction of superstructure of pile foundation	Falling, object strikes, crane accidents
7	Cast-in-place of concrete	Injuries caused by mechanical equipment
8	Transport of equipment and materials	Injuries caused by vehicles

No.	Operation	Main potential hazards
9	Gas cutting and gas welding	Electric shock, fire, and explosion
10	Operation of other machines and equipment	Injuries caused by mechanical equipment

7.1.2 Operation period risks

According to the information obtained from Yichang Maritime Bureau and other relevant departments, accidents in the port area are primarily associated with vessels and wharfs.

Most commonly vessel-related accidents are oil leakage accidents caused by stranding or shipwreck. Water level of the Yangtze River has long been maintained at 3m deep. However, as vessels become increasingly larger in recent years, they draw deep. Although maritime authorities forbid full load for a vessel, stranding still occur now and then. Fire accidents are also common. They are generally caused by circuit aging aboard a vessel, by absence of fire retardant materials, or by the use of substandard engine oil.

Accidents associated with terminal operation include capsize, sinking, injuries, falling overboard, fire, and explosion. Fire and explosion are generally caused by the use of substandard oil products.

7.2 Analysis of construction period risks

Construction may cause injuries to construction workers, which is the main risk involved in construction.

(1) Erecting and dismantling scaffolds

Erecting and dismantling scaffolds may lead to such accidents as collapse, falling, or object strikes for the following reasons:

1) There is absence of a specialized construction plan or proper protection measures; when erecting and dismantling scaffolds, workers work under improper direction or fail to strictly follow the relevant plan.
2) Operators have no relevant certificates when doing the job.
3) When erecting and dismantling scaffolds, workers fail to fasten their safety belts or fail to use protection supplies as required.
4) Relevant workers have a poor awareness of safety. They fail to follow the relevant rules when erecting and dismantling scaffolds.
5) Workers throw away components when erecting and dismantling scaffolds.
6) The rigidity and stability of scaffold components fail to meet the design requirements, or load-bearing components are defective.
7) No guardrail, toe board, or safety net is set up on the construction site.
8) Irrelevant people enter the construction site.

(2) Operation of floating cranes and mobile cranes

Operation of floating cranes and mobile cranes tend to beget crane accidents for the following reasons:

1) The tower crane installation team has no qualification for the installation. The

team members do not receive any safety and technical training. After installation, the tower crane is not inspected by competent authorities.

2) The mobile crane base fails to meet the requirement, or sling load fails to meet the requirement.
3) River flow changes (e.g. rate of flow changes abruptly)when floating cranes are operating; level-luffing cranes or compensation pulley blocks fail; lifting/hoisting is unstable; slings or booms are defective; the sling base is unstable or the sling loses balance when heavy cargoes are hoisted or loaded.
4) A crane is not dismantled in accordance with standard operation procedures
5) A crane's hooks, brakes, stroke limiters, limit switch, and interlock protection device are defective; hoisting is improperly inspected; and electrical equipment is defective. All these may cause extrusion, falling (of slings), object strikes, electric shock, and other accidents.

(3) Temporary electricity use on the construction site

Electric shock is a common accident caused by temporary electricity use on the construction site. Various electrical equipment are used during construction, yet electric wires on the construction site are installed for temporary use, thus electric cables and wires tend to be tangled up. Some distribution boxes, switch gears, and wires are exposed to inclement weather and vandalism. In this case, electric shock tends to occur easily. "TN-S system" and "protection of one switch of one machine" must be implemented for electricity utilization on the construction site. Messy wires must be avoided; wires in distribution boxes must be marked for different circuits. The causes of electric shock are the same as those in operation period.

(4) Gas cutting/gas welding

Fire may be caused by a short circuit and an electrical circuit overload during welding; if there are inflammables and explosives nearby during welding, the flying sparks and spatter may beget fire and explosion. Fire, explosion, and the flying sparks may also injure or kill people in the vicinity. Moreover, the arc light and toxic smog that are produced during welding may beget radiation, pneumoconiosis, intoxication, and other occupational hazards. Materials tend to be piled up high on the construction site, so any match or cigarette butt randomly thrown away by construction workers who have poor awareness of fire prevention may cause fire.

(5) Other operations and considerations

Substandard support materials, improperly installed or disassembled support materials that cause form boards to keel over, or unreliable operating platforms constitute main hazards of formwork. Main hazards involved in construction of the pile's superstructure may arise in the following cases: workers do not use protection supplies, guardrails or safety nets are not set up on the construction site, construction workers work in inclement weather, systems of work involve workers crossing, or materials or tools fall. Main hazards in water terminal operation may arise in the following cases: workers do not wear life jackets, the construction site is insufficiently illuminated during night work, or workers do not use protection supplies.

Workers may fall and get injured or die in the following cases: working at height (openings, scaffolds, etc) is entailed in construction, no safety net is installed, or workers do not fasten their safety belts.

During over-water construction, workers may accidentally fall in the water, which may cause drowning, especially during flood period. Construction of bored piles cast in situ may form holes. If the pile fails to be promptly cast in situ or safety precautions are not taken to prevent the exposure of the wellhead, construction workers may accidentally fall into the well and drown.

Project construction entails diesel oil, engine oil, lubricating oil, and other combustible materials. If the construction site is not properly managed, naked flame may cause fire or even intoxication or suffocation in some extreme cases. The gasholders, oxygen cylinders, and acetylene cylinders entailed in construction may cause explosion, if they are not placed in safe distance from each other or if their use is not properly managed.

Large supports, tower cranes, and other structures need to be erected for construction. These temporary structures take a long time to erect and they are heavily loaded and high, so they tend to be unsafe and special attention should be paid to them. Substandard construction materials, improper construction technology, and shoddy construction may pose dangers to construction and cause huge losses.

If the temporary accommodation for construction workers is built in a low-lying area, it may be submerged or destroyed by heavy rainfall.

Safety signs play an important role in reminding people of being mindful of potential risks and in preventing accidents. The proposed project's construction process entails multiple steps. If there is no safety sign, or safety signs are not accurate or standard, casualties may occur as a result. In addition, it should be noted that during construction, a lot of dust may be produced when powdery material is loaded, unloaded, and transported or when asphalt is being stirred and used for paving a road. Drill rigs, concrete mixers, rollers, and other construction machinery may produce noise; rock drills and boring machines tend to cause vibration.

Risks in project construction and operation primarily come from oil leakage. When construction vessels operate in the project area, oil may be spilled or leaked due to incorrect operation, operation against the rules, or negligence in managing the operation. The impact of these oil leakage accidents can be small, but they may still contaminate water.

7.3 Analysis of operation period risks

The terminal operation for this project does not involve the storage and transport of dangerous goods. Currently, the way in which break bulk cargo are loaded and unloaded can ensure that cargo will be less likely to fall in the water. In addition, the area between the wharf and the river bank is equipped with safety nets that are in proper size so as to prevent cargo and workers from falling in the water. Therefore, risks in terminal operation generally come from the oil leakage caused by collision, fire and explosion caused by oil products, exposure of bulk cargo when they are being loaded and unloaded, and shipping.

This agrees with the survey results on Yichang Navigation Hubs discussed in previous sections that the most common accidents are the oil leakages caused by ships grounding (stranding) and ships collisions, followed by fire accidents caused by aged electric circuits, lack of flame resistance material in ships decoration and usage of subgrade oil product, etc. The common accidents in port operation include ship overturn, personal injury and drowning, fire and explosion, etc.

These accidents all could lead to oil leakage and spill as a result. The concentration threshold of toxicity caused by oil to aquatic organisms is low in general, so any oil leakage during operation period may cause fish in the contaminated water to suffer acute toxicity and mutagenicity. It may also cause phytoplankton and zooplankton to suffer toxicity, or even cause some fish, aquatic plants and animals to die of toxicity. Therefore, oil leakage is the worst water pollution, thus it is the focus of the analysis of operation period risks.

7.3.1 Analysis of oil leakage accident

According to relevant statistics of serious oil leakage accidents abroad, there is a certain probability of abrupt occurrence of oil leakage accidents. Affected by objective conditions and uncertainties, no methods of calculation are effective for analyzing the probability of risks involved in a project. Instead, relevant statistics are used in general to analyze the probability of risks.

According to the statistics over vessel accidents in Hubei and Chongqing section of the Yangtze River, the accident probability of incoming and outgoing ships was 3.6×10^{-4}. The number of times for ships entering and leaving the port for this project is 2,500 a year, then the accident probability of this project is 0.9 accidents/year. Of the accident probability, the oil leakage accidents account for 25%, which means the probability of oil leakage accidents is 0.23 accidents/year.

In accordance with the survey data of the Ministry of Transport of the People's Republic of China on total tonnage and oil fuel tank of cargo ships, the total fuel volume of 2910-ton Haizhou oil fuel tank is 210m^3, the number of oil fuel tanks is 3 and the fuel volume of the biggest oil fuel tank is 106 m^3. Assuming that ships collide with each other when approaching to and berthing at this wharf or loading and unloading at the wharf and an oil fuel tank is broken, causing leakage of diesel into the Yangtze River, then the maximum quantity of diesel which flow into the Yangtze River is about 90t per accident. This analysis on the intensity of oil leakage risks is based on the aforesaid data.

7.3.1.1 **Prediction of oil leakage at the wharf**

(1) Prediction methods

This assessment uses Fay oil-bound film extension equation to predict the risks of pollution caused by oil leakage accidents.

Fay oil-bound film extension equation is widely used at present and it includes three stages:

①At the stage of inertial extension, the diameter of oil-bound film is

$$D = K_1(\beta g V)^{1/4} t^{1/2}$$

②At the stage of viscous extension

$$D = K_2(\frac{\beta g V^2}{\gamma_W^{1/2}})^{1/6} t^{1/4}$$

③At the stage of extension of surface tension

$$D = K_3(\frac{\delta}{\rho_w \gamma_W^{1/2}})^{1/2} t^{3/4}$$

④After extension, the diameter of oil-bound film remains unchanged

$$D = 356.8V^{3/8}$$

In the equation: D --diameter of oil-bound film(m)

g --acceleration of gravity(m/s^2)

V -- total volume of overflow

t --time (calculating from the beginning of overflow)

γ_W—coefficient of kinematic viscosity of water(m^2/s) ; Table 7.4-1shows the relationship between water's viscosity coefficient and temperature

Table 7.3-1 Relationship between viscosity coefficient of water and temperature

Temperature℃	0	5	10	15	20	30	40	60	80
Viscosity $10^{-6}m^2/s$	1.792	1.520	1.307	1.139	1.1004	0.801	0.658	0.475	0.365

$\beta = 1 - \rho_o / \rho_w$; ρ_o, ρ_w are oil density and water density respectively

$\delta = \delta_{aw} - \delta_{oa} - \delta_{ow}$, δ_{aw}, δ_{oa}, δ_{ow} are coefficient of surface tension between air and water, coefficient of surface tension between oil (liquid) and air, and coefficient of surface tension between oil (liquid) and water (N/m) respectively

δ_{aw} is the coefficient of surface tension between air and water (below 20℃, 72.75x 10^{-3}N/m)

δ_{oa} is the coefficient of surface tension between oil (liquid) and air (below 20'C, 25.0x10^{-3}N/m),

δ_{ow} is the coefficient of surface tension between oil (liquid) and water (below 20'C, 1.8x 10^{-2}N/m);

K_1, K_2, K_3 --empirical coefficients at different extension stages; in general, K_1 =2.28, K_2 =2.90, K_3 =3.2.

The dividing point of time of the above stages can be determined based on the condition that the extension diameter of two adjacent stages is equal.

In reality, oil-bound film extension increases the area of oil film and reduces its thickness. When the film thickness is thicker than the critical thickness (namely the thickness when the film diameter remains unchanged after ending of extension), the film remains as a whole; when the film thickness equals to or is thinner than the critical thickness, the film begins to split into pieces and continues to diffuse.

(3) Method of calculating drift of spilled oil

Diesel rapidly extends and forms into film after entering water and drifts under influences of current and wind generated current. Meanwhile, equivalent round film generated from diffusion of spilled oil is also continuing to extend. Hence, the pollution range of spilled oil is the continuously extending and drifting equivalent round film. If initial position of film center is set as S_0, its position S after Δt (time) is calculated through the following formula:

$$S = S_0 + \int_{t_0}^{t_0+\Delta t} V_0 d_t$$

In the formula, drifting speed of film center is V_0 which can be obtained through the following formula:

$$\vec{V}_0 = \vec{V}_{风} + \vec{V}_{流}$$

$$\vec{V}_{风} = U_{10} \bullet K$$

U_{10} --wind speed at the height of 10m

K --3.5% wind factor which is 3.5%

In case of a leakage accident, wind direction has a big influence over the movement of water-immiscible contaminants floating on the surface of water. In case of onshore wind, the leakage accident has influence on the creatures living on the shore; in case of offshore wind, then the impact on onshore sensitive targets is smaller.

(4) Prerequisites for prediction

Oil leakage form is taken into consideration by viewing it as a sudden instantaneous point source. In accordance with distribution of water intakes of the sections to be assessed and actual average annual wind speed, this assessment only provides the calculation of oil-bound film drift in high flow period (current speed is about 2.0m/s) and under the circumstance of most unfavorable wind direction (wind speed is 1.9m/s). The specifics are: the quantity of oil that enters the Yangtze River is 90t, the average wind speed is 1.9m/s, current speed takes the inshore current speed in high flow period which is 2.0m/s and the

drifting speed of oil-bound film is 2.067m/s (parallel to the current direction).

7.3.1.2 **Prediction results and analysis**

(1) Prediction results

Table 7.3-2 shows the drift and diffusion of oil-bound film at the time of oil leakage accidents and Table 7.3-3 shows the extension characteristic value of contaminants.

Table 7.3-2Prediction Results of 90t Spilled Oil Extension Parallel to the Current Direction

No.	Time (S)	Diameter	Area (m^2)	Thickness (mm)	Distance (m)
1	60	63.593	3176.2	33.7	124.0
2	120	89.935	6352.5	16.87	248.0
3	180	110.147	9528.7	11.24	372.0
4	240	127.187	12704.9	8.43	496.0
5	300	142.199	15881.2	6.75	620.0
6	360	155.771	19057.4	5.62	743.9
7	420	168.252	22233.7	4.82	867.9
8	480	179.869	25409.9	4.22	991.9
9	600	201.100	31762.4	3.37	1239.9
10	720	220.294	38114.8	2.81	1487.9
11	840	237.944	44467.3	2.41	1735.9
12	900	246.296	47643.5	2.25	1859.9
13	1036	264.250	54843.0	1.95	2140.9
14	1200	274.152	59030.1	1.82	2479.8
15	1800	303.399	72296.9	1.48	3719.7
16	1840	305.071	73095.7	1.47	3802.4
17	3000	344.728	93334.8	1.15	6199.5
18	3600	360.805	102243.2	1.05	7439.4
19	4200	374.981	110435.3	0.97	8679.3
20	4800	387.710	118060.3	0.91	9919.2
21	5400	399.296	125221.8	0.86	11159.1
22	6000	409.953	131995.4	0.81	12399.0
23	6600	419.839	138437.9	0.77	13638.9
24	7200	429.072	144593.7	0.74	14878.8
25	7534	433.963	147909.5	0.72	15569.0
26	8400	470.8503	174122.7	0.62	17358.6
27	18000	833.9264	546192.0	0.20	37197.0
28	24000	1034.741	840917.6	0.13	49596.0
29	30000	1223.247	1175218.0	0.09	61995.0
30	33000	1313.889	1355837.0	0.08	68194.5
31	36000	1402.491	1544864.2	0.07	74394.0
32	39000	1489.264	1741941.1	0.06	80593.5
33	42000	1574.383	1946751.4	0.06	86793.0

Note：*The drift distance of front edge of oil-bound film

Table7.3-3Extension Characteristic Value of 90t Spilled diesel

Contaminants Characteristic value	Crude oil
Inertial extension stage(s)	0～1036
Viscous extension stage(s)	1036～7534
Stage of extension of surface tension(s)	7534～60061
Radius of 10-minute equivalent circle(m)	100.6
10-minute thickness(mm)	3.4
Critical thickness(mm)	1.95
Critical thickness(mm)	0.72

(2) Analysis of prediction results

When oil leakage accident happens under the circumstance that the wind speed is 1.9m/s and the current speed is 2.0m/s, the oil-bound film will drift to the water area of intake of Lucheng No. 2 Water Plant which is located in downstream of the wharf and is about 1.8km away from the wharf in about 15 minutes upon occurrence of accident. At this time, the diameter of oil-bound film is 246.3m and the area is 47643.5m^2.

The oil-bound film will drift to the water area of intake of Tianjiahe Water Plant which is located in downstream of the wharf and is about 3.8km away from the wharf in about 31 minutes upon occurrence of accident. At this time, the diameter of oil-bound film is 305.1m and the area is 73095.7m^2.

Since the intakes of water plants which are located in downstream of the wharf are set 1.5m under the water, oil-bound film drifting to the water area of these intakes will not be directly sucked when those water plants take water but water quality of these water areas will be affected.

In order to ensure the water quality of the Yangtze River, strict environmental management must be implemented to avoid occurrence of this type of accidents. Meanwhile, we must set up relevant rules and regulations, improve the equipment, enhance the quality of personnel, formulate contingency plans and take appropriate oil leakage control measures to control the pollution caused by oil leakage accidents. Once accidents happen at the wharf, contingency plan must be immediately launched and emergency measures must be taken to reduce impact of oil leakage accidents on the environment.

The main risk associated with this project is leakage from ships. Hence, risk assessment of this project is different from that of production, use, storage and transportation of poisonous and harmful substances and explosive and inflammable substances. Combining with the prediction on freight amount of this project, the risk source is the oil leakage due to collision of ships which has small occurrence probability and basically no fatal accident will be caused thereby. When oil leakage accident happens, the time for oil-bound film to arrive at the nearest intake is about 15 minutes and the time for it to arrive at the planned nearest intake is about 30 minutes. Given that this project is equipped with sufficient emergency equipment, contingency plan can be launched in a shorter period upon occurrence of accidents to effectively intercept the drifting oil-bound film before it arrive at the intakes and effectively control the pollution to the Yangtze River. Therefore, maximum credible value at risk of disasters and accidents of this project, Rmax, is smaller than the risk acceptability, RI. Hence, the risk of construction of this project is acceptable.

7.3.2 Loading and unloading risk analysis

The following accidents may take place based on the project Safety Assessment and investigation and interview with relevant departments. And corresponding risks are also analyzed.

(1) Crane accidents

The hoisting machinery used in the warehouse area, processing zone, and storage yard in the logistics park includes bridge cranes, wheel cranes, and electric single-girder cranes. Causes of crane accidents are as follows:

1) Hooks crack or break; wire ropes break or deform by extrusion; plugs' wire ropes loosen; out-of-service slings are used; routine inspection is conducted carelessly; the load is not tightly packaged or it is imbalanced during the hoisting; the load and slings tend to fall, which may damage the equipment and cause casualties.
2) Brakes are unreliable, wear-out parts are excessively used, braking torque falls short of relevant standard; space between brake pads is different from space between brake wheels; the pins of brakes do not move smoothly; there are defects such as backsliding, seizing up, and rusting.
3) Stroke limiters, limit switch, and interlock protection device have defects; emergency switch, buffer, and end stop, as well as overload limiter and anti-collision device do not work.
4) Shields, covers, guardrails, and fenders are substandard.
5) Crane maintenance personnel accidentally fall from it or are hit by the running crane and fall.
6) The electrical equipment with which a crane is equipped has defects; electrical circuits lack power-system protection; a crane is operated improperly. All these may cause electric shock and fire.
7) Workers who operate hoisting machinery have no qualification certificate for operating special equipment; hoisting machinery operators do not properly wear helmets
8) Hoisting machinery lacks proper management, for example, hoisting machinery has not been checked or tested on a regular basis; or prompt rectification fails when a hidden danger is identified.

(2) Injuries caused by vehicles

Forklifts are used in the logistics park to load, unload, and stockpile cargo. Automobiles can enter the warehouse area for loading and unloading cargo, thus vehicles tend to cause injuries.

1) When the speed of a vehicle exceeds the required limit, especially when a vehicle fails to slow down or its brake fails at a turn of a road, the vehicle may injure the pedestrians at the turn or a crossroad.
2) If operators are absent-minded or are not mindful of the surroundings when transporting cargo from one place to another in the warehouse area, or if they do not pay attention to the abnormality behind their vehicles when they backing vehicles, injuries may occur.
3) Roads in workshops or public roads that are stained by oil may be slippery, causing vehicles to hit pedestrians or other machines/equipment.
4) Forklifts are special equipment. If a forklift lacks a complete set of safety devices

that work (such as steering gear, brake, signal, horn, illumination, etc.), if a forklift has not been regularly inspected and tested, or if a forklift is not repaired right after a failure is identified, the forklift may injure people.

5) Forklift operators are special equipment operators and are supervised by quality watchdogs. If an operator overloads the forklift or use the forklift to carry people, the forklift may injure people.
6) For the forklift that is powered by diesel oil, its oil leakage may cause fire or explosion because diesel oil is combustible
7) When an electric forklift is being charged with electricity, hydrogen (combustible gas) may be produced. If hydrogen meets naked flame or spark, it will cause explosion.

(3) Fire

The stockpiled cargo in the logistics park area excludes inflammables and explosives, but they include liquor (wine, its flash point is over 70℃; low concentration liquor, the volume of alcohol accounts for less than 24% of the liquor's total volume), and rice bran oil (its flash point is over 300℃). The fire risks of the stored cargo fall under Category C, which means the cargo is combustible when they meet naked flame or high temperature.

Attention should also be paid to electrical fire. Electrical fire can be caused by aging electrical facilities/equipment in structures, poor installation of equipment, short circuit, or other failures. If structures are not equipped with fire extinguishers and if fire is not put out promptly right after it occurs, it may cause huge economic losses.

(4) Object strikes

Cargo may hit people when they are transported, loaded, and unloaded. If the cargo inthe storage yard or warehouses is improperly placed, they may move due to gravity or other external forces. As a result, they may hit people and cause injuries. If cargo are piled up so high that the height exceeds the standard, or if cargo are improperly placed, for example, fenders are not used when disc-shaped goods (e.g. rebar discs or coiled steel plates) are stored, the disc-shaped goods may slide or roll under the effect of gravity, thus they may hit people and cause injuries.

(5) Injuries caused by mechanical equipment

If pumps, rotatable parts of electromotor, and other mechanical equipment have defects (e.g. equipment do not have protection system, support is improper, or distance for protection is too short), and if equipment operators accidentally contact the running parts of the equipment, they may be injured. Moreover, if the "no switch on" sign is not set up as required when maintenance personnel is examining and repairing equipment, and if irrelevant people unintentionally switch on the equipment, maintenance personnel may be injured.

7.3.3 Navigation risk analysis

According to *Safety Evaluation* and relevant surveys as well as interviews with relevant departments, information of the following accidents is collected and the risks involved are analyzed.

(1) Collision

After the wharf is put into operation, collision tends to occur with the effect of wind and water flow in the follow cases: vessels are improperly dispatched; communication, vessel traffic monitoring and management, and navigational aids are defective; marine navigators are absent-minded or steer vessels against the rules; vessels are arriving in or leaving port against the required speed, direction, and waterway. After proposed wharf is put into operation, a busy operations area in port will be formed, which will increase vessel traffic flow in the port area. In addition, some sub-components have yet to be completed. Within a certain period of time, construction vessels may disturb each other, so management of ship dispatch should be strengthened.

(2) Analysis of risks regarding vessels arriving in and leaving port

When a ship is arriving in port, accidents such as collision, sinking, stranding, oil leakage, damage to wharf, or even fire or explosion may occur due to the direct impact of wind, water flow, wave, tide, and fog, as well as the direct impact of operating a ship. The causes of those accidents are as follows:

1) Water area marked for berthing in port is insufficient, and turning basin in front of the wharf is not wide enough.
2) Neither the berth area nor turning basin is timely dredged; water in front of the wharf is not deep enough
3) When a vessel is arriving in port at a fast speed, it may beget collision, or even cause spark and fire.
4) When wind speed exceeds Beaufort scale 6, a vessel arriving in and leaving port may beget collision, causing the wharf to collapse.
5) If the fender of the wharf is not timely examined and maintained, it may break down, thus a vessel arriving in or leaving port may press against the wharf and damage it.
6) Berthing/unearthing numbers have not been timely set, causing vessels to be mistakenly operated.
7) Before terminal operation begins, safety nets and gangplanks have not been set up as required, which causes people to fall in the water.
8) Damaged mooring ropes are not timely replaced, causing the ropes to break and ships to run out of control, or sink or hit against the wharf.

