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**WORLD BANK PROJECT**

# *ANHUI SHAYING RIVER CHANNEL IMPROVEMENT PROJECT*

# Environmental Impact Report

**SHANGHAI SHIP & SHIPPING RESEARCH INSTITUTE**

**Commissioned by**

**ANHUI PROVINCIAL HARBOR AND NAVIGATION CONSTRUCTION COOPERATION CO., LTD.**

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# 1. General

## 1. 1. Scope of the Project

The Shaying River is the largest tributary of the Huai River and located at its left bank. It originates from Funiu Mountain in Henan Province and formed by the confluence of the Sha River and the Ying River at Zhoukou City. It goes from the northwest to the southeast, passes through the central area of Henan Province and enters into Changshenggou in Jieshou City on the Henan-Anhui border. It flows through Jieshou City, Taihe County, Fuyang City, and joins the Huai River at Mohekou in Yingshang County. The total length of the Shaying River is 620km, with 206km located in Anhui Province. The basin area of the Shaying River is 36,651 $km^2$, with 4,112 $km^2$ located in Anhui Province. The proposed project will re-open and upgrade the 205.6km long channel of the Shaying River. The location of this project is shown in Figure 1 (Attached).

## 1. 2. Background

The Shaying River is a natural river with long history of navigation. It was one section of the well-known Honggou Canal in Wei Country early in the Spring and Autumn and the Warring States Periods (360 B.C.), and became an important section of the Tongji Qu Canal in Sui and Tang dynasties, which was a large canal running north to south with its center in Luoyang. In 1950s, the total length of waterway at the trunk stream of the Shaying River was about 460km and the traffic volume reached 2, 210, 000 t. The water departments have constructed controlling gates at Mawan, Xiaoyao, Huangtuqiao, Zhoukou, Shenqiu, Fuyang and Yingshang since then. However, none ship crossing facilities were built at these places except a minor lock of 100 dtw ship at Fuyang, which caused the suspension of shipping on the Shaying River. The seasonally navigation of the 112km long channel from Fuyang, Anhui Province to Liuwan, Henan Province was not reopened untill the construction and navigation began at Ciwei Xin River in 1980s.

In order to reopen the overall navigation on the Shaying River, Henan Pronvince and Anhui Province have made great efforts with the support of government. The navigation reopen project at Shaying River was listed in the “Report of Huai River Navigation Plan” in 1982, the “Report of Key Issues on Huai River Navigation Plan”

and the “General Layout Plan of National Inland Waterway Main Channels” in 1995 prepared by the Minitry of Communications. In 1984, the “Feasibility Study Report of Navigation Construction at Shaying River” was developed jointly by the Anhui and Henan Provincial Communication Departments. That report identified the channel from Luohe to Mohekou as Grade V, and planned to construct the Yingshang Ship Lock, Fuyang Ship Lock, Taihe hub, Shenqiu Ship Lock, Zhengbukou hub, Zhoukou Ship Lock, Huangtuqiao Ship Lock, Xiaoyao Ship Lock and Helongtan hub. Shaying River channel is the 12th line among the 18 lines listed in the “Layout Plan of National Inland Waterway Channel and Port (2006-2020)”, which proposes that the main channel network in the whole country should be composed of “two latitudinal lines”, “one lontitudinal line”, “two networks” and “18 lines”. The total length of the channel from Luohe, Henan Pronvince to Mohekou, Anhui Province is 378km and the channel is proposed as Grade V-IV. Shaying River is also proposed as one branch of the “two trunks and three branches” in the “Navigation Development Plan of Anhui Inland Waterway (2005-2020)”, and is proposed as Grade IV. In February 2008, Anhui Developemnt and Reform Committee agreed to start preliminary work of this project by promulgating the “Response Letter to the Proposal of Channel Improvement Project at Shaying River in Anhui Province” (FaGaiJiaoTongHan[2008]No. 87). In February 2007, Anhui Provincial Port & Shipping Investigation & Design Institute (APPSIDI) composed the “Feasibility Study Report of Shaying River Section in Anhui Pronvince Channel Improvement Project” commissioned by Fuyang Port & Shipping Management Bureau (FPSMB), which was finished in March 2008. APPSIDI has begun preparing the initial design report of Shaying River Section in Anhui Province Channel Improvement Project since January 2010, commissioned by the Anhui Provincial Port & Shipping construction investment Group Co., LTD.

## 1.3. Environmental Protection Work for This Project

In accordance with the environmental management procedure for construction project and relevant environmental protection laws and regulations, Anhui Provincial Environmental Science Institute prepared “Environmental Impact Assessment Report of Shaying River Section in Anhui Province Channel Improvement Project” commissioned by FPSMB at the feasibility study stage of this project in March 2008. The EIA report was approved by Anhui Provincial Environmental Protection Department in 2008. The initial design of this project has started since January 2010.

In order to connect with the results of initial design and to improve the quality of EIA report so as to satisfy the requirements of the World Bank (WB), the Shanghai Ship & Shipping Research Institute (SSSRI) initiated the preparation of EIA for Shaying River Section in Anhui Province Channel Improvement Project according to the WB procedure, commissioned by Anhui Provincial Harbor and Navigation Construction Cooperation Co., Ltd. Professionals in the SSSRI carried out field investigation and collected relevant engineering information shortly after accepting the commission. The SSSRI revised and improved the "Environmental Impact Assessment Report of Shaying River Section in Anhui Province Channel Improvement Project" (version according with Chinese EIA procedure) on the basis of engineering materials in the "Initial Design of Shaying River Section in Anhui Province Channel Improvement Project", to make it satisfy the WB policie and requirements.

## 1.4. Objectives of EIA

The objectives of the EIA for this project are to implement the sustainable development strategy, to prevent the adverse impacts on the environment due to the implementation of the channel improvement project, and to promote harmonious development of the economy, society and environment.

## 1.5. EIA Preparation Basis

### 1.5.1. Environmental Protection Laws and Regulations

#### 1.5.1.1. National Laws and Regulations

(1) Environmental Protection law of the People's Republic of China (December 26, 1989);

(2) Law of the People's Republic of China on Prevention and Control of Water Pollution (February 28, 2008);

(3) Law of the People's Republic of China on Prevention and Control of Pollution From Environmental Noise (November 4, 1996);

(4) Law of the People's Republic of China on the Prevention and Control of Atmospheric Pollution (April 29, 2000);

(5) Law of the People's Republic of China on Prevention of Environmental Pollution Caused by Solid Waste (April 1, 2005);

(6) Ordinance on Administration for Environmental Protection of Construction Projects (Promulgated by Decree No. 253 of the State Council of the People's Republic of China on November 29, 1998);

(7) Law of the People's Republic of China on Environmental Impact Assessment (September, 2003);

(8) Classified Management Lists for Environmental Protection of Construction Projects (Promulgated by the Ministry of Environmental Protection of the People's Republic of China on August 15, 2008);

(9) Interim Procedure on the Public Take Part In Environmental Impact Assessment (Promulgated by the Environmental Development Document No.8 of the Ministry of Environmental Protection of the People's Republic of China on February 14, 2006);

(10) Law of the People's Republic of China on Water and Soil Conservation (June 29, 1991);

(11) Measures on Administration of National Wetland Parks (Provisional) (February 28, 2010);

(12) Management Regulations for Prevention of Freshwater Polluted by Shipping (Promulgated by the Ministry of Transport of the People's Republic of China on January 1, 2006);

(13) Measures for the Administration of Environmental Protection of Transport Construction Projects (Promulgated by the No.17(90) Order of the Ministry of Communications of the People's Republic of China);

(14) Circular on the Enhancement of Management Work on Environmental Impact Assessment for Construction Projects using loans from international financial organizations (Promulgated jointly by the Ministry of Environmental Protection, the State Planning Commission, the Ministry of Finance and the People's Bank of China).

1.5.1.2. Regulations of Anhui Province

(1) Suggestions on Further Improving the quality of Environmental Impact Assessment (Promulgated by the Environmental Monitoring Document No. 46 of the Anhui Environmental Protection Bureau on April 10, 2002);

(2) The Circular on Printing the Regulation on Standardization the Environmental Impact Statement for Construction Projects (Promulgated by the Environmental Assessment Document No. 113 of the Anhui Environmental Protection Bureau on June 16, 2006);

(3) Decision on the enhancement of Environmental Protection Work by the Anhui People's Government (Promulgated by the Provincial Government Document No.28 of Anhui People's Government in 1997);

(4) Management Procedure on Environmental Protection in Anhui Province (Promulgated by the Anhui Environmental Protection Bureau);

(5) Ordinance on the Environmental Protection on Agricultural Ecological System (revised version on June 29, 2006);

(6) Ordinance on Prevention and Control of Water Pollution of Huai River Basin in Anhui Province (June, 2006).

#### 1.5.1.3. World Bank Safeguard Policies and Requirements

Based on screening and scoping of environmental and social issues, the following WB safeguard policies apply to the project.

(1) Environmental Assessment□OP/BP4.01□

(2) Natural Habitats □OP/BP4.04□

(3) Involuntary Resettlement (OP4.12)

(4) Disclosure of Information (2002)

### 1.5.2. **EIA Technical Guidelines**

(1) Technical gnidelines for environmental impact assessment-General principles□HJ/T2.1~2.3-93□□

(2) Technical guidelines for noise impact assessment (HJ 2.4-2009)

(3) Technical guidelines for environmental impact assessment-Atmospheric environment (HJ 2.2-2008)□

(4) Technical gnidelines for environmental impact assessment-Surfacewater environment (HJ/T 2.3-93) .

### 1.5.3. **Related plans, Documents and References**

(1) The Initial Design Report of Channel Improvement Project at Shaying River Section in Anhui Province (April 2010);

(2) The Water and Soil Conservation Report of Channel Improvement Project at Shaying River Section in Anhui Province (August 2008);

(3) The Flood Control Assessment Report of Channel Improvement Project at Shaying River Section in Anhui Province (August 2008);

(4) The Environmental Impact Statement of Ship Lock Reconstruction Project at Fuyang (April 2006);

(5) The Environmental Impact Statement of General Plan of Fuyang Port (April 2008);

(6) The Immigration Resettlement Report of Channel Improvement Project at Shaying River Section in Anhui Province (April 2010);

(7) The Standardized Acknowledge Letter From Fuyang Environmental Protection Bureau;

(8) The Commitment Letter for EIA;

(9) The Water Function Zoning in Anhui Province (Drafted by Anhui Water Resource Department and Anhui Environmental Protection Bureau on October, 2003);

(10) The Eleventh Five-Year Plan for Environmental Protection in Anhui.

## 1.6. The Assessment Factors, Class, Scope, Period and Key Issues

### 1.6.1. Assessment Factors

On the basis of identification and analysis of environmental impact factors for this project as well as the actual project situation and environmental status, the EIA team identified the following assessment factors:

(1) Ecological environment: aquatic ecological environment, including phytoplankton, zooplankton, bethos; terrestrial ecological environment, including arable land and plants.

(2) Surface water environment: permanganate value, suspended solid (SS), oil pollutants, ammonia nitrogen.

(3) Acoustic environment: equivalent continuous sound level A (LAeq)

(4) Ambient Air: nitrogen dioxide ($NO_2$), total suspended particle (TSP).

### 1.6.2. Assessment Class

The assessment class of each environmental factor for this proposed project is presented in Table 1-1.

**Table 1-1 Assessment Class and Its Basis**

| Environmental factor | Basis | Class |
|---|---|---|
| Ecological Environment | This project will have impact in an area of about 60 $km^2$, including the coastal area of Shaying River.This area is mainly situated in a plain region. The loss of biomass and biodiversity will be less than 50%, meaning this project will not cause significant and sharp reduction of biomass and species. It also has no impact on environmentally sensitive areas. Therefore, the assessment class is identified as Class II according to the “Guidelines”. | II |
| Acoustic Environment | The noise level will increase no more than 3dB (A) after the construction. There will be little change on the affected population by noise. | III |
| Ambient Air | $NO_2$ and TSP were identified as the main air pollutants according to engineering environmental impact analysis of this project. Since most of | III |

| | | |
|---|---|---|
| | the centralized air pollution sources in the project region (e.g. service areas) will mainly use clean energy, this project will have light impacts on Ambient Air. | |
| Surface Water Environment | The possible water pollution of this proposed project may mainly come from the residual water pollution during dredging at the construction phase, and waste water discharge from service areas and ships at the operation phase. The total amount of pollutants is low, the component of which is simple. These impacts on water environment will last for a limited period. Furthermore, the river sections where the designed waterway will be involved are water body with Class III to IV. | III |

### 1.6.3. Assessment Scope

The assessment scope was determined in accordance with EIA Guidelines and the extent of impacts that project will have on environmental factors. The assement scope of this project is shown in Table 1-2. The indirect impacts caused by the ship gate, service area, ports are analyzed in this report too.

**Table 1-2 Assessment Scope**

| Environmental factor | Scope |
|---|---|
| Water environment | 205.6 km channel from Changshenggou to Mohekou |
| Ambient Air | The disposal area and its surrounding regions with a radius of 200m |
| Acoustic environment | The 100m regions away from each bank of the channel involved in this project |
| Ecological environment | The 100m regions away from each bank of the 205.6km channel from Changshenggou to Mohekou |
| Social issues | Affected cities and towns by this project |

### 1.6.4. Assessment Period

Construction phase: 2010-2014, which will last four years;

Operation phase: 2020 (medium-term), 2020 (long-term)

### 1.6.5. Key Issues of EIA

Major assessment factors: ecological environment, water environment;

Major assessment project phases: construction phase.

## 1.7. Environmental Function Zoning

### 1.7.1. Surface Water Environmental Function Zoning

According to the standard confirmation on this project signed by Fuyang Environmental Protection Bureau, the surface water quality of the Shaying River

Section in Anhui Province (Fuyang) should be in compliance with Category IV in "Environmental Quality Standard for Surface Water" (GB3838-2002). The Huai River section in Anhui Province should meet Category Ⅲ in GB3838-2002.

### 1.7.2. Acoustic Environmental Function Zoning

The acoustic environmental function zoning has not been carried out in Section K0+000 - K72+500 and Section K83+000 - K205+600 of the Shaying River. Section K72+500 - K83+000 lies in urban area of Fuyang City. According to "Zoning for Applicable Areas to 'Standard of Environmental Noise of Urban Area' for Fuyang City", the acoustic environmental function zoning along Shaying River is shown in Table 1-3.

**Table 1-3 Acoustic Environmental Function Zoning along the Project Regions**

| Section | Acoustic Environmental Function Zoning |
|---|---|
| K0+000～K72+500、K83+000～K205+600 | No zoning |
| K72+500～K83+000 | Business and residential districts at both sides of current arterial roads are Class II Area.<br>Other districts at both sides of roads are Class IV Area. |

### 1.7.3. Function Zoning for Ambient Air Quality

The ambient air fuction zoning has not been carried out in Section K0+000 - K72+500 and Section K83+000 - K205+600 of the Shaying River. Section K72+500 - K83+000 lies in urban area of Fuyang City. According to "Eleventh Five Year Plan for Environmental Protection of Fuyang City", the ambient air function zoning along the Shaying River is shown in Table 1-4.

**Table 1-4 Function Zoning for Ambient Air Quality along the Project Regions**

| Section | Function Zoning for Ambient Air Quality |
|---|---|
| K0+000～K72+500、K83+000～K205+600 | No zoning |
| K72+500～K83+000 | Category II |

## 1.8. Assessment Standards

According to the standard confirmation on this project signed by Fuyang Municipal Environmental Protection Bureau, the following standards are applied in this EIA.

### 1.8.1. Environmental Quality Standards

(1) Category IV in "Environmental Quality Standard for Surface Water" (GB3838-2002) is based for surface water of Shaying River section in Anhui (Fuyang). Category III in the same "Standard" is based for Huai River section in Anhui. Category III in "Quality Standard for Ground Water" (GB/T14848-93) is based for groundwater assessment.

**Table 1-5 Quality Standards for Ground Water □GB/T14848-93□(Cited)**

Unit□mg/l□except unit of pH and coliform□

| Item | pH | Permanganate Value | $NH_3$-N | Cyanide | Coliform | Chloride |
|---|---|---|---|---|---|---|
| Category III | 6.5-8.5 | □3 | □0.2 | □0.05 | □3 | □250 |
| Item | Pb | Sulfate | $Cr^{6+}$ | Total water hardness | Hg | As |
| Category III | □0.05 | □250 | □0.05 | □450 | □0.001 | □0.05 |

**Table 1-6 Environmental Quality Standards for Surface Water (GB3838-2002) (Cited)**

(Unit: mg/L, except units of pH and fecal coliform)

| Item | Category III | Category Ⅳ |
|---|---|---|
| pH | 6～9 | 6～9 |
| COD | ≤20 | ≤30 |
| TN | ≤1.0 | ≤1.5 |
| TP | ≤0.2 | ≤0.3 |
| BOD | ≤4 | ≤6 |
| Oil pollutant | ≤0.05 | ≤0.5 |
| fecal coliform (coliform /L) | ≤10000 | ≤20000 |
| SS* | ≤80 | ≤80 |

Note*: SS is assessed based on standards in "Standards for irrigation water quality" (GB5084-2005).

(2) Grade II in "Ambient Air Quality Standard" (GB3095-1996) is based for ambient air quality assessment.

**Table 1-7 Ambient Air Quality Standard (GB3095-1996) (Cited)** Unit: $mg/m^3$

| Pollutant / Timing | $NO_2$ | $SO_2$ | $PM_{10}$ | TSP |
|---|---|---|---|---|
| | Grade II | Grade II | Grade II | Grade II |
| Annual average | 0.04 | 0.06 | 0.1 | 0.2 |

(3) Category II in “Environmental quality standards for noise” (GB3096-2008) is based for both sides of banks of project sites that pass through urban areas.

**Table 1-8 Environmental quality standards for noise” (GB3096-2008)** (Cited)

| Category | Daytime $L_{Aeq}$□dB(A) | Nighttime $L_{Aeq}$□dB(A) |
|---|---|---|
| II | 60 | 50 |

(4) Grade II in “Environmental quality standard for soils” (GB15618-1995) is based for soil environment in disposal areas.

**Table 1-9 Environmental quality standards for soil (GB15618-1995) (Cited)** Unit: mg/kg

| Grade | pH | As | Hg | Pb | Cu | Zn | Cr | Cd |
|---|---|---|---|---|---|---|---|---|
| II | 6.5~7.5 | 25 | 0.5 | 300 | 100 | 250 | 300 | 0.6 |

(5) The control value in “Control Standards for Pollutants in Sludges from Agricultural Use” (GB4284-84) is based for sludges for agricultural use.

**Table 1-10 Control Standards for Pollutants in Sludges for Agricultural Use” (GB4284-84)**

(Unit: mg/kg, except unit of pH)

| Item | pH | As | Hg | Pb | Cu | Zn | Cr | Ni | TP | TN |
|---|---|---|---|---|---|---|---|---|---|---|
| GB4284-84 | pH<6. | 75 | 5 | 300 | 250 | 500 | 600 | 100 | □ | □ |
| | pH□6.5 | 75 | 15 | 1000 | 500 | 1000 | 1000 | 200 | □ | □ |

### 1.8.2. Pollutant Emission Standards

(1) Grade II in “Integrated wastewater discharge standard” (GB8978-1996) is based for residual water discharge. “Effluent standards for pollutants from ship” (GB3552-83) is based for wastewater discharge from ships at operation phase.

**Table 1-11 Integrated wastewater discharge standard (GB8978-1996) (Cited)**(Unit: mg/L)

| Pollutant | Grade II standard |
|---|---|
| pH | 6-9 |
| CODcr | 150 |
| BOD | 30 |
| SS | 150 |
| Oil | 10 |
| Ammonia nitrogen | 25 |

**Table 1-12 Effluent standards for pollutants from ship (GB3552-83)**

(Unit: mg/L, except unit of coliform)

| Pollutant | Grade II standard |
|---|---|
| Oil wastewater from ship | □15 |
| BOD | □50 |
| SS | □150 |
| Coliform□(coliform/100L)□ | □250 |

(2) Grade II in "Emission standards for odor pollutants" (GB14554-93) is based for odor pollutant emissions in dredging area.

**Table 1-13 Emission standards for odor pollutants (GB14554-93) (Cited)**(Unit: mg/m$^3$)

| Pollutant | Grade II standard |
|---|---|
| Ammonia | 1.5 |
| Hydrogen sulfide | 0.06 |
| Trimethylamine | 0.08 |
| Odor concentration (dimensionless) | 20 |

(3) Limits set on noise level at work at daytime and nighttime in "Noise Limits for Construction Site" (GB12523-90) are based for noise assessment during construction phase.

**Table 1-14 Noise Limits for Construction Site** (Unit: dB(A))

| Construction phase | Noise sources | Noise limits (dB(A)) | |
|---|---|---|---|
| | | Daytime | Nighttime |
| Earthwork | Bulldozers, excavators, loaders, etc. | 75 | 55 |
| Piling | All kinds of piling machines, etc. | 85 | Construction Prohibited |
| Frame | Concrete mixer, vibrator, electric saws, etc. | 70 | 55 |
| Decoration | Cranes, lifts, etc. | 65 | 55 |

## 1.9. Environmental Protection Objectives

### 1.9.1. Ecological Environment Protection Objectives

The ecological environment protection objectives are listed in Table 1-15.

**Table 1-15 Ecological Environment Protection Objectives**

| NO. | Protection Objects | | Species | Location |
|---|---|---|---|---|
| 1 | Water eclocigal environment | Aquatic Organism | Phytoplankton, zooplankton, bethos | Dredging sections of all along the waterway |
| 2 | Terrestrial Ecological environment | Plantation | Mainly the Populus simon | Mainly distributed at both sides of banks of the Shaying River and nearby villages |

| | | | | |
|---|---|---|---|---|
| 3 | | Wild animal | National protected wild animals (Grade II): *Milvus lineaus, Cirus cyaneus;*<br>Provicial protected wild animals (Grade I): *Dendrocopos major, Vulpes vulpes* Linnaeus, *Nyctereutes procyonoides* Gray, *Prionailurus bengalensis* Kerr;<br>Provicial protected wild animals (Grade II): *Bufo raddei, Bufo bufo, Chinemys reevesii, Elaphe taeniura, Zaocys dhumnades, Rana plancyi, Phasanus colchicus, Lanius schach, Mustela sibirica Pallas, Meles meles Linnaeus.* | Occasionally appearing along the Shaying River, mainly distributed at lakes along the Shaying River (e.g. Bali River) |
| 4 | | Arable land | Area and quality of arable land(basic farmland) | Mainly distributed outside the banks of the Shanying River |

### 1.9.2. Social Protection Objectives

The protection objectives for social issues are listed in Table 1-16.

**Table 1-16 Protection objectives for social issues**

| No. | Protection objectives | Main Content | Location |
|---|---|---|---|
| 1 | Resettled residents | Life quality | Areas where the bridges will be destructed and rebuilt, disposal areas and cut-beach sections |
| 2 | Ferries | Residents daily travel | See Fig. 6-5 |
| 3 | Cultural heritage | Cultural relics and heritage | No cultural relics or heritage along the project regions |

### 1.9.3. Water Environment Protection Objectives

According to field investigation and consultation with relevant organizations, there are no drinking water intakes along the waterway of the Shaying River. The residents in nearby villages mainly take groundwater as drinking water. There is an industrial water intake (i.e. the Zhoupeng Power Plant water intake).

### 1.9.4. Ambient Air Protection Objectives

The key ambient air protection objectives include concentrated residential areas in disposal areas and within 200m around disposal areas.

### 1.9.5. Acoustic Environmental Protection Objectives

The key protection objectives include concentrated residential areas and nearby villages at both sides of the Shaying River.

## 1.10. Assessment Method and Process

### 1.10.1. Assessment Mehod

The methods applied in this EIA concentrate on “points”, combine “points” and “sections”, and then go through the whole “line”. The assessment methods used in each section are listed in Table 1-17.

**Table 1-17 List of EIA Methods**

| Section | Baseline Assessment | Prediction Assessment |
|---|---|---|
| Acoustic environment assessment | Status monitoring | Model calculation |
| Surface water environment assessment | Information collection combined with status monitoring | Information collection, analogy combined with model calculation |
| Ambient air assessment | Status monitoring | Quantitative prediction |
| Ecological environment assessment | Quadrat survey, information collection | Anology analysis, model calculation, ecological mechanism method |
| Social environment assessment | Information collection, survey and analysis | |

### 1.10.2. EIA Process

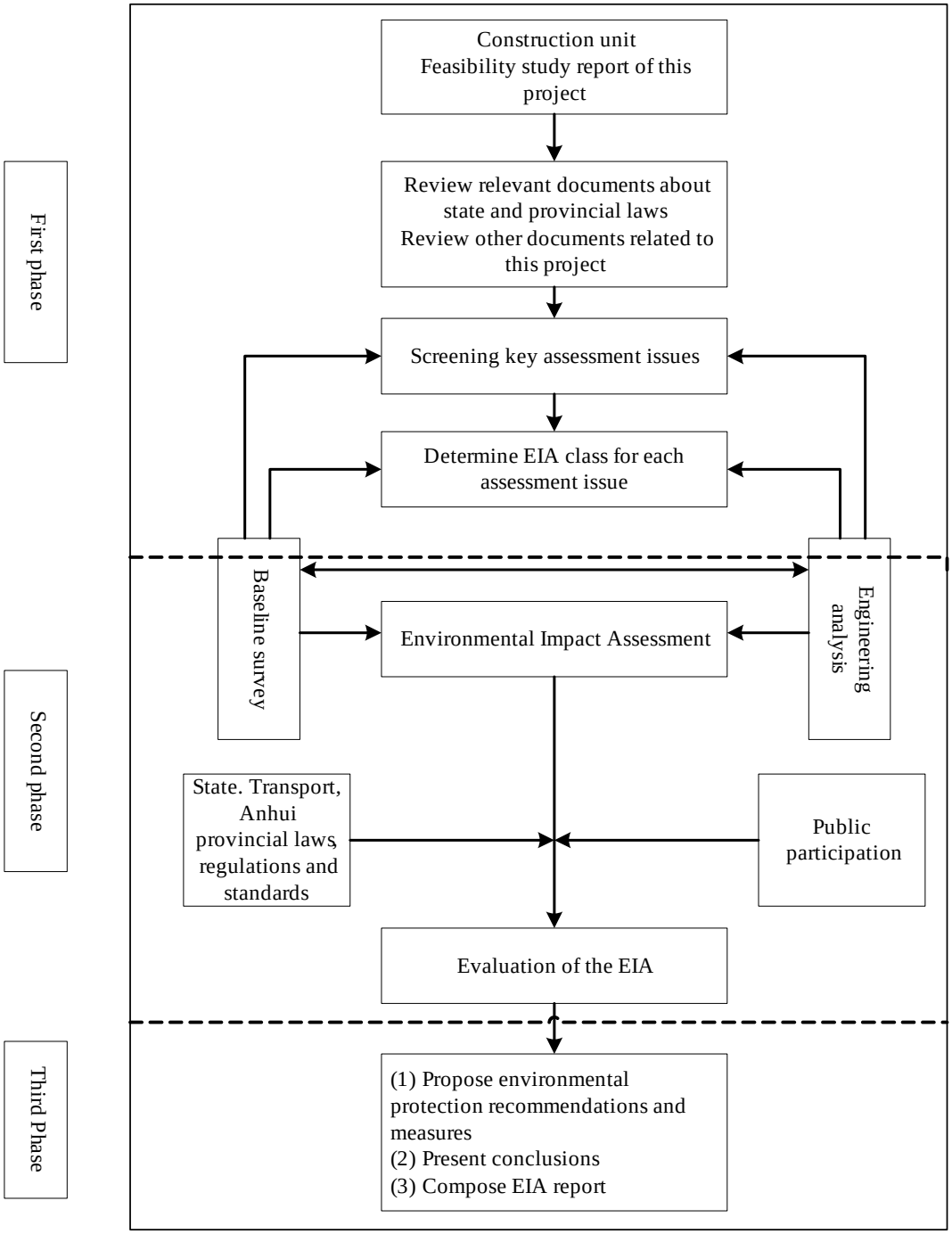



**Fig. 1-1 EIA Process**

# 2. Project Description

## 2. 1. Name and Type of the Project

Name: Anhui Shaying River Channel (Changshenggou - Mohekou) Improvement Project

Type: new project

Construction standard: channel standard is Class IV. The design width of channel is 50m. The minimum design water depth is 2.8m. The minimum bend radius is 330m.