(3) Slope failure

Pilling may impair slope stability: on one hand, in pilling process, pore water pressure of surrounding soil rises sharply and the effective stress of soil decreases, and on the other hand, the vibration acceleration produces an inertial force, which may cause slope instability.For example, at Xinshengwei wharf in Nanjing and Zhanghuabang wharf in Shanghai, slopes were heavily deformed in pilling process; at Digang Port in Anhui, the slope collapsed at the time of pilling and several hundreds of driven piles fell down, causing a loss of 5 million Yuan; at the 200,000t oil wharf built on soft soil in Zhoushan, when constructing cleat, 13 piles were driven in one day, which was too fast that the piles had an displacement (1m), the slope slid down and the cleat fell down into water, causing a heavy loss. Lots of cases of heavily deformed or failed slopes in China show that for

high-piled wharves, the construction of pile foundation may be a threat to slope stability and slope failures caused by pilling are not rare. Therefore, pilling must be considered in analysis of slope stability for high-piled wharves.

#7 berth is built on high piles with beam and slab structure. According to the geological survey report, subsurface erosion may occur and may cause slope collapse. But after carrying out protection measures such as scaling and revetment on the basis of calculations, partial factors of minimum resistance meet with related requirements to ensure slope stability.

10# and 11# berths are built with solid slope structure. During construction process, low water level, high water flow rate or incorrect construction procedures may cause local collapse and fail the slope.

7.4 Risk management and emergency response

All construction projects have the risk of accidents. Thus PIUs shall follow the management requirements for major risk sources to strengthen risk management, implement risk mitigation measures carefully, and adopt appropriate technical methods to minimize their probabilities. The principle to be followed in risk management is *"prevention first and integrated prevention & control"*. Once an accident occurs, the emergency plan shall be initiated immediately to effectively control the trends of the accident. All kinds of risk prevention measures and emergency plans are described in Chapter 11. Project construction can be performed from the perspective of environmental risk on the condition of having implemented prevention measures and emergency plan for risk of accidents.

8 Cumulative Impact Assessment

8.1 Background and methodology

8.1.1 Definition

In a statement issued by the US Council on Environmental Quality (USCEQ) titled as considering cumulative effects under the *National Environmental Policy Act* (NEPA) in 1978, the cumulative impact is defined as follows:" *the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions."*

Technical Guidelines for Plan Environmental Impact Assessment (HJ 130-2014) defines cumulative impact as follows: cumulative impact refers to superposition, combined and synergic effect of the assessed planning and the planning related development activities on resources and environment in the planned period and certain range.

The WB/IFC Handbook also provided definition of cumulative impacts and recommended that cumulative impact assessment should better be conducted during planning stage.

This project is part of Yichang navigation hub which has a master plan (2013-2020). The *Strategic Environment Assessment* (SEA) was conducted for this hub mater plan in 2008. This chapter will set out from the original SEA and carry out Cumulative Impact Analysis (CIA) by updating the actual conditions and for this specific project.

8.1.2 Methodology

Currently, the technical guidelines for environment assessment in China require that cumulative impacts should be considered. However no detailed guidance on assessment method and assessment procedures' has been provided. Therefore international practices (WB/IFC Handbook on CIA) have been used which has the CIA methodology of 6 steps:

1) Identify key VECs (valuable ecological components) and scoping;
2) Identify threshold of VECs taking into consideration of relevant laws and regulations, standards, and experts and public consultation;
3) Establish baseline of the VECs;
4) Qualitatively and quantitatively predict the incremental impacts from the project;
5) Predict accumulative impacts with past, current and future activities and compare against the thresholds; and
6) Propose mitigation and management measures as appropriate.

The approach under the *Technical Guidelines for Environmental Impact Assessment of Plans* is actually similar to the 6-step method. Firstly, identify the main impact in the planned range, determine the assessment focus (namely ecological components (VEC)), determine the time range and spatial extent of assessment, collect the laws, regulations, standards and basic database related to the planning and carry out on-the-spot investigation. Secondly, analyze, predict and assess the impact of implementation of different planning scheme on resources, environment and ecology, put forward the suggestions on optimized adjustment and offer them to the planning scheme formulation authority for them to compare, consider, select and use different planning scheme. The Guidelines brings up some assessment methods, such as, expert consultation method, matrix method and network analysis method and so on which are also similar to that in IFC handbook.

8.2 Assessment scope

According to the *Master Plan of Yichang Hub* and its approval document (J.G.H.F.[2009] No. 320), the scope of Yichang Navigation hub master plan is illustrated in Figure 8.2-1. The scope covers six port districts including main urban port district, Zigui port district, Xingshan port district, Zhijiang port district, Yidu port district and Changyang port district. The proposed project belongs to the main urban ports district.

The Strategic Environmental Assessment (SEA) for the master plan had been developed and received the clearance from the Hubei Provincial EPB on Dec. 31, 2008. This SEA provides good basis for cumulative impact assessment of this project. The scope of assessment includes all the land area and the water area in the master plan and the surrounding areas and sensitive areas that might be affected by the ports. The Mast Plans' duration is from 2005 to 2020 (with reference to 2006 and 2007 data). The projection years are 2010 and 2020. The year 2020 is also the planned ending year of this project. Therefore, the scopes of assessment and timeline for the SEA of the master plan are in line with the construction plan the proposed project and the scope of this CIA. .

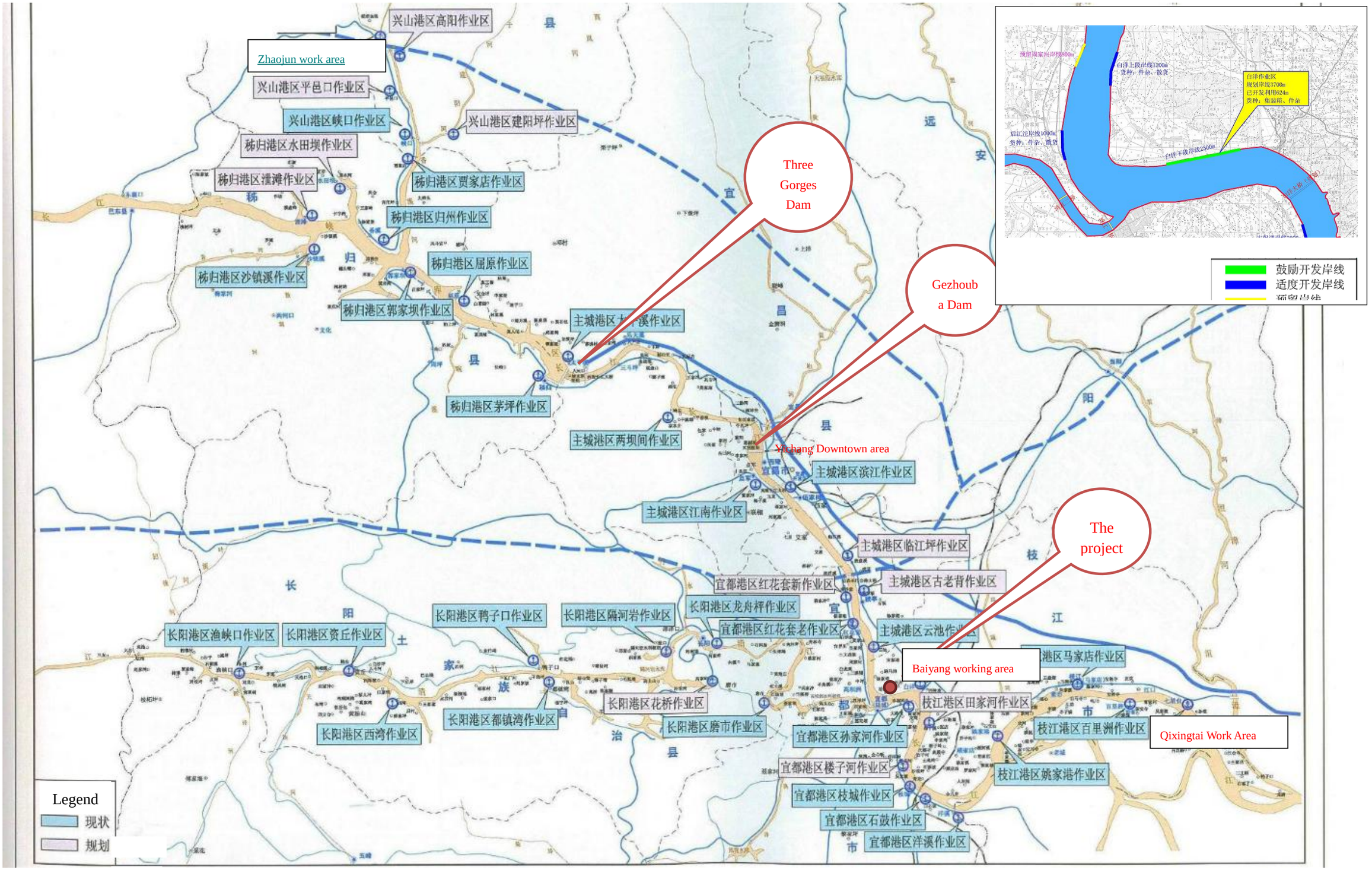


Figure 8.2-1 Scope of Yichang Navigation Hub (all blue markers along rivers indicate existing ports, all pink markers for planned ports)

8.3 Identification of Valued Ecological Components(VECs)

The identification of main environmental impacts and VECs within the planned scope was conducted in accordance with the World Bank practices and public consultation.

8.3.1 Screening and identification of main environmental impact

Based on the master plan scheme, the environment of the ports, nature of goods transported and the layout of Yichang hub, the key areas of Yichang hub and main impacts are screened and shown in Table 8.3-1.

Table 8.3-1 Screening and Identification of Main Environmental Impact

Type	Objects to be affected	Main impacts	Key contents or areas
Resources	Shoreline resources	Implementation of port planning occupies some shoreline resources; development of portside industry and services will also indirectly stimulate the highly-intensified utilization and development of shoreline resources	The differences between the planned function of shoreline in main urban port district, Changyang port district and Zigui port district and the living, travelling and other relevant functions of city; connection of functions
	Land resources	Construction of the planned working area and development and construction of portside industry and service occupy some farmland and wet land and other land resources	Land occupation of Linjiangping, Gulaobei, New Honghuatao, Louzihe and Tianjiehe working areas included in main urban port district, Zhijiang port district and Yidu port district and portside industry
	Water resources	Implementation of the planning will directly or indirectly increase the use of water resources, which may exert greater stress over water resources supply of Yichang Municipality	Focus on the relationship between the increased water consumption and water supply in main urban port district, Maoping working area of Zigui port district, Zhijiang port district and Yidu port district
Natural environment	Ecological environment	Construction of port project has certain impact over aquatic ecosystem and changes original vegetation characteristics and landscape pattern within the land area; development of port industries indirectly influences the aquatic ecological environment through affecting water, air and sound environment; accidents happening in the port directly and indirectly affect the ecological environment	Impact of construction in Linjiangping, Gulaobei and Yunchi working areas of main urban port district as well as New Honghuatao working area of Yidu port district on Chinese sturgeon; impact of oil leakage and chemical products leakage accidents on aquatic ecological environment and human body
	Water environment	Drainage of production waste, domestic sewage and vessel sewage of the port district exert impact on water quality of the river and could further influence the surface water and other water body; impact of accidents happening in the port on water environment	Impact of pollutants in the port on water quality of the river; environmental risks in Maoping, Linjiangping, Shigu and Yunchi working areas and other areas with big throughput and high frequency of accidents on water environment; possible impact brought by

Type	Objects to be affected	Main impacts	Key contents or areas
			passenger transportation in main urban port district and Zigui port district
	Ambient air	Impact of dust from loading and unloading, fugitive dust of storage yard and oil gas generated in daily operation of port on ambient air	Focus on environmental impact of dusts of storage yards and dusts generated in loading and unloading in areas with large quantity of works on coal and ores (Linjiangping, Shigu and Zhicheng working areas and so on)
	Sound environment	Impact of machinery noise and traffic noise on surround environment; boost of port industries to portside industry; planning of port district	Noise impact of highway for port in working areas; impact of loading and unloading noise in working areas with larger throughput and container transportation
Social and economic environment		Impact of development of port industries and relevant industries on hinterland economy, industrial structure, life of residents and development direction of cities	Boost of port industries to portside industry; promotion of implementation of port district planning to urbanization of Xingshan, Zizhui and Changyang and so on, improvement of the implementation on local transportation conditions and changes in spatial layout of Yichang

8.3.2 Public consultation

(1) Public consultation during SEA stage

During the SEA for The Master Plan of Yichang Hub, Public consultation was conducted mainly in the following three aspects: (1) consulting with management personnel of departments under YMG and other relevant governmental departments; (2) carrying out on-the-spot investigation on the public within the areas of planning and conducting investigation on the public on the website of YMG; (3) Disclosing on the YMG official website to seek public opinions.

The results suggested that among the identified impacts, water pollution is the most concerned for the pubic, followed by noise. Among the impacts on resource utilization, it is widely acknowledged that the impacts on shoreline resources and land resource are most significant while the impacts on tourism resources and fishery resources are less significant. Among the social impacts, the impacts on urban development and economic development are significant while the impacts on fishery and land development are less significant. Among the impacts on daily life, the impacts on living environment, traffic condition and residential area are likely to be significant.

Generally, the results of online survey were similar to that of field survey. However, the two survey results differed in the most impact local resource. Most field survey participants (47.2%) considered shoreline is the most affected resource while most online survey participants (31.0%) considered fishery the most affected resource. Only 13.9% online survey participants considered shoreline the most affected resource. 72.6% field survey participants favored the master plan while 82.1% of online survey participants favored the

master plan.

(2) **Public consultation during CIA for this project**

To update, the EA Consultant for this project held a public workshop with Yichang Urban Construction Investment Company in December 2015. The staff from the relevant authorities including the environmental protection authority, agriculture department, planning department and water conservancy department discussed the Project accumulative effects, identified the VECs and their threshold. They do not have different opinions against the identified VECs and their thresholds of this project.

Discussions were also held via phone calls or inter-personal interview with specialists from Hubei Academy of Environmental Sciences and Yichang Institute of Environmental Sciences. They all supported the results of VECs identification.

Based on the public consultations and discussions with experts, the shoreline and water quality of Yangtze River are the most concerned environmental issues. As the project area is near the Chinese Sturgeon Natural Reserve, the Chinese Sturgeon is also included. Thus the VECs identified include Chinese Sturgeon, water quality and the shoreline resource of Yangtze River.

8.4 Identification of VECs threshold

The threshold of VECs refers to their ecological environment capacity, which means that the impact of human activities should not exceed the maximum limit of the self-recovery capacity of VECs.

8.4.1 Threshold for shoreline

According to the SEA and the characteristics of the regional environment, based on the experience of the planning environment impact assessment of other ports, the safe ecological threshold of shoreline utilization is determined to be less than 10% of the overall shoreline. However, it only consider port development, ignoring all non-port but also developed shoreline. . All shorelines artificially developed into other use are not taken into account. In addition, the SEA for The master plan considered the entire surface water shoreline (including branches). But the WB project is on main stream of Yangtze River, and has little to do with other branches. The ecological upper limit of the developed shoreline resources on the main stream of Yangtze River is yet to be determined. Currently, it is generally considered that the Yichang section of Yangtze River is already overdeveloped.

8.4.2 Threshold of Water quality

The surface water functions are based on the natural quality and social quality of the basin or region and the water area is divided by application functions or uses it has. The surface water of Yangtze River in Yichang section is defined as “centralized drinking water source level 2 protection zones and common fish protection zone”. Therefore, its water quality is required to reach surface water Grade III. The corresponding water quality indexes include COD and NH_3-N; their threshold values are $COD_{Mn} \leqq 6mg/L$, and $NH_3\text{-}N \leqq 0.5mg/L$, respectively. Please refer to Table 8.4-1 in detail.

8.4.3 Threshold for Chinese sturgeon

According to the results of literature review and expert investigation, under an ideal state, the appropriate features for prenatal habitat of Chinese sturgeon is [2]: curved or forked river way, with sandbank or shoal, river section length 21.39km, deep water (water depth deeper than 19m, river way length 13.88km, with 172° angle, average width of river way and deep water area 874m and 279m, respectively; the average and the maximum water depth of thalweg 28.01m and 40.55m, respectively; and river way tortuosity ratio 2.56.

Horizontally, the ratio of the distance between the distribution points of Chinese sturgeon and the thalweg and the distance between the distribution point and the bank is 1:4.2, indicating that the Chinese sturgeon prefers to inhabit in deep water.

There is no clear conclusion as to how much influence water pollution has on Chinese sturgeon; however, if the current water quality Grade III can be maintained or improved, the impact on survival of Chinese sturgeon will be reduced. The water quality of Yangtze River is also one of the important ecological elements from public participation.

To summarize, based on the analysis in Chapter 6,as long as the water quality and the hydrological condition of the migration route of Chinese sturgeon in Yangtze River are well maintained (water quality not lower than Grade III, average water depth 38m, flow rate 1.0m/s) or even improved, there will not be negative impacts on Chinese sturgeon.

Therefore, the safety threshold of Chinese sturgeon is determined as shown in Table 8.4-1.

Table 8.4-1 Environmental Goals and Threshold Values

Elements	Target	Indicators	Threshold values or recommended limit
Shoreline	Protection of shoreline ecological function	Planed shoreline occupation for ports development in total shoreline resource (km, %)	No clear understanding on the ecological threshold value yet. More study is needed.
Yangtze River water quality	Protection of water quality	Class III surface water	COD_{Mn} ≦ 6mg/L; NH_3-N ≦ 0.5mg/L
Chinese sturgeon	Protection of the safety of Chinese Sturgeon during migration in this region.	Migrate passage, depth, flow rate, mid-stream width; navigation speed and construction schedule.	Maintain current state: water quality no worse than Class III, average depth 38.32 m, average flow rate 1.14 m/s; 1/5 of river width reserved , navigation speed limit 15 km/h.

8.5 Incremental impact

8.5.1 Incremental impact on shore line resource

The length of shoreline occupied by the proposed project is 1036 m. It is within the planned

[2] *Migrations for Reproduction of Chinese Sturgeon (Acipenser sinensis) and its Habitat Selections in the Yangtze River,* PhD thesis of Wang Chengyou, Huazhong Agricultural University

port occupation according to the Master Plan of Yichang Hub. It is a part of the planned shoreline, accounting for about 1% of the planned port shoreline of the main stream of Yangtze River (94.68km), and about 0.2% of the planned shoreline (468.3 km) of the main stream of Yangtze River. Therefore, the increment impact of the project on the Yichang Hub shoreline is very small.

8.5.2 Incremental impact on water quality

Pollutants, which are treated in Shawan wastewater treatment plant (WWTP) from waste water pollutants generated upon the operation of the project, will be 13.93 tons/year of COD and 1.62 tons/year of NH_3-N. According to the SEA, the remaining water environment carrying capacity is 27,834 tons/year of COD and 1058.3 tons/year of NH_3-N. The discharge amount of COD and NH3-N of this project account for 0.05% and 0.15% of the remaining water environment capacity, respectively, indicating that the incremental pollutant discharge will have little impact on the water quality and basically will not pollute the Yangtze River.

8.5.3 Impact on Chinese sturgeon

It is known from above that the main factors affecting Chinese sturgeon are water quality and hydrological conditions. It has been demonstrated that the increment impact on the water quality is small. The increment impact of this project on the hydrological conditions will be described as follows:

(1) Impact on flow rate

According to the symposium *Flood Control Evaluation Report of World Bank Financed Hubei Yichang Three Gorges Modern Logistics Center Infrastructure Project* occupancy rate of wetted cross section area is 0.49%, which is not significant. After the project is completed, the water flow rate is changed by only 0.5cm/s-2.0cm/s, which is insignificant compared with the average flow velocity between 0.68m/s and 2.0m/s.

(2) Impact on thalweg

The construction is mainly conducted along the bank, so the impact on thalweg is relatively small.

After the project is put into operation, about 2400 ships will be added per year, which is quite small compared with the annual flow of 100,000 ships in Yangtze River Yichang section. However, the navigation line is usually located on both sides of thalweg and the project is only about 3.0km away from the Chinese sturgeon protection zone, downstream from the spawning site, thus the impacts on the thalweg should not be neglected despite its small increment.

(3) Other impacts

The atadromous migration of Chinese sturgeon propagation group takes place in the middle of October every year in the project area. The catadromous migration of Chinese sturgeon adults happens from February to middle of April every year in the project area, and that of juvenile fish from the middle of December to the end of December. If work is carried out in the water in the abovementioned periods, relatively large impact will be exerted on the migration of Chinese sturgeon.

8.6 Cumulative impact

8.6.1 Cumulative impact on shoreline resource

In accordance with the Master Plan for Yichang Hub, totally 69 sections of port shoreline are planned, with a total length of 94.68km (an increment of 62.32 km new port shoreline), mainly in main stream of Yangtze River and the channels of Xiangxi River, Qing River and Huangbo River, taking up 9.6% of total length of corresponding shorelines. The newly planned port shoreline is 62.32km, taking up 63.9% of total planned port shoreline. So the proportion of port shoreline is within 10%. Port banks along different rivers are shown in Figure 8.6-1.

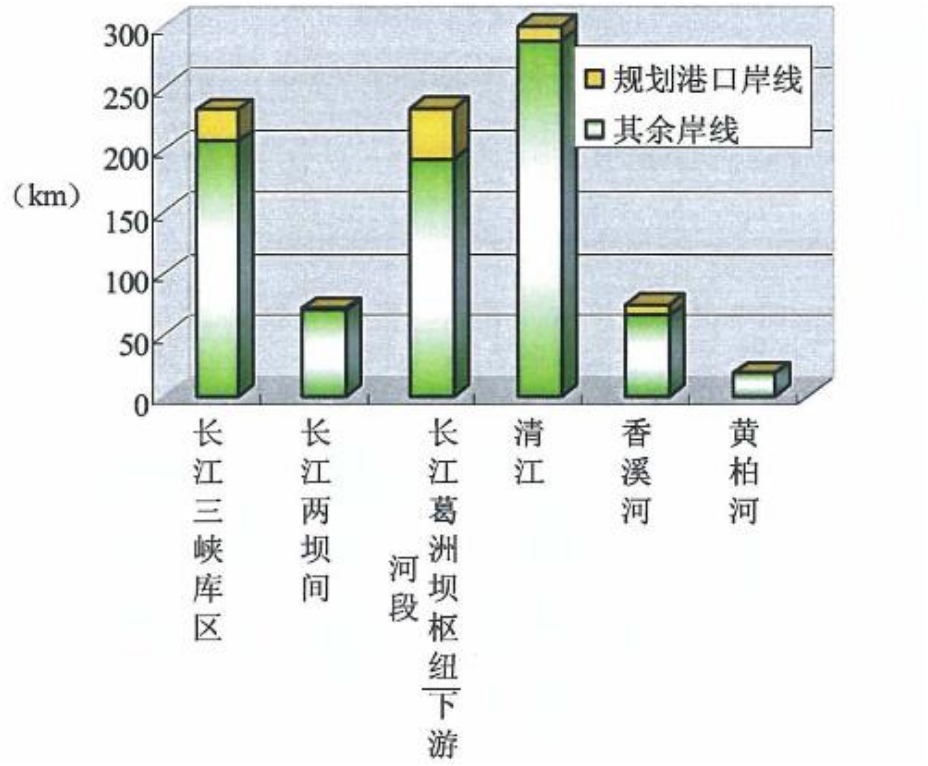


Figure 8.6-1 Distribution and utilization of shorelines (from left to right, each bar is Yangtze River Three Gorges Reservoir Area; Yangtze River Segment between two major dams; Yangtze River Gezhouba Dam Downstream area; branched named Qingjiang River; Xiangxi River,and Huangbo River)

For mainstream of the Yangtze River, The available shorelines are on both sides. The left side starts from the Niutougou in Badong County, down to Yazikou of Qixingtai in Zhijiang City, with total length 253.7 km. The right side starts from Laohuangyan in Badong County, down to Yangxihe in Yidu City, with total length 180.4 km. There is also shoreline on alluvia islands, mainly the shoreline on Bailizhou with total length 34.2 km. Thus the total shorelines length in Yichang is 468.3 km. Currently 146.7 km of them have been developed, accounting for 31.3 % of total shorelines, among them 64.12 km are developed into ports and 82.53 km are developed into other artificial use, including industrial shorelines (mainly for ships manufacturing), livelihood shorelines (mainly for

hydraulic facilities and water resource protection), river cross shorelines, urban pollution discharge shorelines, and other special use shorelines (mainly for landscaping). The unused shorelines have a length of 321.65 km (up to 2016), accounting for 69% of total available shoreline resource.

However the VEC is the natural shoreline or shoreline with original ecological function and free of artificial development. The unused shorelines include agricultural uses and are not exactly the natural shorelines. Therefore the natural shoreline length can be even less.

It is widely accepted that the Yangtze River segment in Yichang has been over-developed. Especially in the urban area, there is nearly no natural shoreline left. In addition, the Chinese Sturgeon Natural Reserve is located in the urban area Yangtze River section. Due to the above two reasons, the city's strategy is to gradually phase out the wharfs in the urban areas and to develop high-standard wharfs in suburban or rural areas. The proposed Baiyang Port is among them. Currently there haven't been plans for the phasing out of the wharfs in the urban areas yet, and it is difficult to assess the impacts. But there have been plans for phasing out the excessive and orderless sand mining wharfs along the river. The details can be referred to Section 6.6 on induced impacts.