Investment: 1,905,805,500 RMB

Components: waterway dredging, rebuilding of bridges that block the navigation, embankment seepage prevention, bank protection, service areas, anchorage areas and navigation aids, etc.

## 2. 2. Prediction of Traffic Volume at Shaying River

Six cities are located in the economic hinterland of Shaying River, including Xuchang, Zhengzhou, Zhoukou, Luohe, Pingdingshan and Fuyang. There are rich resources in hinterland of Shaying River, which is the important base for coal, chemical industry and commodity grain in China. There exist more than 50 kinds of mineral resources in this area, including coal, bauxite, iron ore, salt mine, cement limestone, etc. The prediction of traffic volume at Shaying River is shown in Table 2-1, in which chemicals are mainly Methanol, Carbamide and Synthetic Ammonia.

**Table 2-1 Prediction of traffic volume at Shaying River**

(Unit: 10,000 ton)

| Cargo kinds | 2020 | | | 2030 | | |
|---|---|---|---|---|---|---|
| | Upstream | Downstream | Total | Upstream | Downstream | Total |
| Coal | 0 | 750 | 750 | 0 | 900 | 900 |
| Mining and construction materials | 360 | 0 | 360 | 450 | 0 | 450 |
| Chemicals | 10 | 60 | 70 | 15 | 90 | 105 |
| Other | 75 | 145 | 220 | 115 | 230 | 345 |
| Total | 445 | 955 | 1400 | 580 | 1220 | 1800 |

## 2.3. Key Technical Indicators

The Key economic and technical indicators of the Shaying River Channel Improvement Project are listed in Table 2-2.

**Table 2-2 Economic and Technical Indicators of the Shaying River Channel Improvement Project**

| No. | Item | | Unit | Indicator | | | |
|---|---|---|---|---|---|---|---|
| | | | | Changshenggou--Genglou | Genglou-Fuyang | Fuyang-Yingshang | Yingshang-Mohekou |
| **A** | **Designed water level□Huanghai Sea elevation□** | | | | | | |
| 1 | Designed highest navigable level (Frequency: 10%) | | m | 36.75□35.86 | 35.66□31.4 | 31.1□27.13 | 27.05□25.47 |
| 2 | Designed lowest navigable level (Guaranteed rate: 95%) | | m | 28 | 24.5□23.65 | 19.5□19.13 | 17.0 |
| **B** | **Mileage** | Sections | km | 26.8 | 54.5 | 79 | 45.3 |
| | | Total | km | 205.6 | | | |
| **C** | **Ship and fleet** | | tonnage | Short-term□1 tug (4-7)*(500-600 ton) fleet, 500-ton single-vessel | | | |
| | | | | Long-term□1 pusher 2*(500-600 ton) fleet, 500-ton single-vessel | | | |
| **D** | **Channel scale** | | | | | | |
| 1 | Designed channel width | | m | 50 | | | |
| 2 | Designed channel water depth | | m | 2.8 | | | |
| 3 | Minimum bend radius | | m | 330 | | | |
| **E** | **Bridge rebuilding** | | | 4 | | | |
| | | | | Structure | | Original navigable span | Rebuilt navigable span |
| 1 | Jieshou City Yumin Bridge | | / | Variable cross-section V-type rigid frame pier | | 2*(32m*2.6m) | 90m*7m |
| 2 | S204 Jieshou Shahe Bridge | | / | Reinforced concrete arch truss | | 2* (30m*2.55m) | 90m*7m |
| 3 | Taihe County Shahe Bridge | | / | Reinforced concrete hyperbolic arch | | 2* (40m*1.76m) | 90m*7m |
| 4 | G105 Taihe Shahe II Bridge | | / | Reinforced concrete arch truss | | 2* (50m*4.87m) | 90m*7m |
| **F** | **Key channel construction works** | | | | | | |
| 1 | Channel earthwork | | $10^4$ $m^3$ | 1,836.6 | | | |
| 2 | Embankment earthwork | | $10^4$ $m^3$ | 13.0 | | | |

| No. | Item | Unit | Indicator | | | |
|---|---|---|---|---|---|---|
| | | | Changshenggou--Genglou | Genglou-Fuyang | Fuyang-Yingshang | Yingshang-Mohekou |
| 3 | Slope protection | $10^4$ $m^3$ | 138.3 | | | |
| 4 | Cofferdam | $10^4$ $m^3$ | 233.8 | | | |
| 5 | Embankment seepage prevention | $10^4$ $m^3$ | 27.6 | | | |
| 6 | Permanent land expropriation | Mu | 1780.4 (Channel: 708.4; Service area: 973.4; Bridge: 98.6) | | | |
| 7 | Temporary land expropriation | Mu | 9831.3 | | | |
| 8 | Building demolition | $m^2$ | 30,392.2 | | | |
| **G** | **Estimated total dynamic investment** | $10^4$ RMB | 190,580.55 | | | |

## 2.4. Project Components

### 2.4.1. Channel Improvement Works

#### 2.4.1.1. Channel Construction Standards

The Shaying River is a national high level channel and it is planned to be improved to Class IV according to “Layout Plan of National Inland Waterway Channel and Port” promulgated jointly by National Development and Reform Commission and Ministry of Transport, and “Navigation Development Plan of Anhui Inland Waterway (2005-2020)” approved by Anhui People’s Government (Document No.37 of Anhui Government Office in 2006). Thus, the construction standard of the Shaying River Section in Anhui Province is determined as natural and canalized river of Class IV.

(1) Designed water level

**Table 2-3 Designed water level of the Shaying River Channel**

| Item | Highest navigable water level | Lowest navigable water level | Note |
|---|---|---|---|
| Jieshou-Upstream of Genglou gate | 36.75□35.86 | 28.0 | Frequency of Designed highest navigable level is 10%; Guaranteed rate of Designed lowest navigable |
| Downstream of Genglou gate - Upstream of Fuyang gate | 35.66□31.40 | 24.35 | |

| | | | |
|---|---|---|---|
| Downstream of Fuyang gate -Upstream of Yingshang | 31.10□27.13 | 19.13 | level is 95%. |
| Downstream of Yingshang gate - Mohekou | 27.05□25.47 | 17.0 | |

(2) Channel water depth

It is recommended that the designed channel water depth of the Shaying River is 2.8m.

(3) Channel Width

According to “Navigation Standard of Inland Waterway”, the width of straight channel sections of the Class IV dual-channel should be 50m in this project. The width of curved channel sections should be determined based on the bend radius.

(4) Minimum bend radius

According to “Navigation Standard of Inland Waterway”, the minimum bend radius of the Shaying River channel should be 330m in this project.

(5) Headroom of crossing river structures

Single navigable span should be 90*7.0m (clear width*headroom). Dual navigable span should be 45*7.0 (clear width*headroom). Navigable spans at curved sections or sections where the angle between bridges to flow direction is more than 5º should be widened. The width needs to be demonstrated.

#### 2.4.1.2. Designed Typical Ship Type

The short-term designed ship type is 500-ton motor barge and 4~7*500-ton fleet with one tug. The long-term designed ship type is 500-ton motor barge and 2*500-ton fleet with one pusher.

#### 2.4.1.3. Chuter Cutoff

Twelve sections need chuter cutoff in this project (see Table 2-4).

**Table 2-4 Position list of Chuter Strippling/Cutoff in This Project**

| No. | Place | Starting point | End point | Length (m) | Shore side | Note |
|---|---|---|---|---|---|---|
| 1 | Weiyao Village, Tianying Town, Jieshou City | K9+600 | K9+900 | 300 | Right | Chuter cutoff |
| 2 | Datao Village, Wenji Town, Yingquan District | K40+850 | K41+000 | 150 | Right | Chuter cutoff |
| 3 | Xiazhangwan Village, Zhaoji Country, Yingquan District | K45+050 | K45+500 | 450 | Left | Chuter cutoff |
| 4 | Chendian, Wenjin Town, Yingquan District | K46+800 | K47+300 | 500 | Right | Chuter cutoff |

| No. | Place | Starting point | End point | Length (m) | Shore side | Note |
|---|---|---|---|---|---|---|
| 5 | Fanying Village, Ninglaozhuang Town, Yingquan District | K64+900 | K65+500 | 600 | Right | Chuter cutoff |
| 6 | Gaowan Village, Sanshilipu Town, Yingzhou District | K98+300 | K98+800 | 500 | Right | Chuter cutoff |
| 7 | Zhangdianyuzi Village, Koumu Town, Yingdong District | K107+250 | K107+950 | 700 | Left | Chuter cutoff |
| 8 | Puxiawan Village, Liushilipu, Yingshang County | K112+250 | K112+650 | 400 | Right | Chuter cutoff |
| 9 | Sanwan Village, Huangqiao Town, Yingshang County | K144+450 | K144+900 | 450 | Left | Chuter cutoff |
| 10 | Fangzhou Village, Balihe Town, Yingshang County | K164+750 | K165+150 | 400 | Right | Chuter cutoff |
| 11 | Jinyumu Village, Yanghu Town, Yingshang County | K201+950 | K202+400 | 450 | Left | Chuter cutoff |
| 12 | Weicixin River connected | | | | Left | Chuter cutoff |

### 2.4.2. **Dredging Works**

#### 2.4.2.1. Dredging Volume

The total dredging volume of the Shaying River Channel Improvement Project is 18,367,000 $m^3$, including 1,832,000 $m^3$ earthwork from chuter cutoff and demolition of old embankments, and 9,928,000 $m^3$ earthwork from channel dredging. Earthwork volume at service areas and anchorage areas is 4,627,000 $m^3$. During the construction phase, siltation is 500,000 $m^3$ and natural siltation is 1,480,000 $m^3$. Dredging depth of the channel is 0.2-6 m. The sediment is mainly composed of clay and the disposal distance is 1-4 km.

#### 2.4.2.2. Dredging location

The distribution of river dredging project is shown in Table 2-5.

**Table 2-5 Dredging location**

| Starting & end point | Dredging or not | Dredging type | average depth of dredging |
|---|---|---|---|
| K0+000-K9+600 | no | | |
| K9+600-K9+900 | yes | Chuter Cutoff | |
| K9+900-K38+400 | yes | Shallow Dredging point | |
| K38+400-K39+000 | yes | Overall Dredging segment | 0.6m |
| K39+000-K40+850 | no | | |
| K40+850-K41+000 | yes | Chuter Cutoff | |
| K41+000-K45+050 | yes | Shallow Dredging point | |
| K45+050-K45+500 | yes | Chuter Cutoff | |
| K45+500-K46+800 | yes | Shallow Dredging point | |
| K46+800-K47+200 | yes | Chuter Cutoff | |
| K47+200-K56+300 | yes | Shallow Dredging point | |
| K56+300-64+900 | yes | Overall Dredging segment | 0.5m |

| Starting & end point | Dredging or not | Dredging type | average depth of dredging |
|---|---|---|---|
| K64+900-K65+500 | yes | Chuter Cutoff | |
| K65+500-K80+000 | yes | Overall Dredging segment | 1.5m |
| K83+000-K98+300 | yes | Overall Dredging segment | 1.5m |
| K98+300-K98+800 | yes | Chuter Cutoff | |
| K98+800-K107+250 | yes | Overall Dredging segment | 1.2m |
| K107+250-K107+950 | yes | Chuter Cutoff | |
| K107+950-K112+650 | yes | Overall Dredging segment | 1.2 |
| K112+650-K123+400 | yes | Overall Dredging segment | 0.8m |
| K123+400-K126+000 | yes | Shallow Dredging point | |
| K126+000-K132+800 | yes | Overall Dredging segment | 1.3m |
| K132+800-K137+600 | yes | Shallow Dredging point | |
| K137+600-K140+700 | yes | Overall Dredging segment | 0.8m |
| K140+700-K144+450 | yes | Shallow Dredging point | |
| K144+450-K144+900 | yes | Chuter Cutoff | |
| K144+900-K154+300 | yes | Overall Dredging segment | 0.4m |
| K154+300-K155+400 | yes | Overall Dredging segment | ▪ ▪ 5.5m |
| K155+400-K159+000 | yes | Shallow Dredging point | |
| K162+000-K164+750 | yes | Overall Dredging segment | 0.8m |
| K164+750-K165+150 | yes | Chuter Cutoff | |
| K165+150-K167+800 | yes | Overall Dredging segment | 0.5m |
| K167+800-K172+400 | yes | Shallow Dredging point | |
| K172+400-K173+600 | yes | Overall Dredging segment | 1.5m |
| K173+600-K181+000 | yes | Shallow Dredging point | |
| K181+000-K187+000 | yes | Overall Dredging segment | 0.8m |
| K187+000-K201+950 | yes | Shallow Dredging point | |
| K201+950-202+300 | yes | Chuter Cutoff | |
| K202+300-205+345 | no | | |

2.4.2.3. Technics of Dredging Work

Underwater dredging is applied to dredge sediment in this project using cutter suction dredger. The diameter of cutter head of medium and small dredgers for construction in inland waterway is shorter than 1.5m. Generally speaking, the operation area is small with small waves, so precise setting, operating and controlling are feasible. 200-400 $m^3$/h cutter suction dredgers are used at river sections where dredging volume is magnitude and 80$m^3$/h cutter suction dredger is used at river sections with small dredging volume. Both types of dredgers begin onsite working at sections with medium or low water level. Grab dredgers are used as assistant devices at some bridge sites where earthwork is small.

### 2.4.3. **River Bank and Slope Protection Works**

□1□Bank Protection Plan

The river bank protection works in this project mainly focus on the embankments located at water flow impact points, narrow river sections and chuter cutoff sections. The bank protection plan for each section contains:

 Strengthening existing embankments of water conservancy projects

The channel improvement project involves waterway dredging, watercourse clearance as well as the chuter stripping/cutoff works at sections with small bend radius. These measures will cause the location change of the water flow impact points, and thus it is necessary to lengthen the embankment. According to the initial analysis, the location of water flow impact points will move toward to downstream. Therefore, 47 sites of embankments need to be lengthened 200m toward downstream with the same structure type as the water conservancy projects.

 Slope protection works at river sections where banks are narrow, where deep groove is close to banks, and where there is no or narrow beach in front of the banks

Interlocking solid concrete blocks are used for slope protection in this project at the river sections where where banks are narrow, where deep groove is close to banks, and where there is no or narrow beach in front of the banks.

 Slope protection works at sections with chuter cutoff/stripping and dropped back construction of sub-embankment.

Interlocking solid concrete blocks are used for slope protection at the river sections with chuter cutoff/stripping. The scope of slope protection at sections with chuter cutoff/stripping covers from the lowest navigable water level to 0.5m higher than the highest navigable level. The scope of slope protection at sections with dropped back construction of sub-embankment covers from the bottom sideline of waterway to 0.5m higher than the highest navigable water level.

Detailed bank protection positions are listed in Table 2-6.

**Table 2-6 Scope of Bank Protection Works**

| Shore side | Starting and end point at channel center | Length (m) |
|---|---|---|
| Right | K2+900□K3+200 | 200 |
| | K8+400□K8+700 | 300 |
| | K9+600□K9+900 | 300 |
| | K11+250□K11+750 | 500 |
| | K13+500□K13+900 | 400 |
| | K15+200□K15+500 | 300 |
| Left | K15+750□K16+150 | 400 |
| | K16+900□K17+200 | 300 |

| Shore side | Starting and end point at channel center | Length (m) |
|---|---|---|
| Right | K19+000□K19+275 | 275 |
| | K19+400□K19+550 | 150 |
| | K20+100□K20+350 | 250 |
| | K20+800□K21+100 | 300 |
| Left | K21+700□K22+300 | 600 |
| | K22+900□K23+350 | 450 |
| | K24+000□K24+200 | 200 |
| Right | K22+400□K23+100 | 700 |
| | K24+700□K25+150 | 450 |
| | K27+900□K28+300 | 400 |
| | K28+500□K29+100 | 600 |
| Left | K29+800□K30+250 | 450 |
| Right | K34+850□K35+250 | 400 |
| Left | K38+200□K38+375 | 175 |
| Right | K40+000□K40+350 | 350 |
| | K40+850□K41+000 | 150 |
| | K41+400□K42+100 | 700 |
| Left | K45+100□K45+550 | 450 |
| | K46+750□K47+200 | 450 |
| Right | K47+900□K48+200 | 300 |
| | K48+700□K49+400 | 700 |
| | K50+350□K50+950 | 600 |
| Left | K52+900□K53+750 | 850 |
| | K57+650□K58+250 | 600 |
| Right | K58+600□K59+200 | 600 |
| Left | K59+400□K59+950 | 650 |
| Right | K59+800□K60+400 | 600 |
| Right | K60+770□K61+020 | 250 |
| | K62+350□K62+450 | 100 |
| Left | K62+900□K63+200 | 300 |
| | K63+800□K64+200 | 400 |
| Right | K64+850□K65+550 | 700 |
| Left | K67+750□K68+100 | 350 |
| Right | K70+000□K70+450 | 450 |
| Right | K70+675□K70+775 | 100 |
| Right | K74+650□K74+850 | 200 |

| Shore side | Starting and end point at channel center | Length (m) |
|---|---|---|
| Right | K79+800□K80+200 | 300 |
| Right | K82+400□K83+000 | 600 |
| Left | K94+200□K94+550 | 350 |
| Left | K98+200□K98+550 | 350 |
| Right | K98+300□K98+550 | 250 |
| | K98+550□K98+800 | 200 |
| Left | K104+400□K105+000 | 600 |
| | K107+150□K107+925 | 750 |
| | K108+675□K109+225 | 550 |
| Right | K112+275□K112+675 | 400 |
| | K115+250□K115+600 | 350 |
| | K117+700□K118+550 | 850 |
| Left | K132+150□K132+650 | 500 |
| | K135+650□K136+850 | 200 |
| Right | K135+600□K136+050 | 450 |
| Left | K138+550□K139+000 | 450 |
| Right | K141+300□K141+850 | 550 |
| Left | K144+400□K144+900 | 500 |
| Right | K150+500□K150+700 | 200 |
| Right | K152+100□K152+500 | 400 |
| Right | K152+900□K153+800 | 900 |
| Left | K155+000□K155+250 | 250 |
| | K156+700□K157+100 | 400 |
| Left | K164+750□K165+150 | 400 |
| Left | K167+200□K167+700 | 500 |
| Left | K168+700□K169+150 | 450 |
| Left | K171+450□K172+450 | 1000 |
| | K173+300□K173+700 | 500 |
| Right | K175+300□K175+800 | 500 |
| Right | K176+250□K176+750 | 300 |
| | K176+750□K177+050 | 450 |
| Right | K179+000□K179+450 | 400 |
| Left | K184+800□K185+200 | 550 |
| Right | K185+300□K185+850 | 1050 |
| Right | K188+800□K189+850 | 450 |
| Right | K190+650□K191+100 | 600 |

| Shore side | Starting and end point at channel center | Length (m) |
|---|---|---|
| Right | K198+000□K198+600 | 500 |
| Right | K201+950□K202+400 | 450 |
| Total | | 36,700 |

### 2.4.4. Navigation Aids

213 navigation aids will be set at Anhui Shaying River Channel, including 60 lateral markers, 18 coastal signs, 62 whistle signs, 22 signboard, 32 bridge and culvert signs, 6 controlling gate signs, 1 position indicating beacon, 6 boundary signs, 2 special signs for anchorage areas and 4 place name signs.

### 2.4.5. Bridge Works

Currently, there are 18 bridges at the Shaying River section in Anhui, in which three are located in Jieshou, four in Taihe, seven in Fuyang and four in Yingshang. Among the 18 bridges, there are one railway bridge, two expressway bridges and fifteen others. According to investigation and analysis, four of these bridges need to be rebuilt, including Jishou City Yumin Bridge, Jieshou (Old S204) Shayinghe Bridge, Taihe County Shahe I Bridge and Taihe Yingshang Shahe II Bridge.

#### 2.4.5.1. Bridge Construction Standards

The bridge construction standards are determined in light of “General Specifications for Design of Highway Bridges and Culverts” (JTG D60-2004), “Specifications for Design of Highway Reinforced Concrete and Prestressed Concrete Bridges and Culverts” (JTJ D62□2004), and “Specifications for Survey and Design of Highway Bridge Site”, as well as current status of bridges and urban development plan. The standards are listed in Table 2-6.

After reconstruction, the bridge width and load rating should not be lower than current standards. Urban bridges are designed as Grade I load highway with longitudinal slope no more than 3.0%.

**Table 2-7 List of Bridge Construction Standards**

| No. | Building name | Rebuilding plan |
|---|---|---|

| | | Structure of main bridge | Width (m) | Clear width (Bm) | Headroom (Hm) | Quantity of navigable spans |
|---|---|---|---|---|---|---|
| 1 | Jishou City Yumin Bridge | Continuous beam (location of the new bridge) | 20 | 90 | 7 | 1 |
| 2 | Jieshou (Old S204) Shayinghe Bridge | Tied arch (location of the old bridge) | 20 | 90 | 7 | 1 |
| 3 | Taihe County Yinghe I Bridge | Steel cable (location of the old bridge) | 7 | 90 | 7 | 1 |
| | | Continuous beam (location of the new bridge) | 32 | 90 | 7 | 1 |
| 4 | Taihe Yingshang Yinghe II Bridge | Tied arch (location of the old bridge) | 27.5 | 90 | 7 | 1 |

### 2.4.5.2. Bridge Rebuilding Plan

□1□Jieshou City Yumin Bridge

**Fig. 2-1 Jieshou City Yumin Bridge**

According to the “Letter on Relevant Issues of the Shaying River Section in Jieshou Channel Improvement Project” signed by Jieshou People’s Government and considering much demolition of old bridge, the bridge site can not be set if the new bridge would be built 3m higher on the base of the old bridge elevation due to the too large longitudinal slope. In this project, the new bridge will be moved to Dongsheng Road after the old bridge is demolished. Local government will rebuild another bridge at the old bridge site. The length of the new bridge in this project is 906.5m and its width is 20m. It is designed as Grade I load highway. Variable cross-section continuous box beam structure is proposed for the main bridge. In-situ box beam

structure is proposed for approach bridges. In this proposal, building demolition is 5785 $m^2$ and land expropriation is 65.93Mu.

□2□Jieshou (Old S204) Shayinghe Bridge

After the old bridge is demolished, the new bridge is designed as Grade I load highway, the length of which is 327.5m and width of which is 20m. Tied arch with a span of 100m is proposed for the main bridge. 20m pre-stressed concrete T beams are proposed for approach bridges at both sides. In this proposal, building demolition is 16749$m^2$ and land expropriation is 6.2Mu.

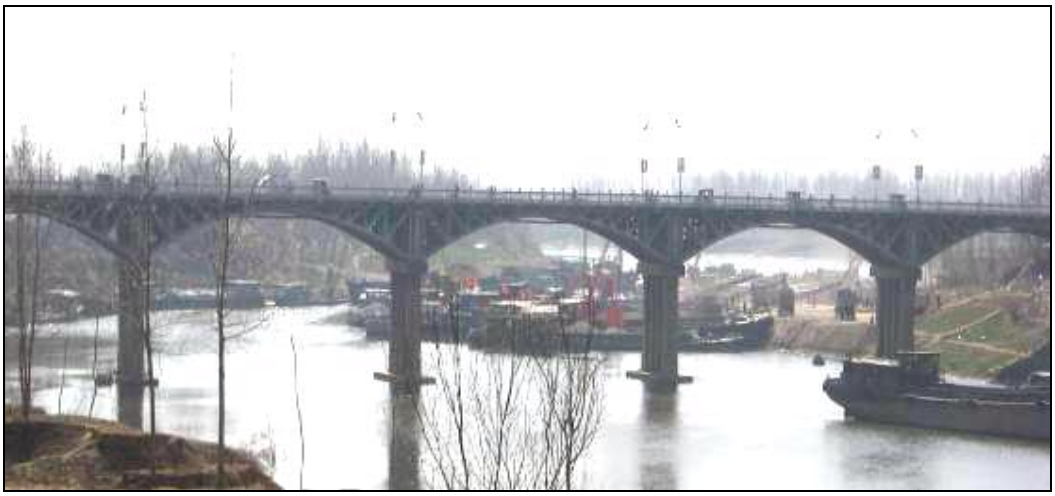


**Fig. 2-2 Jieshou (Old S204) Shayinghe Bridge**

□3□Taihe County Yinghe I Bridge

According to the "Response Letter to the Shaying River Section in Taihe Channel Improvement Project" and "Revised Response Letter to the Shaying River Section in Taihe Channel Improvement Project" signed by Jieshou People's Government, a new pedestrian bridge will be built at the original bridge site for residents' convenience. This bridge is designed as according to crowd load, the length of which is 238m and the width of which is 7m. The original old highway bridge will be rebuilt at 1.6km downstream from Taihe Yinghe II Bridge (i.e. Taihe County Yinghe IV Bridge). The structure of approach bridges will be simple supported beam first and then continuous small box beam. Continuous rigid frame variable height (60m+100m+60m) structure is proposed for the main bridge. The length of the main bridge is 1,027.5m and its width is 32m. In this proposal, building demolition is 6056 $m^2$ and land expropriation is 26.47Mu.

**Fig. 2-3 Taihe County Yinghe I Bridge**

（4）Taihe County Yinghe II Bridge

After the old bridge is demolished, the new bridge is designed as Grade I load highway, the length of which is 617.5m and width of which is 27.5m. Tied arch with a span of 100m is proposed for the main bridge. The structure of approach bridges at both sides will be simple supported beam first and then continuous small box beam. In this proposal, there is no building demolition and land expropriation.

**Fig. 2-4 Taihe County Yinghe II Bridge**

The details of bridge works are listed in Table 2-8.

**Table 2-8List of Details of Bridge Works**

| Bridge name | Length | Width | Building demolition ($m^2$) | Land expropriation (Mu) |
|---|---|---|---|---|
| Jieshou Dongsheng Road Bridge | 906.5 | 20.0 | 5785 | 65.93 |
| Jieshou (Old S204) Shangyinghe Bridge | 327.5 | 20.0 | 16749 | 6.2 |
| Taihe County Yinghe I Bridge | 238.0 | 7.0 | 0 | 0 |
| Taihe County Yinghe IV Bridge | 1027.5 | 32.0 | 6056 | 26.47 |
| Taihe County Yinghe II Bridge | 617.5 | 27.5 | 0 | 0 |
| Total | | | 28590 | 98.6 |

2.4.5.3. Transport Arrangement During the Construction Phase

In this project, there are four bridges need to be rebuilt, including two in Jieshou and two in Taihe.

 Yinghe Road located east of Daqiao South Road in Jieshou City and Dongsheng Road Bridge will be build simultaneously. The traffic can be diverged after the Dongsheng Road Bridge and its connection lines are being opened to traffic. The reconstruction of S204 Shayinghe Bridge can be facilitated as well. Yumin Bridge will be demolished after the completion of S204 Shayinghe Bridge.

 Taihe County Yinghe IV Bridge as well as the urban roads at both sides of this bridge will be built firstly by Taihe Government. The traffic can be diverged after the Yinghe IV Bridge and its connection lines are being opened to traffic. The reconstruction of Yinghe II Bridge can be facilitated as well. Yinghe I Bridge will be demolished and a pedestrian bridge will be built at the original site after the completion of Yinghe II Bridge.

### 2.4.6. Service Area and Anchorage Area Works

Eight anchorage areas and service areas are set in light of situations of Shaying River channel, hubs along the river and planned operation areas. These include two water service areas (Fuyang Guozhuang Service Area and Sanshilipu Service Area), four lock-waiting anchorage areas (Genglou Ship Lock Upstream Anchorage Area, Genglou Ship Lock Downstream Anchorage Area, Yingshang Ship Lock Upstream Anchorage Area, Yingsang Ship Lock Downstream Anchorage Area), two port-waiting anchorage areas (Xuzhai Anchorage Area and Taihe Chengguan Anchorage

Area). The total area of anchorage and service areas is 920.3 Mu, including 764.1Mu overflow land and 156.2 Mu land.

(1) Function

① Function of Shying River Water Service Area

Taking into account the long-term development of transportation at the Shaying River, in short term the first function of water service areas is vessel service, i.e. adding oil, adding water, ship maintaining, parking and garbage disposal, etc. The second function is to serve watermen, including buying commodities and seeing a doctor. The third function is industry management, including water safety and vessel visa, etc. Long-term function could be extended (including information communication and cultural life of watermen, etc.)

In order to meet above requirements, Shaying River water service area should include anchorage zone, terminal for managing ship, office zone, service zone for waterman, maintaining zone, commodity supply zone, adding oil and water zone and garbage recycling zone.

 Function of Anchorage Area

Main functions of anchorage area are to serve vessels passing the ship lock or handling cargo. Anchorage area should meet requirements of parking and navigation safety when vessels are waiting to go into the port or pass through the lock. Port-waiting anchorage areas mainly include parking zones.

(2) Project Scale

Table 2-9 presents the scales of service areas and anchorage areas.

**Table 2-9 Scales of Service Areas and Anchorage Areas**

| Name | | Position | Length (m) | Distance to channel center (m) |
|---|---|---|---|---|
| Service area | Guozhuang Service Area | Right bank of Shaying River K74 | 570 | 145 |
| | Sanshilipu Service Area | Right bank of Shaying River k92, Jianglaowo, Linying Village, Yuanzhai Town | 858 | 135 |
| Lock-waiting anchorage area | Genglou Ship Lock Upstream Anchorage Area | Right bank of Shaying River k25+500, Genglou Ship Lock 0.6 km upstream | 458 | 125 |

| Name | | Position | Length (m) | Distance to channel center (m) |
|---|---|---|---|---|
| | Genglou Ship Lock Downstream Anchorage Area | Left bank of Shaying River k28+500, Genglou Ship Lock 1.4 km downstream | 458 | 105 |
| | Yingshang Ship Lock Upstream Anchorage Area | Right bank of Shaying River k158+300, Yingshang Ship Lock 1.3 km upstream | 514 | 125 |
| | Yingsang Ship Lock Downstream Anchorage Area | Left bank of Shaying River k162+700, Yingshang Ship Lock 2.4 km downstream | 794 | 135 |
| Port-waiting anchorage area | Xuzhai Anchorage Area | Xuzhai Operation Area 2 km upstream, Renwan, Left bank of Shaying River | 570 | 135 |
| | Taihe Chengguan Anchorage Area | Left bank of Shaying River k37+700, Taihe Shahe Bridge 600m upstream | 290 | 75 |

### 2.4.7. Ferry Strengthening and Rebuilding Works

About 120 ferries will be set along the Shaying River channel, among which 23 will have heavy traffic volume. Vessels are parked by the slope of river banks at most of the ferries. The navigation density will be higher after the channel improvement, so the existing ferries need to be strengthened and rebuilt for safety. Simple structures for ferry parking and people boarding will be set as well as the connection lines for people stepping. The lines will be 4m wide and connected with county and country roads.

### 2.4.8. Disposal Area

#### 2.4.8.1. Siting Principles for Disposal Area

(1) Select low-lying land and overflow land to save investment. Prohibit land take of protected basic farmlands. Reduce land take of arable lands.

(2) Fill pond and strengthen base to reach requirements of water conservancy and flood protection and to relieve stress on flood control.

(3) Satisfy environmental protection and urban construction requirements. Prevent pollution from mud slurry.

(4) Satisfy construction conditions and meet relevant specifications and requirements.

(5) Implement land leveling for abandoned earthwork promptly in order to reduce land take of farmland.

(6) To the extent possible use borrow pits made from embankment strengthening in order to reduce temporary land take.

2.4.8.2. Disposal Area Settings

In total 34 disposal areas are select for the disposal of dredging materials. The settings of disposal areas of this project are presented in Table 2-10.

**Table 2-10 Settings of Disposal Areas**

| No. | Position | Source of mud | Disposal volume ($m^3$) | Disposal height(m) | Temporary land-take(Mu) |
|---|---|---|---|---|---|
| 1 | Renwan Village, Dongcheng Street, Jieshou City | Xuzhai Anchorage Area | 672336 | 3 | 368.4 |
| 2 | Weiyao Village, Tianying Town, Jieshou City | K0+000-K10+000 and Genglou Lock anchorage area (upstream) | 424832 | 3 | 219.9 |
| 3 | Zhuzhuang Village, Daxin Town, Taihe County | K28+000-K33+000 and Genglou Lock anchorage area (downstream) | 755657 | 3 | 418.4 |
| 4 | Daliu Village, Daxin Town, Taihe County | K36+000-K40+000 and Taihe Chengguan Anchorage Area | 235260 | 3 | 106.2 |
| 5 | Datao Village, Yingdong district, Fuyang City | K40+000-K48+000 | 662010 | 3 | 362.2 |
| 6 | Sanliqiao Village, Ninglaozhuang Town, Yingquan District, Fuyang City | K48+000-K62+000 | 352990 | 3 | 176.8 |
| 7 | Fanying Village, Ninglaozhuang Town, Yingquan District, Fuyang City | K62+000-K67+000 and Guozhuang Service Area | 1365865 | 3 | 784.5 |
| 8 | Fanying Village, Ninglaozhuang Town, Yingquan District, Fuyang | Cihuaixin River connected | 411235 | 3 | 211.8 |
| 9 | Baimiao Village, Ninglaozhuang Town, Yingquan District, Fuyang City | K67+000-K72+000 | 464491 | 3 | 243.7 |
| 10 | Wangzhuang Village, Yingquan District, Fuyang city | K72+000-K76+000 | 852843 | 3 | 476.7 |
| 11 | Dukou Village, Yingquan District, Fuyang City | K76+000-K80+000 and Quan River connected | 552414 | 3 | 296.5 |
| 12 | Huayuan Village, | K83+000-K86+000 and | 1873302 | 3 | 1089.0 |

| No. | Position | Source of mud | Disposal volume ($m^3$) | Disposal height(m) | Temporary land-take(Mu) |
|---|---|---|---|---|---|
| | Yingzhou District, Fuyang City | Sanshilipu Service Area | | | |
| 13 | Zhaozhuang Village, Yingdong District, Fuyang City | K86+000-K92+000 | 626149 | 3 | 340.7 |
| 14 | Yuanzhai Village, Yingdong District, Fuyang City | K92+000-K95+000 | 371260 | 3 | 187.8 |
| 15 | Gaowan Village, Yingzhou District, Fuyang City | K95+000-K102+000 | 1070901 | 3 | 607.6 |
| 16 | Louxiao Village, Wushipu, Yingshang County | K102+000-K105+000 | 395000 | 3 | 202.0 |
| 17 | Ningda Village, Liushipu, Yingshang County | K105+000-K108+000 | 864755 | 3 | 483.9 |
| 18 | Zhouzhuang Village, Liushipu, Yingshang County | K108+000-K112+000 | 428986 | 3 | 222.4 |
| 19 | Wanghai Village, Yingdong District, Fuyang City | K112+000-K115+000 | 382189 | 3 | 194.4 |
| 20 | Sugou Village, Xinji Town, Yingshang County | K115+000-K118+000 | 309588 | 3 | 150.8 |
| 21 | Wangzhuang Village, Xinji Town, Yingshang County | K118+000-K121+000 | 227842 | 3 | 101.8 |
| 22 | Huangying Village, Xinji Town, Yingshang County | K121+000-K124+000 | 199069 | 3 | 84.5 |
| 23 | Fanzhuang Village, Xinji Town, Yingshang County | K124+000-K130+000 | 331539 | 3 | 164.0 |
| 24 | Xiwan Village, Jianying Country, Yingshang County | K130+000-K135+000 | 263726 | 3 | 123.3 |
| 25 | Chentaizi Village, Gucheng Country, Yingshang County | K135+000-K140+000 | 192524 | 3 | 80.6 |
| 26 | Haizi Village, Jianying Country, Yingshang County | K140+000-K143+000 | 187973 | 3 | 77.8 |
| 27 | Lianggang Village, Huangqiao Town, Yingshang County | K143+000-K147+000 | 708041 | 3 | 389.9 |
| 28 | Bianmei Village, Shibalipu, Yingshang County | K147+000-K157+000 | 196733 | 3 | 83.1 |
| 29 | Xiayuan Village, Balihe Town, Yingshang County | K157+000-K162+000 and anchorage area at upstream of Yingshang Gate | 481627 | 3 | 254.0 |
| 30 | Sanba Village, Balihe Town, Yingshang County | K162+000-K168+000 and Longwangmiao anchorage area | 1460553 | 3 | 841.3 |
| 31 | Yantai Village, Balihe Town, Yingshang County | K168+000-K174+000 | 170704 | 3 | 67.5 |
| 32 | Jianliu Village, Xinliuji Town, Yingshang County | K174+000-K185+000 | 302030 | 3 | 146.3 |
| 33 | Zhaolou Village, Yanghu Town, Yingshang County | K185+000-K196+000 | 193147 | 3 | 80.9 |
| 34 | Baliduo Village, Saijian | K196+000-K205+000 | 378780 | 3 | 192.3 |

| No. | Position | Source of mud | Disposal volume ($m^3$) | Disposal height(m) | Temporary land-take(Mu) |
|---|---|---|---|---|---|
| | Hui Ethnic Town, Yingshang County | | | | |
| Total | | | 18366351 | | 9831.3 |

2.4.8.3. Works in disposal areas

(1) Cofferdam at disposal area

Cofferdams at disposal areas are not permanent, so it is suitable to collect soil in situ and to build the cofferdams. Clay is the key soil component of banks along Shaying River. The scales of cofferdams are determined in accordance with relevant specifications and characteristics of machinery. Inner slope is 1:3 and back slope is 1:3 with 4m-wide tops. The height of cofferdams is 3.5m (with 0.5m adding-hight). The cofferdams are built in dry lands. Soil for construction is collected in situ using machinery. Water drainages at disposal areas are set in light of terrain, shape of the area, settings of mud slurry discharge pipes and mud capacity. Water drainages can be installed at places that are far away from mud slurry discharge openings or at blind angles in disposal areas. This is good for lengthening mud slurry flow, sediment deposition and water discharge conditions.

When water in disposal area is discharged out of the cofferdams, in general, it flows back to river channel through existed ditches for water conservancy. New drainage ditch should be built if there is no existing channel for discharge to river.

(2) Discharge distance and height

According to the layout of disposal areas along the region, the maximum discharge distance is 2,000m and the average distance is 1,000m. The discharge height is 10-14m at low water level.

## 2.5. Construction Methods and Process

### 2.5.1. Sources of Construction Materials

Construction material productions are lacking at regions along both sides of banks of Shaying River. The construction materials for this project need to be purchased from other places. Steel and cement productions can be bought in Jieshou City, Taihe County, Fuyang City and Yingshang County and transported to construction sites by vehicles. Stone and gravel can be purchased at quarries at Fengtai Dashang and Huaiyuan Jinshan and transported to construction sites by

vessels. Yellow sand can be bought at port quarries along the river. Precast concrete blocks can be produced in precasting plant built at sections where construction materials are abundant, and transported to construction sites by vessels.

### 2.5.2. Construction Arrangement

In this channel improvement project, due to the line is long, the construction sites are scattered and the centralized setting of construction sites and temporary constructions is infeasible.

(1) During dredging, the work place is on the dredger and workers stay in dorm ships. Buildings are offices and places for temporary material piling. Such buildings can be rent for transport convenience along the project region.

(2) Bridge rebuilding works are designed as demolishing old bridges and rebuilding new ones in situ. The existing transport conditions on site can meet the requirements. Original connection lines of old bridges can be used for temporary construction sites. Nearby residential houses can be rent for project management offices.

(3) Earthwork machinery mainly includes excavators and dump truck. The transport distance is no more than 3km. Roads that go into the construction sites should be built first.

### 2.5.3. Construction Phase

Though the project components are rather straightforward, the construction will last 4 year, mainly because the navigation will continue during the time, and dreading will take place seasonally and sectionally. The project is scheduled to start at the end of 2010 and will be completed and submitted for acceptance in 2014.

# 3. Engineering Analysis

## 3.1. Analysis of Environmental Impact Factors

### 3.1.1. Analysis of environmental impact factors and Identification of Impact Significance

The key negative impacts that Shaying River Channel Improvement Project will have on the environment include: (1) soil erosion caused by slope protection works; (2) disturbance of contaminated sediment induced by dredging work- which may result in resuspension of sediment particles and release of some contaminations; (3) direct impacts on aquatic organism, especially benthos, caused by dredging works; (4) land-takes of sediment pile yard; (5) impacts of odor pollutant emissions and fuel emissions from dredger on ambient air; (6) secondary pollution of residual water from pile yard; (7) noise from construction machines; (8) impacts of sludge and earthwork transportation on transport; (9) impacts on local economy; (10) impacts of restoration of pile yards on land use and landscape.

Table 3-1 indicates that this project's effects on the environment are comprehensive and diverse, including positive and negative ones, direct and indirect ones as well as short-term and long-term effects. During the construction phase, major impacts are negative. However, when the improvement and dredging are completed, the water depth of Shaying River will increase and the water will flow faster in the channel due to the removal of sediment and garbage in the water. The hydrodynamic conditions of Shaying River will be improved meanwhile. Inner material and energy exchange will be accelerated, so that water quality of Shaying River can be improved and aquatic biodiversity can be increased. Meanwhile, reclamation and landscaping can also improve landscape in this region. Overall navigation at Shaying River will be facilitated after the implementation of this project, which can promote regional economic development. To conclude, this project will have positive social, economic and environmental effects.

**Table 3-1 Identification of Environmental Impact Factors and Impact Significance for the Channel Improvement Project**

| Impact analysis \ Env. impact factors | | Construction phase | | | | | | | | Operation phase | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Slope protection | Dredging | Sediment transportation | Construction of pile yard | Sediment piling | Residual water discharge | Temporary land-take | Land expropriation | Sediment piling | Sediment use | Land development | Pile yard facility | Permanent land-take | Use of water source |
| Natural resources | Soil | -1 | 0 | 0 | -1 | -2 | -1 | 0 | 0 | -2 | +1 | -1 | 0 | 0 | 0 |
| | Groundwater | 0 | 0 | 0 | 0 | -1 | 0 | 0 | 0 | -1 | 0 | 0 | 0 | 0 | 0 |
| | Surface water | -1 | -2 | 0 | -1 | -2 | -2 | 0 | 0 | -2 | 0 | -2 | -1 | 0 | +3 |
| | Ambient air | -1 | -1 | 0 | -1 | -2 | 0 | 0 | 0 | -2 | +1 | 0 | 0 | 0 | 0 |
| | Acoustic environment | -1 | 0 | -2 | -1 | 0 | | 0 | 0 | 0 | 0 | -1 | 0 | 0 | 0 |
| Ecological resources | Urban environment | -1 | -2 | 0 | -1 | -2 | 0 | 0 | 0 | -1 | +2 | +1 | 0 | -1 | +1 |
| | Urban landscape | -1 | -2 | -2 | -2 | -2 | 0 | 0 | 0 | -2 | +3 | +2 | -1 | -1 | +2 |
| | Anhui Taihe Shaying River National Wetland Park | 0 | -2 | -2 | 0 | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | +2 |
| | Agro-ecological environment | 0 | 0 | 0 | -1 | -2 | 0 | 0 | 0 | -2 | -1 | -1 | 0 | -1 | +1 |
| | Aquatic ecological environment | -1 | -3 | 0 | -1 | -2 | -2 | 0 | 0 | 0 | 0 | 0 | 0 | -1 | +2 |
| Societal issues | Land use | -1 | 0 | 0 | -1 | -2 | 0 | -2 | -2 | -2 | +1 | +2 | 0 | -1 | +2 |
| | Industrial development | 0 | 0 | 0 | 0 | 0 | 0 | -2 | -2 | 0 | 0 | +2 | -1 | -1 | +2 |
| | Agricultural development | 0 | 0 | 0 | -1 | -2 | 0 | -2 | -2 | -2 | +1 | -1 | -1 | -1 | +2 |
| | Transport and navigation | -1 | -2 | -2 | -1 | 0 | 0 | -1 | -1 | 0 | 0 | -1 | -1 | -1 | +2 |
| Life quality | Tourism and leisure | 0 | -2 | -2 | -2 | -2 | -1 | 0 | 0 | -1 | +3 | +2 | -1 | -1 | +2 |
| | Health and safety | -1 | -1 | 0 | -1 | -2 | -2 | 0 | 0 | -1 | 0 | +1 | 0 | 0 | +2 |
| | Socio-economic issues | 0 | 0 | 0 | 0 | 0 | 0 | -2 | -2 | -1 | +1 | +2 | 0 | -1 | +2 |
| | Living standard | 0 | 0 | 0 | 0 | 0 | 0 | -1 | -1 | 0 | +1 | +2 | 0 | 0 | +2 |

Note: the impact significance is indicated by numbers in the above table. “0” indicates no effect. “1” indicates minor effects. “2” indicates medium effects. “3” indicates major effects. “+” indicates positive impacts and “-” indicates negative impacts.

### 3.1.2. Analysis of Environmental Impact Factors for This Project

The analysis results of environmental impacts of this Channel Improvement Project are presented in Table 3-2. Adverse impacts of this project mainly occur

during the construction phase, almost of which are reversible and partial impacts, most of which are short-term effects. Positive impacts will be shown out after the completion of improvement and dredging works. They are long-term and comprehensive effects. Thus, after the implementation of this Channel Improvement Project, its positive effects will dominate.

**Table 3-2 Character of Impacts of This Channel Improvement Project**

| Impact analysis \ Environmental factors | | Negative impact | | | | | | Positive impact | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Short-term | Long-term | Reversible | Irreversible | Partial | Comprehensive | Short-term | Long-term | Comprehensive | Partial |
| Natural resources | Soil | | □ | □ | | □ | | | | | |
| | Groundwater | | □ | □ | | □ | | | | | |
| | Surface water | □ | | □ | | □ | | | □ | □ | |
| | Ambient air | □ | | □ | | □ | | | □ | □ | |
| | Acoustic environment | □ | | □ | | □ | | | | | |
| Ecological resources | Urban environment | □ | | □ | | □ | | | □ | □ | |
| | Urban landscape | □ | | □ | | □ | | | □ | □ | |
| | Anhui Taihe Shaying River National Wetland Park | □ | | □ | | □ | | | □ | □ | |
| | Agro-ecological environment | □ | | □ | | □ | | | □ | □ | |
| | Aquatic ecological environment | □ | | □ | | □ | | | □ | □ | |
| Societal issues | Land use | | □ | □ | | □ | | | □ | | □ |
| | Industrial development | □ | | □ | | □ | | | □ | □ | |
| | Agricultural development | □ | | □ | | □ | | | □ | □ | |
| | Transport and navigation | □ | | □ | | □ | | | □ | □ | |
| Life quality | Tourism and leisure | □ | | □ | | □ | | | □ | □ | |
| | Health and safety | □ | | □ | | □ | | | □ | □ | |
| | Socio-economic issues | □ | | □ | | □ | | | □ | □ | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Living standard | □ | | □ | | □ | | | □ | □ | |

Note: "□" indicates that the impact exist.

### 3.1.3. Analysis of Environmental Constrains to the Project

The Shaying River channel is the largest tributary of the Huai River and located at its left bank, with 206km and 4,112 $km^2$ basin area located in Anhui Province. The channel starts from Changshenggou in Jieshou City and goes through Taihe County, Fuyang City, and joins the Huai River at Mohekou in Yingshang County. The air quality in this region is currently good according to ambient air monitoring data. The heavy metal content in sediment at disposal areas is low and there is no residential area in their surrounding region with a radius of 50m, so these areas can be developed as farmland or forest land. Thus, constrains from ambient air, acoustic environment and solid waste to this project is relatively limited. Through site investigation, the EIA team found there is no drinking water intake at the Shaying River. The source of domestic water use of residents in this region is gourndwater or urban water supply system. During the construction phase of this project, the sediment will be piled at disposal area. The taking of some lands and water area will destroy original status of this area. Soil erosion will be exacerbated in short term. However, these adverse impacts can be minimized through prevention and mitigatory measures.

## 3.2. Identification of Environmental Impact

### 3.2.1. Identification of Environmental Issues

At design stage, designers need to avoid environmental impacts, with reasonable design of channel and embankment as well as prevention and protection works. Such design can not only effectively control adverse environmental impacts, but also can guarantee construction of channel and embankments.

At construction stage, the main environmental include: impacts of construction noise on construction sites and its surrounding regions, impacts of road dust on air quality, impacts of sediment piling on ecological environment and plants; impacts of channel improvement on Anhui Province Taihe County Shaying River National Wetland Park and nearby eco-systems, and impacts of domestic and process wastewater on surface water environment.

At operational stage, environmental issues mainly include: impacts of domestic wastewater of staff at service areas on surface water quality, impacts of odor pollution at disposal area on air quality, and noise impacts of vessels on sites at both sides of the banks.

The environmental impacts at different phase of this project are summarized in Table 3-3.

**Table 3-3 Identification of Environmental Impacts of This Project**

| **Project process** | | **Possible environmental impacts** | **Environmental factors** |
|---|---|---|---|
| Design phase | | Setting of channel and embankment; land-take | Land use; natural landscape, etc. |
| Construction phase | Land expropriation and demolition | Land loss; demolition of buildings and public facilities, etc. | Socio-economic issues; ecological environment (agriculture, forest) |
| | Earthwork | Soil erosion; plant destruction, etc. | Ecological environment, Anhui Province Taihe County Shaying River National Wetland Park |
| | Embankment and slope protection, channel dredging, etc | Dust; odor pollutant emissions; waste gas, noise, surface water | Ambient air; ecological environment, acoustic environment, surface water environment; Anhui Province Taihe County Shaying River National Wetland Park |
| | Bridge works | Noise; construction wastewater etc. | Water and acoustic environment; Anhui Province Taihe County Shaying River National Wetland Park |
| | Mixing and laying of earth and stone | construction waste gas | Ambient air |
| | Transportation of earth and stone | Dust; waste gas, noise | Acoustic environment; ambient air |
| Operation phase | Vessel transport | Noise; vehicle emissions | Acoustic environment; ambient air |
| | Slope protection | Land use; shape of lines etc. | Agro-ecological environment; socio-economic issues |
| | Service area | Wastewater discharge | Water environment |

| | | | |
|---|---|---|---|
| | Waterway transportation | Local economic development | Socio-economic issues |
| | | Tourism development | |
| | | Improvement of transport | |
| | | Change of people's quality of life | |
| | Bridge, etc. | Visual landscape etc. | Landscape |

### 3.2.2. Screening of Assessment Factors

On the basis of identification of environmental impacts in Table 3-3, the assessment scoping and screening of assessment factors are carried out. The results are listed in Table 3-4.

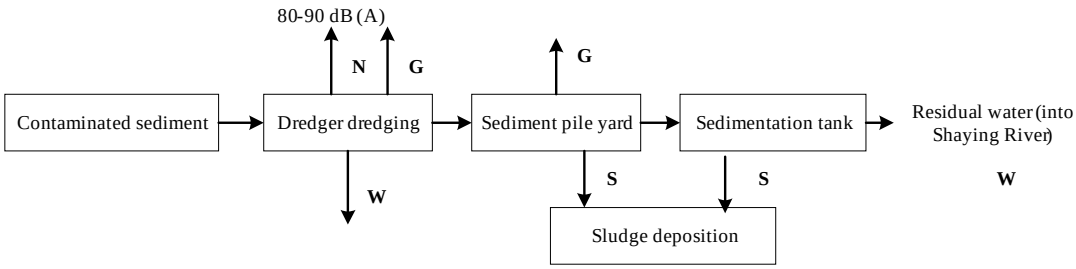
**Table 3-4 Assessment Content and Screening of Assessment Factors**

| Environmental factors | Assessment content | Assessment factors |
|---|---|---|
| Societal issue | Impacts on people's quality of life, infrastructure/ resource use, planned transport, and flood control, etc. | |
| Ambient air | Odor pollutant emissions, material transportation and construction dust during the construction phase | TSP |
| | Vessel emissions at the operation phase | $SO_2$, $NO_2$ |
| Ecological environment | Soil erosion, vegetation destruction, impacts on Anhui Province Taihe County Shaying River National Wetland Park during the construction phase | Agro-ecological environment, soil erosion, wild animals |
| Water environment | Sediment dredging, bridge construction and slope protection, etc. during the construction phase | $NH_3$-N, COD, SS, oil |
| | Wastewater discharge at service areas at the operation phase | |
| Acoustic environment | Machine noise during the construction phase | $L_{Aeq}$ |
| | Transport noise at the operation phase | |

## 3.3. Analysis of Pollution Sources

### 3.3.1. Construction Phase

Under water dredging is applied to sediment dredging in this project using cutter suction dredger. Environmental impacts at this phase include noise, solid waste, wastewater and waste gas due to channel improvement work, bridge works and construction of anchorage areas and service areas. Fig 3-1 shows the technics of dredging work and its pollution flow.




Note: W: wastewater; G: waste gas (odor pollutant emissions); S: solid waste; N: noise

**Fig. 3-1 Techniques of dredging work and its pollution flow**

(1) Wastewater

Wastewater from construction in this project mainly comes from:

 The contaminations in sediment will be released and diffused due to water disturbance caused by cutter suction dredger. The pollution scope is surrounding water body with a radius of 100m, where the SS will increase significantly. Generally speaking, the increase of SS concentration will be more than 80mg/L. The impact will get weaker as the distance increase. The increase of SS concentration will be lower than 4.13mg/L at the point of 1km away from the construction site.

 Underwater constructions such as bridge work and anchorage area works will affect water quality of the Shaying River.

 Residual water comes from dewatering of contaminated sediment sludge after it is transported to disposal area. Water pollution may also be caused by rainfall and surface runoff at sediment pile yard.

 Wastewater with oil pollutants comes from running, gushing, dripping and leakage of oil from machines and comes from machines washed by rain. SS, $BOD_5$, COD,

 Piled construction material and mud or ore from earthwork excavating and

filling are washed by rain, which may cause water pollution. SS is the key pollutant.

 In accident scenarios, leakage from mud slurry transportation pipe, oil leak from vessels may cause environmental pollution. Furthermore, small volume of production and domestic wastewater from dredger and workers' activities will also have impacts on surface water environment.

(2) Waste gas

The key sources of air pollution during the construction phase are:

 Fuel emissions from transport vehicles and working machines and ground dust.

 Odor pollution emissions from sediment at disposal areas. The odor degree is generally Grade 2-3. The key pollutant is compounded of hydrogen sulfide ($H_2S$), thioether, ammonia and indole, etc.

 Dust caused by lime and cement at construction sited that are blown by wind.