8.6.2 Cumulative impacts on water quality

According to the monthly water environment quality report February to May 2016 by Yichang Environmental Protection Bureau, the water quality of Yunchi Cut-down section, which is the nearest to this project, can meet the Grade III standard. So, the man-made development activities along the river in the past and present have not deteriorated the water quality of Yangtze River. The water quality has been maintained at Grade III. See Table 8.6-1.

Table 8.6-1 Monthly Water Environment Quality, Yangtze River in Yichang

Water quality data (February 2016)

River name	Section name	Monitoring point	Section nature	Water quality status	Limit-exceeding item	Corresponding concentration of limit-exceeding item mg/L	Times of limit-exceeding
Yangtze River	Nanjinguan	Left	Control section	Good	None	None	None
		Middle		Good	None	None	None
		Right		Good	None	None	None
	Nanjinguan section			Good	None	None	None
	Yunchi	Left	Cut-down section	Good	None	None	None
		Middle		Good	None	None	None
		Right		Good	None	None	None
	Yunchi section			Good	None	None	None

Water quality data (March 2016)

River name	Section name	Monitoring point	Section nature	Water quality status	Limit-exceeding item	Corresponding concentration of limit-exceeding item mg/L	Times of limit-exceeding
Yangtze River	Nanjinguan	Left	Control section	Good	None	None	None
		Middle		Good	None	None	None
		Right		Good	None	None	None
	Nanjinguan section			Good	None	None	None
	Yunchi	Left	Cut-down section	Mild contamination*	None	0.26	0.30
		Middle		Good	None	None	None
		Right		Excellent	None	None	None
	Yunchi section			Good	None	None	None

* Note: despite that the total phosphorus exceeds limit in the left section of Yunchi, the water quality of Yunchi section still reaches the standard (whether the section reaches the standard is based on analysis of the average value of the left, middle and right sections.

Water quality data (April 2016)

River name	**Section name**	**Monitoring point**	**Section nature**	**Water quality status**	**Limit-exceeding item**	**Corresponding concentration of limit-exceeding item mg/L**	**Times of limit-exceeding**
Yangtze River	Nanjinguan	Left	Control section	Good	None	None	None
		Middle		Good	None	None	None
		Right		Good	None	None	None
	Nanjinguan section			Good	None	None	None
	Yunchi	Left	Cut-down section	Good	None	None	None
		Middle		Good	None	None	None
		Right		Good	None	None	None
	Yunchi section			Good	None	None	None

Water quality data (May 2016)

River name	Section name	Monitoring point	Section nature	Water quality status	Limit-exceeding item	Corresponding concentration of limit-exceeding item mg/L	Times of limit-exceeding
Yangtze River	Nanjinguan	Left	Control section	Good	None	None	None
		Middle		Good	None	None	None
		Right		Good	None	None	None
	Nanjinguan section			Good	None	None	None
	Yunchi	Left	Cut-down section	Good	None	None	None
		Middle		Good	None	None	None
		Right		Good	None	None	None
	Yunchi section			Good	None	None	None

The prediction of impact of construction activities in future on water quality is mainly based on the total pollutant discharge amount of the urban master plan of Yichang and the analysis of port pollutant discharge amount relevant to this project.

(1) Yichang Urban Master Plan

According to Yichang Urban Master Plan (2011-2030), the total area of the urban area in planning is about 4 331 square meters, being the entire administrative territory of Yichang. It is estimated that sewage production in urban area will be 808,000 t/d by 2020, and 1,083,000 t/d by 2030. It will be treated to Class I B standard according to sewage treatment standard（COD60mg/L, NH_3-N8mg/L）, the sewage pollutant discharge amount COD will be 17520t/a, and NH_3-N 2336t/a. Currently, Yichang COD environment capacity is 124578.4 t/a, NH_3-N environment capacity 5218.5 t/a. So, the ratio of COD in environment capacity by 2020 will be 14.1%, and that of NH_3-N will be 44.8%/ Because pollutant discharge amount is within the scope of water environment capacity and the water body can effectively self-clean, if the planning can be strictly followed in future and sewage can be collected and treated as per requirement, the current water quality of the water body can be guaranteed.

(2) Yichang Hub

Seen from the water environment capacity of Yichang, since the implementation of the master plan, the total discharge amount of COD and NH_3-N accounts for very small ratio in the water environment capacity of the main basin (not including the water environment capacity of Xingshan County and Zigui County) (Table 8.6-2) Among them, except the main stream section of Gezhou Dam~Yunchi (left) of Yangtze River, the ratio of COD and NH3-N of other ports usually accounts for less than 1% of the environment capacity, and very often 0.01%~0.29%. However, at the section of Gezhou Dam~Yunchi (left), as the scale of every operation zone grows after the planning is implemented, it is estimated that

the water environment capacity of this section will reach about 3.32% by 2020. It indicates that the port pollutant discharge is only a very small part in the sewage discharge amount of the whole city, far less than the water environment capacity, and the water body can be effectively self-cleaned, so the existing water body functions will not be affected.

Table 8.6-2Comparison between Main Pollutant Discharge Amount of Yichang Hub and Environment Capacity

Pollutant	2020	
	COD	NH3-N
Predicted discharge amount of port pollutant (t/a)	63	10.4
Ratio in water environment capacity (%)	0.04	0.1
Ratio in maximum allowable pollutant discharge amount (%)	0.05	0.2

(3) Other factors contributing to pollutant generation

Considering that cities in future will gradually practice more strict sewage treatment and discharge standards, the treatment and discharge standards of all the sewage treatment plant will have to reach sewage treatment plant Level A discharge standard. So, pollutants entering the surface water body will significantly decrease. Meanwhile, with the advance of the times and the progress of technology, reuse of recycled water will be greatly increased, which is helpful to reducing pollutant discharge in surface water.

To summarize, the cumulative impact on surface water quality is not significant, and the Yangtze River can maintain the current Grade III water quality class.

8.6.3 Cumulative impact on Chinese sturgeons

The current status of Chinese Sturgeon is summarized in section 3.6. Conclusion has been drawn in Section 8.4.3 that: the safety limit for Chinese Sturgeon is that the water quality (class-III standard or better), depth (38.32m averagely) and flow velocity (1.14m/s) in the migration route remain unchanged or be improved. The cumulative impacts on water quality have been discussed in Section 8.6.2. This section will focus on the impacts on hydrological conditions.

(1)Impact on hydrological conditions

The average depth is currently 40.21m. The current flow rate is between 0.68m/s and 2.0m/s.

Since the Yangtze River has deep-water shoreline in Yichang, there will be no dredging involved, thus there is no impact from dredging on the river channel, water depth and mid-stream line.

Major impacts on hydrology are from wharf development. The wharfs in the water will

occupy some wetted rive cross section area, and affect the free flow and flow rate. It will not affect the water depth. According to the master plan, the upstream ports and wharfs will be relocated and integrated while some new ports and wharfs will be developed downstream. Though they are not entirely equal, the dismantling of old facilities will offset some impacts of the new wharfs. It is difficult to predict the impact of large scale development. However the developed will be phased thus the impacts will gradually take effect and the changes in hydrology will occur slowly. Therefore we consider the wharfs development will not cause significant impacts on the living environment of Chinese Sturgeon.

(2) Other impacts

As the economic develops further, the number of ships and the tonnage in the Yangtze River in Yichang section (the natural reserve) will further increase. The ships noise can cause certain impacts on the Chinese Sturgeon and other fishes. The ships propellers can also cause higher possibility of physical damage or casualty on Chinese Sturgeon and other fishes.

The ships, wharfs and paved shorelines can also affect the material and energy exchange between the rive ecological system and other places, and occupy the spaces and migrate routes of Chinese Sturgeon and other fishes.

Overfishing in the river leads to decreasing fish populations, many of which are food for Chinese Sturgeons. The impact of diminishing fish stocks in the food chain on the Chinese Sturgeon is apparent.

Based on above analysis, the water quality and the hydrological condition can be well maintained. With additional measures taken, such as the ports integration, fishery management enhancement, the impacts on Chinese Sturgeon can be control within acceptable level.

8.7 Measures and suggestions

In order to better protect water quality and shoreline resources of Yangtze River, we put forward the following suggestions.

8.7.1 Protection on natural shoreline

(1) Studies ecological threshold value or carrying capacity for main shorelines.

As indicated in section 8.4.1, currently there is no conclusive opinion on the ecological threshold value in the main channel shoreline. In order to strengthen the protection of the ecological shoreline, it is suggested to conduct studies on the ecological threshold value or carrying capacity for main channel shorelines.

(2) Implementation of access system for projects related to riverbank resources

For projects related to shoreline resources, access system should be implemented and project resources utilization assessment system should be set up. Shoreline occupied by and depending land of projects related to Shoreline resources should be selected and reasonably

arranged according to the investment intensity and construction scale of projects and status of the project association. Meanwhile, we should carry out comprehensive assessment on the impact of project development on shoreline resources and environment and comprehensively analyze the social benefits, economic benefits and ecological benefits of the developed project. We should specify that the proportion of length of the shoreline occupied by projects related to shoreline resources to deep length of the supporting land should not be smaller than 1:3, guide the project to be arranged deep into the land and reduce the occupation on shoreline. Meantime, we should set up sound comprehensive shoreline management system and formulate effective assurance measures.

Currently, shoreline of Yichang Municipal is not intensively utilized. Planning of port should reflect the idea of intensive utilization of shoreline. We can reserve the shoreline resources for development at appropriate time. We suggest that the utilization of shoreline can be implemented periodically and should be determined according to the throughput and the shoreline should be gradually developed. We should deeply dig the potential of shoreline utilization, improve the utilization rate of shoreline and strictly control the examination and approval on shoreline utilization.

(3) Restore shoreline in the port shoreline integration initiative

Taking advantage of the opportunity that Yichang Municipality is relocating the excessive and borderless wharfs and urban wharfs, promote the ecological shoreline development. While ensuring structural safety, adopt soft material (soil) as much as possible to make the shoreline permeable to water, water and energy exchanges, so that they can habituated by biological organisms to achieve real ecological restoration.

8.7.2 Suggestions on water quality protection

According to the latest orientation of Yangtze River by the central government in 2016, great efforts will be put to protect instead of to develop the Yangtze River. All the departments are actively developing relevant polities, plans and measures to enhance the protection of Yangtze River. Meanwhile, in April 2016, Hubei has already begun to develop the *Ecological Protection and Green Development Planning of Hubei Yangtze River Economic Belt* to guide the construction of ecological Yangtze River.

Specific advice regarding water quality protection is as follows:

(1) Further promote industrial pollution prevention and control

Accelerate adjustment and optimization of industrial structure, give priority to developing hi-tech industries and other pollution-free industries and strictly forbid to add new projects that cause all kinds of pollution. Speed up shutdown and relocation of polluting enterprise in sensitive area and promote structural optimization and upgrading. Strictly execute the environment impact assessment and the regulations of designing, constructing and putting in use pollution control facilities together with the main production facilities. The principle of “rejecting ten types of projects” for environmental protection approval of construction project shall be implemented to improve the standard of environmental access. Fully implement regulations of total sewage discharge amount control and forbid new erection of direct pollution discharge into the rivers. Strictly execute pollution discharge permit system and strictly forbid pollution discharge without permit, exceeding limit or excessive total amount discharge.

(2) Enhance domestic sewage and rural surface source control

Firstly, speed up promoting urban sewage treatment facility construction and implement sewage intercept where possible. All the towns in catchment area must build and complete sewage treatment facilities or put the sewage into neighboring sewage treatment plant. Sewage treatment plants that are newly built or under construction shall be provided with nitrogen and phosphorus removal facilities to ensure that the outlet water quality reaches Level A discharge standard in the *Urban Sewage Treatment Plant Pollutant Discharge Standards*. Where the outlet water of the existing urban sewage treatment plant fails to reach standard or the plant is not provided with nitrogen and phosphorus removal facilities, the process must be renovated in order to discharge to the standards. Secondly, speed up promoting rural domestic sewage treatment. Accelerate driving the construction of rural domestic sewage water treatment facilities by means of centralization or scattering based on the local conditions.

(3)Strengthen ecological protection and restoration

Firstly, give priority to wetland protection and restoration in riparian zones. Actively carry out wetland protection demonstration project. Actively promote construction of ecological wetland system, planting floating plant, emerging plant and submerged plant, and speed up creating aquatic plant zones at main stream, estuary and riparian zones. Carry out Lake Reservoir embankment renovation, plant configuration project and improve land and water exchange capacity. Configure and renovate farmland forest network and enhance village greening according to local conditions. Secondly, enhance prevention and control of water and soil loss Carry out construction of small valley that is ecologically clean, construction of water conservation forest and ecological forest for public interest. Forbid such activities as ore mining, quarrying, soil taking and sand excavation along the river section.

(4) Enhance monitoring alert system construction

Firstly, enhance water environment monitoring and control. Governments at all levels must make overall plans and coordinate, integrate monitoring resources, optimize monitoring network and establish water environment information sharing platform covering water quality, water condition and weather. Carry out whole-process monitoring for lake reservoirs, especially lake reservoirs that provide drinking water, regarding water quality from water taking, water producing and water supply in water plant. Secondly, speed up building water environment alert system. Complete automatic monitoring system of surface water quality, promote construction of water quality security online bio-alert system, and speed up the construction of around-the-clock real-time water environment quality monitoring system. Meanwhile, speed up water environment alert index system and uniform alert information release system to guarantee water environment safety precaution. Thirdly, establish and complete water environment protection emergency system. Governments and departments at all levels should further establish and complete emergency plan for preventing and controlling water pollution emergencies and implement various emergency measures for response.

8.7.3 Suggestions on Chinese sturgeons

Rapid growth of throughput capacity, frequent various production activities, waste water discharged from accidental discharge, oil pollutants, oil leakage from ship and operation noise can hardly be avoided. Therefore, pollutant discharge in the port area and from ship must be strictly controlled.

Relevant departments of Yichang municipality will carry out uniform planning and layout for the wharfs in the Chinese sturgeon protection zone for uniform management; change the scattered and messy condition of the wharf operation area inside the protection zone to reduce the impact of small and medium-sized wharfs on the protection zone.

The master plan specifically requires gradual demolition of existing operation areas in the Chinese sturgeon reproduction zone and relocation far away to downstream of the reproduction zone, which is favorable to Chinese sturgeon propagation and protection.

The SEA shall be implemented.33 wharf berths in Binjiang, Jiangnan, Wangjiahe and Gulaobei operation areas inside the Chinese sturgeon protection zone shall be removed. 20 new berths will be built in Linjiangping and Gulaobei operation areas.The total number of berths inside the core area of the protection zone will be greatly reduced, favorable to protecting the Chinese sturgeon and the ecological environment in the core area.

Overfishing shall be controlled. Awareness campaign shall be the emphasis. The hazard of overfishing must be explained to the fishermen. The anadromous migration of Chinese sturgeon in this river section happens in the middle of October. As the catadromous migration of Chinese sturgeon adults happens from February to middle of April, and that of juvenile fish from the middle of December to the end of December, it is suggested that relevant government departments should fully consider the abovementioned migration period when developing fishing-off season. Fishing is strictly forbidden during fishing-off season. Meanwhile, law enforcement should be enhanced. Overfishing and heavy fishing must not be tolerated.

9 Social Impact Assessment

9.1 Project stakeholders and risk analysis

9.1.1 Identification of project stakeholders

The major stakeholders of the project are identified as the follows:

1) The World Bank
2) PMO (located in Yichang Transportation Investment Co., Ltd)
3) Yichang Transportation Investment Co., Ltd
4) Resettlement Office of High-tech Development Zone Management Committee
5) Baiyang Industrial Park Resettlement Office
6) Construction contractor of Baiyang Port and Logistics Park
7) Residents, enterprises and units impacted by land acquisition
8) Residents, enterprises and institutes in the neighborhood of projects of Baiyang Industrial Park
9) Existing ports and logistics enterprises of Yichang City
10) Service objects of Baiyang Port and Logistics Park
11) Public media that publicizes information related to the project (newspaper, TV, internet, etc.)

Table 9.3-1 Project stakeholders

Stakeholder	**Stakes**	**Role**	**Attitude towards the project**	**Impact on the project**
World Bank	Loan provider	Provide a part of financial support	Supportive	Significant
PMO	Direct project initiator	Major decision-making in project construction	Supportive	Significant
Yichang Transportation Investment Co., Ltd	PIU	Arranging for specific project construction	Supportive	Significant
Resettlement Office of High- and New-tech Development Zone Management Committee	Indirect stakeholder	Carrying out land acquisition and house demolition work	Supportive	Significant
Baiyang Industrial Park Resettlement Office	Indirect stakeholder	Coordinating the land acquisition and house demolition work	Supportive	Large
Construction contractor of Baiyang Port and Logistics Park	Can gain economic benefits from the project	Undertaking construction of the contracted bid section	Supportive	Significant
Residents, enterprises and units impacted by land acquisition	Can either be the direct beneficiary or victim of the project	Propel or hinder project construction	Can either be supportive or rejective	Significant
Other ports and logistics enterprises in Yichang City	Can either be competitor or partner of the project	Propel or hinder project construction	Can either be supportive or rejective	Relatively small
Customers of this port and logistics park	Direct beneficiary	Propel project construction	Supportive	Relatively small
Residents, enterprises	Can either be the	Propel or hinder project	Can either	Relatively

Stakeholder	Stakes	Role	Attitude towards the project	Impact on the project
and institutes indirectly impacted by the project	direct beneficiary or direct victim of the project	construction	be supportive or rejective	small
Public media	Can enhance popularity and influence by reporting the project	Publicizing and spreading negative or positive news about the project	The attitude of public media depends on the project progress and its social impact	Relatively large

9.1.2 Stakes and risk analysis

The above identified stakeholders assume different responsibilities, have different attitude towards this project and plays different roles in the preparation and implementation of this project. Their stakes and behaviors in the preparation and implementation of this project are closely associated with risks of this project may occur.

(1) World Bank

As the loan provider of this project, World Bank provides certain financial support to construction of this project. Its main demands towards this project are as follows:

Strict regulation and supervision is carried out in the preparation and implementation process of this project to ensure that this project complies with development philosophy of World Bank, bring comprehensive social and economic benefits and realize development goal of this project. World Bank's financial support to this project can urge relevant governmental departments of China to pay more attention to the preparation and implementation of this project and is conducive to the prevention and settlement of relevant risks. Meanwhile, the risks brought to this project by funding of World Bank are: there are strict procedures and technical specifications for preparation and implementation of World Bank funded projects; whether the preparation procedures and management in implementation of domestic projects can meet the relevant requirements is an important factor which influences whether the projects can be prepared and implemented according to the given plan.

(2) PMO

Main demands of PMO which is the leading agency that is responsible for major decision-making and specially established by People's Government of Yichang are as follows:

1) Promoting development of transportation and logistics of Yichang and improving the efficiency of freight and logistics along Yangtze River within Yichang through construction of this project;

2) Promoting multimodal transport in ports of Yangtze River and reducing carbon emission in logistics and transportation process;

3) Facilitating the World Bank funded project to be approved and implemented as soon as possible and expanding the influence of introduction of foreign capital.

As the major decision maker, organizer and coordinator of this project, PMO's association with social stabilization risk of this project lies in whether PMO can ensure scientific and democratic decision-making in the planning and preparation process of this project, ensure the smooth advancement of planning and approval process of this project and lead the relevant functional department to ensure the legality and effective implementation of the policies regarding this project.

(3) Yichang Transportation Investment Co., Ltd

As PIU of this project, main demands of Yichang Transportation Investment Co., Ltd. are as follows: constructing Baiyang Port and Logistics Park and building growth point and platform for sustainable development of enterprises. Smoothly completing this project will be the achievement of leaders and staff of such company which also wants to seize this opportunity to obtain fund support from multiple channels and realize leapfrog development. Therefore, as specific organizer in the preparation phase of this project, Yichang Transportation Investment Co., Ltd. hopes to get vigorous support from relevant departments of Hubei Province and Yichang Municipality to have this project approved by relevant institutions as soon as possible and accept assessment and obtain recognition from World Bank to have the project implemented as soon as possible. Their association with the project risks lies in whether they can prepare the project according to the state and local policies and procedural specifications, scientifically organize the construction and not damage interests of other relevant groups with its own interests in the construction process and set up scientific modern enterprise management system, safely and effectively realize the project's operation and realize the harmony between economic benefits and social benefits in the operation process of this project.

(4) Hi-Tech Zone Resettlement Office Management Committee

As the implementation unit of land acquisition and house demolition, the resettlement office of Hi-Tech Development Zone will also get fund support for them to complete the task. They hope that PIU can carry out land acquisition, house demolition and compensation in accordance with the relevant policies of the state and Hi-Tech Development Zone on one hand and hope that the affected households, enterprises and units to actively cooperate so that they can complete their task within the region under their administration on the other hand. They are indirectly associated with this project for economic benefits. However, since land acquisition and house demolition is act of the government and as the specific executor, their performance will be supervised and examined by the People's Government of Yichang and Management Committee of Hi-Tech Development Zone, they basically have positive attitude towards this project. Their association with the project risks lies in whether they can smoothly implement policies regarding land acquisition and house demolition with professional policy knowledge and skills, guarantee that the affected persons can be reasonably compensated and arranged and provide safe social environment for smooth progress of project construction.

(5) Baiyang Industrial Park Resettlement Office

Baiyang Industrial park Resettlement Office is the specific organizer and executor of land acquisition and house demolition of the Hi-Tech Zone Resettlement Office in Baiyang Industrial Park. As the resettlement agency that directly interacts with the affected people and enterprises, Baiyang Industrial Park Resettlement Office's grasp of policy knowledge and professional skill will be directly connected with the smooth advancement of resettlement. They will also get fund support for their specific implementation of the resettlement. They not only organize land acquisition and house demolition in accordance

with policies as specified by the Hi-Tech Zone Resettlement Office but also are responsible for publicizing the information pertinent to resettlement to the affected people and enterprises and organizing the construction and distribution of resettlement housing. They have positive attitude towards to this project. Their association with the project risks lies in whether they can solidly and meticulously implement resettlement policies as specified by the Hi-Tech Zone Resettlement Office, carry out activities to let the public get involved, collect and solve the complaints and dissatisfaction which may occur in the process of land acquisition and house demolition and ensure the smooth progress of land acquisition and house demolition.

(6) Contractors of Baiyang Port and Logistics Park

As the specific constructor of this project, the Contractors want to complete the construction with lowest cost, in most economical way and in shortest construction period and then to realize their economic benefits in this process. Therefore, they hope and are willing to have a good environment for their construction. Meanwhile, in order to pursue their interests, the Contractor may take some measures which do harms to the daily access and life of surrounding residents in light of organization of and environment for construction so as to provide convenience for their construction. Their association with the project risks lies in whether they can strictly follow various regulations and rules about the project construction, avoid the safety risks, ensure the construction quality and provide qualified results.

(7) The Affected Residents, Enterprises and Units

This group has complicated interests in the project. On one hand, land acquisition may exert influences on their normal life and even production and operation. Hence, they may have negative feelings towards this project. On the other hand, the obvious benefits brought by this project make them look forward to the project construction. What they care about is whether they can be reasonably compensated, whether the negative impact brought by this project can be properly settled, whether the distribution and use of compensation can be reasonable, open and transparent and whether the construction and distribution of resettlement housing can be timely completed and improves their living conditions. Their association with the project risks lies in whether they accept the compensation and resettlement policies after land acquisition and whether there are smooth mechanism and channels for them to express their dissatisfaction and complaints and reasonable pathways and methods to solve the problems.

(8) Other Ports and Logistics Enterprises of the Same Type in Yichang

For other ports and logistics enterprises within the service scope of this project, construction of this project will exert double impact on them: on one hand, there will be inevitable competition relationship among enterprises, which will exert negative impact on operation of other enterprises; on the other hand, construction of Baiyang Port may add momentum to construction and improvement of the ports and logistics system in this region and form effective pattern of cooperation with due labor division, thus achieving the goal of co-existence and common prosperity. Therefore, the competition and cooperation relationship between Baiyang Port and Logistics Park and enterprises of the same type make other enterprises of the same type have both negative feelings and positive attitude towards the project. Planning, communication and cooperation of the enterprises and relevant management departments are needed to transfer the disadvantages into advantages and realize win-win.

(9) Service Objects of this Project

Service objects of this project include both enterprises and units in Baiyang Logistics Park and the surrounding users and the users being connected by comprehensive logistics system of water, railway, road and air. They look forward to the convenient traffic and logistics brought by construction of this project and hope that the project will provide convenience for and reduce the cost of their production and operation. Hence, they positively support the project but have little impact and action on this project since they are not the direct party to the construction of the project.