(3) Solid waste

During the construction phase, solid waste mainly comes from garbage on vessels, construction waste and working staff's domestic refuses. All of these pertain to general solid waste.

In accordance with characteristics of this project and collected information, the types and sources of construction solid waste are listed in Table 3-5.

**Table 3-5 Types, Sources and Volume of Construction Solid Waste**

| Type | Name | Source | Volume (t/d) |
|---|---|---|---|
| Construction vessel | Waste from vessel maintenance | Discarded machine parts, loss of paint and iron scrap, machinery and sediment by ship equipment, and updated ropes, etc. | 0.04 |
| | Domestic waste from vessels | Various food, kitchen refuses and plastic tableware, cups, bags, glass, and pottery and porcelain, cloth and paper, etc. | 0.11 |
| | Total | / | 0.15 |
| Solid waste on land | Domestic refuses | Various food, kitchen refuses and plastic tableware, cups, bags, glass, pottery and porcelain, cloth and paper, etc. | 0.05 |
| Construction waste | | Demolition and rebuilding of bridges | - |

Note: Referencing the "Design specification of environment protection for port engineering", daily waste from vessel maintenance of each vessel is 20kg. The total daily waste from vessels will be 0.04 ton during the construction phase if it is calculated with two vessels per day. Domestic waste will be 0.11 ton (calculated with 10 persons per vessel). Index for domestic waste on land is 1kg per person per day. The total amount of domestic waste will be 0.05 ton if it is calculated with 50 working staff.

(4) Noise

Major noise sources during the construction phase of channel improvement project are construction vehicles and machines, including heavy trucks, bulldozers, excavators, concrete mixers, etc. The noise level ranges between 78-90 dB (A). Noise level of vessels at dredging sites, dredgers and mud slurry transport equipment ranges between 90-110 dB (A).

(5) Pollution accident sources

Damaged pipeline for mud slurry transport during the sediment dredging may lead to the leakage of mud slurry or spilling into the water. Mud slurry may discharge directly into the river at disposal area due to breakage of cofferdam. The above accidents may induce short-term and partial pollution in surrounding water area.

### 3.3.2. Operation Phase

Key pollution sources at the operation phase are fuel emissions, machine noise and watermen's domestic wastewater from vessels navigating in the channel and channel manager's domestic wastewater and refuses at service areas.

(1) Sources of water pollution

Wastewater in this project is mainly composed of wastewater on land and wastewater from vessels. Wastewater on land comes from service areas, i.e. the proposed Guozhuang Service Area and Sanshilipu Service Area. There will be about 20 managers in each service area. Wastewater from service area includes domestic wastewater, and wastewater from vessel maintenance and from gas station, etc. On the basis of analysis of freight traffic volume at the operation phase, it is estimated there will be 200 visitors to each service area per day in 2020. If the water consumption is calculated as 120L per person per day, total domestic wastewater at one service area will be around 26.4 ton per day. Annual increase rate of visitors to service areas will be 5% per. That is, in 2030, about 326 persons will visit each service area per day. If wastewater per capita is 120L per day, total domestic wastewater in each service area will be around 41.52 ton per day. Main components

of the wastewater are COD and ammonia nitrogen. The COD concentration is 200-300 mg/L and concentration of ammonia nitrogen is 15-25 mg/L. On the basis of analogy of similar service areas, wastewater from vessel maintenance and gas stations is calculated as 5 $m^3$ per day.

Diversion of rain and sewage should be applied for water discharge system in service areas. In design, oil water from restaurants, vessel maintenance and gas station needs to be treated by grease trap before discharged into sewage system. It then converges with domestic wastewater treated in septic tank and goes into underground wastewater treatment equipment. The treated wastewater can meet Grade II in GB8978-1996 and be discharged to nearby ditches.

In accordance with requirements in Article 28 in the "Management Provisions of Vessel Pollution of the Inland Water Environment" (Ministry of Communications, No. 5 Order, 2005), watermen's domestic wastewater during navigation should be treated or stored. That is, treatment equipment or containers should be installed on the vessel according to wastewater volume. Discharge of domestic wastewater that can not meet the discharge standards is forbidden in the inland water region. Thus, local maritime sectors need to improve the supervision of domestic wastewater from vessels, in order to make sure the discharge can meet the standards. There should be no pollution of Shaying River from domestic wastewater.

In light of the prediction of freight traffic volume at Shaying River during the operation phase, most of the vessels will transport coal and construction materials, which does not refer to oil pollution in ballasted water. However, it is possible there will be ballasted water with oil at the operation phase while the waterway is getting smooth. Since it is hard to predict the water volume, local maritime sectors are required to strengthen management. Once there come vessels with ballasted water, maritime sectors should ask the ship owners and cargo owners to treat the ballasted water, washing water and bilge oil water and to make sure the discharge can meet relevant standards.

(2) Air pollution sources

Waste gas from vessels is the main sources of air pollution. Emission inventory of waste gas from vessels is calculated with methods recommended by Lloyd's Register, UK. The fuel emission factor of $NO_2$ is 7.2 kg per 1 ton fuel. That of $SO_2$ is 10 kg per ton fuel. Fuel consumption of vessels at inland waterway is calculated as 3.71 kg per 1,000 ton per·km.

It is predicted the freight traffic volume at Shaying River during the operation phase will reach 14 million ton in 2020 and 18 million ton in 2030. If annual operation period is 330 days, daily $NO_2$ emission will reach 1.247 kg per km and daily $SO_2$ emission will be 1.731 kg per km in 2020. In 2030, daily $NO_2$ emission will reach 1.603 kg per km and daily $SO_2$ emission will be 2.225 kg per km in 2020. In the context of development of science and technology and promotion of high-tech, vessels at inland waterway will be more environmentally friendly and energy-saving in the future. Thus, the air pollutant emissions may be reduced.

(3) Solid waste

Solid waste during the operation phase mainly comes from domestic waste on land and garbage from vessels. At the proposed Guozhuang Service Area and Weicixin River Service Area, there will be about 20 managers in each service area. On the basis of analysis of freight traffic volume during the operation phase, it is estimated there will be 200 persons visiting each service area per day in 2020. If the solid waste is calculated as 0.8 kg per person per day, total solid waste at each service area will be about 176 kg per day. That is, 352 kg per day in the two service areas. Annual increase rate of visitors to service areas will be 5%. That is, in 2030, about 326 persons will visit each service area per day. Then solid waste will be 276.8 kg per day in each service area and 553.6 kg per day in the two service areas. Solid waste is mainly domestic waste without hazardous components. One to two garbage bins can be installed to collect refuses and treated by local municipal domestic waste treatment organizations. Watermen’s domestic waste can be stored in garbage bins installed on ships. Municipal domestic wastewater treatment organizations in cities along the river can be commissioned to treat the solid waste from vessels.

(4) Noise

Noise source during the operation phase is mainly machine noise of engines on ships. When the machine is running, the noise level at the point of 5m away from the sound source can reach 80-90 dB (A). It is continuous linear stationary noise source, which will have adverse impacts on shore residents. However, in the context of development of science and technology and promotion of high-tech, vessels at inland waterway will be more environmentally friendly and energy-saving in the future. Thus, the engine noise may be reduced.

(5) Accident pollution sources

The navigation capacity of Shaying River will be significantly improved after the completion of the channel improvement project, but vessel crash or sink happens sometimes for various reasons. According to prediction of freight traffic volume during the operation phase and relevant statistics, most of the vessels will transport coal and construction materials. Channel management sectors should be informed timely after the vessel crash or sink. The management sector needs to report to sectors at higher levels and local government considering the accident situation. The sector should also prepare an emergency plan and start savalging sunk objects and rescuing as soon as possible, in order to minimize the impacts on surface water.

Table 3-6 presents details of pollution sources during the construction phase and operation phase.

**Table 3-6 Pollution Sources during the Construction Phase and Operation Phase**

| Pollution source | Construction phase | Operation phase |
|---|---|---|
| Water pollution sources | The contaminations in sediment will be released and diffused due to water disturbance caused by cutter suction dredger. The pollution scope is surrounding water body with a radius of 100m, where the SS will increase significantly. Generally speaking, the increase of SS concentration will be more than 80mg/L. The impact will get weaker as the distance increase. The increase of SS concentration will be lower than 4.13mg/L at the point of 1km away from the construction site.<br>Wastewater with oil pollutants comes from running, gushing, dripping and leakage of oil from machines and comes from machines washed by rain. | Waste water mainly include waste water on land and domestic wastewater from vessels. Total domestic wastewater at service areas will be around 52.8 ton per day. Main components of the wastewater are COD and ammonia nitrogen. The COD concentration is 200-300 mg/L and concentration of ammonia nitrogen is 15-25 mg/L. wastewater from restaurants in service areas, vessel maintenance and gas stations is 5 ton per day. Local maritime sectors need to improve the supervision of domestic wastewater from vessels, in order to make sure the discharge can meet the standards. There should be no pollution of Shaying River from domestic wastewater. It is possible there will be ballasted water with oil at the operation phase. It is suggested local maritime sectors to strengthen management. Once there come vessels with ballasted water, maritime sectors should ask the ship owners and cargo owners to treat the ballasted water, washing water and bilge oil water and to make sure the discharge can meet relevant standards. |
| Air pollution sources | Waste gas mainly includes fuel emissions from transport | It is predicted the freight traffic volume at Shaying River during the operation phase will reach 14 million |

| Pollution source | Construction phase | Operation phase |
|---|---|---|
| | vehicles and working machines, odor pollution emissions from sediment at construction sites and disposal areas. The odor degree is generally Grade 2-3. The key pollutant is compounded of hydrogen sulfide ($H_2S$), thioether, ammonia and indole, etc.<br>Dust caused by lime and cement at construction sited that are blown by wind. Lampblack from staff's living stoves. | ton in 2020 and 18 million ton in 2030. If annual operation period is 330 days, daily $NO_2$ emission will reach 1.247 kg per km and daily $SO_2$ emission will be 1.731 kg per km in 2020. In 2030, daily $NO_2$ emission will reach 1.603 kg per km and daily $SO_2$ emission will be 2.225 kg per km in 2020. In the context of development of science and technology and promotion of high-tech, vessels at inland waterway will be more environmentally friendly and energy-saving in the future. Thus, the air pollutant emissions may be reduced. |
| Noise sources | Noise during the construction is inevitable. Major noise sources are construction vehicles and machines, including heavy trucks, bulldozers, excavators, concrete mixers, etc. The noise level ranges between 78-90 dB (A). Noise level of vessels at dredging sites, dredgers and mud slurry transport equipment ranges between 90-110 dB (A). | Noise source during the operation phase is mainly machine noise of engines on ships. When the machine is running, the noise level at the point of 5m away from the sound source can reach 80-90 dB (A). It is continuous linear stationary noise source, which will have adverse impacts on shore residents. However, in the context of development of science and technology and promotion of high-tech, vessels at inland waterway will be more environmentally friendly and energy-saving in the future. Thus, the engine noise may be reduced. |
| Solid waste | Solid waste mainly comes from garbage on vessels, construction waste and working staff's domestic refuses. All of these pertain to general solid waste. | Solid waste during the operation phase mainly comes from domestic waste on land and garbage from vessels. Total solid waste at each service area will be about 352 kg per day in 2010 and 553.6 kg per day in 2030. Solid waste is mainly domestic waste without hazardous components. One to two garbage bins can be installed to collect refuses and treated by local municipal domestic waste treatment organizations. Watermen's domestic waste can be stored in garbage bins installed on ships. Municipal domestic wastewater treatment organizations in cities along |

| Pollution source | Construction phase | Operation phase |
|---|---|---|
| | | the river can be commissioned to treat the solid waste from vessels. |

# 4. Environmental Baseline

## 4. 1. Overview of Natural Environment

### 4. 1. 1. Geographical Location

Fuyang City is located in the northwest of Anhui Province. It lies at 114°52′ to 116°30′E and 32°24′ to 33°35′N. It is bordered by Zhoukou and Xinyang City in Henan Province in the West and Southwest, and by Haozhou City in the North and Northeast, and by Huainan City and Liuan City in the South and Southeast. It lies in the geology boundary between the Qinling Mountains and Huai River

### 4. 1. 2. Topographical Features

Fuyang City is flat and open, with a landform slope of 1/8000, high in Northwest high and low in Southeast. The West of Fuyang City is 30m above the sea level (based on the elevation system of Yellow Sea, which is applied for the following height), the height of Middle Fuyang is 29.5m and the East is 28.5m. Affected by erosion from rainfall and water flow as well as the long term human activities and current river floods, the Fuyang City has different landforms in Yingxi, Yingdong and Quanbei districts. The Old City in the middle of Fuyang is 29.0-30.0m above the sea level. The planned South District of Fuyang City is 31.5m above the sea level. Bothe sides of the Doupenggou in north of West District is lower, which is 28.5-29.0m above the sea level. The southeast of Yingxi District is 29.0-30.0m above the sea level.

The Shaying River base is hith in the Northwest and low in the Southeast. The land here is flat with plain landscape. The gound elevation from Jieshou to Wanggang Section is 37-25m above the sea level. The average ground slope is between 1/4000 and 1/1000.

Most of the floodplain drops sharply to the riverbed. The floodplain at both river banks is dissymmetry, with width ranging from 30 to 200m and only 10m in the narrow regions. In some river sections, there is little or no floodplain which endangering the embankment. The land of floodplain is relatively flat, which is 0.5~3.0 higher in ground level than the embankment. It is vast plain in the inside of the embankments. There are pits, ponds and low-lying land along the embankments, most of which caused by the soil taking for embankment remedy. These are different in scale, with area ranging from tens to thounds of square meters and depth ranging from 1.5 to 2.5m. The pits, pongs and low-

lying land in dangerous river section will have water permeation during flood season.

### 4.1.3. Geological Structures

In aspect of geological structure, the Fuyang City lies in the North-East second uplift belt of the Neocathaysian structural system in the East Section of the latitudinal megastructural systems of Kunlun and Qinling in geotectonic frameworks and. Its main structure is:

Latitudinal megastructural system: The Suxian Depression, Bengpu Uplift, Huainan Depression, Huoqiu-Feidong Uplift in the latitudinal megastructural system of Kunlun and Qinling. The main fault ruptures are the Banqiao Fault located between Woyang and Mengcheng(this Fault dips to North with a 1000m fallen), the Lixin-Wuhe Fault and the Madian-Mohekou Fault(these two Faults dip to North parellelly, with extended length of over 150km), and the Fuyang-Shungengshan Fault (this fault runs from North-West to North-North-West, dips to South West, and is a compressive fault).

### 4.1.4. Engineering geology

Affected by the shock downward dominated upward-downward activities during the Tertiary (T) and Quaternary (Q) period, this area accepted plenty of alluvial and diluvial deposit, which forms the deep depositional layer by continuously inundation and deposition with the maxium thickness of 800m, and finally became the Huaibei alluvial plain. However, the geological activities had been relatively stable since the Holocene Epoch of the Quaternary period, which made much of the Q3 layer outcropped. The geological effect of river flow is lateral erosion during this period. The old layer was continuously swept by water and redeposited in the river bed, and finally formed the new Q4 layer as well as the rencent alluvial regions along the river banks. Recently, the channel are continuously deposited and diverted by the overflowing of Huang River, and wide river banks as well as snake-shaped waterway have been formed.

There are two types of stratum in this region, including the extensive exposed Q3 layer and the recent alluvial Q4 layer along the river banks. Q3 layer is mainly composed of clay and silt. The exposed layer is mainly clay. Q4 layer distributes in strips along the river banks, which is 3~15km wide and composed of silt and sand. The Q4 layer is rough in surface and uneven in thickness, with lower intensity.

### 4.1.5. Climate and Weather

The project region falls within warm and semi-humid continental monsoon climate, of the transitional zone from Warm Temperature Zone to Subtropic Zone. Climate change is affected by monsoon and topographic feature, lack of rainfall in winter and spring and abundant in rainfall in summer and autumn.

Annual mean temperature is 15□, while the extreme high temperature is 41.5□ in summer, and the extreme low temperature is -22.8□ in winter. The annual accumulated temperature no less than 10□ is 4743.6□. Annual mean sunshine is 2230h. Annual mean relative humidity is 73%. Annual mean evaporation amounts to 1600mm. Annual frost-free period lasts 220d. The maximum frost depth is 15cm. Annual mean wind velocity is 2.8m/s, while most severe wind reached 24m/s.

Annual mean rainfall totals 770mm in the basin. The maximum 24 hours rainfall reached 169mm once in a decade. The spatial distribution of precipitation reduces gradually from southeast to northwest, and the temporal distributon is uneven between months. Precipitation in flood season takes about 60% of rainfall in the whole year. Runoff volume in flood season accounts for 70-80% of the total annual runoff. Precipitation differs greatly from year to year, while the maximum annual precipitation is four times that of the minimum annual precipitation. At the meanwhile, there might be continuious drought or water-logged years. According to the anlysis of statistic materials, the annual maximum rainfall is 951.4mm in Yingshang Station, 889.1mm in Fuyang Station, and 1428.1mm in Jieshou Station. The annual minimum rainfall is 406.8mm, 447.1mm and 447.4mm in Yinghsang, Fuyang and Jieshou respectively in 1966. The characteristic values of the mina meteorological elements in the project region are listed in Table 4-1.

**Table 4-1 Value of the Main Meteorological Elements in the Project Region**

| Item | Content | | Unit | Value |
|---|---|---|---|---|
| Temperature | Average | Annual | ℃ | 15 |
| | Extremum | Highest | ℃ | 41.5 |
| | | Lowest | ℃ | -22.8 |
| Rainfall | Average | Many years | mm | 770 |
| | Maximum 24h | Once in a decade | mm | 169 |
| Evaporate | Annual mean | | mm | 1600 |
| Relative humidity | Annual mean | | % | 73 |
| Sunshine | Annual hours | | h | 2230 |
| Accumulated temperature | □10℃ | | ℃ | 4743.6 |
| Wind velocity | Annual | | m/s | 2.8 |
| | Maximum | | m/s | 24 |
| Wind direction | Dominant wind direction | | | E |

| | | | |
|---|---|---|---|
| Frost depth | Maximum | cm | 15 |
| Frost-free period | Annual | d | 220 |

### 4.1.6. **Overview of Water System**

#### 4.1.6.1. Overview of Shaying River

The Shaying River is the largest tributary of the Huai River and located at its left bank. It originates from Funiu Mountain in Henan Province and passes through Pingdingshan, Luohe, Zhoukou in Henan Province and Fuyang in Anhui Province, and joins the Huai River at Mohekou in Yingshang County. The total length of the Shaying River is 620km, with 414km located in Henan Province and 205.6km in Anhui Province. The basin area of the Shaying River is 36,651 $km^2$, with 32539 $km^2$ located in Henan Province and 4,112 $km^2$ in Anhui Province.

The Shaying River Basin slopes from northwest to southeast. It is surrounded on three sides by mountains (mainly the Funiu Mountains and Waifang Mountains) at the upstream of Luohe River. The elevation of the mountains is generally 600~1500 above the sea level (The Yellow Sea base level in 1985), and the highest is 2153m. The transition area from mountains to plain terrain is vast hilly terrain, with average ground elevation of over 100m. The plain terrain is flat with elevation between 30m and 100m.

The Shaying River Basin fans out at the upstream of Zhoukou. The featherlike river system is distributed along the banks of Shaying River with plenty of tributaries. River basin at the downstream of Zhoukou, especially at the downstream of the provincial border, shows the zonal distribution with few tributaries joining into. There are 8 main tributaries of the Shaying River, including the Beilu River, Xiaoying River, Jialu River, Xinyun River, Xincai River and Heici River on the left bank, as well as the Li River and Fenquan River on the right bank.

Accoring to the statistical data between 1956 and 2001, the annual mean runoff of the Shaying River is 7,120,000,000 m3, while the runoff in flood season accounts for 70~80% of the total annual runoff. The wet season cover from May to September, and the dry season covers from November to February in the coming year. The surface water level and runoff depend closely on the precipitation. The water level is high and runoff is larger in summer because of abundant in rainfall, which is opposite in winter because lacking of rainfall. The highest water level most happens in July or August, and the lowest happens between November and February in the coming year. The average water velocity is 0.1~0.3m/s, while the maximum 2.5m/s. The ground gradient is 0.05‰ from Jieshou to Fuyang, 0.05‰ from Fuyang to Yingshang and 0.06‰ from Yingshang to Mohekou.

4.1.6.2. Overview of Other Rivers in Fuyang City

All the internal rivers in Fuyang City belong to the Huai River System. There are over ten rivers pass through the Fuyang City, including Huai River, Shaying River, Quan River and Cihuaixin River. The main navigable rivers in Fuyang are the Shaying River, Quan River, Cihuaixin River and Hong River. The Shaying River is the largest tributary of Huai River. The Quan River is the largest tributary of the Shaying River. All the rivers mentioned above form the crisscross water traffic and transportation network.

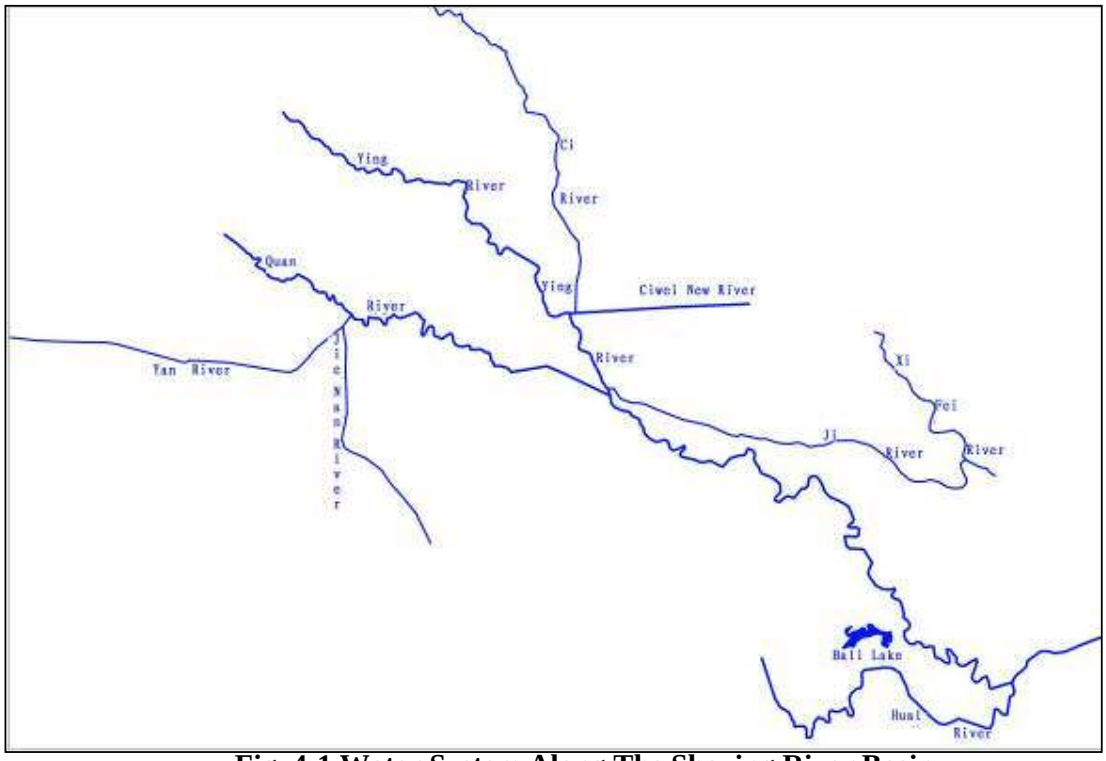



**Fig. 4-1 Water System Along The Shaying River Basin**

(1) Huai River

The mainstream of the Huai River enters into Anhui Province by the San River between Henan and Anhui Province. It passes through Liuan, Fuyang, Huainan, Bengpu, Chuzho, etc., enters into Hongshantou in Jiangsu, and then joins the Hongze Lake. Fuyang City lies at the upstream of the mainstream of the Huai River. The water volume in dry season is effectively controlled by human.

The mainstream of the Huai River Fuyang Section is natural channel, which has the Wangjieliu Shoal, Runheji Shoal and Shibalichangwan Shoal.

(2) Quan River

The Quan River is the main tributary of the Shaying River, which originates from Shaolinggang in Yangcheng County, Henan Province. It is joined by Ni River in Hongshanmiao in Shenqiu County. The river at the upstream of the meeting point is Fen River, at the downstream is the Quan River, so the Quan River is also called Fenquan River. It passes through Yancheng, Shangshui, Xiangcheng, Shenqiu in Henan Province as well as the Fuyang City in Anhui Province. The total length of the Quan River is 241km, with 82.27km located in Henan Province (from Zhoulou to Fuyang). The basin area is 1990 $km^2$. Quan River passes through Linquan County, Jieshou County and Fuyang County in Fuyang, and joins the Shaying River at Sanliwan, Fuyang City. It tributaries include the Ni River, Liuan River and Yan River.

The water depth of Quan River is controlled by the Yangqiao Hub, Fuyang Hub and Cihepu Hub.

(3) Cihuaixin River

The Cihuaixin River is an artifical canal used comprehensive for flood prevetion and drainage, irrigation and navigation. It is the largest new open waterway after founding of the P.R.C. The Cihuaixin River was dug since1971 and finished in 1984. It begins from Cihepu in Fuyang City, passes through Fuyang, Lixin, Mengcheng, Fengtai and Huaiyuan County, and joins the Huai River at Shanqiao. Its total length is 134km, with 34.18km located at Fuyang City. Its basin area is 239.2 $km^2$. There are four large water-control hubs along the Cihuaixin River so as to control the runoff and water level of the river, including the Cihepu Hub, Chahua Hub, Kantuan Hub and Shaqiao Hub. The basin area is 4,641$km^2$. The annual mean ruoff is 856,000,000 $m^3$. It can discharge flood from the Shaying River at the speed of 2,000 $m^3$/s. It can drain water-logged fields at the 2,994 $km^2$ Heici River basin and 2,504 $km^2$ upper Xifei River basin. Irrigation can draw water from the Huai River at the speed of 120 $m^3$/ s using the built water-control projects.

### 4. 1. 7. **Earthquake**

The main active ruptures classified by direction are East-West, North-West and North-East at the areas which around the Fuyang City with a radium of 250km. The geological conditions in Fuyang City and its nearby areas are complex. There are there ruptures within 10km near the City, including the Linquan-Liufu Rupture, Fu-Feng Rupture, Wanglaorenji Rupture. The layers near the ruptures are not continous, and have unusual magnetic and gravity characteristics. Accoring to the Seismic ground motion parameter zonation map of China（GB18306—2001）, the seismic peak acceleration of Fuyang City is 0.1g, equaling to the seven grade of the basic

earthquake intensity.

## 4. 2. Ecological environment

### 4. 2. 1. Investigation and Assessent of Ecological Environment Baseline

Collect information of existing biodiversity species along the Shaying River Section in Anhui Province, from the annals, Statistic Yearbook of involved Counties and Cities, relevant materials provided by forestry authorities, environmental protection authorities, water resource authorities, agricultural authorities and the Ministry of Land and Resource, and the relevant papers and books about the Shaying River and Huai River Basin.

Investigation of ecological environmental is carried out by means of material collection and review, analysis of remote sensing images and field investigation, and qualitative analysis and quantitive analysis. The consultation with villagers and forestry workers are important supplement for the backgournd eco-environment information for studying regions.

#### 4.2.1.1. Assessment Scope

The scope for this ecological status investigation covers the Shaying River Section in Anhui Province and its nearby areas along the banks, and areas where may be affected by the project. Considering the works distribution of river orientation, bridege, chuter cutoff and the disposal areas as wel as the existence status of rare animals and plants, the assessment scope can be expanded to certain extent. The investigation scope of wild animals can be expanded to their activity and inhabitant areas.

The assessment scope of ecological environment in this project is the 1km region along both sides of the banks of the 205.6km channel from Changshengou to Mohekoui.

#### 4.2.1.2. Principle of Site Selection and Key Investigation Sites

(1) Principle of site selection

The purpose of investigation is to exactly speculate the overall status of plants, animals and aquatic ecosystem in assessment area through study on the samples. Therefore, the selected samples should be representative, and it can conclude more exact overall characteristic with minimum sampling.

□ The selected samples for vegations should be the more common species, and should cover most of the important vegetation types. At the same time, the selected sites should distribute evenly along the river.

□ The layout of sampling sites should prevent the repeatedly site setting for the same vegetation. More sites can be set for the important vegetations.

□ Try to avoid the non-sampling error, and to avoid site selection of sites along the road which are easily accessed to.

□ The sampling sites for aquatic ecosystem should combine the shape of river and distribution of construction places.

(2) Key investigation sites

Investigation sites for terrestrial ecosystem are areas close to Genglou Ship Lock (k26), Fuyang Ship Lock (k80) and Mohekou (k202+707). For other rivers, sampling sites distribute evenly along the channel.

Investigation sites for aquatic ecosystem mainly located at River Section from Fuyang to Yuanzai (four sampling sites, i.e. K78+500□k80□k81+500□k83) and River Seciton from Yanghuzhen to Mohekou (four sampling sites, i.e. k92□k94+500□k192+500□k202+700). For other rivers, sampling sites distribute evenly along the channel.

#### 4.2.1.3. Assessment Methods of Ecological Environment Baseline

As discussed above, the methods of material collection and review, analysis of remote sensing images and field investigation, and the methods of qualitative analysis and quantitive analysis, are combined to investigate and assess the existing eco-environment. The consultation with villagers and forestry workers are important supplement to the backgournd eco-environment information for studying regions.

(1) Material Collection and Review

Collect information of existing biodiversity species along the Shaying River Section in Anhui Province, from the annals, Statistic Yearbook of involved Counties and Cities, relevant materials provided by forestry authorities, environmental protection authorities, water resource authorities, agricultural authorities and the Ministry of Land and Resource, and the relevant papers and books about the Shaying River and Huai River Basin.

(2) Field Investigation

1) Land Use Type and Vegetation Sampling with GPS

The GPS sampling points are the base for identification of vegetation types using remote sensing images. Refering to the interpretation of vegetations and land use types from GPS, assessment team needs to verify the error rate through field investigation and record the following content for each GPS sampling ponts:

 The elevation value and latitude and longitude of each GPS sampling point.

 Vegetation types in each sampling point, as well as the slope directions and soil types.

 Dominant species of plants and the activities of animals.

 The physiognomy charcters and structural features of typical vegetations.

2) Investigation of Plant Communities

Identify the position of typical plant communities based on field investigation, and carry out the investigation of plant communities using sampling notation method of French-Swiss logical school, in which the area of tree community sampling quadrat is $10\times10m^2$, of the shrub community is $10\times10m^2$, and of the herbage community is $1\times1m^2$. Record all the types, dominant plants, coverage (overcast), tree height and diameter of brest-height (DBH), and determine the position of sampling points using GPS.

Carry out the distribution of sampling and field investion on typical eco-environment, based on the collection and analyis of the historical statistic information on biotic resources as well as the results of field observation and inspection time.

3) Investigation of plant species

Identify the status of plant species and resources as well as the species and survival conditions for rare or endangered species during the investigation. Field investigation can take the mothods of path investigation and sampling investigation. Path investigation method can be applied to investigate the area without native vegetations. Sampling investigation method can be applied to investigate the key construction areas (e.g. chuter cutoff and disposal area) and the area of vegations in good condition. The mothods of field investigation, civilian vist and market investigation are combined to investigate the rare or endangered plants as well as ancient or old trees. Specimens and photos are taken of for the questioned plant species.

4) Investigation of the resources of terrestrial animals

The information on amphibians and reptiles mainly comes from field visit and literature collection and review. Methods of mammals' investigation mainly include field investigation with five-step pliers, field visit and information collection. Methods of birds' investigation include fixed point observatioin and path method. In the key sampling points, the sampling density should be enhanced, or belt sampling method can be adopted to record the inhabitat characters of birds, using the monocular or binocular microscope, GPS locator and digital cameral. Identify the animal species, resources and survivals, especially state important pretected species, in the assessment scope during the investigation.

5) Investigation of aquatic organisms

The qualitative samples of plankton are taken at selected sampling points by haulling plankton horizontally with No.25 qualitative net. The quantitative samples of plankton are taken by taking water at the point of 50cm under the water with 2L water container, pouring water sample into the plankton filter, and then pouring the filtrate remained in rubber tube into the sample tube. The qualitative samples of zoobenthos are taken with trawl nets and mud grabs by collecting zoobenthos at the shoal area and some mollusk samples from fishermen. The quantitative samples of zoobenthos are taken using a Peterson grab to collect the surface mud samples of sediments and collect the zoobnethos attached to the aquatic vascular plants. The mud samples are washed using screen net, picked out using plier, and then fixed with 75% ethonal. The composition of fish resources are identified by investigating the surround markets along the river, e.g. Yanghuzhen Market and Yuanzhai Market, through buying and inquiry the price of different fishes.

6) Investigation of wetland types along the river

Field investigation method is applied to investigate the wetland types along the Shaying River Section in Anhui Province. Investigation scope is within 1km regions along the banks of the Shaying River. Wetland types as well as the aquatic plants, zoobenthos and planktons existed in the wetland are being recorded.

#### 4.2.1.4. Estimation of Biological Productivity

The measurement and prediction of biological productivity

The direct gathering method is used to measure the biological productivity of shrub, herb and crops. The biomass of arbor forest is predicted using the method of wood volume measurement. The average net productivity of plant communities are predicted by refering

to relavant information both at home and abroad as well as field investigation of the local status.

### 4.2.2. **Current Status of Terrestrial Ecological Environment**

#### 4.2.2.1. Soil

There are four soil types in the Shaying River Basin, including cinnamon soil, moist soil, irregular lime concretions black soil and paddy soil. The paddy soil distributes in areas with good water resource conditions.

#### 4.2.2.2. Vegetation

(1) Composition of plant species

1) Aquatic vascular plants

 Composition of aquatic vascular plants

There are 28 types of aquatic vascular plants at the Shaying River Sectioin in Anhui Province, totally 22 genera and 17 families. They all belong to Angiospermae.

 Life form and Eco-type

According to the classification system of life form and Eco-type, the wetland aquatic vascular plants at the Shaying River Section in Anhui Province can be divided into two types, including the aquatic plant and hygrophytes.

 aquatic plants include: Emergent plants (mainly *Phragmites communis, Zizania caduciflora*), in which *Phragmites communis* are growing in small group; floating-leaved plants, which mainly belong to Lemnaceae and Trapaceae, e.g. Trapa bispinosa and Marsilea quadrifolia; floating plants, which mainly is Lemna minor and distribute at the junction point of the Huai River and Shaying River; submersed plants, which mainly belong to Potamogetonaceae, Hydrocharitaceae, Haloragidaceae and Ceratophllaceae.

 Hygrophytes

They mainly distribute in the wetland at the junction of the Huai River and Shaying River, waterside of river channel and other wet areas. They are mainly the seed-bearing plants and some ferns that belong to the grass family, sedge family and Plygonaceae.

③ Characteristics

The plant characteristics at the Shaying River Section in Anhui Province are transition from the South Temperate Zone to the North Sub-tropical Zone. Accordint to the Wu Zhengyi's classification system of Chinese seed-bearing plants, the 22 genera of aquatic seed-bearing plants can be divided into 8 distribution types. Among them, 10 genera, namely 45% of all the genera, belong to World Distribution, which include *Ceratophyllum*, *Polygonum*, *Potamogeton*, *Spirodela*, *Phragmites*, *Typha*; 6 genera, namely 27% of all the

genera, belong to the four tropic distribution types (e.g. Pantropic and Tropic distribution), which include *Alternanthera*, *Vall isnera*, *Marsilea*, *Oryza*; and 6 genera, namely 27% of all the genera, belongs to the 3 temperate distribution types (e.g. North Temperate and Old World Temperate), which include the *Trapa*.

2) Terrestrial vascular plants

There found 53 species of terrestrial plants in this investigation, which belong to 24 families. The species in different families are listed as follows: 15 species in Asteraceae, 5 species in Poaceae, 1 species in Labiatac, 5 species in Leguminosae, 2 species in Apiaceae, 1 species in Polygonaceae, 1 species in Liliaceae, 1 species in Plantaginaceae, 1 species in Cruciferae, 1 species in Scrophulariaceae, 1 species in Amaranthaceae, 2 species in Moraceae, 2 species in Salicaceae, 1 species in Cruciferae, 2 species in Caryophyllaceae, 1 species in Euphorbiaceae, 1 species in Malvaceae, 1 species in Solanaceae, 1 species in Verbenaceae, 2 species in Geraniaceae, 1 species in Rubiaceaek, 1 species in Equisetaceae and 1 species in Ulmaceae.

It can be seen that the Asteraceae is the dominant family in the regions of the Shaying River, and accounts for 28% of the total species in this region.

(2) Distribution characters of plants along the River

According to the field investigation, the eco-types in the area of the Shaying River Section in Anhui Province Channel Improvement Project are artifical ecosystems. The main ecotope types are agriculture field, artificial woodland, grass land and shrub plant.

1) Agro-Ecosystem

Mainly distribute at both sides of banks of the Shaying River and the nearby areas residential areas along the River. There are varities of crops in agro-ecosystem.

The commercial crops mainly include Triticum aestivum Linn, Vicia faba Linn; Vegetables include Solanum melongena, Lycopersicon esculentum, Cucurbita moschata, Raphanus sativus, Brassica campestris□Wild herbs include Commelina communis, Chenopodium glaucum, Verbena officinalis, Xanthium sibiricum, Setaria viridis, Menispermum dauricum, Rubia cordifolia and Salvia plebeian.

2□Artificial woodland ecosystem

The primary arbor is the Populus simon. It is all the plantation forest, and no shrub exists under the trees. There are only some herbs. Therefore, species are single in the ecosystem. It mainly distributes along the bankd of the Shaying River and the nearby villages.

3□Grass land and abandoned land ecosystem

The primary species are Imperata cylindrical, Zoysia japonica, Galium aparine, Xanthium sibiricum, Artemisia lavandulaefolia. They distribute in the slope of the embankments of the Shaying River, on the river banks, in the plantation forest and in the abandoned field sometimes.

4□Shrub ecosystem

The primary species are Lycium chinense and Broussonetia papyrifera. It distributes at the slope of embankments along the Shaying River, on the river banks and at the fringe of plantation forest.

(Farmland)

(Artificial woodland)

□Grass land, abandoned land□ □Shrub□

**Fig. 4-2 Key plant types along the Shaying River**

(3) Distribution characteristics of the plant communities

According the distribution characteristics of the plant communities in the project assessment scope, different sampling quadrats for plant types are set at the recommend sampling points, for example in the herbs and plantation foresets. The sampling quadrats are set at the nearby areas of Genglou Ship Lock (k26), the Fuyang Ship Lock (k80) and the Mohekou (k202+700). The environmental characteristics (see Table 4-2) for sampling quadrats include the elevations of different quadrats are between 16 and 60m, and the primary soil types are brown soil and irregular lime concretions black soil. The survey results of the sampling quadrats for different plant types are summarized in Table 4-3.

**Table 4-2 Environmental characteristics for herb sampling quadrats（1m*1m）**

| **Samping point** | **Point 1** | **Points 2** | **Point 3** |
|---|---|---|---|
| Elevation (m) | 20 | 27 | 16 |
| Slope direction | None | Sunshined slope | None |
| Slope degree (°) | None | 30 | None |
| Slope position | None | Underneath | None |
| Soil type | Brown soil | Brown soil | irregular lime concretions black soil |

1) Herbage

**Table 4-3 Survey results of the herbage sampling quadrats □1m*1m□**

| **Sampling point** | **Point 1** | **Point 2** | **Point 3** |
|---|---|---|---|
| Species | Zoysia japonica, Polygonum, Vicia hirsute, Erigeron Canadensis, Myosoton aquaticum, Galium aparine, Goosegrass Herb, Vicia sepium□ Imperata cylindrical, Eulalia speciosa, Cyperus rotundus , Common Sage Herb, Veronica incana, Hemistepta lyrata, Hairy Bittercress, | Zoysia japonica, Polygonum, Vicia hirsute, Erigeron Canadensis, Myosoton aquaticum□Galium aparine□ Goosegrass Herb, Vicia sepium, Imperata cylindrical, Cyperus rotundus , Common Sage Herb, Veronica incana, Hemistepta lyrata, Hairy Bittercress, Xanthium | Zoysia japonica, Vicia hirsute, Erigeron Canadensis, Myosoton aquaticum, Galium aparine□ Goosegrass Herb, Vicia sepium,Imperata cylindrical, Cyperus rotundus, Common Sage Herb, Veronica incana, Hemistepta lyrata, Hairy Bittercress, Xanthium sibiricum, Kalimeris |

| **Sampling point** | **Point 1** | **Point 2** | **Point 3** |
|---|---|---|---|
| | Xanthium sibiricum, Kalimeris indica, Daucus carota Sativa, Equisetum hiemale, Torilis japonica | sibiricum, Kalimeris indica, Daucus carota Sativa□ Equisetum hiemale, Torilis japonica | indica, Daucus carota Sativa□Equisetum hiemale, Torilis japonica |
| Primary species | Zoysia japonica, Goosegrass Herb, Equisetum hiemale, Xanthium sibiricum, Imperata cylindrica | Zoysia japonica, Goosegrass Herb, Equisetum hiemale, Xanthium sibiricum, Imperata cylindrica | Zoysia japonica, Goosegrass Herb, Equisetum hiemale, Xanthium sibiricum, Imperata cylindrica |
| Overcast rate (%) | 41 | 38 | 45 |
| Biomass□$g.m^{-2}$□ | 149 | 138 | 160 |

It can be seen from Table 4-3, that the plant species, overcast rate and biomass are different at different sampling points. The primary species in the sampling quadrats at the Shaying River wetland are Zoysia japonica, Goosegrass Herb, Equisetum hiemale, Xanthium sibiricum and Imperata cylindrical. The biomass of plant communities i different between different soil types. The general trend is biomass distributed in the brown soil is lower than that in the irregular lime concretions black soil.

2) Emergent herbage

**Table 4-4 Survey results of the emergent herbage sampling quadrats □1m*1m□**

| **Sampling point** | **Point 1** | **Point 2** | **Point 3** |
|---|---|---|---|
| Species | Phragmites australis, Zizania caduciflora, Zoysia japonica, Vicia sativa, Poaceae, Galium aparine | Phragmites australis, Zizania caduciflora, Zoysia japonica, Poaceae | Phragmites australis, Zizania caduciflora, Polygonum, Zoysia japonica, Poaceae、Galium aparine,Vicia sativa, Goosegrass Herb |
| Primary species | Phragmites australis, Zizania caduciflora | Phragmites australis | Phragmites australis, Zizania caduciflora |

| | | | |
|---|---|---|---|
| Overcast rate (%) | 68 | 72 | 77 |
| Biomass （$g.m^{-2}$） | 237 | 248 | 221 |

The investigation of the sampling quadrats of the emergent herbage shows that the primary species in the Shaying River wetland are Phragmites australis, Zizania caduciflora, and some accompanying Galium aparine, Vicia sepium and Zoysia japonica. There is little different in the biomass between different samping quadrats, ranging from 214 $g.cm^{-2}$ to 287 $g.cm^{-2}$. They distribute at the shoal area along the Shaying River banks.

3) Plantation forest

**Table 4-5 Survey results of plantation forest sampling quadrats□10m*10m□**

| **Sampling point** | **Point 1** | **Point 3** | **Point 4** |
|---|---|---|---|
| Type | Artificial Woodland | Artificial Woodland | Artificial Woodland |
| Species | Populus simon | Populus simon | Populus simon |
| Primary species | Populus simon | Populus simon | Populus simon |
| Total density□tree·ha-1□ | 924 | 1100 | 1037 |
| Average height□m□ | 13.5 | 13.2 | 13.8 |
| Average DBH□cm□ | 26 | 23.5 | 27 |
| Coverage rate□%□ | 28 | 26.5 | 27 |
| Biomass ($kg·m^{-2}$) | 185 | 181 | 192 |

It can be seen from Table 4-5 that, the primary arbor species is the Populus simon distribute at both sides of the embankments along the Shaying River. The average height of the Populus simon in sampling quadrats is 10-17m, average DBH is 19-35cm, the coverage rate of the communities is 20-35%. The density of the sampling quadrats is 900-1300 tree·ha-1, and the biomass is between 220.2 $kg·m^{-2}$ and 155.0$kg·m^{-2}$.

4.2.2.3. Wild Animals

(1) Amphibians and Reptiles

□ Composition of species

According to the preliminary investigation, there are 16 species and 7 families of the Amphibians and Reptiles at the Shaying River, in which 7 species and 2 families are Amphibians and 9 species and 5 families are Reptiles (see Annex Table 2). Among them,

the wildlife species under provincial second class protection include Bufo raddei, Bufo gararizans, Chinemys reevesii, Elaphe taeniura, Zaicts dhumnades, Rana plancyi, etc.

 Eco-distribution

Amphibians are animals which can live both on land and in water, having a body temperature that varies with the temperature of its surroundings. They mainly distribute in the grass field close to water, next to river and in some wet communities. Reptiles distribute at different habitats. Testudinidae and Trionychidae inhabit the waterways, ponds and rivers, other families inhabit in villiages, field and river banks. The Reptiles distribute more widely than Amphibians.

 Faunal composition

Among the 16 species Amphibians and Reptiles in this region, 8 species are Cosmopolitan, 5 species are Palaearctic region, and 3 species are Oriental region. Among the 7 species Amphibians, 3 species are cosmopolitan, 2 species are Palaearctic region, and 2 species are Oriental region. Among the 9 species of the Reptiles, 5 species are cosmopolitan, 3 species are Palaearctic region, and 1 species are Oriental region.

It can be seen from the Appendix about Amphibians and Reptiles that, the Cosmopolitan species are primary species in both of the Amphibians and Reptiles, which account for half of the species amount. It also can be seen from the whole faunal composition that, the amount of Oriental Region Special is small, accounting for only 18.75% of the total species amount. The species of Amphibians and Reptiles take only 28.57% and 11.11% respectively of the total animal species.

(2) Bird

1) Compostion of bird species

According to this investigation and historical literature, there are 82 species, 32 families and 14 orders of birds that might exist in the nearby areas of the Shaying River Section in Anhui Province, in which birds of the order Passeriformes are the most belonging to 43 species and 14 families.

Based on the field investigation, there are 31 species, 21 families and ten orders of bird resources in the project region. Among all the observed birds, birds of the order Passeriformes are the most, belonging to 17 species and 11 families, which account for 54.84% of the total birds. The compostion of birds ranges in descending order is: Passeriformes (17 species, 11 families), Charadriiformes (3 species, 2 families), Coractiiformes (2 species, 1 family), Columbiformes (2 species, 1 family), Falconiformes (2 species, 1 family), Galliforms (2 species, 1 family), Podicipedifomes (1 species, 1

family), Ciconiiformes (1 species, 1 family), Galliforms (1 species, 1 family) and Piciformes (1 species, 1 family). Compared to bird species from information collection, there are no Turniciformes, Lariformes, Cuculiformes, Charadriiformes and Strigiformes during this investigation.

The birds found in this investigation account for 69.23% of the total orders, 66.67% of the total families, and 39.50% of the total species. The result differs greatly from historical data, mainly because the investigation season is winter and the primary bird species are winter migrants and resident bird species. At the meanwhile, the construction works also caused the reduction of species and amount of birds.

2□The resident types and characteristics of bird resources

Among the 31 observed bird species, winter migrants and resident birds are the dominant species, accounting for 78.97% and 29.03% of the total bird species. Based on the comprehensive analysis on the resident birds, the bird species observed during this investigation take 68.75% of bird species speculated from information colletion. For the winter migrants, it is 31.03%.

3□Eco-distribution and density of birds

According to the environemtnal characteristic of the habitats for the observed 31 species birds during this investigation, the birds in the Shaying River Section in Anhui Province distributed in the 6 habitats as follows:

Villiages: 13 species, 10 families and 2 orders, primary species are Passer domesticus, Sturnus cineraceus and Pica pica.

Farmland:15 species, 12 families and 3 orders, primary species are Passer domesticus and Sturnus cineraceus.

Plantation forest: 18 species, 13 families and 4 orders, primary species are Passer domesticus, Sturnus cineraceus and Pica pica.

Grass Land: 20 species, 9 families and 4 orders, primary species are Passer domesticus, Sturnus cineraceus and Pica pica.

River Channel: 7 species, 6 families and 6 orders, primary species is Tachybaptus ruficollis.

Pond: 5 species, 5 families and 4 orders, primary species are Tachybaptus ruficollis and Gallinula chloropus.

From the species diversity of bird communities in the five habitats (see Table 4-6), one can see that the species diversity of Grass Land is the highest, followed by Plantation forest, Field, Villige, River channel and Pond. The grass lands along the river banks of

Shaying River Section in Anhui Province provide favorable habitats for birds in this region, so its diversity is the highest. However, the species diversity in ponds are relative lower, for the ponds are man-made and disturbed greatly by human activities.

**Table 4-6 Species diversity in different habitats for bird communities**

| Habitats | Villiage | Field | Plantation forest | Grass land | River chane | Pond |
|---|---|---|---|---|---|---|
| Species | 13 | 15 | 18 | 20 | 7 | 5 |
| Diversity□H'□ | 2.6484 | 3.0558 | 3.6670 | 4.0744 | 1.4261 | 1.0186 |

4□Structural features of the water bird communities at the Shaying River in Anhui Province

Water birds are defined as birds which live on wetland in theory of Ecology. They are the important component parts of the wetland ecosystem. Investigation of the composition and eco-distribution of water birds in wetlands plays an important role in protection of wetland ecosystem and water birds.

According to the analysis on the historical data on birds, there are 22 species, 7 families and 5 orders of birds exist in the Shaying River Section in Anhui Province. The species for different birds ranged in descending order are as follows: Charadriiformes (8 species, 2 families), Anseriformes and Ciconiiformes (5 species, 1 family), Galliforms (2 species, 2 families), Podicipedifomes (1 species, 1 family) and Lariformes(1 species, 1 family). Among them, the provincial protected birds include Anser fabalis, Todorna ferruginea, Anas platyrhynchos, Anas poecilorhyncha and Aix galericulata.

No protected water birds are found during this field investigation, because the frequently human activities and the construction are carried out in investigation regions.

□3□Mammals

1) Species compositin

For the investigation time is later winter and it is cold, the small beasts are inactive, and no mammals were catched for the 150 times of plier setting. Therefore, the investigation of mammals mainly refers to the historical data. According to the preliminary statistic, there are 15 species, 9 families and 5 oders of mammals in the investigation region, including 2 species of Insecetivora (Einaceus europaeus and Crocidura suaveolens□, 1 species of Chiroptera (Pipistrellus minus), 1 species of Lagomorpha (Lepus capensis), 6 species of Rodentia(Cricetulus barabensis, Tscheskia triton, Mus musculus, Apodemus agrarius, Rattus tanezumi and Rattus norvegicus), and 5 species of Carntivora (Vulpes vulpes, Nyctereutes procyonoides, Mustela sibirica, Meles meles, Prionailurus bengalensis (see Annex Table 5). Among them, the Vulpes vulpes,

Nyctereutes procyonoides and Prionailurus bengalensis are the Key protected wild animals under class two protection in Anhui Province.

2) Structural features for mammals

Among the 15 species mammals along the Shaying River, 9 species belong to the Palaearctic region which account 60% of the total mammals, 3 species belong to the Oriental regions and 3 species belong to the Cosmopolitan, meaning the Palaearctic are dominant species at the Shaying River basin.

3) Eco-distribution

Mammals are the highest form among vertebrates, and have good adaptive ability to environment. They distribute widely in villiages, fields, wetlands, grass lands and swamps (see Table 4-7). The Rodentia is primary species and its quantitiy is large. The amount of Carntivora which need large living space is small in the region, because the frequently human activities and over exploitation of natural resources.

**Table 4-7 The eco-distributon and food for mammals at the Shaying River**

| Order | Eco-distribution | Main food |
|---|---|---|
| Insecetivora | Villages and fields | Invertebrate and inspects |
| Chiroptera | Nearby Villiages and open fields | Inspects |
| Lagomorpha | Fields and grass lands | Plants |
| Rodentia | Villages, fields and grass lands | Grain and grass seeds |
| Carntivora | Villages and fields | Sigmodontine |

(4) Key protected fauna

According to historical data, in the project region there are 2 species of National protected wild fauna (Grade II); 4 species of Provicial protected wild fauna (Grade I); 10 species of Provicial protected wild fauna (Grade II) Provicial protected wild fauna (Grade II). The details of these fauna are listed in Table 4-8.

Due to long-time artificial changes to the Shaying River, and intensive human activities in the project area, those protected fauna are rarely seen. For example, the Carntivora which need large living space are not found during the field visit of this investigation. Some common or normal fauna can be found though.

**Table 4-8 Fauna under protection Along the Shaying River Section in Anhui Province**

| Order | Family | Chinese Name | Latin Name | Protection grade |
|---|---|---|---|---|
| Falconiformes | Accipitridae | □□ | Milvus lineaus | State grade □ |
| | | □□□ | Cirus cyaneus | State grade □ |
| Piciformes | Picidae | □□□□□ | Dendrocopos major | Provincial grade I |

| | | | | |
|---|---|---|---|---|
| Carntivora | Canidae | □□ | Vulpes vulpes Linnaeus | Provincial grade I |
| | | □ | Nyctereutes procyonoides Gray | Provincial grade I |
| | Felidae | □□ | Prionailurus bengalensis Kerr | Provincial grade I |
| | Mustelidae | □□ | Mustela sibirica Pallas | Provincial grade □ |
| | | □□ | Meles meles Linnaeus | Provincial grade II |
| Salientia | Bufonidae | □□□□ | Bufo raddei | Provincial grade II |
| | | □□□□ | Bufo bufo | Provincial grade II |
| | Ranidae | □□□ | Rana plancyi | Provincial grade II |
| Chelonia | Emydidae | □□ | Chinemys reevesii | Provincial grade II |
| Serpentes | Colubridae | □□□□ | Elaphe taeniura | Provincial grade II |
| | | □□□ | Zaocys dhumnades | Provincial grade II |
| Galliforms | Phasianidae | □□□ | Phasanus colchicus | Provincial grade II |
| Passeriformes | Laniidae | □□□□ | Lanius schach | Provincial grade II |

4.2.2.4. Agricultural Eco-environment

□1□Status of Land Resource

The average land resources are small along the Shaying River, and lower than the average level of 1.39 Mu/Person in Anhui Province. The average land resources of Yingshang and Taihe County are relatively higher than that of Jieshou and Fuyang City. The detailed information on the land resources along the river are shown in Table 4-9.