(10) Enterprises, Units and Residents Surrounding the Project

This group which is indirectly influenced by the project is mainly distributed near the project boundary and has relatively more complicated interest demands. On one hand, the project construction may exert negative impact on their access, life and operation environment but may bring about some employment and business opportunities. They hope to minimize the negative impact and expect the development chances brought about during the construction period and after completion of the project construction. From an overall perspective, this group supports the project. However, special attention should be given to the establishment of risk identification and warning mechanism in the construction process. This group's association with the project risks lies in whether impact on operation and living environment caused in the construction and operation process of this project and other negative factors can be effectively solved.

(11) Public media

Public media is always very sensitive to the construction projects relating to people's livelihood. Any information may be spread via media, such as newspaper, TV and internet, and in this process, its influence, positive or negative, can be magnified. Generally, media as an indifferent dissemination channel has no direct interest relation with the project, but due to the coverage and influence of public media and the public's sensitivity to bad news and their desire of getting to the bottom, great attention must be paid to public media during project preparation, implementation and operation. Public media is highly related to project risk because it always acts as witness and participant in generation and development of social risks. Social impacts of the project will be widely disseminated via media. If getting along well with public media, the potential risk to social stability may be avoided and eliminated effectively. On the contrast, if not getting along well with public media, social risks may be enlarged and amplified.

9.2 Project impact and risks analysis

Some investigations conducted for this project and social impact analysis experience of similar projects demonstrate that this project will bring some adverse impacts and risks while bringing some positive impacts to project location and surrounding area. These positive and negative impacts must be identified and measures can be taken to enlarge positive aspects, reduce or remove adverse impacts, and prevent or eliminate social risks.

Table 9.2-1 Identification of social impacts

Classification	Positive impacts	Adverse impacts	Social risks
Economy	Improve local logistics and transport capability, promote development	Almost no adverse impact.	No other risks except for the financial risk of the project

Classification	Positive impacts	Adverse impacts	Social risks
	of Baiyang Industrial Park, promote local economic development		
Social stability	Provide more jobs, optimize local economic and social structure, promote urbanization and social stability	People on the land occupied by the project may lose their livelihoods and houses.	Social disputes may occur when the people whose lands are requisitioned or whose houses are demolished can't get appropriate compensation, good job or proper arrangements.
Transport	Promote formation of multi-modal transport system in project location and surrounding area	Operation of the port and logistics park will increase the pressure of road transportation.	Traffic accidents may occur along national road G318 and trunk roads at Baiyang Town.
Other impacts	Drive development of similar enterprises and related business.	Other similar enterprises may be challenged and shocked if lack of good planning and coordination.	This may lead to vicious competition and many workers may lose job.

9.2.1 Economic impact

This project will greatly promote the economic development of Baiyang Industrial Park and the local area. During 3-4 years' construction of the project, more than 200 labors will work at the site, and more than 800 during the busiest period. Their daily consumption will promote the sales of daily necessities and development of service industry in Baiyang Industrial Park.

After the port and the logistics park are completed and put into operation, more than 1500 labors will work here to promote development of series of supporting industries, such as logistics, transportation, auto repairing, catering and real estate. A residential area with an area of 1.73km^2 is planned 4000m away from the logistics park. Phases I & II of the residential area have been completed, and Phase III is to be completed by around 2020. The whole area will accommodate 30,000 people and it will be a low-carbon and ecologically livable town.

9.2.2 Project impacts to social stability

In spite of many positive social impacts, the port and the logistics park may bring risks to social stability.

In terms of positive aspects, this project offers a chance for local development, since the port and the logistics park will create jobs, drive local economic development and change urban construction pattern. But in this process, some issues may bring risks to social stability if not well handled. For example, the port and the logistics park both require land acquisition and those whose lands are requisitioned must be resettled and compensated in a good way; otherwise, the project may have obstructions. For another example, during project construction, most of the workers are not locals and they may have conflicts and disputes with the locals due to traffic, project impacts or other little things. Small conflicts may evolve into big problems if without proper handling measures. So, the PMO has formulated rules and regulations for elimination and control of potential risks.

9.2.3 Project impacts to local traffic

The port and the logistics park generally will promote the formation of multimodal transport system at local area. But during construction process, construction vehicles and transporting vehicles of construction materials will run frequently on G318 which is near the logistics park and may increase the traffic pressure of G318, especially that the heavy load vehicles may damage the roads in the surrounding area.

Figure 9-1 Mixed traffic on national road G318

Figure 9-2 No traffic lights at intersections

According to the FSR, the freight volume of the port and logistics park will exceed 14 million tons by 2025, above 50% of which depend on road transportation. That is to say, after the project is put into operation, the large transportation volume certainly will increase

traffic pressure of G318, especially the section at Baiyang Town and will have influence on road maintenance and life of residents along G318. On one hand, current conditions of G318 may be unable to endure the heavy load trucks; on the other hand, non-motor vehicle lane is not built at the section from the logistics park to Taibaochang, so the pedestrians, motor vehicles and non-motor vehicles travel on the road disorderly. No basic traffic safety facilities and signs including traffic lighting are provided at intersections of G318 in Baiyang Town, so traffic accidents may occur.

9.2.4 Other induced impacts and risks

The construction and operation of the port and logistics park may cause some other impacts, positive or negative mainly to the social public and other stakeholders in the local area. For example, the project may have influence on the enterprises (of all kinds, such as transportation, logistics and port etc.) near Baiyang Industrial Park. Positively, one kind of scale economy may be formed at the area to establish the multimodal transport and logistics network integrating waterway, railway, road and air transport and create a win-win situation. However, negatively, the port and logistics park have competition with other similar enterprises and a new market pattern may appear for local logistics industry. In order to pursue benefits and avoid risks, this project has been included in the General Plan for Local Economic and Social Development of the High-tech Development Zone, for the purpose of rational layout, proper division of work, harmonious development and co-prosperity.

Another impact of the project is that high mobility of people resulting from project construction and logistics may promote disease transmission and therefore post threat to human health. So, prevention and response plan shall be developed. See details in 5.1.5.2.

9.3 Impact and risks of land acquisition

9.3.1 Impact of land acquisition

The land to be acquired belongs to two villages, i.e. Yazishan Village and Guixihu Village.

In terms of house demolition, this project needs to permanently demolish private buildings of 137068.18 m^2, which will affect 252 households and 911 persons.

Table 9.3-1 Private buildings to be demolished

Affected village	Number of household	Number of people	Area of demolition (m^2)
Yazishan Village	33	110	124514.90
Guixihu Village	219	801	12553.28
Total	252	911	137068.18

Six enterprises and institutions are affected, including a floor area of 6019.20 m^2 and 44 employees will be affected.

Table 9.3-2 Affected enterprises and institutions

Enterprise or institution	Area of demolition (m^2)			Affected staff
	Brick-concrete	Brick-wood	Simple	
Guixihu Village Committee	300	500	100	0
Green Waxing Plant	600	700	300	20
Guixihu Waxing Plant	300	700	300	18
Guixihu Steel Pipe Rental Shop	0	200	500	4
Guixihu Sand and Stone Factory	800	500	200	
Pressurization room of Baiyang Water Plant	19.2	0	0	0
Total	2019.2	2600	1400	44

The land acquired permanently is 2,139.8 mu, all being collective land. in which 1,716.18 mu belongs to Guixihu Village, and 417.82 mu belongs to Yazishan Village. All the land is collectively-owned. In total, 463 households and 1,616 persons are affected, in which 192 households and 666 persons come from Yazishan Village, and 271 households and 950 persons come from Guixihu Village.

Table 9.3-3 Details of land acquisition (mu)

Village	Orchard	Fish pond	Land for construction and other use	Total
Guixihu Village	1,154.72	184.2	383.06	1,721.98
Yazishan Village	361.99	0	55.83	417.82
Total	1,516.71	184.20	438.89	2,139.80

9.3.2 Risks of resettlement

Land acquisition and house demolition carry high risks from past experiences. Since this project requires a large volume of land acquisition and house demolition and it concentrates in Yazishan Village and Guixihu Village, it will exert significant impact on the residents, indicating high risks in resettlement.

1. Attitude of affected persons towards the resettlement standards and policies

The resettlement compensation standards for this project have been formulated upon negotiation and in compliance with applicable municipal, provincial and national laws and regulations.

According to Notice of the Hubei Provincial Government on Issuing the Unified Annual Output Value and Comprehensive Price of Acquired Land in Hubei (March 13, 2014), compensation will be paid according to the unified annual output value of the acquired land. The compensation should be 19 times of the unified annual output value, including land compensation and resettlement subsidies, among which land compensation accounts for 9 times of the unified annual output value. 70% of land compensation will be directly paid to the land-acquired households while 30% will be paid to the village collective for public welfare undertakings. On the other hand, the resettlement subsidies are the 10 times of the

unified annual output value and it will be fully paid to the land-acquired residents. Compensation for standing crops will also be directly paid to land-acquired residents. The compensation coefficient for orchard is 1.2 times of the unified annual output value. Moreover, For land-acquired villagers whose average area of cultivated land is less than 0.3 mu, they will be insured under the social pension program with social pension compensation be paid off to them in full. For people under age of retirement, they can choose to be insured either under the Pension System of Urban Employees or under the Pension System of Rural and Urban Residents.

Displaced families can either choose cash compensation or resettlement house compensation.

For families who choose cash compensation, compensation for the housing and ancillary facilities to be demolished will be paid in cash, and the families can use the compensation to get resettled by themselves. Cash compensation must ensure that the compensation payment is no less than the replacement cost of the demolished house.

For families who choose resettlement house compensation, they will be compensated with a free resettlement house according to the area of the demolished residential house. However, the maximum area of the resettlement house shall not exceed 240 m2. Areas exceeding 240 m2 will be compensated by cash.

However, if the average area per capita of the displaced families is less than 40 m2, the average area per capita of resettlement house shall be 40 m2.

Due to different types and structures of the resettlement house, its area may exceed that of the demolished house. In this case, the excessive area shall be purchased by the displaced households by cost price of constructing the resettlement house.

The decoration of the demolished house will be compensated by 100-400 Yuan /m2, varying from the complexity and quality of the decoration. Apart from the above compensations, the displaced households will also obtain compensation for moving out, transition and relocation.

Generally, the above standards comply with existing national and local laws and can meet the basic conditions for rehabilitation of affected persons. However, as the living conditions of each household vary from each other, they may hold different attitudes towards the above standards.

Particularly, Baiyang Industrial Park was formerly administered by Zhijiang City and managed by Yichang Hi-Tech Zone in 2013, so that the compensation standards may be executed in compliance with standards of Zhijiang City. This may result in difference between the executed standards and those of the Hi-tech Zone, and therefore cause suspicion and grievance of the affected persons. For this reason, public consultation and participation are of vital importance and should be referenced to confirm the feasibility of the resettlement compensation standards.

2. Rehabilitation difficulties for land-acquired households

According to the survey, about 36% of the affected households have more than 50% land to be acquired, and 23.97% have more than 75% of their land to be acquired. If the compensation is insufficient then their livelihood and income will be seriously impacted.

9.3-4 Impact rate of land acquisition on rural households

Percentage of orchard acquisition	Guixihu Village		Yazishan Village		Total	
	No. Of households	Percentage (%)	No. Of households	Percentage (%)	No. Of households	Percentage (%)
75-100%	62	22.88	49	25.52	111	23.97
50-75%	18	6.64	38	19.79	56	12.10
10-50%	25	9.23	45	23.44	70	15.12
0-10%	166	61.25	60	31.25	226	48.81
Total	271	100.00	192	100.00	463	100.00

On average, the rural income only accounts for about 20% of the total family income for these affected households, but since some families (3% according to the survey) mainly rely on rural income for a living; land acquisition will impact their income greatly. They need to be paid special attention during implementation of resettlement compensation standards.

3. Grievance with construction & allocation of resettlement houses

The relocated households of this project are all placed in the resettlement houses of Baiyang Industrial Town Resettlement Community Phase II. Baiyang Industrial Town is 1,000 m away from Taibochang resettlement residential community. Resettlement houses are divided into four types: 89 m^2, or 93 m^2, 120 m^2 and 139 m^2, which are for relocated household's own choice. The PMO is responsible for ensuring that the following basic living conditions are met in house delivery: Main structure, roofing and waterproofing work of the house is complete. Internal and external wall is plastered with cement mortar. The house is equipped with ordinary wooden doors, aluminum windows, as well as supply of water, electricity, gas, cable TV, and Internet. Currently, main work of the resettlement houses have been completed and exterior wall decoration is in progress. After 2016, the resettlement houses can be put into service.

Judging from the construction site and past experience of house resettlement in Baiyang Port Phase I, the relocated households' living conditions will witness four changes: First, the living area will be guaranteed or even enlarged; second, the quality of housing and living environment will be improved; third, relocated households will be able to enjoy modern urban life; four, relocated households' values of real estate will significantly increase. However, there are still some adverse effects. Properly solving these issues will help smooth the progress of relocation and maintain a good social environment. Related issues identified in the public participation include:

1) Will resettlement houses be delivered as scheduled? Some of the affected households are worried that the transition period promised by PMO will be extended, thus resulting in inconvenience.

2) Is allocation of resettlement houses open and transparent? The affected households strongly urge the transparency in house allocation.

3) Are construction quality of resettlement houses guaranteed? Affected households hope that PMO and the Construction Unit ensure the construction quality.

4) Will the size of resettlement houses meet the needs? Seen from past practice of Baiyang Port-Phase I, some of the resettlement houses' sizes haven't met the requirement of relocated households. Hence, the affected households hope the situation will be improved

in Phase I of the project.

5) Will supporting services and facilities be provided as soon as possible? Affected households hope that the various service facilities such as clinics, activity center, markets, bus stations can be build and put into service as soon as possible.

To solve the above-mentioned issues, the PMO has prepared a detailed Resettlement Action Plan in accordance with the procedures of domestic construction projects and the requirements of WB.

4. Grievance with the management and usage of the collectively retained part in land compensation fund.

30% of the land compensation will be retained as the collective part, which will be used for development of welfare and collective economy. The management and usage of the funds is an important aspect that villagers are concerned about. Villagers of Yazishan Village and Guixihu Village have their wishes to develop collective economy by the fund. However, relevant plans and specific projects cannot be implemented in a short period. Mess in fund management will damage the interests of all villagers, thus bringing negative impact on the implementation of the project. To solve this problem, the PMO has also prepared a detailed action in Resettlement Action Plan.

5. Grievances with information disclosure and problem solving.

The resettlement work not only needs to meet the national/local regulations and policies, but also need to be open and transparent. Information disclosure should be carried out in different channels and at different levels. Hence, a smooth feedback channel and problem-solving mechanism shall be prepared. Therefore, the PMO and Resettlement Office at all levels has prepared detailed information disclosure system and complaints/grievances feedback mechanism in the Resettlement Action Plan.

9.4 Management of construction teams and camps

The construction period of the project is 3-4 years. The number of daily workers will be more than 200 (800 in peak periods). The workers belonging to different construction team come from different construction units and regions. According to general experience, 90% of the workers come from the company of successful bidder or from non-local places. The workers form a relatively tight sub-group self-organization. As the workers will work and live in a relatively narrow place, its management is a great challenge. From past experience of domestic and foreign construction projects, the management of construction teams and camps has potential risks. Hence, relevant preventative measures shall be taken.

9.4.1 Management risks of construction teams and camps

The risks that may arise mainly include:

1) Grievance of local residents due to damage in road traffic, water, and other public facilities brought by construction machineries.
2) Conflicts and disputes between local residents and construction teams due to noise/dust/water pollution, etc.
3) Disputes with local residents due to use of local public services or maintenance of construction sites.
4) Disputes due to mismanagement of construction teams from different subprojects;
5) Disputes with local residents in economic activities and interactions.

6) Disputes and conflicts due to lifestyle, social customs, ethics and others,

9.4.2 Management measures of construction teams and camps

In order to prevent the above-mentioned issues, Yichang Transportation Investment Co., Ltd has prepared the *Administrative Measures for Construction of Baiyang Port and Logistics Park Project* (see annex). The administrative measures cover selections of the construction teams, day-to-day management and code of conduct for construction workers. Yichang Transportation Investment Co., Ltd requires that all parties involved in the construction shall comply with the administrative measure and have it included in the two-side contract. Baiyang Industrial Park will arrange specialized agencies and personnel to help Yichang Transportation Investment Co., Ltd and the Construction Company to conduct monitoring and inspection work. PMO will carry out periodic inspection in every quarter. Any problems found will be timely rectified by the contractor. Contractors having serious problems and ineffective rectification measures will be dismissed.

9.5 Mitigation measures of social impacts

PMO will work with Yichang Hi-tech Zone Management Committee and Baiyang Industrial Park Management Office in taking effective measures to minimize all the negative social impact/risks. Detailed measures are shown in Chapter 11.

10 Information Disclosure & Public Participation

Public participation is an important part in environmental impact assessment. It is a two-way exchange between PIAs, evaluation agencies and the masses. Through public participation, we can truly understand the environmental issues of public concern. By public participation, the work of environmental assessment will be more open, and its conclusion will be more practical.

10.1 Purpose & method

1) The aim is to let the public know about the purpose, size, and location of the project, as well as its potential impact during/after its construction. Besides, the aim is to let the public know the policies and measures to be taken so as to won the public's understanding, support and cooperation;
2) The results of public participation will help us analyze the characteristics of polluted environment as well as the status quo of environmental factors, thus reflecting the objective level of EIA and protect the public's interest;
3) The public is familiar with the resources involved in EIA, such as natural, ecological, and living resources. Through public participation, the public is invited to participate in the confirmation of environmental protection measures. Thus, these measures will be more practical and efficient;
4) The public will get an opportunity to discuss the project feasibility.

The public participation involves the area along the project, in accordance with *Environmental Impact Assessment Law of the PRC, Interim Measures for Public Participation in Environmental Impact Assessment* (H.F [2006] No. 28), WB's OP4.01- *Environmental Assessment*, and WB's BP17.05- *Public Participation*. The respondents mainly include relevant functional departments, mass organizations, enterprises and institutions, and directly affected residents.

10.2 First round information disclosure and public consultation

The EIA unit shall disclose to the public information relating to environmental impact assessment after receiving the commission of the project owner, in accordance with the requirements of Interim Measures for Public Participation in Environmental Impact Assessment(H.F [2006] No. 28), WB's OP4.01- *Environmental Assessment* and BP17.50-*Information Disclosure*.

(1) First round online disclosure

After completing the outline of EIA, we conducted the first round public disclosure on the website of the Hubei Provincial Environmental Protection Bureau (Related links: http://www.hbepb.gov.cn/wsbs/gsgg/hpgs/hpdwhp/201511/t20151110_81165.html. We welcome advices and suggestions from the public on the project. For details, see Figure 10.3 - 1. No feedback has been received during the public disclosure period yet.

(2) Public disclosure on project sites

We also conducted public disclosure at the project site on issues such as the project's basic

information and environmental impacts. See Figure 10.3-1.

First round online disclosure

Public disclosure on project site

Figure 10.3-1 Public disclosure

Central-Southern Safety & Environment Technology Institute Co., Ltd. has twice assigned designated person to conduct the survey of public opinion on the project area. The designated person has provided the local people with the overview, scale and significance of the project, as well as the project's positive/negative effects. After that, a questionnaire has been provided to the respondents for analysis. The questionnaire is shown below.

The main target of the questionnaire involves the residents in the affected area. The representatives include residents and enterprise workers in surrounding villages and communities of the project area.

(3) Basic situation of respondents

We issued a total of 45 questionnaires and received 45. The recall rate is 100%. Composition of respondents, see Table 10.3-1.

Table 10.3-1 Basic information of respondents

Project	Category	Population	Proportion(%)
Age	Under 30	3	7
	31-40	6	13
	41-50	14	31
	51-60	16	36
	Over 60	6	13
Occupation	Farmer	42	93
	Employee	2	4
	Unknown	1	2
Education level	Primary school	3	7
	Junior middle school	28	62
	High school / polytechnic school	10	22
	College degree or above	4	9

The table above shows that the participators in the survey are representative and typical, involving different ages, gender, education level, and occupation.

(4) Results and analysis

See Table 10.3-2.

Table 10.3-2 Summary of public opinions

No.	Main survey items	Opinions	Number of people (person)	Proportion (%)
1	Attitude towards the construction of this project	Supportive	44	98
		Opposed	0	0
		Indifferent	1	2
2	Impact on personal income during project construction	Beneficial effects	25	56
		Negative effects	10	22
		No effect	10	22
3	How is the environmental quality in current residence?	Good	28	62
		Average	16	36
		Poor	1	2
4	Main environmental problem at project site?	Air pollution	17	38
		Water pollution	5	11
		Noise	13	29
		Ecological damage	10	22
5	Environment problems that you are mostly concerned about	Noise	10	22
		Ecological damage	14	31
		Landscape destruction	5	11
		Water pollution	9	20
		Air pollution	7	16
6	Which factor brings greater environmental impact?	Noise	20	44
		Exhaust	5	11
		Water pollution	7	16
		Dust	13	29
7	Land acquisition and house demolition are needed in this project. Which kind of compensation do you prefer?	Cash compensation	15	33
		Relocation	29	65
		Others	1	2
8	Degree of impact on the Yangtze River	Great	1	2
		Medium	25	56
		Little	19	42
9	*Impact on economic development of this region*	Great	44	98
		Little	1	2
		None	0	0
10	Can you accept the environmental impact?	Acceptable	44	98
		Unacceptable	1	2
		Indifferent	0	0
11	Will you accept land acquisition, house demolition and relocation?	Yes	40	89
		No	0	0
		Accept under certain conditions	5	11
12	As to mitigation measures, what is you recommendation?	Greening	35	78
		Watering	7	16
		Dust-proof windshield	1	2
		Others	2	4

According to our survey, most of the people think their surrounding environment is not bad. They have certain awareness in environmental protection. However, this awareness is not

comprehensive enough. Therefore, propaganda and education on environmental protection is needed. On the other hand, people are more concerned about environmental problems like ecological damage, noise and water pollution. During the construction period, it is hoped that the construction unit take watering measures to reduce atmospheric effects. The public also showed some concern on the following matters: a) For land acquisition and centralized resettlement, part of the people still feel worried about living environment changes and future livelihoods; b) As to labors in the orange grove, the number of women accounts for a large part. Hence, the land acquisition may affect their participation in economic activities and their economic status in the family. Some women worry that it will be difficult to find a non-farm job after land acquisition due to their poor education level; the women also worry that it will be difficult for them to adapt to the community life in town after centralized resettlement.

Solutions to issues like ecological damage and relocation will be explained in EMP; as to problems caused by resettlement, measures will be given in RAP; as to the recommendation in accelerating construction speed, we will report it to the Project Owner.

(5) Consultation with originations

We selected 5 unit/enterprises for investigation: Guixi Lake Village Committee, Guixi Lake Waxing Plant, Guixi Lake Gravel Plant, Guixi Lake Tube Rental Station, and Huacheng Machinery Plant. For details, see Table 10.3-3.

Table 10.3-3 Summary of public participation-units/enterprises

No.	Main survey content	Opinion	Number of people(person)	Proportion (%)
1	Attitude towards the construction of this project?	Support	4	80
		Opposition	1	20
		Indifferent	0	0
2	Economic impact on the regional/departmental development brought by the construction	Beneficial effects	5	100
		Negative effects	0	0
		No effect	0	0
3	Environmental quality along the project site	Good	0	0
		Average	4	80
		Poor	1	20
4	The main environmental problem at project site? (Multiple choice)	Air pollution	5	100
		Water pollution	2	40
		Noise	5	100
		Ecological damage	0	0
5	The environment issues that you are most concerned about (Multiple choice)	Noise	5	100
		Geological disasters	1	20
		Ecological damage	0	0
		Landscape destruction	0	0
		Water pollution	4	80
		Air pollution	3	60
6	Which factor brings greatest environmental impact in the operation phase? (Multiple choice)	Noise	1	20
		Exhaust	5	100
		Water pollution	2	40
		Dust	2	40
7	*Whether the construction will help improve people's life*	Yes	1	20
		No	0	0

No.	Main survey content	Opinion	Number of people(person)	Proportion (%)
	quality in the region	Little impact	4	80
8	Impact on ecological environment and agricultural resources along the construction site	Great impact	0	0
		Little impact	5	100
		No impact	0	0
9	Impact on Yangtze River	Great	0	0
		Medium	4	80
		Little	1	20
		Almost no impact	0	0

Statistical analysis:

The recall rate of the questionnaire is 100%, indicating that most of the units/enterprises are willing to take this opportunity to express their opinion. They have great expectation that their voice will be heard. Guixi Lake Waxing Plant holds opposite opinions on the construction. They think the construction will expropriate the plant, so they are not supportive. On inquiry, we find that the gravel plant shall only be temporarily expropriated. Other units/enterprises are supportive of the project, and hope the construction could be speed up.

10.3 Second round public consultation

(1) Second round online disclosure-abridged edition

After completing the EIA draft, we conducted online publicity (abridged edition) on the website of Hubei Provincial Environmental Protection Bureau on December 7, 2015(http://www.hbepb.gov.cn/wsbs/gsgg/hpgs/hpdwhp/201512/t20151208_81744.html) in solicitation of public opinions and suggestions. Up to now, we haven't received any feedback yet.

(2) Online disclosure-whole copy

The Construction Unit ((Yichang Transport Investment Co., Ltd.) provided information of EIA report and public participation on its company website in relevant to this project on February 5, 2016: http://www.ychxjt.cn/zixunzhongxin/tongzhigonggao/2016-02-04/461.html.

(3) Newspaper disclosure

The Construction Unit provided information on EIA report (download link for whole copy) and environmental impact on paper of Sanxia Evening News on February 5, 2016. And the full report can be downloaded from the website. Please see Figure 10.4-1 for details.

Second round online disclosure

Online disclosure of complete information

Disclosure on newspapers

Figure 10.4-1 Shots of information disclosure

(4) Consultation through Questionnaire

Questionnaires were provided to the residents as well as units/enterprises in project affected area. The two types of questionnaire surveys are described separately in the following sections.

(5) Consultation with organizations

Questionnaires were provided to eight units/enterprises, i.e. High-tech Zone Branch of Yichang Environmental Protection Bureau, Yichang Water Conservancy and Hydropower Bureau, Yichang High-tech Zone Land Resources Bureau, Yichang Management Office of Fishery, Ship Inspection and Port Supervision, Yichang High-tech Zone Planning Bureau, Guixihu Village Committee (Baiyang Town, Zhijiang City), Yichang Baiyang Port Containers Co., Ltd., and Yichang Baiyang Logistics Park Co., Ltd. The results of questionnaire survey are shown in Table 10.4-1.

Table 10.4-1 Information of investigated units/enterprises

No.	Units/enterprises	Contact tel.	Filled by	Opinions
1	Yichang High-tech Zone Land Resources Bureau	18907205101	Zhao Xizheng	Support
2	Yichang Management Office of Fishery, Ship Inspection and Port Supervision	15586377877	Chen Xueyong	Support
3	Yichang High-tech Zone Planning Bureau	13207224663	Jiang Yang	Support
4	Guixihu Village Committee (Baiyang Town, Zhijiang City)	15171777388	Jiang Bixin	Support
5	Yichang Baiyang Port Containers Co., Ltd.	13972010935	Man Yongjie	Support
6	Yichang Baiyang Logistics Park Co., Ltd.	13807203902	Liu Xu	Support
7	High-tech Zone Branch of Yichang Environmental Protection Bureau	18007201155	He Kun	Support
8	High-tech Zone Branch of Yichang Water Conservancy and Hydropower Bureau	15171746147	Li Yongtao	Support
9	Yichang Chinese Sturgeons Management Office	13618606080	He Bin	Support

In conclusion, nine units/enterprises all agree to the implementation of the project and they hold that this project complies with local planning and will promote local economic development.

(6) Consultation with residents

To know the real ideas of the residents in project affected area, we conducted a site survey in March 2016. The investigated residents include local farmers, workers, enterprise employees and persons taking other jobs to be representative of all the affected residents. Totally 150 questionnaires were issued, and 143 were filled and collected, accounting for 95.3%. Information of the investigated residents is shown in Table 10.4-2.

Table 10.4-2 Information of investigated residents

Investigated residents		**Number and proportion**	
		Number	**Proportion (%)**
Gender	Male	100	70
	Female	43	30
Age	22-30	18	13
	21-40	20	14
	41-60	92	64
	Above 60	13	9
Educational background	Primary school or below	45	32
	Junior middle school	72	50
	High school and polytechnic school	12	8
	College degree or above	14	10
Occupation	Enterprise employees	11	8

Investigated residents		Number and proportion	
		Number	Proportion (%)
	Farmers	89	62
	Workers	1	1
	Others	42	29

(7) Survey results

Before issuing questionnaires, we introduced the project and its impacts on environment to the investigated residents. Statistics of survey results are shown in Table 10.4-4.

Table 10.4-4 Statistics of survey results

Content of questionnaire		Number	Proportion (%)
1. Attitude towards the construction of this project	Supportive	117	82
	Opposed	0	0
	Indifferent	26	18
2. Impact on personal income during project construction	Beneficial effects	105	73
	Negative effects	1	1
	No effect	37	26
3. How is the environmental quality in current residence?	Good	84	59
	Average	30	21
	Poor	29	20
4. Main environmental problem at project site?	Air pollution	66	46
	Water pollution	35	24
	Noise	66	46
	Ecological damage	17	12
5. Environment problems that you are mostly concerned about	Noise	66	46
	Ecological damage	32	22
	Landscape destruction	9	6
	Water pollution	35	24
	Air pollution	52	36
6. Which factor brings greater environmental impact?	Noise	87	61
	Exhaust	27	19
	Water pollution	41	29
	Dust	19	13
7. Land acquisition and house demolition are needed in this project. Which kind of compensation do you prefer?	Cash compensation	78	55
	Relocation	61	43
	Others	4	2
8. Degree of impact on the Yangtze River	Great	2	1
	Medium	59	41
	Little	82	57
9. Impact on economic development of this region	Great	137	96
	Little	6	4
	None	0	0
10. Can you accept the environmental impact?	Acceptable	133	93
	Unacceptable	3	2
	Indifferent	7	5
11. Will you accept land acquisition, house demolition and relocation?	Yes	132	92
	No	0	0

Content of questionnaire		Number	Proportion (%)
	Accept under certain conditions	11	8
12. As to mitigation measures, what is you recommendation?	Greening	72	50
	Watering	32	22
	Dust-proof windshield	18	13
	Others	56	39
	Supportive	18	13

(8) Analysis of survey results

Opinions of investigated residents are analyzed:

① Degree of satisfaction with current environmental conditions and the greatest environmental problems

59% of the investigated residents thought that the current environmental quality was good, 21% thought it was common, and 20% thought it was poor. 46% of the investigated residents considered air pollution as the greatest environmental problem, 46% thought the greatest environmental problem is noise, 24% thought it was water pollution and 12% thought it was ecological damage. This shows that the environmental conditions have to be improved.

② Environmental problem most concerned by the investigated residents

46% of investigated residents most cared about noise, 36% most cared about air pollution, 24% most cared about water pollution and 22% most cared about ecological damage, and 6% most cared about landscape damage.

③ Environmental impacts of the project

Among the investigated residents, 73% thought the operation of the project would cause noise, 29% thought it would cause water pollution, 19% thought it would cause automobile exhaust, and 13% thought it would cause dusts; 57% thought project impact on Yangtze River was small, 41% thought it was medium and 1% thought it was large; 93% can accept the environmental impacts of the project, 5% didn't care about that, and 2% can't accept. This tells us that all pollutants during project implementation must be well disposed of to avoid new pollution.

④ Project impact on local residents and local economic development

Among the investigated residents, 73% thought the project would bring beneficial effects on their life and incomes, 26% thought it would bring no effects and 1% thought it would bring negative effects; 96% thought the project would greatly promote local economic development, and 4% thought it wouldn't greatly stimulus local economy.

⑤ Attitudes toward land acquisition and house demolition

Among the investigated residents, 92% would accept land acquisition, house demolition and resettlement and 8% wouldn't accept them; 55% preferred cash compensation, 43% wanted to be relocated, and 2% preferred the combination of the two.

⑥ Basic attitudes toward the project

100.00% of the investigated residents supported the construction of the project, without

objection. This shows that the project complies with local residents' wishes and interests.

In conclusion, all of the investigated residents are supportive for the construction of the project.

10.4 Conclusions

To know the opinions of local residents, a questionnaire survey was conducted and public participation information was twice disclosed. The PIU should solicit opinions and suggestions from the public and implement necessary environmental protection measures during project construction.

Survey results show that the project is supported by the overwhelming majority of local residents. They thought that the project would promote local economic and social development, increase their incomes and improve regional logistics infrastructure. So, the residents believe that the project is beneficial to the local socio-economic development, and it can increase their income and also improve the logistics infrastructure development, i.e. project is consistent with the public's wishes

The investigated residents proposed lots of advices on environmental protection. These advices provide guidance for project design and construction and should attract attention of the PIU, government authorities and other relevant departments.

11 Environmental and Social Management Plan

This Environmental and Social Management Plan (ESMP) is formulated to provide measures to avoid reduce or mitigate the potential negative social and environmental impact of the proposed project identified in EIA to an acceptable level. It mainly consists of: institutional arrangement, major environmental impacts during project implementation and operation, mitigation measures during project phases, monitoring plan and reporting, training programs and budgeting. During project appraisal, upon review and approval of the PMO of World Bank Funded Yichang Three Gorges Modern Logistics Infrastructure Project, this ESMP will be carried out during the implementation of the project.

During project preparation phase, the ESIA is formulated to ensure that all the proposed environmental issues be solved and be included in the phases of project implementation; ESMP is formulate to propose methods and measures to avoid reduce and mitigate these impacts to an acceptable level. Part of the work of the ESMP has been commenced as a part of the EIA. During project plan design and EIA, the recommended plan is selected as the final plan upon consideration of all the aspects (project implementation and budgeting, etc.) and the principle of minimizing environment impact.

The ESMP is formulated based on communication with project plan designers and comparison of the proposed plan and the plan aimed at protecting sensitive receptors. It constitutes an important part of the EIAR by providing mitigation measures to the identified negative impacts so as to ensure that the potential social and environmental impacts of the project is minimized to a level that meets the requirements of local and national environmental standards as well as the World Bank safeguard policies. Generally, the ESMP has the following six components.

11.1 Institutional arrangement

Hubei EPB is responsible for reviewing and approving the EIAR during project preparation phase and the inspection & acceptance of project completion. On the other hand, local EPB is responsible for supervision during project construction and operation.

PMO is located in the Management Committee of Three Gorges Pivotal Port, and it is responsible for coordinating related authorities and supervising project progress of the PIU, and communicating and reporting to the World Bank. The Management Committee of Three Gorges Pivotal Port is established by Yichang Party Committee and Municipal Government to accelerate the construction of the Three Gorges Pivotal Port and the Three Gorges Modern Logistics Center.

The PIU(Yichang Transportation Investment Co., Ltd.) is responsible for carrying out environmental management, formulating the environmental action plan, coordinating environmental management work between authorities and the Contractor, guiding the Contractor in the execution of the management measures, and execution and management of environmental action plan during project construction, and arranging feasibility study, environmental protection plan and environmental management during project design phase.

Responsibilities of related agencies and parties are listed in Table 11.1-1

Table 11.1-1 Key Environmental Management Responsibilities

Stakeholder	Responsibility
Design and preparation	
PMO/Project Owner	1. Overall supervision of EMP preparation; Liaison with relevant government authorities for environmental management; 2. Organize the FSR, and EMP preparation; 3. Ensure inclusion of environmental measures in works contracts
Design Institute	1. Incorporate mitigation measures into technical specifications of bidding documents.
Local Environ. Protection Bureau (EPB)	1. Review and approve EIA, ensure EMP funding availability
Others	Information disclosure and public consultation.
Construction	
PMO/Project owner	1. Ensure that contractors' environmental responsibilities are clearly specified in relevant contract documents; 2. Manage and supervise the EMP implementation, ensure the contractors will fulfill their environmental responsibilities; 3. Hire independent environmental monitor to check the EMP implementation and monitor discharges;
Contractor	1. Implement mitigation measures as per bidding documents, contract and EMP, provide regular reports accordingly. 2. Designate special staff to conduct on-site environmental management, and especially conduct management on various pollution sources.
Supervision Engineer	1. Supervise the construction activities and the implementation of EMP measures by contractors as per contract requirements.
Local EPB	1. Inspect the operation of discharge treatment facilities and discharge; 2. Review the appropriateness of mixing stations, inspect the flying dust and noise control, determine the construction time. 3. Receive and handle public complaints if any. 4. Regular inspection to construction sites on implementation EMP measures, identify non-compliance and request corrections timely.
Other government agencies	1. Local government to develop a mechanism for the public to participate in the supervision; and ensure disposal and borrow that pits are well managed.
Operation	
PMO	1. Project handover.
Project Owner and operation units	1. Establish environmental protection teams to be responsible for the environmental mitigation measures and monitoring plan during operation stage;prepare emergency response plan and organize drills.
Environment Monitor	1. Conduct monitoring upon request of project owner.
Local EPB	1. Monitor the implementation of monitoring plans; Review the effectiveness of environmental protection measures and identify the needs of additional environmental protection measures.
Fishery bureau	1. Fish proliferation; 2. Supervise the fishing activities, including fishing boats, machines and nets.
Chinese Surgeon Natural Reserve Managt Office	1. Protection and proliferation of Chinese Sturgeon, including: Developing the implementation plan; Establishing a supervision mechanism; and Supervising the special fund management.

Stakeholder	Responsibility
Design and preparation	
Water conservancy and Hydropower Bureau	1. Supervise the soil erosion control plan implementation, ensure relevant measures are taken accordingly; 2. Hydraulic monitoring; 3. River section stabilization to ensure flood safety and navigation safety.
Maritime Affairs Bureau	1. Navigation management; 2. Ships management; 3. Pollution control in navigation routes.
Ports and Navigation Bureau	1. Development, maintenance and management of navigation facilities; 2. Development and management of all ports, participate in port plans, develop port area border plan, and maintain the use of navigation routes and shoreline; supervise the port operation.
Transportation bureau	1. Guide the highway and waterway science and technology, environmental protection and energy saving; 2. Organize management of key development projects for highway or waterway; 3. Logistic park management.

11.2 Mitigation measures

The mitigation measures are formulated based on domestic laws, regulations, standards and specifications, past project experiences, and upon consideration of the General Environmental, Health and Safety Guidelines, Environmental, Health and Safety Guidelines for Ports and Ships, and Health and Safety Guidelines for Shipping Industry of the World Bank. Please refer to Table 11.2-1 for specific mitigation measures during project design, preparation and construction period, and refer to Table 11.2-2 for specific mitigation measures during project operation, and refer to Table 11.2-3 for potential risks and prevention measures during project construction and operation. Moreover, the PIU also formulated a general protocol (i.e. Environmental Code of Practice) on environmental protection during project construction (the ECOP) (See below).

The costs for carrying these mitigation measures will be included in the total budget of the project.

BAIYANG Port and Logistics Park Project Construction Management Measures (ECOP)

By YICHANG Municipal Traffic Investment Corporation

Section 1 General Provisions

1.1. In order to realize civilized construction management and improve the management level of construction site for the standardization, systemization and institutionalization of civilized construction, these management measures are hereby developed.

1.2. All organizations, units and individuals who participate in BAIYANG Port Logistics Park construction must strictly abide by the provisions of these measures.

1.3. The site's civilized construction shall be controlled and implemented by the

project management office and the department of quality and safety shall be responsible for supervision.

Section 2 Basic Requirements of Civilized Construction

2.1. The construction unit shall take measures as stipulated to protect the working environment, urban sanitation quality and personnel health and safety.

2.2. Construction unit shall be responsible for civilized construction. If a general construction contract was concluded, the general contractor should bear the sole responsibility for civilized construction and the subcontractor should be subject to the management by the general contractor and responsible to the general contractor.

2.3. The construction unit shall organize the preparation and implementation of civilized construction method statement, establish a safe, fire protection, public security and health system, implement the responsibility system of civilized construction and conduct management on civilized construction by objectives.

2.4. The construction unit shall perform construction within the approved extent of construction site. If the construction site has to be expanded or any road, greenbelt or other municipal infrastructure has to be occupied, the construction unit should go through examination and approval procedures with relevant administrative department.

2.5. Construction site personnel should wear their work cards.

2.6. The construction unit should enclose and seal the construction site. The buildings' scaffold shall use fully-enclosed veridical safety net up to standard to avoid object falling from height and dusting. The safety net should be kept clean.

2.7. The construction site's ground and road should be hardened and maintained smooth and firm. The construction unit shall assign fulltime personnel to be responsible for the cleaning work at the construction site.

2.8. The construction site's construction materials, components, tools and so on shall be stored within the area designated on the general planar arrangement, and shall be hang with the signboards indicating name, varieties, specifications and so on, instead of encroaching upon any access road and safety facilities or being mixed.

2.9. For stacking of sand, stone and other bulk materials at the construction site, a stack pond not higher than 50cm should be set with rainwater retaining measures. Residual soil produced at the construction site shall be stacked in a pond not higher than 30cm, and the stacking location should not be close to the enclosure, and the piling height should be no more than 2m and measures should be taken for covering and the spoiled soil should be transported out in time.

2.10. Construction may cause barriers for entrance and exit of surrounding residents or cause road traffic jam, so the construction unit should take effective measures in advance and set up civilized public slogans and warning signs.

2.11. Before starting work, site formation, power and water utilities connection and access road and construction organization design should be completed as required and the construction organization design shall include the construction site's specific measures for civilized construction.

2.12. Civilized construction must adhere to the following five standards:

(1) Enclosed construction. The construction area shall be fully enclosed and isolated; the road, traffic and social operation area should not be mixed with the construction area.

(2) Meeting the need of temporary traffic organization.

(3) Clean transport.

(4) Minimizing environmental impact. Reducing the impact from noise, dust and night light arising from construction upon the surrounding environment to a minimum extent.

(5) Reducing the impact on the surrounding people's living and traveling

2.13 The construction site must be:

2.13.1. Unimpeded:

(1) The sidewalk at the construction site must be unimpeded;

(2) The units and residents' access road to and from the construction site must be unimpeded.

2.13.2. accident-free:

(1) No pipeline accident during construction period;

(2) No major industrial accident in construction;

(3) The road around the construction site should be smoothed without accumulation of sand.

2.13.3. Five Musts:

(1) The construction area must be strictly segregated from non- construction area;

(2) At the construction site tags must be hang for construction and the management staff shall wear name badges before taking up their jobs;

(3) At the site the construction materials must be stacked in a neat and orderly manner;

(4) At the site the living facilities must be clean and civilized;

(5) At the site ideological work must be carried out, giving priority to create a civilized site and to create a safe and civilized environment.

2.14. The Engineer should incorporate civilized construction in the scope of supervision, and should require the construction unit to take actions of rectification, if found any act not conforming to civilized construction requirement; if the construction unit refused to rectify, the Engineer shall promptly report to the Owner.

2.15. The construction unit should, based on the characteristic of the season, do good job of flood control and all temporary facilities should be provided various preventive measures against collapsing.

2.16. The construction unit shall make emergency plan against any public health event and shall be equipped with a set of emergency response personnel, health care medical kit and first-aid equipment.

2.17. In event that the construction site's operating personnel suffered infectious diseases, food poisoning or acute occupational poisoning, the construction unit should timely report to the Owner and the civilized construction administrative department or any other relevant administrative department, and cooperate with the investigation process.

2.18. Upon completion of this construction project, the construction unit shall timely remove all temporary facilities or enclosure and clean the construction site and the surrounding environment affected.

Section 3 Civilized Construction Organization Design

3.1. The construction unit, in preparation of construction organization design, shall design civilized construction, and the relevant departments shall jointly review the construction organization design.

3.2. Detail of civilized construction organization design

(1) Construction site planar arrangement Including temporary facilities, onsite traffic, field operation areas, construction equipment and tools' layout, finished and semi-finished products, and stacking of raw materials, etc.;

(2) Design of construction site enclosure;

(3) Design of onsite engineering signboards;

(4) Individual design of temporary buildings or structures, ground hardening and temporary access roads and so on;

(5) Design of wastewater treatment and drainage at the site;

(6) Dust and noise field control measures;

(7) Protection of existing municipal piping network and surrounding environment or buildings and structures in the construction area;

(8) Civilized construction management organization and responsible person at the site;

(9) Nighttime construction control measures.

3.3. Site enclosure and temporary facilities must be erected according to the approved design and should not be put into use unless and until self-checked and accepted by the construction enterprise security functional department and then submitted to and accepted by the Engineer based on the self-inspection.

3.4. The construction unit shall, in accordance with the civilized construction design, develop civilized construction measures (including the construction site enclosure, ground hardening, large temporary facilities, and municipal pipeline protection and so on).The construction unit, in the tender offer, should incorporate the civilized construction measures into the contract price.

Section 4 Construction Site Enclosure Standard

4.1. Construction Enclosure

4.1.1. Around the construction site continuous enclosure must be provided. The enclosure shall be stable, safe, clean and artistic, and shall meet the following requirements:

(1) The height shall be not less than 2.5m;

(2) The gate shall be made of metal material, the office area shall be provided with automatic retractable doors, and at the construction site impenetrable metal solid doors shall be used.

4.1.2. Reflective logo signs shall be erected every other 2m outside the enclosure

approaching the carriageway and reflectors shall be installed every other 4m outside the enclosure of non-temporary carriageway.

4.1.3. Outside the enclosure the background pattern designated by YICHANG Traffic Investment Corporation shall be adopted and the promotional banners approved by YICHANG Traffic Investment Corporation shall be equipped.

4.1.4. The main entrance of the office area shall be installed with 7m-wide retractable doors, the main entrance of the construction site shall be installed with 8m-wide solid doors, and other entrances or exits shall be installed with 5m-wide solid doors.

4.1.6. Around the construction site's entrance door the security room shall be provided and security personnel trained can take their job in uniform dress to register external personnel accessed. To establish a guard duty-watch system (including temporary entrance and exit management), regulations concerned should be posted on the wall.

4.2. Edge Protection

4.2.1. In case of operation at the height 2m or more above the base plane, the edge must be provided with guard rails.

4.2.2. The buildings' scaffold shall use fully-enclosed veridical safety net up to standard to avoid object falling from height and dusting. The safety net should be kept clean.

Section 5 Temporary Facilities

5.1. Temporary facilities construction requirement

5.1.1. The construction unit should, in the civilized construction method statement, make explicit the erection positions on the planar graph so as to set up the temporary facilities in a scientific and reasonable manner. The erection position is required to avoid high-voltage lines, flood control ditch, landslide, and abrupt slope, spoil ground, waste soil yard or the like area, and uniformly arranged as stipulated to keep the structure safe, neat and clean.

5.1.2. The setting position, height, structural strength, stiffness, stability and anti-wind capacity of steel-structured color plate house, cement composite board house and masonry-concrete structure house shall conform to design specifications, quality standards and the relevant requirement, and the mobile house should have product qualification certificate and inspection report, and before use, should be installed, checked and accepted. And none of them should be put into use unless checked and accepted by the Engineer with signature.

5.1.3. The materials for erection of temporary facilities should not be used unless approved by the Engineer. It is forbidden to use bamboo, scaffold plates, colored cloth, plastic cloth, single-layer colored plate, templates or the like materials for the erection. The wires or cables within the temporary facilities should be laid in sleeves.

5.1.4. Construction work area should be separated from the office and living areas and the office of the project management and dormitory living area should be fully enclosed and installed with mobile doors.

5.1.5. On the wall of office, safety operation and civilized construction management grid, management network graph and construction chart shall be mounted and hang on. The meeting rooms of double-floored mobile house shall be set on Floor 1.

5.1.6. Within the living areas, no building materials, tools and inflammable or explosive dangerous goods should be stacked.

5.2. Staff Dormitory

5.2.1. The construction unit shall not set up his staff dormitory in any buildings which have not been completed.

5.2.2. The dormitory (living area) should be equipped with signboards and on the dormitory doors' right to corner the dormitory personnel and the service list shall be posted. The terrace should be hardened and equipped with drainage ditches, domestic sewage discharge should be handled following the specified procedures, if there is no drainage opening, the drainage pond should be equipped to avoid arbitrary discharge.

5.2.3. Within the dormitory, unified standard bunk single beds shall be used, instead of using steel fasteners, bamboo chips, transverse board and other similar materials for erection, and within the dormitory, washstands and lockers shall be provided. It is forbidden to build a hearth without authorization or use gas and coal stoves in the same room.

5.2.4. The dormitory set at the construction site should have necessary living space, the indoor clear height should be not less than 2.4m and the channel width should be not less than 0.9m.The dormitory shall be provided with open-type windows and the dormitory's beds shall not exceed two tiers and it is prohibited to use shared wide beds.

5.3. Eatery

5.3.1. The eatery shall meet all requirements under *the Food Hygiene Law of the People's Republic of China*.

5.3.2. The location shall be suitable and the spacing between the eatery and the toilet shall be shorter than 20m, the indoor and outdoor environment should be clean and neat, the cooking and eating area shall be separated, raw and cooked food should be stored separately, and freezing, disinfection, anti-mosquitoes, flies or cockroaches and other measures shall be taken.

5.3.3. The eatery must apply for hygienic permit and should conform to hygiene standard and the eatery personnel must have "health certificate" and all licenses certificates shall be mounted on the wall; the personnel should wear uniform white dress and hats, and in the kitchen it is forbidden to accommodate people and stack building materials, tools and so on.

5.3.4. The floor of cooking area and coil base shall be veneered with ceramic tiles and provided with antiskid and cleaning facilities.