**Table 4-9 Statistics on status of land resources along the Shaying River Section in Anhui Province**

| Administrative districts | | Land area□Mu□ | Cultivated land area□Mu□ | Population□Person□ | Average cultivated land area□Mu/person□ |
|---|---|---|---|---|---|
| Jieshou City | Dongcheng | 58650 | 23535 | 69014 | 0.34 |
| | Xicheng | 26700 | 6360 | 61056 | 0.10 |
| | Tianying | 43500 | 21230 | 30746 | 0.69 |
| | Yingnan | 63000 | 17900 | 31339 | 0.57 |
| Taihe County | Shuizhen | 63900 | 39000 | 44319 | 0.88 |
| | Jiuxian | 104700 | 54812.3 | 59600 | 0.92 |
| | Daxin | 96000 | 59087 | 52461 | 1.13 |
| | Xiaokou | 85500 | 55143 | 60400 | 0.91 |
| | Chengguan | 94500 | 25367 | 52000 | 0.49 |
| | Zhaoji | 85500 | 53409 | 44302 | 1.21 |
| Yingquan District | Wenji | 214500 | 118000 | 128000 | 0.92 |
| | Ninglaozhuang | 175500 | 96000 | 100000 | 0.96 |
| | Xingliu | 172500 | 98000 | 110000 | 0.89 |
| | Zhoupeng | 131250 | 54000 | 76013 | 0.71 |
| | Wuming | 212250 | 124345 | 122013 | 1.02 |
| Yingzhou District | Sanshilipu | 75000 | 2564 | 41432 | 0.06 |
| Yingdong District | Kouzi | 122745 | 69000 | 83000 | 0.83 |
| | Yuanzhai | 84000 | 39700 | 6300 | 6.30 |
| | Yanglou | 61500 | 34697 | 36275 | 0.96 |
| Yingshang District | Jiangkou | 118500 | 74835 | 84960 | 0.88 |
| | Gucheng | 85800 | 49095 | 41463 | 1.18 |
| | Huangqiao | 106500 | 54150 | 66692 | 0.81 |
| | Xiaqiao | 138465 | 60930 | 50996 | 1.19 |
| | Liuji | 110250 | 65595 | 59992 | 1.09 |
| | Yanghu | 74670 | 35595 | 54498 | 0.65 |
| | Wushilipu | 93750 | 44175 | 38366 | 1.15 |
| | Liushilipu | 108360 | 70095 | 61791 | 1.13 |
| | Xinji | 77160 | 42525 | 48050 | 0.89 |
| | Jianying | 121500 | 71700 | 75784 | 0.95 |
| | Shencheng | 118185 | 57960 | 163254 | 0.36 |

| Administrative districts | | Land area□Mu□ | Cultivated land area□Mu□ | Population□Person□ | Average cultivated land area□Mu/person□ |
|---|---|---|---|---|---|
| | Balihe | 118725 | 44205 | 56201 | 0.79 |
| | Chuigang | 37050 | 30615 | 25550 | 1.20 |
| | Wanggang | 115950 | 55440 | 40760 | 1.36 |
| | Saijianhuizu | 67500 | 27750 | 23995 | 1.16 |

(2) Agricaltural industrial structure

Fuyang City lies in the Plain of the Huai and Huang River, and locates at the junction of Qinling and Huai River. Its land is flat. The place enjoys a temperate climate with well-marked seasons with plenty of rainfall and sunshine, which is suitable for the growth of different kinds of crops, plants and animals. It is fertile of wheat, rice, sweet potato, cotton, corn, bean, fruit, vegetable, mint and traditional medicine materials. It is an important base for producing the farm product and by product, the demonstrative base for feeding cattles with crop stalks, and the important production region for goat skins.

The basic information on the agricultural production for each county and district along the Shaying River is shown in Table 4-10.

**Table 4-10 Basic information on agricultural production along the Shaying River (Unit: 10,000 RMB)**

| Administrition District | Crop farming | | Forestry | | Animal husbandry | | Fishery | |
|---|---|---|---|---|---|---|---|---|
| | Output | □ | Output | □ | Output | □ | Output | □ |
| Jieshou City | 152057 | 55.7 | 16761 | 6.1 | 90702 | 33.2 | 4970 | 1.8 |
| Taihe County | 297535 | 57.2 | 17117 | 3.3 | 186972 | 1.7 | 8276 | 1.9 |
| Yingzhou District | 88265 | 50.0 | 6629 | 3.8 | 71377 | 40.4 | 4176 | 2.4 |
| Yingdong District | 106055 | 49.6 | 5799 | 2.7 | 90205 | 42.2 | 5537 | 2.6 |
| Yingquan District | 112927 | 51.6 | 6341 | 2.9 | 86914 | 39.7 | 6695 | 3.1 |
| Yingshang District | 226402 | 46.6 | 22621 | 4.7 | 192065 | 39.5 | 31272 | 6.4 |

**Figure 4-2 The land use map along the Shaying River**

It can be seen from Table 4-10 that:

(1) The crop farming is dominant along the Shaying River, which accounts for 50% of agricultural output.

(2) The proportion of forestry and fishery is small, which accounts for 7% of the agricultural output.

(3) Expect for Taihe County, the animal husbandry is relatively developed along the Shaying River, whose output takes 40% of the total agricultural output.

### 4.2.3. Current Status of Aquatic Ecological environment

#### 4.2.3.1. Phytoplankton

(1) Species composition

According to the qualitative and quantitative investigation of the plankton at the sampling points among the Shaying River, there are 21 species and 7 phylums of

phytoplankton during this season, including 8 species of Bacillariophyta (which take 38% of the total phytoplankton)□3 species of Chlorophyta, Chrysophyta and Cryptophyta respecitively (all of which take 14% of the total phytoplankton respectively), 2 species of Euglenophyta (which take 10% of phytoplankton), 1 species of Pyrrophyta and Cyanophyta respectively (which takes 5% of the phytoplankton respectively) (See Annex Table 6).

□2□The dominant and common species

The dominant and common species of phytoplankton in the sampling river basin include Cryptomonas erosa, Navicula sp., Colacium vesiculosum, Synedra sp., Phacus orbicularis, Fragilaria sp., Chroomonas caudate, Cryptomonas ovata, Cyclotella sp., Ankistrodesmus sp. and Uroglena volvox.

(3) Density and biomass

On the basis of analysis the density and biomass of phytoplankton along the Shaying River, it can be found that, the density of Cyanophyta is the largest, 15000 ind.·L-1; the densities of Bacillariophyta, Chlorophyta and Chrysophyta are also large, which is 3500 ind.·L-1□ 3000 ind.·L-1 and 2000 ind.·L-1 respectively. The density of Pyrrophyta is the smallest, which is 15 ind.·L-1. The biomass of Cyanophyta is the largest, which is 44.95 mg·L-1. The biomass of Bacillariophyta, Chlorophyta and Chrysophyta are relative large. The biomass of Phrrophyta is the smallest, which is 0.02 mg·L-1□See Table 4-11□. It can be seen that the Cyanophyta and Bacillariophyta are the dominant species along the Shaying River.

**Table 4-11 Quantitative investigation of the species of phytoplankton at the key sampling water areas along the Shaying River Section in Anhui Province**

| Phylum | Bacillario-phyta | Chloro-phyta | Eugleno-phyta | Chryso-phyta | Crypto-phyta | Pyrro-phyta | Cyano-phyta |
|---|---|---|---|---|---|---|---|
| Density (ind.·L-1) | 3500 | 3000 | 1000 | 2000 | 205.00 | 15 | 15000 |
| Biomass (mg·L-1) | 6.24 | 3.88 | 1.50 | 3.64 | 0.31 | 0.02 | 44.95 |

4.2.3.2. Zooplankton

(1) Species compostioin

During this investigation, 12 species of zooplankton were found in this region, including 2 species of Protozoan, 9 species of Rotifer and 1 species of Copepoda. The

species of Protozoan and Copepoda are relative fewer than that of Rotifer.The dominant species are Branchionus urceus, Polyarthra euryptera and Branchionus calyciflorus (see Annex Table 7).

(2) Amount and biomass

According to the investigation, the average density of zooplankton along the Shaying River is 257 ind.·L-1, and the average biomass is 0.1276 mg·L-1. Density of different species is ranged as: Rotifer>Protozoan>Copepoda. Biomass is ranged as: Rotifer>Copepoda>Protozoan. The biomass of Rotifer, Copepoda and Protozoan accounts for 68.73%□28.79 % and 1.49 % respectively of the total biomass.

**Table 4-12 Density and biomass of zooplankton along the Shaying River Section in Anhui**

| Place | Zooplankton | | | | Ratio of different zooplankton□%□ | | | |
|---|---|---|---|---|---|---|---|---|
| | Total | Rotifer | Protozoan | Copepoda | Total | Rotifer | Protozoan | Copepoda |
| Density (ind.·L-1) | 257 | 215 | 30 | 12 | 100 | 83.66 | 11.67 | 4.67 |
| Biomass□mg·L-1□ | 0.1276 | 0.0877 | 0.0019 | 0.038 | 100 | 68.73 | 1.49 | 29.78 |

4.2.3.3. Zoobenthos

(1) Species composition

According to this investigation, 31 species, 10 families and 7 orders of zoobenthos in the region, including 14 species of Gasteropoda, 5 species of Lamellibranchia, 5 species of Annelida, 2 species of Crustaceas, 5 species of Hexapeda (see Annex Table 8). The dominant species are Branchiura sowerbyi, Bellamya purificata and Anodonta woodiana. Bellamya purificata takes a large part of the zoobenthos. In addition, the amount of Unio douglasiae is large in shallow water and herb-riched regions.

(2) Spatial distribution

According to the investigation, the average density of zoobenthos is 39 ind.·m-2□See Tabel 4-13 and 4-15□. The density is 33.0 ind.·m-2 at the River Section from Fuyang to Yuanzhai, and 45.0 ind.·m-2 at Section from Yanghuzhen to Mokekou. The densities of Annelida and mollusks are relative large, 17.6 ind.·m-2□12.1 ind.·m-2 respectivly. The density of Arthropods is small, only 9.2 ind./m2. The Annelida, Mollusks and Arthropods take 45.2%□31.1%□23.7% of the total zoobenthos in the region.

The amount of Annelida does not change too much between different sampling points and distributes evenly. The amount of Mollusks and Arthropods differs greatly between different sampling poins.

(3) Biomass of Zoobenthos

The average biomass of zoobenthos in the investigated regions is 16.1 g·m-2. The biomss is 16.9 g·m-2 at the River Section from Fuyang to Yuanzhai, and is 15.3 g·m-2 at River Section from Yanghuzhen to Mohekou. The average biomass of Annelida, Mollusks and Arthropods is 14.8 g·m-2□0.7 g·m-2 and 0.6 g·m-2 respectively. Mollusks take 92.0% of the total zoobenthos biomass, Annelida 4.3% and Arthropods 3.7% (see Table 4-14, and 4-16). Therefore, Mollusks take a majority part of the biomass.

Comparing the species composition and density of zoobenthos at the two river sections, we can find that the density is lower at the Fuyang to Yuanzhai River Section with a little amount of Arthropods, and the species compositin is relative complex at the Yanghuzhen to Mohekou River Section with higher density of Mollusks and Arthropods.

**Table 4-13 Density of Zoobenthos at the Fuyang to Yuanzhai River Section**

| Place | Density of zoobenthos (ind.·m-2) | | | | Ratio of different zoobenthos□%□ | | | |
|---|---|---|---|---|---|---|---|---|
| | Total | Mollusks | Annelida | Arthropods | Total | Mollusks | Annelida | Arthropods |
| Point 1 | 22.0 | 8.0 | 14.0 | 0.0 | 100.0 | 36.4 | 63.6 | 0.0 |
| Point 2 | 39.0 | 12.0 | 27.0 | 0.0 | 100.0 | 30.8 | 69.2 | 0.0 |
| Point 3 | 11.0 | 4.0 | 6.0 | 1.0 | 100.0 | 36.4 | 54.5 | 9.1 |
| Point 4 | 26.0 | 16.0 | 4.0 | 6.0 | 100.0 | 61.5 | 15.4 | 23.1 |
| Point 5 | 44.0 | 21.0 | 15.0 | 8.0 | 100.0 | 47.7 | 34.1 | 18.2 |
| Point 6 | 56.0 | 8.0 | 28.0 | 19.0 | 100.0 | 14.3 | 50.0 | 33.9 |
| Average | 33.0 | 11.5 | 15.7 | 5.7 | 100.0 | 37.9 | 47.8 | 14.3 |

**Table 4-14 Biomass of zoobenthos at the Fuyang to Yuanzhai River Section**

| Place | Biomass of zoobenthos□g·m-2□ | | | | Ratio of different zoobenthos□%□ | | | |
|---|---|---|---|---|---|---|---|---|
| | Total | Mollusks | Annelida | Arthropods | Total | Mollusks | Annelida | Arthropods |
| Point 1 | 11.1 | 10.7 | 0.4 | 0.0 | 100.0 | 96.4 | 3.6 | 0.0 |
| Point 2 | 12.3 | 11.2 | 1.1 | 0.0 | 100.0 | 91.1 | 8.9 | 0.0 |
| Point 3 | 2.8 | 2.4 | 0.3 | 0.1 | 100.0 | 85.7 | 10.7 | 3.6 |
| Point 4 | 26.4 | 25.9 | 0.2 | 0.3 | 100.0 | 98.1 | 0.8 | 1.1 |
| Point 5 | 39.6 | 38.6 | 0.4 | 0.6 | 100.0 | 97.5 | 1.0 | 1.5 |
| Point 6 | 8.9 | 6.6 | 1.0 | 1.3 | 100.0 | 74.2 | 11.2 | 14.6 |
| Average | 16.9 | 15.9 | 0.6 | 0.4 | 100.0 | 94.4 | 3.4 | 2.3 |

**Table 4-15 Density of zoobenthos at Yanghuzhen to Mohekou River Section**

| Place | Density of zoobenthos (ind.·m$^{-2}$) | | | | Ratio of different zoobenthos□%□ | | | |
|---|---|---|---|---|---|---|---|---|
| | Total | Mollusks | | Total | Mollusks | | Total | Mollusks |
| Point 1 | 51.0 | 12.0 | 16.0 | 23.0 | 100.0 | 23.5 | 31.4 | 45.1 |
| Point 2 | 45.0 | 4.0 | 26.0 | 15.0 | 100.0 | 8.9 | 57.8 | 33.3 |
| Point 3 | 39.0 | 22.0 | 17.0 | 0.0 | 100.0 | 56.4 | 43.6 | 0.0 |
| Average | 45.0 | 12.7 | 19.7 | 12.7 | 100.0 | 28.1 | 43.7 | 28.1 |

**Table 4-16 Biomass of zoobenthos at the Yanghuzhen to Mohekou River Section**

| Place | Biomass of zoobenthos□g·m-2□ | | | | Ratio of different zoobenthos□%□ | | | |
|---|---|---|---|---|---|---|---|---|
| | Total | Mollusks | | Total | Mollusks | | Total | Mollusks |
| Point 1 | 12.9 | 10.9 | 0.3 | 1.7 | 100 | 84.50 | 2.33 | 13.18 |
| Point 2 | 5.5 | 3.2 | 1.1 | 1.2 | 100 | 58.18 | 20.00 | 21.82 |
| Point 3 | 27.6 | 26.7 | 0.9 | 0.0 | 100 | 96.74 | 3.26 | 0.00 |
| Average | 15.3 | 13.6 | 0.8 | 1.0 | 100 | 88.70 | 5.00 | 6.30 |

4.2.3.4. Fish Resources

(1) Species compostion

According to literature review as well as the preliminary statistic analysis, there are 45 species, 14 families and 7 orders of fish resources at the Shaying River Section in Anhui Province (see Annex Table 9). There are 26 species of Cyprinifmes (24 species of Cyprinidae and 2 species of Cobitidae), 3 species of Silurformes (1 species of Siluridae and 2 species of Bagridae), 9 species of Perciformes (3 species of Serranidae, 1 species of Eleotridae, 1 species of Gobiidae, 1 species of Belontiidae, 1 species of Channidae, 1 species of Mastacembelidae), 1 Clupeidae of Clupeiformes (2 specise of Clupeidae), Salmoniformes (3 species of Salangidae), 1 species of Synbranchiformes and Anguilliformes. It can be seen that the Cyprinidae is dominant fish resources. □See table 4-17□□

**Table 4-17 The type constitute of Fish Resources**

| type | The type constitute of Fish Resources | | | | | | |
|---|---|---|---|---|---|---|---|
| Order | Cyprinifmes | Silurformes | Perciformes | Clupeiformes | Salmoniformes | Synbranchiformes | Anguilliformes |
| Family | 2 | 2 | 6 | 1 | 1 | 1 | 1 |
| Genus | 26 | 3 | 9 | 2 | 3 | 1 | 1 |
| Percent | 57.78% | 6.67% | 20.00% | 4.44% | 6.67% | 2.22% | 2.22% |

The main fish resources in Shaying river basin are herring (*Mylopharyngodon piceus*), grass carp (*Ctenopharyngodon idellus*), chub (*Hypophthalmichthys molitrix*), bighead carp (*Aristichthys nobilis*), carp (*Cyprinus carpio*), crucian (*Carassius auratus*) etc..

View from the living habits of fish：Shaying river basin are mostly settled fish, including the main fish resources such as herring , grass carp, chub, bighead carp, carp, crucian etc., which are mainly herbivorous or omnivorous-based. They are widely distributed in the Liaohe River, Huaihe River, Yangtze River, Minjiang River to the Pearl River. In Shaying river basin, they are widely distributed in the natural river such as Ying river, Quan river, Ci river etc. and other natural lakes such as Balihe lake. However, a few migratory fishes are still distributed in Shaying river basin which are coilia ectenes, whitebait, japanese eel.

Coilia ectenes：It's a long-distance migratory fish between river and sea, which usually live in coastal waters. From mid February every year, Coilia parent fishes begin to reproductive migratory from the sea into the river one after another, which can reach farthest to Gan River in Jiangxi province and Dongting Lake in Hunan province and other places. It spawns in the Yangtze River middle and lower reaches and its subsidiary in lakes and rivers. After spawning, coilia parent fishes generally return to estuaries and coastal waters and juveniles are down to the estuary downstream feeding fattening until November fall to the offshore for winter. According to historical data, as Shaying river is the two tributaries of the Yangtze River and there are several ship gates for a long time, so there is few coilia ectenes. As coilia parent fishes mainly spawn in the lakes along the Yangtze River, tributaries or shallow bend in the main stream flow rate of more moderate areas, and Shaying river flows fast, so coilia ectenes spawning areas in the Shaying river basin may exist in the Balihe lake which is in the Shaying river and Huai river confluence.

Whitebait：Whitebait freshwater fish living in coastal waters, with sea to river migratory habits. It's mainly distributed in the coastal areas from Zhejiang to Shandong province, especially in Poyang Lake, Chao Lake, Tai Lake and the Yangtze Delta to Chongming, etc. Whitebait mainly lives in the shallow water and slow flow region. According to historical data, As Shaying river flows fast and there are several ship gates for a long time, so there is few whitebait. In Shaying river basin, Whitebait are mainly distributed in the Quan river, Ci river and other natural water with more moderate flow and in the Balihe

lake which is in the Shaying river and Huai river confluence.

Japanese eel As a migratory fish, it usually live in freshwater, in autumn mature broodstock will fall down to the sea by the estuary for spawning and breeding. The spawning areas are in the sea with the centre of Ryukyu oceanic trench. In Yangtze River basin, It falls from sea to river in February to May. Male eels typically grow in the Yangtze Estuary. Female eels fall into the tributaries and lakes of Yangtze River for breeding. To the mature age, in the autumn from September to November, a large number of female eels will fall to the Yangtze Delta and in conjunction with a male eel in the estuary, then fall to the sea for reproduction. At present, the Japanese eels are mostly artificial breeding, mainly in Guangdong, Fujian, Zhejiang, Jiangsu province. So the natural rivers and lakes along Shaying river basin is the general migration channel of the female Japanese eel.

(2) Spawning areas for fishes

The spawning season for fish is between February to July. Since it is winter during this investigation, fishes are not in the spawning period, so no fish spawning areas were found during this field investigation. According to information collection and authorities' visits, there are no spawning, feeding or wintering areas for fishes at the Shaying River. Spawning areas designated by the local fisheries department are distributed in Balihe lake of Yingshang county, Meng river in Funan county and Ci river in Taihe county.

The selection of spawning areas depends closely on the hydrological environment. For example, the four largest spawning areas are located at the swollen water regions. The characters of the primary spawning areas include: average water velocity is more than 0.8m/s, the current is swift, water is rich in sand, and the water flow is disordered. According to the study of the Nanjing Institute of Geography of the Chinese Academy of Sciences, when water flows through the Ship Lock, the swift current is blocked off by the dissipation shed, which make the upstream water move rotatively. Therefore, the flow is disordered for a long distance under the ship lock, which provides necessary flow conditions for spawning and forms the new and potential spawning ground. Therefore, we believe that the spawning areas might be formed at the Yinghe Ship Lock during February and July.

(3) Key Protected Fishes

According to the field investigation and historical data, there are no State Special Protection wild fishes at the Shaying River Section in Anhui.

### 4.2.4. Current Status of Wetland

According to field investigation and information collection, there are 6 types of wetland along the Shaying River Section in Anhui Province, including river, pond, fish

farm, meadow marsh, delta and man-made ditch (see Figure 4-4 and Table 4-18). The remote images and wetlands distritution are shown in Figure 3 (Attached).

**Table 4-18 Distrubution of wetlands along the Shaying River Section in Anhu**

| Category | Type | Main characteristics and location |
|---|---|---|
| River wetland | 1.River | Have water all over the year; The mainstream of Shaying River and its tributaries |
| | 2. Delta | Distribute in the river basin, and encircle by water all around. Mainly distrute in the Shaying River delta wetland in Fuyang City and Yingshang County |
| Meadow wetland | 3.Meadow wetland | High vegetation abundance, have water during all the year or at fixed period. Mainly distrute at river section from Yanghuzhen to Mohekou |
| Man-made wetland | 4. Pond | Most are man-made. Distrubute the low-lying places between villiages and the Shaying River |
| | 5.Man-made ditch | Most are used for irrigation and water dischargment from residentials |
| | 6. Fish farm | Fish raising areas around the villiage |

□Meadow wetland□

□River□

□Man-made ditch□

□Delta□

□Fish farm□ □Pond□

**Figure 4-4 Wetland types along the Shaying River Section in Anhui Province**

### 4.2.5. Anhui Province Taihe County Shaying River National Wetland Park

#### 4.2.5.1. Overview

**Box. Management system of wetland parks in China – An Overview**

- "The Circular on Enhancement of Wetland Protection and Management" (State Council, [2004] No.50) states clearly that, "*various forms should be taken to enhance the wetland protection and management in those areas that do not meet the requirement of building nature reserves, such as building the small wetland protection regions, different kinds of wetland parks, multi-purpose wetland management regions and delimiting the habitats of wild plants and animals.*"
- "The Circular on Development and Construction of wetland Parks" (State Forestry Bureau [2005] No.118) states: "*Wetland parks can be divided into state wetland parks and provincial wetland parks. The construction of state wetland should have written application from provincial foresty authorities and the agree letter on the proposed site for state wetland park as well as the general plan of the wetland park which are submitted to State Forestry Bureau. Then the State Forestry Bureau will organize Independent Review Committee of state wetland to carry out the field investigation and assessment, and to approve the construction of wetland parks which meet requirement……The provincial wetland parks are approved by the provincial forestry bureaus.*" However, the construction of wetland in China is still at the initial stage. The already built are all state wetland parks. The provincial wetland parks are at the state of planning and preparation.
- "State Wetland Park Management Measures [pilot]" promulgated by the State Forestry Bureau on February 28, 2010. It stipulates that "*State forestry Bureau is responsible for the approval of State wetland park construction, the state or provincial forestry authrities are responsible for guiding and monitoring the management of state wetland park construction, and the stete wetland park management authorities are responsible for the daily management of state wetland park.*" These requirements also apply to the setting up, construction and management of currently local wetland parks.

According to the No.297 document promulgated by the state forestry bureau, Anhui Province Taihe County Shaying River National Wetland Park was established on December 23, 2009.

The main purpose of Anhui Province Taihe County Shaying River National Wetland Park is ecological construction, which include: □ To enhance the construction of forestry belt along the banks of the Taihe Shaying River, to stable the Shaying River channel, and to improve the navigable and flood storage ability of the Shaying River with the water control project in Genglou, so as to protect life and property of the nearby villages. □ to improve the water quality near Genglou by taking measures of biological and project engineerings, so as to improve the environment quality at the Shaying River.□ to enrich the vegetations at the banks of the Shaying River, to increase the biological diversity, and to improve the water conservation ability of the planned region. □ to accelerate the construction of Taihe new city by introducing and protection of landscape plant in wetland park, and to integrate the around tourist resource so as to promote the development of tertiary industry.

The primary wetland type in the construction regions of Anhui Province Taihe County Shaying River National Wetland Park is river wetland. The wetland park is 13.5km in length and 1.3 $km^2$ in area. In the north of the project region, the new built Genglou water control project made the original Shaying River channel straight, and 300 Mu lake and 800 Mu beach land are formed because of the side leakage of old Shaying River channel. There are also two brooks located in the wetland park, which are Wanfu Brook and Baiyang Brook.

According to " Master Plan of Anhui Province Taihe County Shaying River National Wetland Park", the wetland park can be divided into four functional zones, including the Wetland Ecological Conservation Zone, the Shaying River Leisure Zone, Wetland Eco-function Demonstration Zone and the Management Zone.

(1) Wetland Ecological Conservation Zone is located in the north of the wetland park, lying north of the Shaying River from Wanfu Brook to 308 Provincial Highway. Its area is 101.3 ha.

According to field investigation, argriculural ecosystem is dominant in the regions. The Wanfu Brook is an important tributary of the Shaying River. The natural wetland ecological resources in Wanfu Brook region reduce greatly, because of agriculture and impacts of human disturbance. This place became a semi-artificial agricultural ecosystem gradually (see Figure 4-5).

According to the “Mater Plan of Anhui Province Taihe County Shaying River National Wetland Park”, it is necessary to protect the wetland and its ecosystem in this region. The projects of connecting rivers, building habitat islands, construction water conservation protective forest can be carried out in this region referring to the construction standards of wetland protection regions. In the wetland ecological conservation zone, only works of scientific study, protection and observation on wetland are allowed, and construction works which are irrelevant to wetland ecosystem protection are not allowed to carry out in this region. All the man-made facilities in this regions are installed on the preconditions of ensuring the completeness and minimum disturbance of native ecosystem.


**Table 4-5 Status of wetland ecological conservation zone in Anhui Province Taihe County Shaying River National Wetland Park**

(2) Wetland Eco-function Demonstration Zone

This zone lies in the south old channel of the Genglou water control project, with an area of 122.3 ha. The new built Genglou water control project made the original Shaying River channel straight, and 300 Mu lake and 800 Mu beach land are formed because of the side leakage of old Shaying River channel.

According to field investigation, after open to navigation of the Genglou Ship Lock on June 1, 2009, the old channel formed by the new built Genglou project are primary river, area of the beach land is small, and the agricultural ecosystem is dominant in surround regions.

According to the “Mater Plan of Anhui Province Taihe County Shaying River National Wetland Park”, the wetland eco-function demonstration zone is the transition zone from Wetland Ecological Conservation Zone to the Leisure Zone. It has two functions: 1) Ecotourist demonstration function: It can make tourist unstanding of the wetland and improve people’s protective awareness of wetland and eco-environment

through arranging some on-water amusement, such as aquatic yacht and rowing boat. 2) Eco-benefit demonstration: the Genglou water control project can be used as demonstration for eco-benefit, showing the effectiveness of eco-treatment of the Shaying River in Taihe County. The main function of this zone is to protect and restore of wetland ecosystem. Tourists are allowed to enter.


**Table 4-6 Status of the Wetland Eco-function Demonstration Zone in Anhui Province Taihe County Shaying River National Wetland Park**

(3) Shaying River Leisure Zone

This zone locates at both sides of the Shaying River, from the Genglou water control project to Taihe Bridge. The planned area is 441.7 ha.

According to field investigation, agricultural ecosystem is dominant in this region. It is primary artificical protective forest inside the embankments of the Shaying River, and agricultural ecosystem which is mainly field outside the embankments (see Table 4-7).