5.3.5. The cooking utensils, tableware and public drinking utensils should be regularly cleaned and disinfected.

5.4. Toilet and bathroom

5.4.1. The construction site should be equipped with water-flush toilets. The toilet wall surface should be painted, the ground should be hardened, doors and windows should be all in readiness, between squatting positions a partition board not lower than 0.9m should be installed.

5.4.2. Toilet and bathroom structures shall meet the requirement, men's and women's

should be separated and clearly marked, indoor floor should be veneered with ceramic tile, closet pans and water tanks shall be made into a certain gradient, and flushing or cleaning measures should be taken in place, and not accumulated dirt or water logging and so on are allowed.

5.4.3. Septic tanks and cesspits should be closed and regularly cleaned, and no reverse osmosis, overflowing and pollution to the surrounding environment are allowed.

5.5. Temporary work shed

5.5.1. Work sheds temporarily erected at the construction site such as steel bar workshop, woodwork shop, repair shop or warehouse should have stable structure, in compliance with the requirement of withstanding Force-8 wind and the erection height should not be more than one layer.

5.5.2. Each shed's signage shall be neat and the fire equipment shall be complete, and all flammable and explosive materials shall be stored in accordance with the relevant provisions.

5.5.3. The personnel responsible for each job shop and place's sanitation, fire protection, safe operation procedures and so on should be listed on an eye-catching signboard mounted on the wall, and no operators are allowed to smoke and do any illegal hot work.

5.6. Charts and Bulletins

5.6.1. The following chart and signboards should be hung at the construction area:

(1) The signboard of project overview;

(2) The signboard of project overview;

(3) The signboard of safety discipline;

(4) The signboard of civilized construction;

(5) The signboard of fire protection and security;

(6) The signboard of safety target control elements;

(7) The record board of safety production activities;

(8) Construction site general planar arrangement

5.6.2. The following chart and signs should be hung at the office area:

(1) Construction visual progress diagram;

(2) Traffic, construction and pedestrian channels' diagram;

(3) Temporary drainage and seal drainage piping diagram;

(4) Distribution diagram of utility pipelines;

(5) Layout of fire fighting equipment;

(6) Electrical wiring layout of temporary power supply for construction;

(7) Civilized construction management network diagram;

(8) The signboard of safe work management objectives;

(9) The signboard of safe work management system's factors distribution;

(10) The safe work management network diagram;

(11) Labor protection management network diagram

5.6.3. The chart and signboards should be suspended normatively and neatly on conspicuous positions at the main entrance and exit of the construction area, firmly installed with neat and orderly typeface, and their set height, size and background pattern can be determined according to the project scale and the environment.

5.6.4. The Project Overview and Profile Signboards and construction site's planar arrangement should be made of 1.9m * 2.85m * 0.05m color steel plates, other chart or signboard should be uniformly made of 0.9m * 1.3m * 0.05m color steel plates, with frame on the back, and should be installed in the vicinity of the construction site project headquarters and placed within the fixed bulletin board.

5.6.5. The construction site planar arrangement should mark with the site orientation and all office, production and living facilities' location, and fixed equipment, tools, fire control facilities, gates (including temporary entrances and exits), access road and orientation of water and power utilities. Once the construction stage is adjusted, the planar arrangement should be changed in a timely manner.

5.6.6. The site must be mounted with bulletin boards and timely reflect the field safety.

5.6.7. The construction unit should, based on the characteristic of the season, do good job of flood control and wind resistance, and all temporary facilities should be provided various preventive measures against collapsing.

Section 6 Environmental Protection

6.1. Wastewater treatment and discharge

6.1.1. Domestic wastewater or other wastewater must be treated separately and then drained into the municipal drainage piping network or into the river.

6.1.2. The slurry produced in the process of construction, without sedimentation, should not be discharged into the municipal drainage piping network or into the river, and the waste slurry or sludge shall be transported by enclosed special vehicles.

6.1.3. Construction site must be equipped with the vehicle washing pool (flushing tank) and sedimentation tank, and provided with a high-pressure water gun, the rinsing tank top shall be made of profile steel with the strength and wind resistance satisfactory, and smooth surface, to flush vehicles and ensure they are clean when driving out.

6.2. Dust Control

6.2.1. As for any portion of ground unhardened for any particular reason and with the approval of the Engineer and the Owner, the ground should be regularly compacted and water logged thereon should be removed so as to reduce pollution over the surrounding environment.

6.2.2. It is forbidden to burn any poisonous, harmful and foul substances at the construction site.

6.2.3. When loading or unloading any powdered material, watering should be

performed for moistening and handling in the warehouse

6.2.4. It is forbidden to throw rubbish outside the construction site.

6.2.5. The rubbish or muck and other waste tending to produce dust within the buildings or structures must be handled in containers, instead of dripping or shedding.

6.2.6. In Force-4 or above strong wind weather, no earthwork is allowed.

6.2.7. In the process of handling any construction wastes, mucks and dust-producing waste, measures of spraying water for de-dusting and using enclosure vehicles for transporting shall be taken. No vehicle is allowed to leak or hit the road with mud.

6.3. Noise control

6.3.1. Low-noise process and construction methods shall be taken.

6.3.2. Noise from construction work may exceed the field noise limit, so prior to commencement the construction unit should make declaration to construction administrative department and environmental protection department, and no work should be commenced without their approval.

Section 7 Construction Site Safety and Security

7.1. Establish a sound safety and security system, and assign fulltime personnel to be responsible for public security and fire management.

7.2. Construction site's management staff and operators shall wear their job cards. The work card shall be made by the project management subsidiary and shall have their own photograph, name, employer, type of work or job position; the management staff and work personnel's mark card should be distinguished by colors.

7.3. Establish visitor's registration system and DO NOT put up any family members and people without fixed duties.

7.4. Establish gatekeepers' registration system to register all persons entering into the site for negotiation of business, DO NOT allow any people without fixed duties to enter into the construction site. The security personnel shall have the right to expel offenders out of the site.

7.5. The license plate number of vehicles entering into the construction site must be registered, and all materials carried by any freight vehicle leaving the construction site should not be transported away from the site without signature of the personnel in charge of the site, otherwise, the guard and security personnel have the right to detain them. The site security personnel should abide by rules and regulations concerned and maintain duty shift record.

7.6. Strengthen education on construction workers in terms of law and disciplines and civilized construction. It is forbidden to fight and exchange blows at the site and commit any illegal activities. No construction worker is allowed to commit any act harassing local communities in violation of customs or code of ethics.

7.7. Cause the migrant workers to observe laws and disciplines or civilized construction requirement, carefully carry out team activities, and install standardized publicity showcase with latest content, and create civilized site atmosphere.

Table 11.2-1 Main Impact and Mitigation Measures during preparation and construction

Activity	Potential Impact	Mitigation Measures	Implemented by	Estimate Cost (10,000 Y))	Supervised by
A. Design phase					
Bidding	-	(1) Include the mitigation measures as described in *Environmental and Social Management Plan* into the bidding documents; (2) Include the environmental management plan into contract of the contractor, project supervisor and environment supervisor for convenient implementation, supervision and check.	PIU	-	PMO
Construction	-	(1) Before construction, construction design must be conducted and be reviewed and approved by related authorities. (2) Project schedule shall be appropriate to make sure quality is not compromised for a tight cut-off date.	Bid winner	-	PIU
Scheme Selection	-	(1) Make reasonable layout, take full advantage of the depth and width of the factory zone of logistics park and arrange the machine with large noise and longer operation time and storage yard which is easy to cause air pollution in places far away from the boundary of factory zone in the design phase as possible as practical. (2) From the perspective of environmental impact, allocating all of the earth & rocks in a longitudinal direction as possible as practical and balanced utilization are the best method to reduce the impact of borrow pit and dumping site. Allocation and balance of earth & rock should not only consider this project but should take the whole development zone into consideration. (3) Master plan of Yichang Navigation Hub and master plan of Yichang Baiyang Industrial Park should be complied with.	Design institute: YTIC	-	PMO
Public consultation	sensitive points are affected; farmland acquisition	(1) Optimize and compare the construction scheme in one step and reduce the area of land to be acquired. (2) Formulation of resettlement plan should be fully negotiated with people of the project affected area before developing resettlement action plan.	Resettlement Office of Wuhan University	Reserve fund for the project	PMO
B. Construction phase					
General management	(1) All the construction materials come from a certified supplier and their quality complies with the required standards. (2) A management system for safe production and operation shall be established before construction and perfected during actual construction. The system shall be strictly adhered with. (3) Enhance equipment maintenance, such as anti-frost protection during winter. Special equipment shall be erected and inspected according to requirements and maintained regularly. (4) Recommend construction contractor to formulate special construction plans for items with large safety risks and ask for expert review if necessary. The high-risk construction items mainly include: temporary electricity use on site, pile driving boat operation, above-water hoisting, construction boat, construction during navigation, underwater welding operation, concrete pouring, erection and dismantling of large supports, manufacture and installation of parts, etc. (5) Hot work onsite must be supervised and emergency plans shall be formulated to avoid fire or explosion incidents. (6) The layout of construction site shall be planned rationally, especially the arrangement of temporary structures shall facilitate foundation preparation, erection, use and removal; the location of offices shall not be in subsided and lowland places; the living and production buildings, substations, powerhouses shall be built on dry foundations and shall be protected against wind, explosion, fire and earthquakes; safety signs shall be set up onsite and shall not be removed unless officially required. (7) Safety management on supporting worker teams and leased equipment shall be strengthened during construction. Qualification check shall be implemented on supporting worker teams and safety and green operation agreement be signed between the supporting worker teams to clarify responsibilities. According to the requirements of the Construction Law of the P.R.C, safety awareness training shall be conducted for them to make sure that the supporting teams and migrant works operate in a safe manner. (8) Supervise the safety production to eliminate safety risks; the identified safety risks and countermeasures shall be recorded and accounted. Large risks and countermeasures shall be reported to the responsible person of the construction contractor. (9) A safety awareness training system for each construction item shall be established. Operators, especially those carrying out special works must be trained before operation with a training license. Safety production awareness training shall be conducted regularly to enhance the safety awareness of the operators. (10) A sound pre-warning system and incident emergency plan shall be established and a rescue team shall be established. Emergency exercises shall be conducted regularly to improve the emergency response.		Construction contractor	Included into the project cost	PIU
Earthwork	Dust, soil erosion and land occupation	(1) Contractor must go through the procedures of dumping sludge and residues according to the regulations and pile them up in the designated backfill field of waste soil from construction upon approval. (2) Strengthen management over storage yard of earth & rocks used for backfill, develop surface compaction, regular water-spraying and cover measures of earth & rocks (increase the frequency of water-spraying during sunny and windy weather to avoid flying dusts on the roads and working surfaces); sludge and waste building materials that are not useful any more should be carried away timely and should not be stacked for long time. As for the allocation and use of earth & rocks from internal projects and auxiliary production buildings, amount of waste soil (residues) should be minimized. (3) Protection measures should be taken over temporary storage site of waste soil, avoid excavation and filling in the rainfall period to prevent soil erosion and water pollution caused by rain.	Contractor	Included into the project cost	PIU, Yichang EPB; Housing Bueau, Yichang Water Resource Bureau
Clearing and	Waste residues	(1) Strengthen the recycling; residues from drilling piles can be used for backfill.	ditto	Included into	The same as

Activity	Potential Impact	Mitigation Measures	Implemented by	Estimate Cost (10,000 ¥))	Supervised by
transport of sludge and residues	and land occupation of bored piles	(2) Spray water to prevent dust in the process of excavation, drilling, demolition and backfill.		the project cost	above
Site levelling	Construction and the construction site	(1) Strictly limit the construction scope, try not to occupy the water; set signboard and safety fence on the construction site; (2) Hardening treatment must be done on the floor of construction site; (3) Timely restore the land in accordance with its planned use upon completion of construction.	ditto	35.0	The same as above
Living and maintenance and rinse of machine	Waste water from construction	(1) Set up septic tank on the construction camp and the domestic sewage is used for irrigation of farmland after being treated in the septic tank; (2) Waste water from construction should be recycled after undergoing grease trap and sedimentation treatment and is strictly prohibited from draining into the surrounding water.	ditto	12.0	The same as above
Building and construction on land	Noise from construction	(1) Operation of equipment with large noise and vibration at noon or night is strictly prohibited; the Contractor should use machinery equipment with low noise or with sound insulation or elimination equipment. (2) Reasonably arrange the construction time and construction site and the operation areas with large noise should be far away from the sensitive points; (3) Monitor the noise of the surrounding sensitive points when constructing at night. (4) The following measures should be taken when constructing at night: construction at night should be reported to Yichang Environment Protection Bureau for approval and record and announcement should be made to the nearby residents ahead of time; sound insulation measures and other noise reduction measures should be taken when constructing at night to reduce the impact of noise on the surrounding environment as possible as practical.	ditto	26.0	The same as above
Transportation and concrete placement	Exhaust gas from construction	(1) Spray more water on the transportation road to reduce the impact of road dust on the surrounding environment (add the time and intensity of water-spraying during sunny and windy weathers) to reduce the impact of dust on surrounding environment (Yazi Village). (2) Fully closed construction method should be taken during the construction period to prevent dust pollution. Vehicles for materials transportation should be covered with tarpaulin or canopy or have other falling-prevention measures. These vehicles should not be overloaded to prevent falling of materials in the transportation process and the transportation route and time should be well planned. Driving in the residential areas should be avoided as possible as practical. When it is unavoidable, the driving speed shall be less than 20 km/ h, especially while passing through Guixihu Village and Baiyang Town, etc. (3) The waste building materials are strictly prohibited from burning as fuels in the construction process. Canteens on the construction site should use liquefied petroleum gas or electric cooking appliance but cannot use fuel cookers. (4) Reconstruct the access roads such as National Highway No. 318 according to the actual requirements and daily maintenance system shall be established. (5) Separate planning and design for logistics park and the Taibaochang National Highway 318 shall be conducted to set up special non-mechanized lanes and passage ways. In road crossings with a large flow of pedestrians, three-dimensional transportation facilities shall be considered. (6) Set up signaling facilities in the main entrances of National Highway 318 across Baiyang Town.	ditto	20.0	Yichang EPB
Concrete pouring	Impact of concrete mixing on sensitive receptors	Purchase ready-for-use goods for wharf and building construction to reduce impact on the air	Contractor	-	-
Building and construction	Domestic wastes and garbage construction wastes	The Contractor should be responsible for cleaning and transporting away the brickbat, ash and broken plate materials and other project wastes from construction of the port districts and logistics center and dumping of them in the waste transfer station is prohibited. Domestic wastes can be collected and dumped into the nearby trash can and large amount of rubbish should be directly transported to the waste transfer station outside the project area. The cleaner should collect the rubbish in the trash can and transport them to the waste transfer station at the stipulated time.	ditto	-	Urban Management Dept.
		(1) Encourage waste reutilization (2) Requirements on the management of storage sites: a. set up signs to explain the waste storage; b. take protection measures against water, wind and seepage; c. set up fences and ceiling to avoid from exposure to open sunlight; d. enhance propaganda, and release notices on waste management to the construction enterprises, transportation vehicles to inform them of the location to dump garbage.	ditto	-	The same as above
Building of construction camp, vegetation and greening, construction of piles in water	Terrestrial and aquatic ecology	(1) Make efforts to preserve the mature soil of local farmland for site restoration and regional greening upon completion of construction. (2) When constructing near the farmland, be sure that the construction is advanced within the scope of land acquired. The temporary land occupation should be controlled within the scope of planned red line. Road embankment is used for construction passages to narrow down the scope of construction activities and reduce occupation on orange grove. Strengthen the protection over forest and grassland. Newly built construction camp should be arranged in a centralized way or the nearby residential areas and enterprises can be used for construction camp. Avoid scattered construction camp. The construction personnel should transport the domestic wastes out of the construction site upon centralized treatment on them and avoid throwing them away at free will which will influence the local ecological environment. (3) Raise the construction personnel’s awareness of protecting wild animals and hunting wild animals is strictly prohibited.	ditto	1003.04 (993.04 for soil and water conservation and 100 for others)	Yichang EPB; Water Resource Bureau

Activity	Potential Impact	Mitigation Measures	Implemented by	Estimate Cost (10,000 Y))	Supervised by
		(4) Strictly implement the measures to protect water environment; **a)** To deal with the issues of increase in signs, lane changing, disturbance of workers and equipment on the passing vehicles, a detailed plan on construction safety and rules and regulations shall be formulated. Moreover, safety supervision and road patrol shall be strengthened to avoid safety risks during construction. b) To ensure transportation safety during road construction, it should guarantee that the construction safety plan must be approved before construction, and the contractor must hold construction licenses, and all the workers shall have job certificates. Meanwhile, all the road signs, lamps shall be erected as required; all the construction workers shall wear the provided uniform and have safety construction labels. c) Award & punishment system shall be implemented on the construction site. A part of the construction cost must be allocated for construction safety measures, such as purchasing temporary safety signs and labels and granting awards for workers and teams that comply with the safety construction requirements. d) Before project commencement, the contractor must check the design documents in detail, and formulate safety measures including safety management and accountability systems. e) The traffic signs on the construction site are a safety guarantee for road users and construction workers. The signs shall be erected on in areas in front of the construction sections.			
Pile foundation construction under water	**Impacts on aquatic organisms**	(1) Strengthen education on the Contractor and construction personnel, strictly prohibit the construction personnel to fish the rare aquatic animals under protection by taking advantage of their operation on water; reasonably organize the construction and the underwater construction should not be done in the spawning season of Chinese sturgeon in Yangtze River (February to middle April, middle October, middle – end of December), spawning and breeding season of general fish and fattening period of fry (April to June) and peak time for rare aquatic animals under protection to go about (May to August) and should be done in dry season (December to February) to avoid migratory peak period of rare aquatic animals under protection. (2) Optimize the construction technique plan and techniques In order to prevent the ships from damaging the rare aquatic animals in the river section, the Contractor should optimize the construction technique plan and control the drainage of pollutants from construction and the ships. Pay close attention to the construction progress and try to shorten the operation time on water as possible as practical. (3) All the solid wastes produced during construction period shall be collected and disposed together. It is prohibited from tossing solid wastes into the Yangtze River. (4) The contractor shall use standard ships and apply for construction operation licenses from maritime authorities according to the *Management Regulations on Prevention and Control of Pollution of Inland Waters Environment from Ships, Provisions of the People's Republic of China on the Administration of Navigation Safety for Above-Water and Underwater Activities and Provisions of the People's Republic of China on Maritime Administrative Licensing Requirements*, and operate only in the waters approved by the operation license. Meanwhile, a detailed maintenance plan shall be formulated and it shall ask for maintenance of construction site from maritime authorities to ensure shipping and construction safety. (5) The following matters shall be addressed for underwater works: a). When the project construction needs to occupy many waterways, please contact with the managing authorities to set up navigation marks, so as to ensure construction and shipping safety. b). During construction, the navigation marks shall clarify the shipping limit and the boundary line of the wharf, so that the passing ships can timely keep a distance from the wharf. Meanwhile, signal lights shall be equipped to provide signals accurately. Moreover, put up warning signs in prominent places to warn the other passing ships of safety. c). The management of ships approaching the wharf shall be strengthened. Coordination and communication for the wharf construction shall be strengthened. (6). The contract shall strengthen safety management throughout project construction to maintain shipping safety and guarantee smooth proceeding of the project. The use of strong lights shall be restrained and eliminated to avoid disturbing the sights of the ship drivers. (7) An above-water construction plan shall be designed in advance to improve safety construction accountability. Meanwhile, emergency plans should be established; safety training shall be conducted on workers; During above-water construction, patrols and supervisions shall be strengthened so as to quickly identify abnormal situations and report them to maritime authorities for solution. (8) Wave-proof measures shall be formulated and implemented during the construction and operation period of the project to protect against waves; it is recommended to install anti-bumping devices in the front of the wharf to reduce damage of ships and wharf during possible collisions in the future; the ships approaching and leaving the wharf shall operate carefully in strict compliance with *Regulation for Preventing Collision on Inland Waterways*, and take effective avoiding actions when encountering other ships to prevent collision.	**The same as above**	**10**	Yichang EPB; Water Resource Bureau; Yichang Agricultural Bureau; Maritime Affairs Office;; Chinese Sturgeon Nature Reserve Management Office
Publicity on safety and culture protection	Social environment	(1) PMO shall include the regulations and camp management documents of the construction teams into the bidding document, and require the construction contractor to establish its management system of construction workers and camps; (2) Conduct closed-off management of the construction camps; (3) Establish a standardized manual on procedures of construction works and carry out construction works according to it; (4) Formulate a detailed management manual of the construction camps and regularly check its implementation; (5) Establish a joint interaction system between Baiyang Industrial Park, PIU and Contractor to clarify accountability; (6) Set up stations of safety management and disease prevention. (7) Other measures:	Contractor (the Design institute is responsible for including it into the	15.0	PIU

Activity	Potential Impact	Mitigation Measures	Implemented by	Estimate Cost (10,000 Y))	Supervised by
		(1) If cultural relics are found in the construction process, excavation should be stopped immediately and relevant information should be reported to the local cultural relics protection department. Before the competent department completes the identification on cultural relics and takes necessary protective measures, the excavation should not be resumed. (2) Educate the construction personnel on knowledge of diseases control and so on and provide necessary self-protection equipment for them, such as, safety helmet, earplug and other safety devices. (3) Announcement should be made through broadcast, TV and newspaper ahead of time and do well in the demolition and resettlement. (4) Epidemic prevention is mainly through good habits of the construction personnel and education on necessary schistosomiasis prevention and hygienic knowledge. Paying attention to the dietetic hygiene and taking necessary measures for schistosomiasis control can control the development of communicable diseases. Enhance monitoring and control on key infectious diseases such as hepatitis A, diarrhea, etc., and improve the contractor's understanding of health and epidemic prevention work, and the water quality as well as environmental sanitation in the construction camps. (5) Education, publicity and management on the construction personnel is the main means for epidemic prevention in the construction period. Hold thematic bulletin on AIDs in the residential area of construction personnel and the Contractors are suggested to provide healthy entertainment activities for construction personnel in their spare time to enrich their life; the Contractors are also suggested to take blood testing before recruiting the construction personnel to understand the physical conditions of them. Meanwhile, it is necessary for the managers to ban the construction personnel to take drugs and go whoring. Once found, they will be fired and transferred to the public security organ. Upon completion of the project, this place which is relatively closed and backward in the past will be urbanized, the transportation will be more convenient, the population of flowing people will be enlarged and hotels, entertainment and catering industry will be developed. At the same time, some undesirable social phenomenon will also emerge, which will nourish the potential spread of AIDs. After the project is put into operation, government of the development zone should also pay attention to this problem, guide the publicity department to regularly or irregularly carry out publicity on knowledge of AIDs prevention through broadcast and bulletin board and other medias. Health and epidemic prevention station and the hospital should strengthen the check on AIDs and the public security organ should strengthen the management on registration of migrants, regularly rectify and clamp down the recreation places, hotels and hair salon and other places which are easy to spread AIDs and make sure their activities be legal. (6) Make sure the internal and external camp is clean, beautiful and hygienic and the planning is reasonable; set up dustbin (trash can) and arrange the specialized person to clean the rubbish, spray water and remove the dust. (7) Well disinfect and kill the rats, mosquito and flies. (8) Office and resting room of the construction personnel should be clean and hygienic and of no dirt and sewage. The tools and materials in them should be neatly placed. (9) There is good ventilation and delighting in the room and the humidity and temperature are comfortable. There are facilities for storing clothes and articles. (10) Implement the power and water consumption system. Connecting wire, lamp cap and socket at will in the room is banned. Faucet should be closed after using the water. (11) Sanitation requirement in the toilet: clean and have good ventilation, no faces and rubbish; frequently disinfect with lime or by spraying and scattering; arrange the specialized person to clean faces and make the cleaning. (12) Protect the environment and domestic wastes and leftovers should be dumped into the designated location; make thorough cleaning once a week and specialized person should be arranged to take charge of the cleaning of their zone.	bidding documents)		
Land acquisition and demolition & allocation	Social impact	(1) For doubts of part of the residents on construction of the resettlement area and resettlement, make vigorous publicity on the policies of the similar projects within the region that were implemented in the earlier stage, publicize the preferential policies through calculation and organize them to visit Taibaochang resettlement area to assure them of the resettlement. (2) For the worry of household ready to resettle due to demolition over the quality of resettlement housing, organize them to visit the construction of resettlement housing. Report the determined construction plan of resettlement housing in the future at any time to them and set up the communication channels for them and the construction unit. Through such channels, the households ready to resettle or their representative can regularly or irregularly inspect the quality of resettlement housing under construction. (3) For the worry of part of residents over unemployment after loss of land, PMO undertakes to give priority to employment of local labor force in the implementation process of this project. In the future, the enterprises of Baiyang Industrial Park will give priority to employment of the labor force from the two affected villages and carry out targeted training on the labor force in accordance with needs of the project after completion and the employment needs after enterprises settle down in Baiyang Industrial Park. (4) For lack of transparency of capital distribution which may occur in land acquisition, PMO and Baiyang Town and various villages will set up account open system for income from land acquisition and regularly make the income from land acquisition and its distribution public in PMO, Baiyang Town and various communities. Various villages will convene the mass meeting to decide the distribution of income from land acquisition and make it public through posting. Internal and external monitoring agency of this project will track and monitor the use and distribution of land income. (5) For the problem that part of residents are discontented with the compensation standard for land acquisition of Phase 1 and Phase 2 of Baiyang Port construction due to difference generated by new standard promulgated by the provincial government, PMO and Baiyang Town patiently and carefully explain, ensure the transparency of publicity on legal policies, truthfully report the actual conditions to government of High and New-tech Development Zone and PIU to obtain understanding and support from the superior departments and PIU, take uniform compensation polices to eliminate potential factors leading to social	Local governmen t	-	

Activity	Potential Impact	Mitigation Measures	Implemented by	Estimate Cost (10,000 Y))	Supervised by
		instability through negotiation. (6) For difficulties that part of vulnerable people are facing in the demolition and resettlement process, PMO will coordinate Baiyang Town and various villages to develop special supportive measures for the vulnerable families and help them overcome the adverse impact brought by this project and restore and improve their life. The main measures include: including the vulnerable families into the assistance list to accept the aid from civil affairs department and other channels; helping the vulnerable families relocate; letting them choose the resettlement housing first; if temporary dwelling is needed, the village and town government will help them find the temporary dwelling; providing the employment opportunity created in the implementation process of this project to the vulnerable families first. (7) Other measures a) Formulate a compensation standard in compliance with the unified output value stipulated by the Hubei government; b) Make sure that the compensation is not less than the replacement cost of the demolished houses; c) Provide two compensation options, i.e. cash compensation and resettlement housing for the choice of DPs; d) Make sure that the resettlement transition subsidies can meet the needs of the DPs; establish a monitoring system to supervise the allocation of resettlement transition subsidies; set up a cut-off date for the delivery of resettlement housing and increase transition subsidies if the actual delivery goes beyond the time limit; e) The resettlement housing will be allocated by casting lots which will be open to the public; f) All the compensation standards and reports shall be disclosed to the public and posted in the affected villages to be supervised by the DPs; g) All the eligible DPs will be insured under the urban and rural residents pension security insurance, and the professionaltraining will be offered to the labor force; h) The job opportunities, especially the subservience jobs shall give priority to the eligible labor force among the DPs; i) The resettlement fund allocated to village collectives will be managed by the Baiyang Industrial Park. The use of this fund will be determined on the meeting of village representatives; j) Establish a system for collecting the complaints and grievances of the DPs; k) Establish an independent monitoring system of resettlement work.			