**Table 4-7 Status of the Leisure Zone in Anhui Province Taihe County Shaying River National Wetland Park**

According to the General Plan of Anhui Province Taihe County Shaying River National Wetland Park, this zone focuses on leisure and pleasure. The entertainment projects charactered of water culture and river culture are organized in this zone. It can

provide urban residents with a special activity space with combined the function of landscape viewing, scientific education and leisure, by building all kinds of eco-tourist sightseeing gardon, fruit-picking gardon, culture gardon, etc.

(4) Management Zone: Taihe □ Bridge is the main entrance of the Wetland Park. The 6 ha waterfront region near the bridge is planned to be management zone for the wetland. The old houses are rebuilt as management office of the wetland park. Simple hospital is also built here. The overall area of this zone is 48.7 ha.

**Table 4-8 Status of Service Zone in Anhui Province Taihe County Shaying River National Wetland Park**

4.2.5.2. Location Relation of This Project and Anhui Province Taihe County Shaying River National Wetland Park

The location relation of this project and the Anhui Province Taihe County Shaying River National Wetland Park is shown in Figure 4-9. It can be seen from the figure that, the Section k25~k38+500 of this project is located in the Anhui Province Taihe County Shaying River National Wetland Park. The main engineering works of this project section within the wetland park include: 3# disposal area, channel dredging, G105 Taihe Shahe □ Bridge rebuilding. The construction works of service area and anchorage area building, disposal area and chuter cutoff are not involved. According to the preliminary design material of this project, the volume of k25~k38+500 channel dredging is shown in Table 4-19.

**Table 4-19 Volume of k25~k38+500 channel dradging within the Taihe County Shaying River National Wetland Park**

| Origination and Destination | Dredging volume on the Land | Dredging volume underwater |
|---|---|---|
| K25+000□K30+000 | 0 | 0 |
| K30+000□K31+000 | 0 | 16020 |
| K31+000□K32+000 | 0 | 5315 |

| Origination and Destination | Dredging volume on the Land | Dredging volume underwater |
|---|---|---|
| K32+000□K33+000 | 0 | 11196 |
| K33+000□K36+000 | 0 | 0 |
| K36+000□K37+000 | 0 | 20483 |
| K37+000□K38+000 | 0 | 7590 |
| K38+000□K39+000 | 0 | 36098 |

It can be seen that the constructive sections of this project mainly focus on Section k30~k33 and k36~k38+500, both of which locate in the Shaying River Leisure Zone and Service Zone of the Anhui Taihe County Shaying River National Wetland Park.

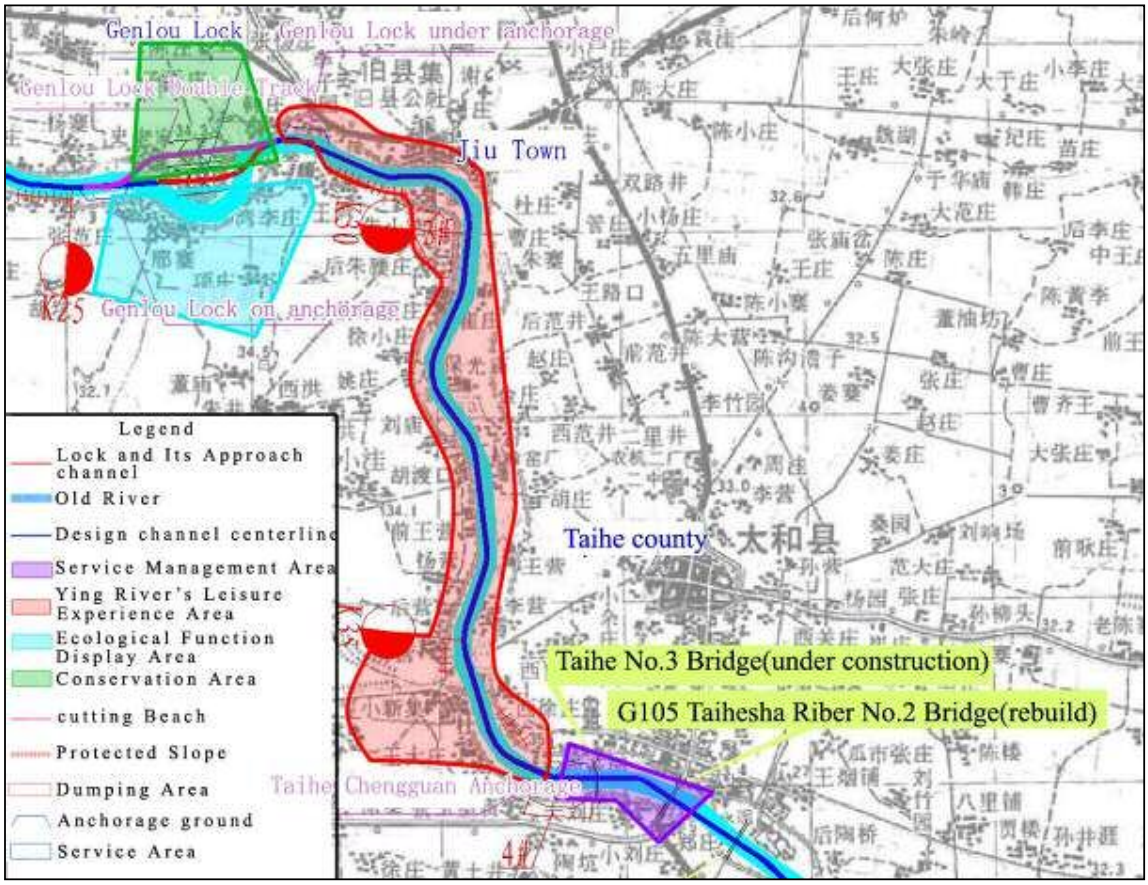



**Table 4-9 Location relation of this project and the Anhui Taihe County Shaying River National Wetland Park**

### 4.2.6. Conculusions

(1) The project region at the Shaying River Section in Anhui Province is generally plain, where is densely populated and has a long history of aerial farming. It belongs to the typical agricultural ecosystem.

(2) According to field investigation, the Shaying River was reconstructed, improved and developed many times in the past. Influenced by human activities, the eco-environment along the Shaying River is basically artificial ecosystem. The primary vegetations are field, plantation forest, grass land, abandoned land and shrub vegetation.

(3) According to historical data, in the project region there are protected fauna at various levels. Due to long-time artificial changes to the Shaying River, and intensive human activities in the project area, those protected fauna are rarely seen. For example, the Carntivora which need large living space are not found during the field visit of this investigation. Some common or normal fauna can be found though.

(4) According to field investigation, Cyanophyta and Bacillariophyta are the dominant species of phytoplankton along the Shaying River. The amout of Rotifer is the largest among zooplankton, and it is widely distributed. Mollusks and Annelida are the dominant species of zoobenthos. Cyprinidae is dominant fish resources.

(5) No State Special Protection wild fishes are found at the Shaying River Section in Anhui during this investigation. There are also no spawning areas, feeding areas, wintering areas for fishes found in the Shaying River.

(6) The Section k25~k38+500 of this project is located in the Anhui Province Taihe County Shaying River National Wetland Park. The main engineering works of this project section within the wetland park include: 3# disposal area, channel dredging, G105 Taihe Shahe □ Bridge rebuilding. The construction works of service area and anchorage areas building, disposal area and chuter cutoff are not involved. The constructive sections of this project mainly focus on Section k30~k33 and k36~k38+500, both of which locate in the Shaying River Leisure Zone and Service Zone of the Anhui Taihe County Shaying River National Wetland Park.

## 4. 3. **Overview of Societal Status**

### 4. 3. 1. **Administrative Division**

Fuyang City is located in the northwest of Anhui Province, to border Shandong in the north and Henan and Hubei in the west. It is the important city of Auhui Province with a long history of over 2500 year. In the early 1996, Fuyang City is approved as provincial city by the State Council, and covers one city, 3 districts and 4 counties. The total populatin in Fuyang City is 9,200, 000. Total area is 9,775 $km^2$. There are over 570,000 people in urban area of Fuyang City. The area of built area is 60.7 $km^2$.

### 4.3.2. Socio-economic Development

Since the reform and opening-up as well as the open of the Beijing-Kowloon Railway, the economy of Fuyang City has developed fast, the urban construction has been accelerated and people's living level has been improved greatly. The comprehensive economic strength has been greatly improved, the adjustment of agricultural structure has been accelerated, and the capability for defense against natural disasters has been enhanced. The Light and Heavy Industries Coordinately developed industrial production system has been set, with leading industries of the Light and Texitile, Chemical, Food, Tobacco, Feather, Electronics and Machinery. The tertiary industry has been rapidly developed, and Urban and rural markets have been brisk. By the end of 2005, the total GDP of the Fuyang City is 32,460,000,000 Yuan. The industrial structure of the three industries is 32.3□29.4□38.3.

Fuyang City is located in the northwest of the Shanghai Economy Zone, and at the junction of the Beijing-Kowloon Economy Belt and the Longhai-Lanxin Economy Belt. It has very good locational conditions. According to the new general plan, Fuyang City will be build as the central city in Anhui Province and the modern large city in the centre of the Beijing-Kowloon Economy Belt.

This project is on the main development direction of the Fuyang City. The project can provide citizens with convenient travel conditions, and provide a good living and production environment for Enterprises and government institutions as well as the residents. It can also reduce the traffic passing through the urban area, mitigate the urban traffic pressure, advance the construction and development of the City, and provide good conditions for development of the city economy.

### 4.3.3. Economic Situation in Hinterland

There are rich resources in hinterland of Shaying River. It is the important base for coal, chemical industry and commodity grain in China. There are more than 50 minerals under exploitation, such as coal, Fe, Al, Cu, Salt, limestone and plaster. The proven coal reserves amount to 3 billion tons, bauxite 0.21 billion tons, iron ore 0.66 billion tons, saltmine 270 billion tons and cement limestone 0.36 billion tons. The land area of the hinterland of Shaying River is 44,700 km2, which accounts for 14.6% of the total areal of Henan and Anhui Province. The cultivated land area is 2,597,000 ha, which takes 21.6% of the total area. Its population is 38,540,000, which accounts 23.4% of the total population in the two provinces. The primary agricultural product and by product are wheat, bean, cotton, oil plant and tobacco leaves. A modern industrial system of

considerable size complete with all necessary departments has taken shape, with a large number of national large and medium-sized enterprises, such as the Pingmei Coal Mining Group, the Dengmei Coal Mining Group, Huainan Xinji Coal Mining Group and the Shenma Group. The GDP of the hinterland reached 406.9 billion Yuan in 2005, which takes 25.5% of the GDP in the two provinces. Investment in the fixed assets reached 171.0 billion Yuan, which takes 24.8%. The value-added of agricultural and industrial enterprises above designated size was 126.8 billion Yuan, which takes 27.1%. The Shaying River Improvement Project will optimize the transportation structure, promote the sustainable development of national economy, and have good economy and social benefits.

#### 4.3.4. Cultural Resources

The cultural hertitage is defines as the place which has archaeological, paleontological, historical and religious value as well as natural value. Therefore, according to the Business Guideline of World Bank, the cultural heritage not only covers the heritage remained by the ancient residents (e.g. ruins, shrines and war field), but also covers the unique natural landscapes such as canyon and waterfall.

The assessment team investigated the cultural heritage in the project regions through the following approaches: ① Visit the Fuyang Cultural Relics Office; □ Carry out field investigation of the cultural heritage during the investigation of the 34 disposal areas and 12 chuter cutoff sections; □ Visit the local residents, and investigate the heritage in project regions with method of public participation inventory.

Fuyang City has 17 provincial protected cultural heritages, including 5 in the urban area, 2 in Jieshou City, 1 in Linquan County, 6 in Taihe County, 2 in Funan County, 1 in Yingshang County. There are 67 County protected cultural heritages, in which 9 in the urban area, 12 in Jieshou City, 11 in Linquan County, 7 in Taihe County, 20 in Funan Count and 8 in Yingshang County. According to the investigation, there are no important relics or cultural heritage in the affected regions by this project at the Shaying River.

## 4.4. Environmental Quality

#### 4.4.1. Ambient Air Quality

The regular monitoring results of Ambient Air quality for Fuyang City, Jieshou City, Taihe County and Yingshang County in 2007 are listed in Table 4-20, which are provided by the Fuyang Environmental Monitoring Station.

**Table 4-20 The annual average value of ambient air quality along the Shaying River in 2007**

| Monitoring Place | Item | | | |
|---|---|---|---|---|
| | $SO_2$ | $NO_2$ | $PM_{10}$ | TSP |
| Fuyang City | 0.022 | 0.032 | 0.099 | 0.149 |
| Jieshou City | 0.023 | 0.030 | 0.112 | 0.158 |
| Taihe County | 0.024 | 0.030 | 0.123 | 0.172 |
| Yingshang County | 0.021 | 0.028 | 0.096 | 0.138 |
| Standard | 0.06 | 0.04 | 0.10 | 0.20 |

It can be seen from Table 4-20 that, the annual average concentration of $SO_2$ in Fuyang City, Jieshou City, Taihe County and Yingshang County ranges from 0.021 to 0.024mg/m3 in 2007. The annual average concentration of $NO_2$ ranges from 0.028 to 0.032mg/m3, $PM_{10}$ ranges from 0.096 to 0.123mg/m3, and TSP ranges from 0.138 to 0.172mg/m3. Among them, $SO_2$, $NO_2$ and TSP have attained the second grade standard of GB3095-1996 Ambient Air Quality Standard. $PM_{10}$ is over the standards in Jieshou City and Taihe County, because there are many construction sites around the monitoring points. Generally speaking, the ambient air quality is good along the Shaying River.

### 4.4.2. Surface Water Quality

(1) Monitoring time and frequency

Fuyang Environment Monitoring Station monitored the status of surface water in Shaying and Huai River on April 23 and 24, with one time sampling and analysis each day.

(2) Monitoring Results of water quality

The status monitoring sites of surface water are shown in Annex Figure 2 (Attached), and the monitoring results are listed in Table 4-21 (the average value of the two days).

(3) Assessment Methods

Compare the monitoring results of the assessment factors in assessment region with the determined value for function water environment, evaluate the water quality with method of single factor index, analysis the water quality and then determine whether or not the water quality meets the water quality standards.

The single pollutant index can be calculated as:

$$Pi = Ci / Si$$

Where Ci represents the monitoring concentration of pollutant I (mg/l), Si represents the assessment standard for pollutant i(mg/l)

When pHi□7.0, Pi =□7.0 - pHi□/□7.0 – $pH_{low\ limit}$□

When pHi>7.0, Pi =□pHi - 7.0□/□$pH_{Upper\ limit}$ - 7.0□

**Table 4-21 Monitoring results of surface water (Unit: mg/L, except units of pH and fecal coliform**

| Monitoring time | River | Section Number | Section position | pH | BOD | Fecal coliform (coliform /L) | TN | TP | COD | Oil pollutant | SS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| April 23 and 24, 2008 | Shaying River | 1 | 100m downstream junction of Henan and Anhui Province | 7.67 | 7 | 2300 | 6.82 | 0.486 | 20 | 0.07 | 35 |
| | | 2 | Jieshou Section | 7.69 | 7 | 1750 | 6.78 | 0.496 | 23 | 0.93 | 53 |
| | | 3 | Taihe Shuipu Section | 7.69 | 5 | 1800 | 6.06 | 0.451 | 14 | 0.02 | 47 |
| | | 4 | Taihe Jiuxian Section | 7.72 | 6 | 1700 | 5.17 | 0.399 | 21 | 0.01 | 41 |
| | | 5 | Taihe County Sectioin | 7.67 | 6 | 1600 | 5.30 | 0.411 | 23 | 0.04 | 38 |
| | | 6 | Intake of Zhoupeng power plant | 7.79 | 6 | 1100 | 7.55 | 0.281 | 20 | 0.04 | 50 |
| | | 7 | Fuyang City Section | 7.67 | 6 | 1400 | 7.73 | 0.348 | 20 | 0.05 | 89 |
| | | 8 | Fuyang Kouziji Section | 7.72 | 6 | 1020 | 7.14 | 0.309 | 23 | 0.04 | 46 |
| | | 9 | Fuyang Jiangkouji Section | 7.74 | 6 | 940 | 6.74 | 0.288 | 18 | 0.03 | 37 |
| | | 10 | Yingshang County Section | 7.78 | 4 | 1350 | 6.72 | 0.396 | 18 | 0.03 | 40 |
| | | 11 | Yingshang Wanggang Section | 7.78 | 4 | 1250 | 5.85 | 0.385 | 18 | 0.03 | 40 |

| Monitoring time | River | Section Number | Section position | pH | BOD | Fecal coliform (coliform /L) | TN | TP | COD | Oil pollutant | SS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 12 | Yingshang Saijian Section | 7.79 | 5 | 1100 | 6.74 | 0.405 | 18 | 0.03 | 37 |
| | | 13 | Yingshang Mohekou Section | 7.91 | 6 | 1300 | 6.68 | 0.435 | 22 | 0.01 | 41 |
| | Huai River | 14 | 200m upstream point joining the Huai River | 7.97 | 3 | 1700 | 4.40 | 0.378 | 13 | 0.01 | N/A |
| | | 15 | 200m downstream point joining the Huai River | 7.83 | 4 | 1800 | 3.53 | 0.389 | 15 | 0.01 | N/A |

When Pi□1, meaning that the water quality meets corresponding standards of water function zone;

When Pi >1, meaning the water quality does not meet the correspond standards of function zone.

Once there is one pollutant index Pi>1 at a monitoring section, the water quality can not meet the standards of function zone at this section.

□4□Assessment Standards

According to the confirmation letter signed by Fuyang Environment Protection Bureau, the surface water quality of the Shaying River section in Anhui (Fuyang Section) should meet Grade IV in "Environmental Quality Standard for Surface Water" (GB3838-2002). The Huai River section in Anhui should meet Grade □.

**Table 4-22 Environmental Quality Standards for Surface Water" (GB3838-2002) (Cited)**

(Unit: mg/L, except units of pH and fecal coliform)

| Item | Category III | Category □ |
|---|---|---|
| pH | 6～9 | 6～9 |
| COD | □20 | □30 |
| TN | □1.0 | □1.5 |
| TP | □0.2 | □0.3 |
| BOD | □4 | □6 |
| Oil pollutant | □0.05 | □0.5 |
| fecal coliform (coliform /L) | □10000 | □20000 |
| SS* | □80 | □80 |

Note*: SS is assessed based on standards in "Standards for irrigation water quality" (GB5084-2005).

□5□Results

The single factor index was calculated using the monitoring results. Results are shown in Table 4-23.

According to the monitoring and assessing results of the status of water quality at Shaying River, the current surface water quality at the Shaying River Section in Anhui Province (Fuyang Section) cannot meet Grade IV in "Environmental Quality Standard for Surface Water" (GB3838-2002). The Huai River section in Anhui cannot meet Grade □.

According to the calculated results of single factor index in Table 4-23, the factors which are over the standards are mainly TN, TP and BOD. Among them, TN is beyond the standards as high as 5.15 times at the Fuyang City monitoring section. TP is beyond the standards as high as 0.65 at the Jieshou City monitoring section. BOD is beyond the standards as high as 0.17 at the two monitoring section in Jieshou. It can be seen that, in the 13 monitoring sections at the Shaying River Section in Anhui (Fuyang Section),

monitoring items TN and TP are serious over the standards, especially at the Jieshou Section, also are BOD and oil pollants. In the two monitoring section at the Huai River, TN and TP are also over the standards.

According to investigation and analysis, the sewage treatment plants for county level or above have all been built in the Fuyang City. There are 6 sewate treatment plants, which include the Fuyang City Sewage Treatment Plant, Taihe County Sewage Treatment Plant, Jieshou City Sewage Treatment Plant, Yingshang County Sewage Treatment Plant, Funan County Sewage Treatment Plant and Linquan Country Sewage Treatment Plant. The total daily wastewater treatment capacity is 210,000 ton. The Yingdong Sewage Treatment Plant (the construction scale in the first stage is daily wastewater treatment capacity of 30,000 tons) began to be constructed in June 2009 and is estimated to put into operation by the end of this year. It can be seen that the municipal networks have basically covered the county level or above. Most of the industrial wastewater and municipal wastewater can be centralized treated by the sewage treatment plants. Therefore, one of the major pollution sources at the Shaying River section in Anhui Province come from the non-point pollution from agriculture in countryside. The pollutions also may come from the Shaying River upstream section in Henan Province.

**Table 4-23 Calculation results of single factor index for surface water (Unit: mg/L, except units of pH and fecal coliform)**

| Monitoring time | River | Section Number | Section position | pH | BOD | Fecal coliform (coliform /L) | TN | TP | COD | Oil pollutant |
|---|---|---|---|---|---|---|---|---|---|---|
| April 23 and 24, 2008 | Shaying River | 1 | 100m downstream junction of Henan and Anhui Province | 0.34 | 1.17 | 0.12 | 4.55 | 1.62 | 0.67 | 0.14 |
| | | 2 | Jieshou Section | 0.35 | 1.17 | 0.09 | 4.52 | 1.65 | 0.77 | 1.86 |
| | | 3 | Taihe Shuipu Section | 0.35 | 0.83 | 0.09 | 4.04 | 1.50 | 0.47 | 0.04 |
| | | 4 | Taihe Jiuxian Section | 0.36 | 1.00 | 0.09 | 3.45 | 1.33 | 0.70 | 0.02 |
| | | 5 | Taihe County Sectioin | 0.34 | 1.00 | 0.08 | 3.53 | 1.37 | 0.77 | 0.08 |
| | | 6 | Intake of Zhoupeng power plant | 0.39 | 1.00 | 0.06 | 5.03 | 0.94 | 0.67 | 0.08 |
| | | 7 | Fuyang City Section | 0.34 | 1.00 | 0.07 | 5.15 | 1.16 | 0.67 | 0.10 |
| | | 8 | Fuyang Kouziji Section | 0.36 | 1.00 | 0.05 | 4.76 | 1.03 | 0.77 | 0.08 |
| | | 9 | Fuyang Jiangkouji Section | 0.37 | 1.00 | 0.05 | 4.49 | 0.96 | 0.60 | 0.06 |
| | | 10 | Yingshang County Section | 0.39 | 0.67 | 0.07 | 4.48 | 1.32 | 0.60 | 0.06 |
| | | 11 | Yingshang Wanggang Section | 0.39 | 0.67 | 0.07 | 3.90 | 1.28 | 0.60 | 0.06 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 12 | Yingshang Saijian Section | 0.39 | 0.83 | 0.06 | 4.49 | 1.35 | 0.60 | 0.06 |
| | | 13 | Yingshang Mohekou Section | 0.46 | 1.00 | 0.07 | 4.45 | 1.45 | 0.73 | 0.02 |
| | Huai River | 14 | 200m upstream point joining the Huai River | 0.49 | 0.75 | 0.17 | 4.40 | 1.89 | 0.65 | 0.20 |
| | | 15 | 200m downstream point joining the Huai River | 0.42 | 1.00 | 0.18 | 3.53 | 1.94 | 0.75 | 0.20 |

### 4.4.3. Groundwater Quality

(1) Monitoring results

Fuyang Environment Monitoring Station took 8 groudwater samples at the Shaying River on April 23, 2008. The sampling points for groundwater quality are shown in Annex Figure 2 (Attached). The monitoring results are shown in Table 4-24.

(2) Assessment method

A statistical analysis was made of the monitoring results of groundwater quality. The assessemtn methods are the single factor assessment and comprehensive assessment recommend by the“Quality Standard for Ground Water” (GB/T14848-93).

Single factor assessment: determine the assessment value of a single factor using corresponding standards listed in Table 4-25.

**Table 4-25 The assessment standard for single factor**

| Grade | □ | □ | □ | □ | □ |
|---|---|---|---|---|---|
| Fi | 0 | 1 | 3 | 6 | 10 |

The formula for comprehensive assessment is:

$$F = \sqrt{\frac{\overline{F}^2 + F_{\max}^2}{2}} \quad \text{.....(1)}$$

$$\overline{F} = \frac{1}{n}\sum_{i=1}^{n} F_i \quad \text{.....(2)}$$

Where $\overline{F}$ refers to the average value of the single factor Fi□$F_{max}$ refers to the maximum value of Fi; n refers to number of factors.

(3) Assessment standards

The groundwater quality should meet Category III in “Quality Standard for Ground Water” (GB/T14848-93). The relevant pollutants and limit value of their concentration are shown in Table 4-26.

**Table 4-26 Quality Standards for Ground Water □GB/T14848-93□(Cited)**

**Unit□mg/l□except unit of pH□**

| Item | pH | Permanganate Value | $NH_3$-N | Cyanide | Coliform | Chloride |
|---|---|---|---|---|---|---|
| Category III | 6.5-8.5 | □3 | □0.2 | □0.05 | □3 | □250 |
| Item | Pb | Sulfate | $Cr^{6+}$ | Total water hardness | Hg | As |
| Category III | □0.05 | □250 | □0.05 | □450 | □0.001 | □0.05 |

Based on the calculation results from single factor assessment $F_i$ and comprehensive assessment $\overline{F}$ as well as Table 4-27, the grade of ground water quality can be determined.

**Table 4-27 Grade of ground water quality**

| Grade | Excellent | Well | Good | Bad | Extremely bad |
|---|---|---|---|---|---|
| F | <0.8 | 0.8□<2.50 | 2.50□<4.25 | 4.25□<7.20 | >7.20 |

**Table 4-24 Monitoring results of groud water quality (Unit: mg/L, except units of pH and fecal coliform)**

| Monitoring time | Monitoring position | pH | Permanganate Value | $NH_3$-N | Cyanide | Coliform | Chloride | Pb | Sulfate | $Cr^{6+}$ | Total water hardness | Hg | As |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| April 23, 2008 | Jieshou City 1# | 8.19 | 0.5 | 0.025L | 0.004L | 3L | 56 | 0.001L | 62.8 | 0.004L | 32 | 0.000076 | 0.000 |
| | Jieshou City 2# | 8.27 | 0.5 | 0.025L | 0.004L | 3L | 46 | 0.001L | 53.0 | 0.004L | 24 | 0.000063 | 0.000 |
| | Taihe Jiuxianji | 7.48 | 0.5 | 0.025L | 0.004L | 3L | 29 | 0.001 | 33.0 | 0.004L | 252 | 0.000087 | 0.000 |
| | Taihe County | 7.30 | 0.5 | 0.025L | 0.004L | 3L | 32 | 0.001L | 49.1 | 0.004L | 436 | 0.000010 | 0.000 |
| | Fuyang City | 7.81 | 0.5 | 0.025L | 0.004L | 3L | 47 | 0.001L | 13.0 | 0.004L | 99 | 0.000014 | 0.000 |
| | Fuyang Kouziji | 7.62 | 0.5 | 0.025L | 0.004L | 3L | 40 | 0.001 | 29.9 | 0.004L | 140 | 0.000082 | 0.000 |
| | Yingshang County | 7.30 | 0.5 | 0.025L | 0.004L | 3L | 46 | 0.001L | 32.0 | 0.004L | 440 | 0.000028 | 0.000 |
| | YingshangSaijianzhen | 7.16 | 0.5 | 0.025L | 0.004L | 3L | 64 | 0.002 | 31.0 | 0.004L | 780 | 0.000017 | 0.000 |

Note: The detection limit of NH3-N is 0.025 mg/L, of Permanganate Value is 0.5mg/L, of Cyanide is 0.004mg/L, of Cr+6 is 0.004mg/L, of Pb is 0.001mg/L.