Table 11.2-2 Mitigation measures during operation phase

Activity	Potential Impact	Mitigation Measures	Implemented by	Estimated Cost (10,000Y)	Supervised by
Road, vehicle and transportation	Noise	(1) In accordance with *Environmental Impact Assessment Report of Rebuilding and Expansion of 318 State Grade one Road from Wancheng Bridge to Yunchi*, the rebuilding and expansion project plans to take such measure as setting sound-insulation ventilation window for villagers of Yazishan Village and the investment will be RMB 175,000. Such measure can meet the noise reduction requirements. Therefore, this assessment will not take further noise reduction measures on the sensitive points for the time being. (2) Improve the performance of vehicles and operating machines to reduce the noise generated by them. Strictly supervise and control the operating machines and vehicles getting in and out of the Port and ban the vehicles which do not comply with the technological indicators of noise control from getting in the Port and eliminate the operating machines which do not comply with the standard on noise control. (3) Well afforest and strengthen maintenance on the road during the later stage to ensure flatness of road after the building of internal road (Guihu Road and Second Songgang Road) is completed.	Yichang Transportation Bureau	17.5 (measures for controlling road noise is from the original environmental impact assessment report)	Provincial EPB: Yichang EPB; Yichang Transportation Bureau;
	Traffic safety	(1) Set zebra-stripe and other road-crossing facilities in accordance with the design. (2) Maintain the above facilities during the operation period. (3) Strengthen the traffic management and do well in traffic dispersion to make sure smooth traffic.	Project Leading Group	-	Yichang Transportation Bureau;
Life of management personnel	Waste water	(1) Daily domestic sewage of Three Gorges Logistics Center enters into the urban sewer system after being treated in the septic tank and meeting Level-3 standard of *Integrated Wastewater Discharge Standard*. (2) Wastewater containing edible oil enters into the sewer system of the park after undergoing oil separation treatment and meeting Level-3 standard of *Integrated Wastewater Discharge Standard*.	Contractor	20.0	Provincial EPB: Yichang EPB; Yichang Maritime Affair Office;
	Solid wastes	(3) Domestic rubbish of the logistics park during operation period should be piled up at the designated location and the environment and sanitation department of			

Activity	Potential Impact	Mitigation Measures	Implemented by	Estimated Cost (10,000Y)	Supervised by
		the place in which the project is located will regularly move and dispose of the rubbish.			
Loading and unloading	Waste water	(1) Ground rinsing water and rainwater in the earlier stage These mainly include rinsing water on the wharf surface and runoff rainwater in storage yard. After being collected, this kind of water will enter into the sedimentation basin of this project and will be used for spraying in the storage yard after sedimentation. Hence, it will not exert impact on water environment of Yangtze River. In particular, storage yard of phosphate should be covered to avoid leaching by rainwater and generation of wastewater containing phosphorus. (2) Sewage containing oil from machine maintenance enters into the sewer system of the park after undergoing sedimentation and oil separating treatment and meeting Level-3 standard of *Integrated Wastewater Discharge Standard*; domestic sewage of workers enters into the sewer system of the park after being treated in the septic tank; set up sound sewage collection system.	Operating Unit	200.0	The same as above
	Exhaust gas and dust	**(1) Management Procedures** 1) Maintain good conditions of transferring equipment (such as, crane, forklift and truck) 2) Upgrade and reform the ground vehicles, use trucks and vehicles causing low pollution and alternative fuel and mixed fuel. 3) Encourage to reduce the idling of engine in loading and unloading period. 4) Encourage the storage planning to avoid or reduce the re-storage and reshuffling of goods as possible as practical. 5) Design new facilities to shorten the distance between loading and unloading facilities of ships and the freight yard. **(2)Spraying water in storage yard** 1) Spraying water for dust suppression can be considered when the portal crane unloads ships and the sprinkler should be simultaneously started with the unloading grab to prevent dust pollution. 2) Single-scoop loading machine and discharge hopper should also be equipped with spray nozzles which should be started in the loading and unloading process to reduce dust pollution. 3) Try efforts to reduce free falling of materials, try to decrease the height from which the materials fall to the land in loading and unloading of bulk cargo and reduce the pile height of dry goods. Fetch the goods from the bottom and stop operation when the wind speed exceeds the maximum operating conditions (namely 10m/s). (3) Arrange 150m windproof net at eastern side of bulk cargo storage yard, 460m windproof net at northern side, 320m windproof net at western side and 8m windproof at southwestern side. (4) Frequently clean the site and properly spray water to control secondary dust pollution. (5) Set up green belt along the boundary of the Port and choose the trees that can absorb harmful gas and reduce the wind speed, such as, oriental arborvitae, bull bay, pittosporum tobira and locust tree and so on. Afforest other land not used as possible as practical to prevent dust pollution.	The same as above	2800 (2790 for windproof net, 100 for watering cart and other capital is included in the project contract)	Provincial EPB: Yichang EPB;
	Noise	(1) Well maintain the operating machine; (2) Eliminate the operating machine which does not comply with the noise standard.	The same as above		The same as above
	Solid wastes	(1) In accordance with requirements of *Standard for Pollution Control on Hazardous Waste Storage* (GB18597-2001), temporary storage facilities should be set in the Park and cotton yarn and cloth containing oil generated from equipment check and maintenance and the waste cutting oil should be held in container complying with the standard after being collected in a unified manner. Then the container should be marked with label complying with the standard. Finally, the above hazardous wastes should be submitted to the professional agency with relevant qualification for collection and disposal. In the operation period, records on conditions of hazardous wastes and regular check on containers holding the above mentioned hazardous wastes should be made. Once damages are found, measures should be taken to clean and replace them. (2) The waste spoil and refuse in the port area and logistics centers shall be cleaned by whoever produced them; it is prohibited to discharge these wastes into the temporary waste dumps; Domestic wastes can be transported to the nearby dustbins, while large quantities of wastes can be directly sent to the temporary waste dumps outside the project area. Cleaners shall timely transport the waste in the dustbins to the temporary dumps. The domestic wastes produced during operation period will be cleaned and disposed by the local environmental protection department regularly; (3) Timely clean and recycle the scattered materials in the loading and unloading process. (4) Timely collect and recycle the packing materials that can be recycled.	The same as above	50	The same as above
Production and processing	Solid wastes	(1) In accordance with requirements of *Standard for Pollution Control on Hazardous Waste Storage* (GB18597-2001), temporary storage facilities should be set in the Park and cotton yarn and cloth containing oil generated from equipment check and maintenance and the waste cutting oil should be held in container complying with the standard after being collected in a unified manner. Then the container should be marked with label complying with the standard. Finally, the above hazardous wastes should be submitted to the professional agency with relevant qualification for collection and disposal. In the operation period, records on conditions of hazardous wastes and regular check on containers holding the above mentioned hazardous wastes should be made. Once damages are found, measures should be taken to clean and replace them. (2) Domestic rubbish of the logistics park during operation period should be piled up at the designated location and the environment and sanitation department of the place in which the project is located will regularly move and dispose of the rubbish. (3) Recycle and use the scraps from timber and steel processing. (4) Timely recycle, use or dispose of the packing materials.	The related enterprises in Three Gorges Logistics Park	20.0	The same as above

Activity	Potential Impact	Mitigation Measures	Implemented by	Estimated Cost (10,000Y)	Supervised by
	Noise	(1) Eliminate the operating machine which does not comply with the noise standard; well maintain the processing machine; (2) Do well in shock absorption of the processing machine, close the operation area and reduce the noise.	Operating Unit		The same as above
Ship operating	Domestic sewage and wastewater containing oil	(1) Ships arriving at the Port shall not discharge domestic sewage and wastewater containing oil in the water area around the wharf. Where sewage and wastewater need to be received onshore, application should be made to the maritime safety administration which will entrust the receiving ships of the recognized department to receive and dispose of the sewage and wastewater of ships for value. (2) Equip the wastewater reception facilities and devices on land as soon as possible.	Construction Unit and Operating Unit	50	Yichang Fishery Management Office; Yichang Management Office Fishery Ship Port Supervision;; Yichang Maritime Affair Office
	Exhaust gas	(1)Strengthening control and management from the source 1) Discharge of NOx and SOx should not exceed the limited value as specified by international treaties. 2) Use low-sulfur fuel if possible. 3) Slow down in access area of the Port and only when leaving the Port can ships sail at full speed. Avoid or restrict blowing to the pipeline or chimney of steam boiler when ships are in the Port or under unfavorable atmospheric conditions. a) If power can be supplied to the ships by the Port from the land to reduce the power consumption of ships during loading and unloading and the berthing of ships exceed certain time period, then the ships are required to shut down the power generator (and only use power supplied by the Port) b) The Port authorities should set the air quality for ground operation in accordance with local air quality problems which should be taken into consideration when necessary. c) Air pollutants generated by ships should be subject to the provisions of supplementary provisions VI of *MARPOL 73/78 Convention* after it comes into effect.	Ship Operating Unit	10	Yichang Management Office Fishery Ship Port Supervision; Yichang Maritime Affair Office; Provincial EPB; Yichang EPB.
	Noise	Sounding their horns is banned when ships go into the port.	Operating enterprise		The same as above
	Solid wastes	(1) Strengthen supervision on rubbish from ships. The harbor superintendence departments should formulate specific measures with strong operability, patrol more frequently and strictly ban the discharge in violation of regulation. Strengthen management of Recording Books of Ship Rubbish to provide basis for timely penalize the discharge in violation of regulation. (2) Join in the ship wastes information tracking system jointly founded by the Ministry of Transportation and the Port, strictly prevent discharge of ship wastes without approval by technological means and do well in the relevant publicity and education. (3) Domestic sewage and production garbage of the port district are strictly prohibited from discharging into water. Ship rubbish should be put into sealed bag or bucket, collected and disposed of in a unified manner. Rubbish from ships from epidemic area and overseas should be quarantined and sterilization and disinfection should be done on the ship if epidemic disease is found. Relevant management measures of World Bank: 1) Facilities of the port should provide sufficient means to receive and manage wastewater and wastes and satisfy the needs of itself, incoming ships and designed service object of the port. Develop specifications on wastes reception facilities together with local government in accordance with commitment of the Port to MARPOL Convention. Wastes reception facilities of the Port should have adequate capacity to receive the wastes generated by the Port and ships, including receiving containers with suitable size and in suitable location, and have the capacity to deal with seasonal fluctuation of wastes. 2) Provide information on ship wastes to the capital so as to identify the facilities receiving solid wastes and the acceptable processing procedures. 3) Discharge of solid wastes by ships should be banned in accordance with provisions of MARPOL and the state. In order to protect environment of the Port, the strictest restriction measured can be taken when necessary. 4) Set up collection and disposal system for wastes generated by ships at berth and anchor in accordance with provisions of *Comprehensive Manual of International Maritime Organization on Port Reception Facilities.* Refuse hoppers that can be shut down should be offered at the berth and non-self-propelled or self-propelled barge with refuse hopper should be used to collect rubbish on ships at anchor. 5) As for food wastes transferred from the ships to the Port, management should be exerted in accordance with local law designed to protect health of human being and animals. The local requirements may include dispose, burn or landfill treatment of the wastes.	Operating enterprise	50	Yichang Maritime Affair Office; Management Department Port District;

Activity	Potential Impact	Mitigation Measures	Implemented by	Estimated Cost (10,000Y)	Supervised by
	Leakage of diesel oil	(1) Prevention measures for vessel traffic accidents include: 1) Equipping necessary navigation aid facilities and other safety facilities in areas near the wharf; 2) Facilitating construction of vessel traffic management system; 3) Strengthening management over vessel traffic order in the waterway. (2) Risk management and emergency plan Refer to 11.3 for emergency plan of sudden environmental events in Baiyang Port District.	Baiyang Port; Yangtze River Waterway Bureau; Yichang Maritime Bureau		Provincial EPB: Yichang EPB; \Yichang maritime office;
	Cumulative impacts	1) Reduce impacts on the migratory passages of fishes, and prohibit ships passing through the scope of 100 m on the both sides of mid-stream line during February. The local requirements may include dispose, burn or 2) Conduct ecological compensation Conduct artificial breeding and releasing of Chinese sturgeon. The PIU can provide fund to the protection zone of Chinese sturgeon for artificial breeding and releasing 3) Conduct ecological rehabilitation of the wharf shorelines. Use eco-friendly materials that can guarantee good water and air permeability (the cost for this item shall be excluded from project budget)	Project Leading Group	100	Yichang Management Office Fishery Ship Port Supervision;

Table 11.2-3 Major risk prevention and safety measures

Major risks	Corresponding prevention measures	Supervisor	Implementers
1. Thunderstorm	(1) Lightning protection facilities shall be provided on the tall machines and temporary structures such as crane and working-at-height platform during construction. (2) Lightning protection and grounding system shall be provided in the port area and the logistics park. Independent lightning protection and grounding device shall be provided for power substation and high-pole lamp. (3) Reliable lightning protection devices shall be designed for electrical equipment, electronic information system and buildings (structures) to prevent harm and damage of thunder to human body, equipment and buildings (structures). Lightning prevention design for buildings shall conform to national standards and relevant regulations such as Design Code for Protection of Structures Against Lightning. (4) Emergency response plan for lightning hazards shall be formulated to make it possible that organization and guidance, technical instructions, materials and funds, and rescuers will be in place in the shortest time to ensure highly efficient and properly handling of the hazard.	Security inspection department	Contractor
2. Rain and snow	(1) Workers shall be well equipped for antiskid protection and anti-freezing protection on rainy or snowy days; construction shall be suspended in extremely bad weather. When it freezes seriously, sacks or industrial salt may be used for antiskid and anti-freezing. (2) Since heavy rains and thick fog may result in bad visibility, when the visibility is less than 1km, the port must stop wharfing and unwharfing of ships and proper actions shall be taken for antiskid safety protection after rain and fog. (3) In the later stage of serious rainy, snowy or freezing weather, since the melting of ice and snow may cause large-scale secondary and derivative hazards, the engineering structure shall be inspected and potential safety hazards shall be eliminated in time to prevent accident due to immersion in rain and snow.	The same as above	Contractor
3. Flood prevention at the port	(1) Construction of underwater structure of the wharf project shall be carried out not in the flood control period of the Yangtze River if possible; the temporary barriers in the construction site shall be cleaned off timely after construction to reduce the impact on flood discharge of the watercourse. (2) Bank revetment reinforcement shall be provided along the river bank, and the connecting part of the bridge approach and the bank shall be stabilized; Disturbance of pile foundation construction to the river bank shall be reduced as much as possible; during and after construction, keep monitoring the watercourse and embankment, and handle any problems found immediately. (3) Flood prevention shall be done before flood comes: loading and unloading at the wharf shall be stopped; emergency response plan for flooded wharf shall be made and maneuver shall be arranged. (4) Bridge approach and belt conveyor shall be properly set to avoid disturbance to the road on the embankment (including sub-embankment) of the Yangtze River.	The same as above	Contractor
4. Strong wind	(1) When the wind force is stronger than grade 6 at the port, lifting operation shall be suspended. (2) Reliable wind-proof and typhoon-proof devices such as anchor device and wind speed and force grade warning device shall be provided for large loading and unloading machines to prevent abrupt gust and typhoon. (3) Wind-proof devices for large machines shall be interlocked with the travelling mechanism of the machines to ensure that the wind-proof device will work after the travelling mechanism brakes the machine and the machine comes to a complete stop, so as to prevent the overturn of the machine. (4) All the transit openings of the belt conveyors shall be sealed to prevent dust.	The same as above	The same as above
5. Loading and unloading in the port area	(1) In accordance with relevant regulations, safety devices such as brake, travel limiter, anemometer, overload protection device, wind-proof device and light and sound warning devices shall be equipped to lifting equipment including floating crane, quay crane and portal crane and shall be checked regularly. (2) Lifting equipment shall have good performance and quality; steel structure components shall be connected firmly; rotating part of winches shall be well lubricated; limit switches, brakes, lighting and firefighting equipment in machine room and operation room shall be complete and reliable. (3) The safety rails of the ladder, platform and walkway of the cranes must be kept in good condition, and any damage shall be repaired immediately once found. (4) Sound signal device and lighting of cranes must be in good condition and all housings of live part shall be grounded reliably. (5) Manufacturers of lifting equipment must have appropriate qualifications and lifting equipment must pass the safety verification and acceptance check of competent authorities before trial operation. (6) Before lifting operation, all machines and tools such as the lifting equipment of crane, steel wire rope, mooring rope, chain and lifting hook shall be checked; ensure all machines and tools are in normal condition and no faulty one shall be used. Workers shall wear personal protective articles as required. (7) When working, special person must be assigned to command, and operations shall be done in strict accordance with operation specifications; there shall be clear division of work among the driver, flatman, and the commander, who shall stick to their posts; and there shall be unified signal, gesture and whistle tone. (8) When in overhaul, the main switch must be turned off first, and a clear sign saying “No Turning On During Operation” must be put on the switch. If operation with power on is necessary, reliable safety protection measures must be taken and special person must be assigned to monitor the operation. (9) Safety protection devices shall be provided for the exposed rotating or transmission part of machines, and the safety protection devices shall have simple structure and proper layout, and must not have sharp edge or flange. (10) Pedestrian warning signal device shall be provided for movable machines; sound and light warning devices shall be provided when the machines are starting or moving. (11) Safety rails shall be provided in at-height working face and guard net shall be installed at the margin, both shall have periodic inspection. (12) When working at a height of above 2m, workers shall wear safety equipment such as safety belt and antiskid shoes; workers working or doing repair work at height must wear safety belt and must have monitors beside. (13) Protection devices or other safety devices such as various protectors, guard fence, and guard rails shall be provided for large machines and lighting towers and at dangerous places and at-height working places where maintenance personnel comes frequently. (14) All workers shall be provided with personal protective equipment; above-water loading and unloading workers shall be provided with special protective equipment such as life jacket and antiskid shoes. (15) Loading of heavy and awkward cargo at 7# berth shall conform to *Technical Requirements for Loading and Unloading of Heavy and Awkward Cargo at Port*.	The same as above	Operating unit

Major risks	Corresponding prevention measures	Supervisor	Implementers
	(16) Appropriate tools and accessories shall be provided according to the type of cargo to be loaded or unloaded. No lifting machines or riggings shall be used with overload. (17) It is recommended that the layout of loading and unloading equipment at the wharf surface of 7# berth, 12# berth and 13# berth be well designed, and minimum distance warning device and emergency stop device be provided to prevent equipment collision. (18) Escape route shall be provided at the vestibule of the overhead belt conveyors at the back of the wharf of 8~11# berths, which shall be kept clear at emergency to guarantee life safety. (19) The rotating part of the movable steel bridge approach and the automatic lifting equipment at the back of 8#~9# floating wharves shall be well lubricated, and availability and reliability of safety devices such as brake protection device, overload protection device, and locking device shall be ensured.		
6. Working at the container yard	(1) Safe and proper vehicle route and footway shall be provided at the storage yard; clear signs of vehicle route, footway, traffic direction, vehicle speed limit, and no parking shall be provided; separation facilities (separation strip stone and separation fence) that separate container area and passageway shall be provided at the container storage yard. (2) Container bays at container storage yard shall be arranged properly according to different processes and location and code shall be marked. (3) Containers shall be stacked firmly and loaded evenly; overloading, concentrated loading, uneven weight distribution, uneven loading and container collision are not allowed. (4) Stacking of containers shall meet the following requirements: 1) No containers shall be stacked on another container which has larger length and size; 2) No containers shall be stacked on another single container which has smaller length and size; 3) If 1 container is stacked on other two containers, the two containers below shall have the same height, otherwise the upper container shall not be stacked; the four corner fittings of the upper container shall be aligned with the external end corner fittings of the two containers below; to avoid displacement of the containers, spin locks or connecting fittings may be provided between the containers to make the dimensions of the upper container and lower containers uniform.	The same as above	The same as above
7. Wharf structure	(1) Special attention shall be attached to the design and construction of ground foundation and stabilization of wharves (especially the 7# general and heavy cargo wharf) and bridge approach, so as to minimize the influence of uneven settlement of foundation on wharf structure. (2) Intensify monitoring of 7# and 12~13# pier foundation stability to avoid unstable pier foundation caused by scoring of pier surface at the wharf. (3) The range and thickness of underwater riprap protection shall be determined according to the river regime analysis and requirement on bank stability, and design and construction of which shall be carried out in strict accordance with *Code for Design and Construction of Port and Waterway Revetment Engineering*. After the construction and delivery of the project, monitoring on the changes of front riverbed and river regime at the wharf shall be carried out and corresponding safety precautions shall be taken according to the actual situation. (4) Strength and loading capacity of foundation of lifting equipment at the wharf shall be taken into consideration to avoid subsidence of track. (5) Anti-collision facilities at the wharf shall be designed in accordance with relevant specifications. (6) During the construction period and after completion, close attention shall be paid to the deformation of bank slope; bank slope monitoring points shall be set; and any problems shall be handled immediately once found.	The same as above	The same as above
8. Dust and noise	(1) In order to control noise, equipment with low noise shall be preferred and protection equipment shall be provided for workers. (2) Fans shall be provided at dusty places for local ventilation and dust exhausting; personal protective articles such as anti-dust mask shall be provided for workers. (3) Water atomization and spraying device shall be set at each transit place to remove dusts. (4) Dust concentration in the ambient air shall be tested regularly and publicity and education on the harmfulness of dust shall be strengthened so as to enhance the safety awareness of workers on prevention of silicosis. (5) Special cabinets for lifesaving devices (containing life jackets, apparatuses, protective clothing, protective rubber boots etc.) shall be provided at the wharf and shall be inspected and maintained regularly so as to be kept in good condition. (6) When at high temperature, working time shall be adjusted, and construction shall be suspended in the time period when the temperature is the highest of the day; sunshades shall be provided for workers to take a break; cool drinks shall be supplied and heatstroke prevention medicines shall be prepared; food safety and proper diet shall be ensured. (7) When at low temperature, winter protection and warm keeping shall be performed and winter clothing shall be provided for workers working at low temperature.	The same as above	The same as above
9. Shipping	(1) Strengthen management of wharfing and unwharfing ships: there is overlapping part between adjacent berths of the initial project wharf and second stage wharf at the turning basin, and the initial project and second project have the same PIU, therefore a transport scheduling organization shall be established for uniform on-site control. (2) A wharf ship management system shall be established; wharf communication and ship traffic management and auxiliary navigation facilities shall be well equipped; management of monitoring on water area at the wharf shall be strengthened; make sure that the ships wharf and unwharf with prescribed speed, direction and shipping lane.	The same as above	The same as above

11.3 Emergency response plan

Even though measures have been carried out to prevent environmental risks, emergencies and accidents may still occur, so emergency response plan is necessary.

Yichang has developed a sound emergency plan, see chart 11.3-1 for the information of emergency organizations.

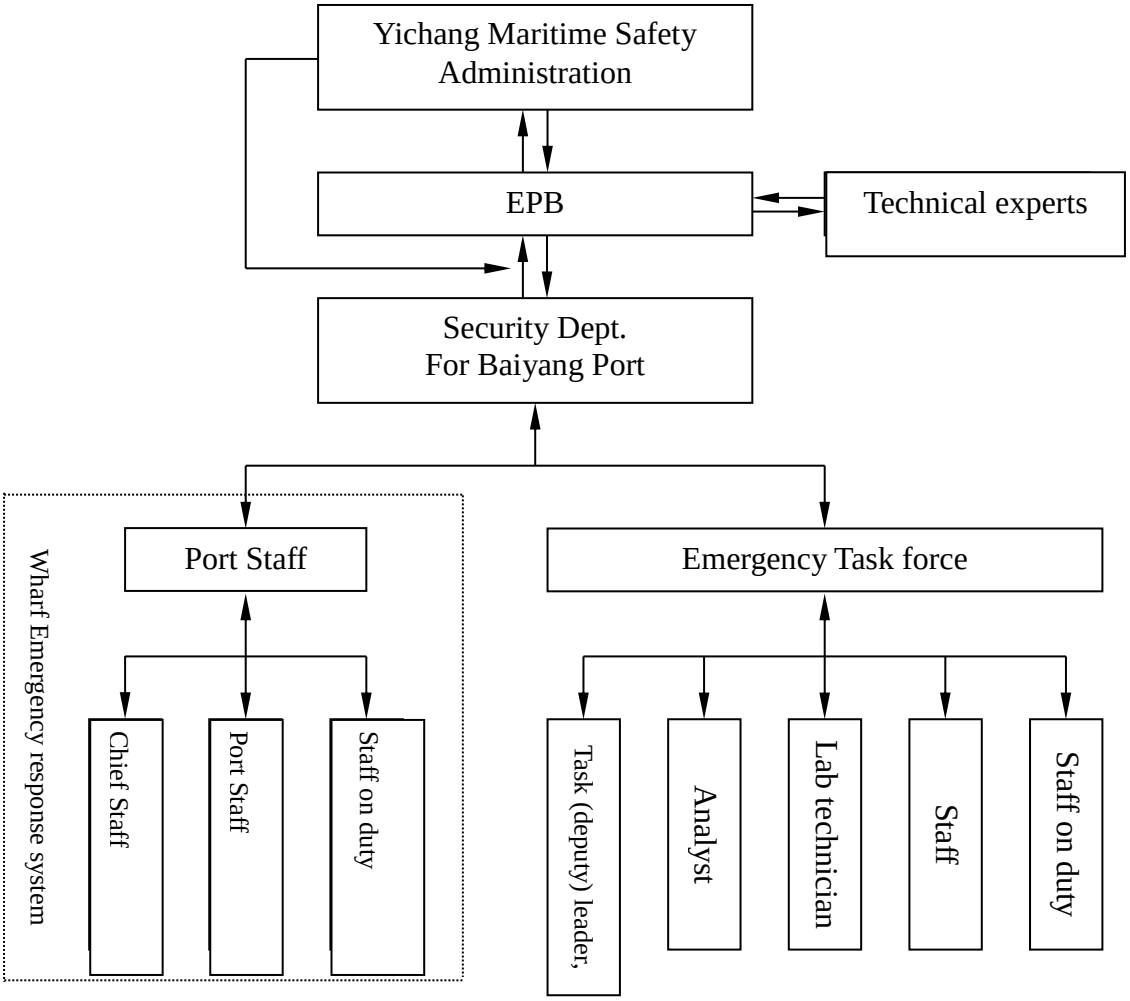


Chart 11.3-1 Emergency Response Organization

(1) Emergency Response Organization

The members of the emergency response organization include leaders of the Marine Control Center of Yichang Maritime Safety Administration, members of the Emergency Response Team under the leadership of Work Safety Department at Baiyang Port, and relevant technical advisory experts. The head of the emergency response team led by the Work Safety Department of Three Gorges Modern Logistics Center should act as an incident commander before the leaders of the Marine Control Center of Yichang Maritime Safety Administration and the leaders of the company's Security Department arrived at the scene of an incident. When relevant leaders reached the scene, they should serve as incident commanders in place of the head of the emergency response team.

According to the Ministry of Environmental Protection, environmental pollution caused by work safety accidents should be reported to competent departments in the emergency response system. Any work safety accident should be promptly reported to Yichang Environmental Protection Bureau and Hubei Environmental Protection Bureau.

See chart 11.3-2 for emergency response action steps

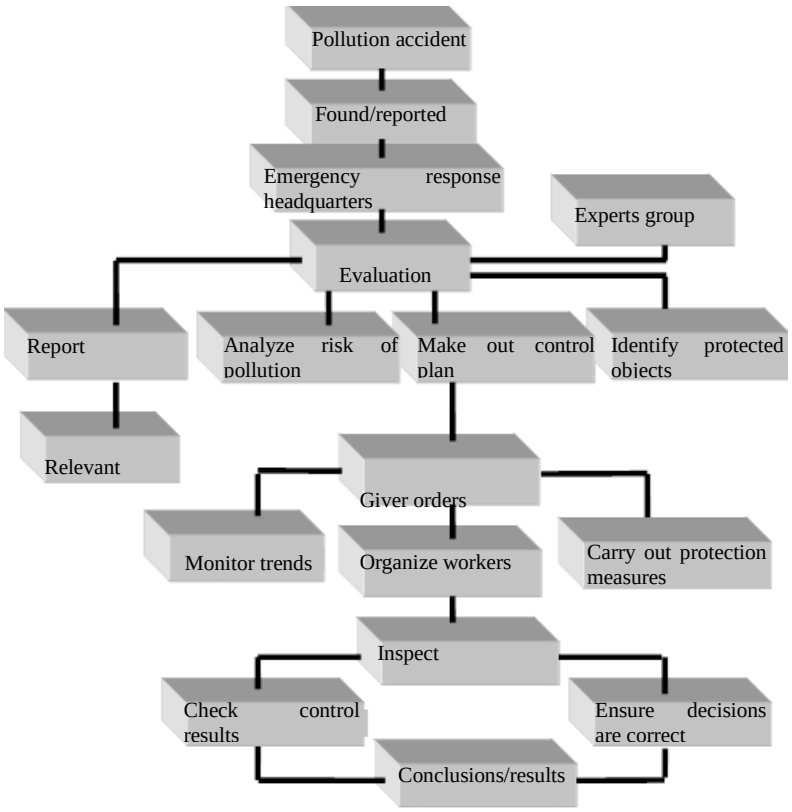


Chart 11.3-2 Emergency response action steps

Table 11.3-1 Responsibilities of the divisions of Emergency Response Organization

No.	Members	Responsibilities	Notes
1	Yichang Maritime Safety Administration	Receiving reports on the danger of waterborne accidents; supervising implementation of the emergency plan for contamination caused by oil; coordinating with the emergency actions taken by waterborne accidents rescue teams and relevant transport departments; mobilizing the human resources, material resources, and logistics support that various departments have; summoning emergency experts to provide technical advice for construction of this wharf.	
2	Competent departments of environmental protection	Organizing for relevant experts to project technical advice; organizing for workers to monitor the potential environmental hazard that may be caused by accidents and providing relevant guidance; organizing	Hubei Environmental Protection Bureau

No.	Members	Responsibilities	Notes
		for workers from relevant organizations to monitor the scene of an accident and particularly the change in the water quality of the areas where the water intakes of water treatment plants at the upper and lower reaches of the Yangtze River are located; providing relevant technical support for environmental monitoring; making technical requirements for the clean-up, spilled oil recovery, and disposal of oil absorption felts after an accident.	027-87167130 Yichang Environmental Protection Bureau 0717-6448003
3	Technical advisory panel	Maritime and environmental protection departments organize for relevant experts to form a technical advisory panel, providing technical advisory services and taking part in decision making for emergency response. Chinese experts in oil leakage response may be employed, if necessary, to provide advisory services for estimating the impact of an accident, making decisions on emergency response, cleaning up, and compensating for pollution damage after an accident.	Formed for an accident as a makeshift panel
4	Safety department for Baiyang Port and operations area.	Director of the emergency command center acts as a commander for emergency response at the wharf. The director issues an order directing this subsidiary to mobilize its resources to take part in emergency rescue, makes decisions on serious accident management plans, and determines the time and method for reporting an accident to the competent department in the system or for requesting other rescues.	Legal representative Head of the department
5	Emergency Response Team of Work Safety Department for the Baiyang Port and operations area of Gorges Modern Logistics Center	The head of the team leads relevant workers to thoroughly implement this plan. When receiving the report on an accident, the team leader should organize for associates working at the port area to take emergency measures. He/she should act as a commander for emergency response before leaders of the competent department of the Maritime Safety Administration and leaders of the company's emergency response team arrive at the scene. In the absence of the team leader, his/her deputy performs the duties of the team leader. The team members should execute the orders issued by the team leader or the commander for emergency response. Specifically, they organize workers at the scene to recover or remove the spilled oil.	Formed after the project is completed

(2) Members of the emergency response team

Members of the emergency response team include staff working in Baiyang Port and operations area and external support team members. External support teams are arranged by Yichang Maritime Control Center based on the impact of an accident.

(3) Emergency facilities, equipment, materials, and management

As oil leakage accidents occur abruptly, this wharf should be equipped with relevant emergency response facilities and staffed with workers for implementing the

emergency response plan, so that actions can be taken promptly when an accident occurs and the impact of an accident can be minimized.

According to Requirements on Emergency Response Equipment/Facilities for Oil leakage in Terminals in Ports (JT/T451-2009), this wharf should be equipped with the equipment listed in table 11.3-2.

When an oil leakage accident occurs, a containment boom should be promptly placed around the scene of the accident and oil absorption felts should be used to absorb oil. If the effect of an accident and weather conditions at the time exceeds what workers at the wharf can handle with the equipment at hand, relevant workers should promptly report the accident to the Maritime Control Center under Yichang Maritime Safety Administration for external support.

Table 11.3-2 Emergency response equipment

Name	**Specification**	**Quantity**	**Notes**
Containment boom	For emergency	1300m	
Oil collection equipment	Total capacity: 20m^3/h	1	Relying on Phase I
Oil trawl	1 m^3 per one set	1	Relying on Phase I
Oil absorption felt		0.5 t	
Oil leakage dispersant	Concentration type	0.3 t	
Oil leakage dispersant sprinkler		1	
Light oil tank	Effective volume: 1 m^3	1	
Boat used for placing containment booms		1	Relying on Phase I

(4) Emergency response

If an oil leakage accident occurs or may occur in port, the control center and watch-keepers in the port area should promptly report the accident to the emergency response team. When the team receives the report, it should promptly organize technical staff to evaluate the area affected by the accident and to estimate the direction in which the spilled oil flows and the impact of the oil leakage to water treatment plants upstream and downstream from the port, so as to develop a preliminary plan for emergency response.

After the preliminary evaluation of the oil leakage accident, head of the emergency response team will decide whether an emergency plan should be launched. If the area affected by the accident is relatively small and the workers at the wharf are capable of handling the accident with the existing equipment, the team should promptly organize people to deal with the accident with selected equipment. Otherwise, an emergency plan should be promptly launched.

According to the emergency response plan, the emergency response team leader or the workers designated by the leader should report the accident to the competent department and to the accident-related shipper, insurance company, maritime safety administration, and environmental protection department. The report includes the following:

i. when and where the accident occurred; name of the relevant vessel; where the vessel was when the accident occurred;
ii. Weather conditions and hydrologic regime when the accident occurred;
iii. Measures taken after the accident; accident control;
iv. Accident developments and potential consequences;
v. Necessary help (emergency response facilities, supplies, human resources, environmental monitoring, medical aid, etc.) ;
vi. Emergency response organizations, contacts, and contact number.

All mem**be**rs of the emergency response team should promptly take emergency actions, including oil leakage control, clean up, and monitoring. In addition, right at the moment when an accident occurs, water plants downstream should be informed immediately and relevant workers should be organized to closely monitor the water quality in the area of water intakes. Once contamination exceeding relevant standards is detected, people should immediately stop using water in the area.

See Table 11.3-3 for information about Tianjiahe water intake downstream from the wharf.

Table 11.3-3 Information of water plant downstream nearest to the port

Name	Location	Direction
Tianjiahe Water Plant's intake	3.8km downstream from Berth 11	North bank of the Yangtze River

(5) Emergency response time and control analysis

Yichang Maritime Safety Administration is responsible for the water traffic safety control in the aforesaid water area. It takes 15 minutes to reach the scene of an accident/potential accident in general segments of the Yangtze River. When receiving the call regarding an accident, relevant boats will set out in five minutes. The oil leakage response mechanism has a 50t of oil control capacity and beyond.

(6) Spilled oil recovery

Oil absorption felts can be reused after they are recycled. If there is still spilled oil flowing to the bank of the port area after it is contained and recycled, relevant organization should organize staff working at the wharf, external support teams, and residents nearby to remove oil from the river bank. Collected oil should be transported to and recycled at waste oil recycling companies (authorized by the Yichang Maritime Safety Administration and other competent authorities).

(7) Accident reporting system

Whenever an accident occurs, it should be promptly reported to competent authorities. After the accident, the Three Gorges Logistics Company should report to the Yichang Maritime Safety Administration and Environmental Protection Bureau the information with regard to the cause of an accident, oil leakageage, contamination removal, and the impact of the contamination. The Yichang Maritime Safety Administration and Environmental Protection Bureau should then organize workers to investigate the accident and determine the compensation for the loss caused by oil leakage. The compensation can be paid to relevant victims after it is approved by the court.

(8) Training

The managers, equipment operators, and cleaners for emergency response at the wharf should receive relevant training to acquire the knowledge required for fulfilling their responsibilities. It is advisable that workers for emergency response work with a license, so that they may be better prepared both theoretically and practically for emergency response, including oil leakage control and contamination removal.

(9) Exercise

Relevant exercises should be held as a way to improve emergency commanding capability and the ability to respond to waterborne emergencies. Such exercises can improve the emergency response team's ability to handle emergencies and ensure safety, increase communication and coordination between emergency rescue organizations, and test participants' ability to respond to emergencies.

(10) Regular review

It must be ensured that every worker concerned has a copy of this emergency response plan. The plan should be reviewed once a year, so that the information regarding the members of emergency response organizations and their contacts can be updated.

11.4 Environmental monitoring

The impact of construction and operation to the environment will be monitored for the project. Environmental monitoring is aimed at ensuring that the environmental protection measures listed in the environmental and social impact report are implemented, so as to keep the impact of construction to the environment at an acceptable level in accordance with relevant national laws, regulations, and standards.

Environmental monitoring in the operations area and logistics park during construction and operation should be undertaken by an organization qualified for environmental quality monitoring in accordance with relevant regulations. The organization should regularly monitor the environment, compile monitoring reports, and submit the reports to the competent authority. The monitoring reports are subject to review by environmental protection departments at all levels. In case of any problem identified during monitoring, the organization should report the problem to the competent authority so that effective measures can be taken to address the problem in a timely manner.

According to environmental monitoring results, sensitive spots that may be noticeably affected by contamination are used as monitoring points for monitoring contamination caused by the project during construction and operation. Noise, air environment, and surface water environment are primarily monitored. Factors to be monitored are determined based on the characteristics of pollution caused by the project.

Methods of monitoring and analysis that are listed in the *Technical Specification for Environmental Monitoring* issued by the Ministry of Environmental Protection are adopted for this project. National standards for environmental impact assessment are used for evaluating the project's environmental impact. Based on the features of the World Bank Funded Hubei Yichang Three Gorges Modern Logistics Center

Infrastructure Project, an environmental monitoring plan involving different phases has been developed. See table 11.4-1 for the plan.

Table 11.4-1 Environmental Monitoring Plan

	Project		Construction Phase	Operation Phase
Ambient air	Source of pollutants		Dust caused by construction	Dust, vehicle exhaust
	Factors to be monitored		TSP, PM_{10}	TSP, NO_x
	Standard	Quality standard	Ambient Air Quality Standard (GB3095-2012)	Ambient Air Quality Standard (GB3095-2012)
		Emission standard	—	—
	Monitoring points		Concrete batching plant, lime-soil mixing station, Guixihu Village, Yazishan Village, Baiyang Town, Wanfunao Village	Guixihu Village, Yazishan Village
	Monitoring frequency		Once every quarter (increasing frequency during peak of construction) ， 3-4days per quarter	Once a year， one day a time
Ambient noise	Source of pollutants		Mechanical noise during construction	Traffic noise
	Factors to be monitored		LAeq(dB)	LAeq(dB)
	Standard	Quality standard	Environmental Quality Standard for Noise (GB3096-2008)	Environmental Quality Standard for Noise (GB3096-2008)
		Emission standard	Emission Standard of Environment Noise for Boundary of Construction Site (GB12523-90)	—
		Standard of measurment	Environmental Quality Standard for Noise (GB3096-2008)	Environmental Quality Standard for Noise (GB3096-2008)
	Monitoring points		Guixihu Village, Yazishan Village	Guixihu Village, Yazishan Village
	Monitoring frequency		Once every quarter, two days a time, once during nighttime and once during daytime	Once a year，two days a time，once during nighttime and once during daytime
Water environment	Source of pollutants		/	Domestic/production wastewater
	Factors to be monitored		/	pH, NH_3 –N, COD, BOD_5 , oil, etc.
	Standard	Quality standard	/	/
		Emission standard	/	Integrated Wastewater Discharge Standard (GB8978-1996) Class III
	Monitoring points		/	General outlet of sewage
	Monitoring		/	Once a year

	Project	Construction Phase	Operation Phase
	frequency		

No monitoring equipment will be additionally equipped for this project; monitoring organizations should prepare equipment by themselves.

The monitoring cost throughout construction is 150,000 CNY (50,000 CNY/y × 3 years). The monitoring costs for the first three years of the operation phase will be covered by the World Bank loan, while the monitoring costs during the operation phase starting in the fourth year will be covered by the project operation company. The monitoring cost during the operation phase is 180,000 CNY (60,000 CNY/y × 3 years).

The monitoring organization should compile monitoring reports based on the results of environmental monitoring during construction and operation, and it should submit the reports to the local environmental protection bureau and other competent authorities.

11.5 Training program

The environmental protection training program is to familiarize project stakeholders with the ESMP, and national and local laws on the environmental protection of project construction and operation, so to as make sure that the mitigation measures are implemented as required.

The trainees are environmental staff and supervisors and the training constitutes a part of technical assistance. The training program during project construction is also available to the Contractor and construction workers. Before project construction commences, all the construction units, operation units and supervisors must attend compulsory EHS training. Specific training programs are listed in Table 11.5-1.

Table 11.5-1 Training plan for technical staff

Characteristics	Staff	Training content	No. of trainee	Duration	Year	Cost (10,000 Y)
Overseas						
Environmental management	Managers of Project Coordination Office	Experiences and best practices in environmental management during construction phase	5	10 days	2016	12.5
	Professionals from PMO and PIU	Environmental management technological management	20	10 days	2016	45.0
Domestic						
Environmental protection	Environmental workers from Contractor	Environmental monitoring methods, reports and post training; annually: ESMP, environmental monitoring and reporting, emergency plan	10～20	3 day / time	2016-2020	9.0
Supervisi	Environme	Environmental protection	5～10	5 day /	2016	7.5

Characteristics	Staff	Training content	No. of trainee	Duration	Year	Cost (10,000 Y)
Overseas						
on	ntal supervision engineers, environmental managers	regulations, construction planning, environmental monitoring standards and planning, environmental air monitoring and pollution control, noise monitoring and control	people	time	-2020	

11.6 Reporting and grievance handling

The overall period of project implementation is about three years. According to China's environmental management regulations and World Bank's policy requirements, the borrower shall be responsible for evaluation and monitoring of ESMP implementation (2 times a year). The purpose is to make sure that all the requirements and measures in the approved ESMPs are carried out or met. Problems should be identified and solved in a timely manner, so as to mitigate the negative environmental impact in the follow-up work of the project.

Environmental supervision and reporting are arranged as below:

1) Project supervision engineer shall record the implementation of ESMP in details in the supervision log and monthly report, and shall submit weekly report and monthly report to the PMO;

2) PMO shall carry out on-site supervision on the implementation of ESMP regularly or irregularly, and shall take records for semi-annual report;

3) The external environmental supervision agency shall, after receiving entrustment, supervision the implementation of mitigation measures timely, monitor the quantitative indicators regularly, and prepare external supervision report and submit it to PMO as required by this section and the contract;

4) In case of environmental complaint, the external environmental supervision agency and the PMO must notify the local competent administrative authority of environmental protection, and shall report to all levels of superior authorities if necessary.

5) PMO shall, based on the information of 1-4 and the reports, assisted by external environmental supervision agency/experts, prepare the chapter on implementation progress of ESMP, which shall be incorporated into the semi-annual progress report and shall be submitted to the World Bank in time.

The chapter on implementation of ESMP shall mainly include:

1) Implementation of ESMP: main construction works in this stage, training on environmental management provided in this stage, implementation of mitigation measures, problems existed and causes; rectification measures for the next step.

2) Results of environmental monitoring: give brief explanation of the data, describe the problems existed and non-compliance, analyze their causes, and propose

rectification measures; grievances of residents and solution shall be included if necessary;

3) Overall evaluation and conclusion on the implementation of ESMP in this stage, suggestions and plan for the next half year.

12 Conclusions

The proposed project is located in Baiyang Industrial Park, Yichang Hi-tech Industry Development Zone, in the territory of Baiyang Town, Zhijiang City (a prefecture-level city of Yichang) on the north bank of Yangtze River. The project comprises five components, namely Baiyang Port Operation Area, Baiyang Logistics Park, transport infrastructure, Three Gorges Modern Logistics Information Center and project management & capacity building, covering totally 17 sub-components.

Baiyang Port area is located about 3.0 km outside the natural reserve of Chinese sturgeons. It is designed with cargo handling capacity of 7,000,000t/a including 1,200,000t/a general cargoes, 5,000,000t/a bulk cargoes, 80,000 TEU containers per year (equivalent to 800,000tons). In the port, one 3,000-ton berth for heavy lifts e.g. steels, four bulk cargo berths and two multi-purpose berths will be built, occupying totally 1036m long shoreline.

Baiyang Logistics Park covers an area of 76.6km^2, comprising of mixed-use logistics area, trade and logistics area A and trade and logistics area B. Transport infrastructure component comprises of Shawan Road Overpass (urban secondary trunk road, total length: 675m, of aerial construction, two-way four lanes, bridge width: 17m, bridge length: 280m), Guihu Road (urban secondary trunk road, width: 30m, total length: 1,126m, two-way four lanes, width of carriageway: 16m), and Songgang Second Road (urban secondary trunk road, width: 30m, total length: 900m, two-way six lanes, width of carriageway: 24m). In the Information Center, the office building, dispatching building and information service building will be constructed.

Project management & capacity building refer to the project management system including project management office, project implementation unit and project monitoring organization.

This project is supported by World Bank. It needs a total investment of 3.019 billion Yuan, including 200 million from World Bank, 897 million from capital funds, 1749 million from banks in China. The construction period of the project is four years from July 2016 to December 2020.

The project is in line with industrial policies and planning of China and will achieve the following goals: improve infrastructure and investment environment of the Logistics Center, reduce logistics cost, improve logistics service quality, strengthen industrial management, establish an orderly, competitive and open logistics market, improve the integrated transportation system, promote the development of modern logistics and finally stimulate economic development of Yichang City.

The project site has good environmental quality, but large-scale construction may have environmental and social impacts. It will generate domestic wastewater, noise and solid wastes and may cause ecological damage and environmental safety accidents. The project will have impacts on surrounding environment, especially water quality of this section of Yangtze River. But the adverse environmental impacts of the project can be well controlled by carrying out the "simultaneous design, construction and operation" of environmental protection facilities with the construction project, the trans-regional prevention and control of water pollution of Yangtze River and the measures proposed herein. In this way, the construction of the

project will be accepted by the environmental functions of the target area.

In addition, the project has small incremental contribution to the cumulative impact. The cumulative impacts of past, present and future foreseeable activities is within the bearing capacity of local ecology, matches with the shoreline resources planning and water functional zoning, and almost will not affect the migration and survival of Chinese sturgeon.

The project is environmentally feasible so long as it is constructed at the proposed site and within the proposed construction range and all environmental protection measures specified herein are strictly carried out.