**Table 4-28 The assessment results of groud water quality**

| Monitoring position | pH | Permanganate Value | $NH_3$-N | Cyanide | Coliform | Chloride | Pb | Sulfate | $Cr^{6+}$ | Total water hardness | Hg | As | Monitoring position |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Jieshou City 1# | Monitoring Value | 8.19 | 0.5 | / | / | <3 | 56 | / | 62.8 | / | 32 | 0.000076 | 0.00093 |
| | Grade | I | I | I | I | I | II | I | II | I | I | II | I |
| | *F* | 0.729□Excellent□ | | | | | | | | | | | |
| Jieshou City 2# | Monitoring Value | 8.27 | 0.5 | / | / | <3 | 46 | / | 53.0 | / | 24 | 0.000063 | 0.00092 |
| | Grade | I | I | I | I | I | I | I | II | I | I | II | I |
| | *F* | 0.717□Excellent□ | | | | | | | | | | | |
| Taihe Jiuxianji | Monitoring Value | 7.48 | 0.5 | / | / | <3 | 29 | 0.001 | 33.0 | / | 252 | 0.000087 | 0.00083 |
| | Grade | I | I | I | I | I | I | I | I | I | II | II | I |
| | *F* | 0.717□Excellent□ | | | | | | | | | | | |
| Taihe County | Monitoring Value | 7.30 | 0.5 | / | / | <3 | 32 | / | 49.1 | / | 436 | 0.000010 | 0.00064 |
| | Grade | I | I | I | I | I | I | I | I | I | III | I | I |
| | *F* | 2.129□Well□ | | | | | | | | | | | |
| Fuyang City | Monitoring Value | 7.81 | 0.5 | / | / | <3 | 47 | / | 13.0 | / | 99 | 0.000014 | 0.00079 |

| Monitoring position | pH | Permanganate Value | $NH_3$-N | Cyanide | Coliform | Chloride | Pb | Sulfate | $Cr^{6+}$ | Total water hardness | Hg | As | Monitoring position |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Grade | I | I | I | I | I | I | I | I | I | I | I | I |
| | *F* | Excellent | | | | | | | | | | | |
| Fuyang Kouziji | Monitoring Value | 7.62 | 0.5 | / | / | <3 | 40 | 0.001 | 29.9 | / | 140 | 0.000082 | 0.00079 |
| | Grade | I | I | I | I | I | I | I | I | I | I | II | I |
| | *F* | 0.709□Excellent□ | | | | | | | | | | | |
| Yingshang City | Monitoring Value | 7.30 | 0.5 | / | / | <3 | 46 | / | 32.0 | / | 440 | 0.000028 | 0.00072 |
| | Grade | I | I | I | I | I | I | I | I | I | III | I | I |
| | *F* | 2.129□Well□ | | | | | | | | | | | |
| Yingshang Saijianxiang | Monitoring Value | 7.16 | 0.5 | / | | <3 | 64 | 0.002 | 31.0 | / | 780 | 0.000017 | 0.00070 |
| | Grade | I | I | I | | I | II | I | I | I | V | I | I |
| | *F* | 7.101□Bad□ | | | | | | | | | | | |

(4) Assessment results

The assessment results of ground water quality are listed in Table 4-28.

It can be seen from Table 4-28 that, all the monitoring items at the sampling points of Jieshou, Taihe and Fuyang have attained Grade III in “Quality Standard for Ground Water” (GB/T14848-93), many of which meet the requirement of Grade□. The total water hardness at the Yingshang Saijianzhen sampling point does not attain the water quality of Grade III in “Quality Standard for Ground Water” (GB/T14848-93). Other monitoring items at this points all meet the Standards of Grade□and □. Therefore, it is better to abate some hardness before drinking ground water at Yingshang Saijianxiang, so as to reach water quality of Grade III.

### 4.4.4. Soil Quality at Disposal Area

(1) Sampling position

Considering the characteristic of this project, the assessment team selected 7 large mud-disposal areas along the river as sampling monitoring points, which are shown in Table 4-29 and Figure 2 (Attached). Fuyang Environment Monitoring Station was committed to monitor the soil quality of the disposal areas. Sampling methods are in light with relevant environment monitoring technical guideline. Analysis methods are the methods recommened in the Environmental quality standard for soils” (GB15618-1995).

**Table 4-29 Monitoring points of soil quality at disposal areas**

| No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Position | Jieshou Xuzhai | Taihe Jiuxian | Taihe County | Fuyang City | Fuyang Kouziji | Yingshang County | Yingshang Saijian |
| Disposal areas | 1# | 3# | 4# | 11# | 19# | 29# | 34# |

(2) Monitoring results

The main monitoring items for soil quality are pH□As□Hg□Pb□Cu□Zn□Cr□Cd. Monitoring results are listed in Table 4-30.

**Table 4-30 Monitoring results of soil quality (unit: mg/kg, except pH)**

| Monitoring Position | | pH | As | Hg | Pb | Cu | Zn | Cr | Cd |
|---|---|---|---|---|---|---|---|---|---|
| Jieshou | 1#disposal area | 7.06 | 3.0 | 0.09 | 14.6 | 14 | 43.0 | 5.7 | 0.027 |
| Taihe | 3#disposal area | 6.96 | 2.6 | 0.08 | 17.8 | 13 | 43.3 | 11.7 | 0.026 |
| Taihe | 4#disposal area | 7.12 | 3.3 | 0.10 | 14.0 | 8 | 51.8 | 20.6 | 0.028 |
| Fuyang | 11#disposal area | 7.13 | 3.0 | 0.10 | 13.9 | 24 | 119.0 | 16.9 | 0.027 |
| Fuyang | 19#disposal area | 6.97 | 3.1 | 0.12 | 10.2 | 27 | 86.0 | 23.4 | 0.024 |
| Yingshang | 29#disposal area | 6.88 | 3.0 | 0.10 | 10.2 | 23 | 55.8 | 8.0 | 0.029 |
| Yingshang | 34#disposal area | 7.08 | 2.6 | 0.12 | 9.2 | 23 | 50.1 | 11.5 | 0.035 |

(3) Assessment standards

In order to protecte the agricultural production and maintain the limit value of human health, Soil quality in disposal areas should meet Grade II in “Environmental quality standard for soils” (GB15618-1995).

**Table 4-31 Standard value of Grade II in “Environmental quality standard for soils” (GB15618-1995) (unit: mg/kg)**

| Items | pH | As | Hg | Pb | Cu | Zn | Cr | Cd |
|---|---|---|---|---|---|---|---|---|
| Standard value | 6.5~7.5 | 25 | 0.5 | 300 | 100 | 250 | 300 | 0.6 |

(4) Assessment results with method of single factor index

The single factor index is applied to assess soil quality in this project. The assement results are listed in Table 4-32.

**Table 4-32 Assessment results of soil quality**

| Monitoring position | | As | Hg | Pb | Cu | Zn | Cr | Cd |
|---|---|---|---|---|---|---|---|---|
| Jieshou | 1#disposal area | 0.12 | 0.18 | 0.05 | 0.14 | 0.17 | 0.02 | 0.05 |
| Taihe | 3#disposal area | 0.10 | 0.16 | 0.06 | 0.13 | 0.17 | 0.04 | 0.04 |
| Taihe | 4#disposal area | 0.13 | 0.20 | 0.05 | 0.08 | 0.21 | 0.07 | 0.05 |
| Fuyang | 11#disposal area | 0.12 | 0.20 | 0.05 | 0.24 | 0.47 | 0.06 | 0.05 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Fuyang | 19#disposal area | 0.13 | 0.24 | 0.03 | 0.27 | 0.34 | 0.08 | 0.04 |
| Yingshang | 29#disposal area | 0.12 | 0.20 | 0.03 | 0.23 | 0.22 | 0.03 | 0.05 |
| Yingshang | 34#disposal area | 0.10 | 0.24 | 0.03 | 0.23 | 0.20 | 0.04 | 0.06 |

Table 4-32 indicates all the monitoring items in the 7 sampling monitoring points meet requirement of Grade II in “Environmental quality standard for soils” (GB15618-1995). The water quality in project regions is good.

(5) Assessment results of soil quality with methods of comprehensive assessemtn

Based on results of single factor assessment of soil quality, AdaBoost-NN model is used to assess the comprehensive pollution conditions of soil.

$P_{comprehensive}$=□$P^2$/2□$P_{max}{}^2$/2□1/2

Where P represents the average value of different single pollution index; $P_{max}$ represents the maximum value of the single pollution index.

**Table 4-33 Classification Standards for Soil Qualtiy Comprehensive Assessment**

| Class | Soil quality comprehensive pollution index $P_{Comprehensive}$ | Pollution grade | Pollution level |
|---|---|---|---|
| 1 | □0.7 | Excellent | Clean |
| 2 | □1.0 | Safe | Not very clean |
| 3 | □2.0 | Light pollution | Pollutant concentration in soil exceed background value |
| 4 | □3.0 | Medium pollution | Soil and crops are clearly polluted |
| 5 | □3.0 | Heavy pollution | Soil and crops are heavily polluted |

**Table 4-34 Results of soil comprehensive assessment**

| Monitoring points | Jieshou Xuzhai | Taihe Jiuxian | Taihe County | Fuyang City | Fuang Kouziji | Yingshang County | Yingshang Saijian |
|---|---|---|---|---|---|---|---|
| Disposal areas | 1# | 3# | 4# | 11# | 19# | 29# | 34# |
| $P_{comprehensive}$ | 0.147 | 0.139 | 0.169 | 0.353 | 0.266 | 0.185 | 0.193 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Pollution grade | Excellent | Excellent | Excellent | Excellent | Excellent | Excellent | Excellent |
| Pollution level | Clean | Clean | Clean | Clean | Clean | Clean | Clean |

It can be seen from the comprehensive assessment that the soil pollution grade at the Shaying River is excellent, the pollution level is clean. Therefore, reasonable and effective pollution prevention measures should be taken during the construction of this project, in order to prevent the soil quality descending caused by the construction of projects.

### 4.4.5. **Silt Quality**

#### 4.4.5.1. Monitoring Location

The Shaying River passes through Jieshou City, Taihe County, Fuyang City (Yingzhou District, Yingquan District and Yingdong District) and Yingshang County. According to the field investigation, the industrial enterprises, factories and mines that have great pollution on the Shaying River mainly located at the urban area of counties and cities. Therefore, considering the characteristic of this project as well as the distribution status of pollutin source along the river, the set of sampling locations should follow the principles as:

(1) Set sampling locations evenly, in order to understand the sludge pollution level along the Shaying River.

(2) Mainly monitor the urban river section with high density of pollution source, for the pollution is more serious at the sections and can represent the relative serious pollution level of sludge.

(3) Set sampling locations at the representative river section in different counties to understand the pollution from counties along the Shaying River.

In this assessment, 7 silt sampling location were selected, which are shown in Figure 2(Attached). These sampling location cover all the 4 counties along the river section as well as 3 villages with relative developed economy (including the Jiuxian in Taihe County, Kouzizhen in Yingdong District and the Saijian in Yinghsang County). The distribution of sampling locations is basically even, and can represent that silt pollution level along the Shaying River.

4.4.5.2. Monitoring Items, Period and Methods

(1) Monitoring items

Monitoring items include pH□As□Hg□Pb□Cu□Zn□Cr□Ni□TP□TN.

(2) Monitoring Body

Fuyang Environment Monitoring Station is committed to monitor silt quality of the 7 sampling locations along the Shaying River.

(3) Monitoring time and methods

Time: April 23, 2008

Methods: river sludge was sampled by excavating sampler. Excavating sampler has a cup with “claws”. The cup can be opened through spring. The “claws” are closed quickly when the sampler reached the riverbed so that the silt sample is collected.

Analysis: pre-treatment: the silt samples were dehydrated by centrifuge or filter paper. The samples were then fully blended and set in enamel or glass plates with a thickness of about 5 cm. Samples were then dried in the shade and ventilation places and crushed down with glass rod. The gravel of different size and residual plant and animal bodies were picked out. The samples were filtered by 20 mesh screen until there is no silt contained on the screen. The sluge filtered by screen was splitted to 5-10 g with method of the four-way division, and then grinded in a mortar.

The measurement of silt samples: According to the “Control Standards for Pollutants in Silts from Agricultural Use” (GB4284-84), the samples need to be digested by $HNO_3$-$HClO_4$ or $H_2SO_4$-$HNO_3$-$HClO_4$, add $HNO_3$ to a constant volume, and then measured with corresponding methods.

4.4.5.3. Monitoring Results

The monitoring results of silt are listed in Table 4-35.

**Table 4-35 Monitoring results of silt (Unit: mg/kg, except pH)**

| Monitoring Sections | | Name | pH | As | Hg | Pb | Cu | Zn | Cr | Ni | TP | TN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Jieshou County | K2+800 | 6.84 | 1.9 | 0.11 | 12.1 | 17 | 33.3 | 14.3 | 11.2 | 0.169 | 0.297 |
| 2 | Taihe Jiuxian | K29+500 | 6.92 | 1.8 | 0.11 | 12.8 | 9 | 36.8 | 8.2 | 10.5 | 0.217 | 0.702 |
| 3 | Taihe | K38+500 | 7.11 | 2.3 | 0.10 | 12.1 | 31 | 36.0 | 12.2 | 10.6 | 0.237 | 0.445 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | County | | | | | | | | | | | |
| 4 | Fuyang City | K78+000 | 6.98 | 2.0 | 0.10 | 11.4 | 21 | 57.0 | 20.9 | 15.4 | 0.566 | 0.402 |
| 5 | Fuyang Kouziji | K112+500 | 7.03 | 1.8 | 0.10 | 10.9 | 6 | 44.5 | 7.0 | 9.8 | 0.245 | 0.448 |
| 6 | Yingshang County | K158+500 | 7.04 | 2.0 | 0.10 | 10.8 | 19 | 50.0 | 14.0 | 12.0 | 0.151 | 0.655 |
| 7 | Yingshang Saijian | K197+200 | 6.87 | 2.2 | 0.10 | 13.1 | 19 | 50.6 | 13.4 | 11.7 | 0.221 | 0.192 |

4.4.5.4. Assessment Standards

"Control Standards for Pollutants in Sludges from Agricultural Use" (GB4284-84) is selected as assessment standards for sludge. The detailed standard value are listed in Table 4-36.

**Table 4-36 Control Standards for Pollutants in Sludges for Agricultural Use**

(Unit: mg/kg, except unit of pH)

| Item | pH | As | Hg | Pb | Cu | Zn | Cr | Ni | TP | TN |
|---|---|---|---|---|---|---|---|---|---|---|
| GB4284-84 | pH<6.5 | 75 | 5 | 300 | 250 | 500 | 600 | 100 | □ | □ |
| | pH□6.5 | 75 | 15 | 1000 | 500 | 1000 | 1000 | 200 | □ | □ |

According to the results of surface water quality, the pH of surface water in the Shaying River is bigger than 7. Therefore, pH□6.5 is used as assessment standard for sludge.

4.4.5.5. Assessment Results and Analysis

(1)Assessment Results

Single pollution index is applied to assess the status of sludge in the Shaying River. The assessment results are listed in Table 4-37.

**Table 4-37 Assessment result of sludge quality**

| Position | As | Hg | Pb | Cu | Zn | Cr | Ni | TP | TN |
|---|---|---|---|---|---|---|---|---|---|
| Jieshou County | 0.025 | 0.007 | 0.012 | 0.034 | 0.033 | 0.014 | 0.06 | □ | □ |
| Taihe Jiuxian | 0.024 | 0.007 | 0.013 | 0.018 | 0.037 | 0.008 | 0.05 | □ | □ |
| Taihe County | 0.031 | 0.007 | 0.012 | 0.062 | 0.036 | 0.012 | 0.05 | □ | □ |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Fuyang City | 0.027 | 0.007 | 0.011 | 0.042 | 0.057 | 0.021 | 0.08 | □ | □ |
| Fuyang Kouziji | 0.024 | 0.007 | 0.011 | 0.012 | 0.044 | 0.007 | 0.05 | □ | □ |
| Yingshang County | 0.027 | 0.007 | 0.011 | 0.038 | 0.050 | 0.014 | 0.06 | □ | □ |
| Yingshang Saijian | 0.029 | 0.007 | 0.013 | 0.038 | 0.051 | 0.013 | 0.06 | □ | □ |

□2□Heavy Metal Distribution Feature

According to the monitoring results of sludge provided by the Fuyang Environment Monitoring Station, amount of heavy metal pollutants in the sludge is small, which is far lower than the control value in “Control Standards for Pollutants in Sludges from Agricultural Use” (GB4284-84) . Therefore, the dredging sludge from Shaying River Channel Improvement Project can meet the requirement of agricultural use, can be backfilled and then recultivated as farm land. Comparing the heavy metal concentration in the sludge of Shaying River with that of “Control Standards for Pollutants in Sludges from Agricultural Use” (GB4284-84) (See Table 4-38), it can be seen that the heavy metal concentration in Shaying River sludge is lower than the second grade of “Control Standards for Pollutants in Sludges from Agricultural Use” (GB4284-84), such as Pb, Zn, Cr and Cu. Therefore, the sludge is piled at the disposal areas, air dried, and reused as farm land. The heavy metal will not have serious impact on agricultural growthing and human health.

Comparing the monitoring results of soil quality in Table 4-30and sludge quality in Table 4-35, it can be seen that there are no obvious differences between the heavy metal concentrations in sludge at the river and that of soil in the disposal areas. Therefore, the heavy metal in sludge in disposal area will not affect the soil and ground water.

**Table 4-38 Comparison of heavy metal concentration in the sludge of Shaying River with that of “Control Standards for Pollutants in Sludges from Agricultural Use” (GB4284-84)**

| Item | Pb | Zn | Cr | Cu |
|---|---|---|---|---|
| Jieshou County | 12.1 | 33.3 | 14.3 | 17 |
| Taihe Jiuxian | 12.8 | 36.8 | 8.2 | 9 |
| Taihe County | 12.1 | 36.0 | 12.2 | 31 |
| Fuyang City | 11.4 | 57.0 | 20.9 | 21 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Fuyang Kouziji | 10.9 | 44.5 | 7.0 | | 6 | |
| Yingshang County | 10.8 | 50.0 | 14.0 | | 19 | |
| Yingshang Saijian | 13.1 | 50.6 | 13.4 | | 19 | |
| Soil pH value6.5~7.5 | □300 | □250 | □300(Paddy field) | □200(Paddy field) | □100(Farm field) | □200(Orchard) |

(3) N/P concentration in sludge

According to analysis on sludge samples at the Shaying River provided by the Fuyang Environment Monitoring Station, the concentration of total Nitrogen and Phosphorus in sludge range from 0.2□0.7mg/kg and 0.15□0.56mg/kg, respectively, with an average of 0.45mg/kg and 0.26mg/kg. The concentration of total Nitrogen and Phosphorus in sediments of the Shaying River is low. Therefore, when the sludge dradging works disturb the polluted sediments, the release of Nitrogen and Phosphorus will be small and have little impacts on the whole water quality.

Generally speaking, there are few nutrient salts, Nitrogen, Phosphorus and organic compounds in sludge of the Shaying River. After the completation of the whole project, the navigation ability of the whole channel can be improved, most of the Nitrogen and Phosphorus as well as other pollutants in the sludge can be removed, and water quality at Shaying River will be improved.

(4) Comparison between Chinese and international sludge utilization standards.

A comparison between abovementioned standards and similar standards in USA, EU and Canada has been carried out, listed in Table

**Table 4-39 Comparision of sludge utilization standards**

| | Standards/Directives | | Cu | Zn | Pb | Cd | Cr | Ni | As |
|---|---|---|---|---|---|---|---|---|---|
| China | GB 4284-1984 | pH<6.5 | 250 | 500 | 300 | 5 | 600 | 100 | 75 |
| | | pH□6.5 | 500 | 1000 | 1000 | 20 | 1000 | 200 | 75 |
| | GB 18918-2002* | pH<6.5 | 800 | 2000 | 300 | 5 | 600 | 100 | 75 |
| | | pH□6.5 | 1500 | 3000 | 1000 | 20 | 1000 | 200 | 75 |
| | CJ 247-2007* | | 1500 | 4000 | 1000 | 20 | 1000 | 200 | 75 |
| USA | 40 CFR Part 503 | Clean Sludge | 1500 | 2800 | 1200 | 39 | 300 | 420 | 41 |
| | | Top Standard | 4300 | 7500 | 3000 | 85 | 840 | 420 | 75 |
| EU | | | 1500 | 3000 | 200 | 40 | - | 400 | - |
| Canada | | | 500 | 2000 | 1000 | 20 | 1000 | 100 | 10 |

** Other Chinese standards relevant to the sludge utilization are also included in the comparison.*

Based on the comparison, Chinese *Pollutants Control Standard for Sludge Utilization for Agricultural Purpose (GB4284-1984)* is even more stringent than its counterparts in the US, EU and Canada.

### 4.4.6. Acoustic Environmental Quality

(1) Monitoring Body

Fuyang Environment Monitoring Station is committed to monitor the acoustic environment quality along the Shaying River.

(2) Monitoring results

15 sampling points are set for monitoring the acoustic environment quality. The monitoring results are shown in Table 4-40, and the sampling points are shown in Figure 2 (Attached).

**Table 4-40 The monitoring results of acoustic sensitive points (LAeq□dB(A))**

| No. | Monitoring points | Monitoring results | |
|---|---|---|---|
| | | Daytime | Nighttime |
| 1 | Jieshou City | 53.5 | 45.6 |
| 2 | Jieshou Xuzhai | 51.4 | 46.2 |
| 3 | Taihe Shuipu | 49.6 | 43.4 |
| 4 | Taihe Jiuxianji | 48.7 | 46.0 |
| 5 | Taihe County | 58.6 | 50.0 |
| 6 | Fuyang Cihepu | 44.0 | 43.8 |
| 7 | Fuyang Ciyt | 48.7 | 47.7 |
| 8 | Fuyang Yuanzhai | 45.7 | 42.1 |
| 9 | Fuyang Kouziji | 44.9 | 42.3 |
| 10 | Fuyang Jiangkouji | 48.4 | 41.3 |
| 11 | Fuyang Xinmiaoji | 44.6 | 42.0 |
| 12 | Yingshang County | 52.6 | 40.6 |
| 13 | Yingshang Wanggangji | 51.5 | 42.4 |
| 14 | Yingshang Saijian | 48.4 | 39.7 |
| 15 | Mo Estuary Yingshang River | 56.8 | 43.6 |

□3□Assessment standards

Both sides of banks of project sites that pass through urban regions should meet Category II in “Environmental quality standards for noise” (GB3096-2008). The standards are listed in Table 4-41.

**Table 4-41 Environmental quality standards for noise**

| Category | Daytime $L_{Aeq}$□dB(A) | Nighttime $L_{Aeq}$□dB(A) |
|---|---|---|
| II | 60 | 50 |

(4) Assessment results

According to the monitoring results of acoustic in Table 4-340 and Standards in Table 4-41, the status acoustic in all the monitoring points meet the second grade of the Environmental Quality Standards for Noise (GB3096-2008), meaning that the acoustic environment along the Shaying River is good.

# 5. Analysis of Alternatives

## 5. 1. Alternatives of Service Areas

The serve objects of the service areas are fishermen and vessels. The location of service areas are next to cities with convenient transportation. Fuyang Guozhuang and Sanshilipu are selected to construct service areas in this project, which are located at the upstream and downstream of Fuyang Ship Lock.

### 5. 1. 1. Alternatives of Fuyang Guozhuang Service Area

The project design company put forward two alternatives for the Fuyang Guozhuang Service Area, which located in Guozhuang (Left bank of the Shaying River K72+500~K74+000) and Xiaoying□Right bank of the Shaying River K65+550~K66+400□in Ninglao Town in Yingquan Districtiion. The location is shown in Fig. 5-1.

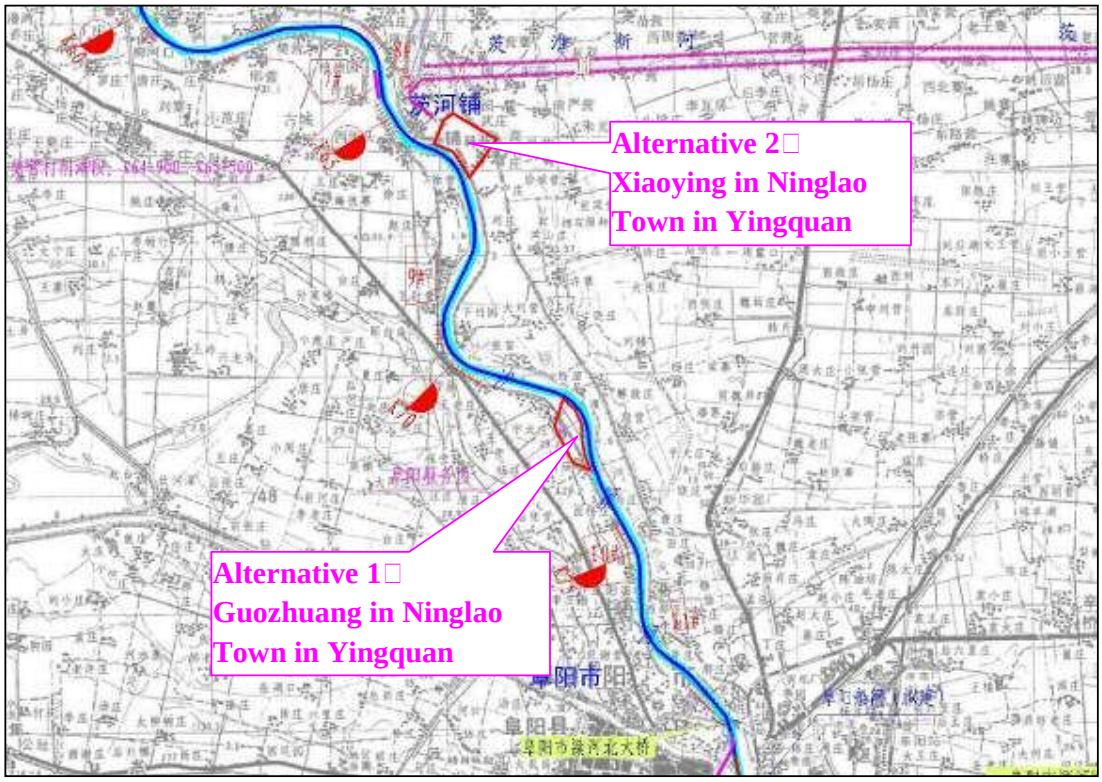



**Fig. 5-1 Location of alternatives for the Fuyang Guozhuang Service Area**

The EIA team compared the alternatives from aspects of environmental impact, demolition, social impact, engineering conditions and plan compatibility. The analysis results are listed in Table 5-1.

**Table 5-1 Comparison of alternatives for Fuyang Guozhuang Service Area**

| Comparison content | Alternative 1 | Alternative 2 | Recommendation |
|---|---|---|---|
| Position | Guozhuang in Ninglao Town in Yingquan Districtiion (Left bank of the Shaying River K72+500~K74+000) | Xiaoying□Right bank of the Shaying River K65+550~K66+400□in Ninglao Town in Yingquan District | — |
| Environmental impact | Surrounding regions are mainly agricultural ecosystem; villages distribute dispersedly and have certain distance with the service area; Service area has little impact on natural ecology, regional acoustic environment and ambient air | | Matched |
| Land-take | Land-take is 125.8 Mu, in which 30 Mu is arable land and 95.8 Mu is beach land | Land-take is 225.02 Mu,in which 60 Mu is arable land and 165.02 Mu is beach land | Alternative 1 is better |
| Demolition | Little demolition□1600m2□ | No demolition | Alternative 2 is a little better |
| Social impact | Connected to G105 easily; near urban area (5km away from Fuyang City□; Convenient transportation for fishermen to buy living good | Far away from Fuyang City(10km), not convenient for fishermen to buy living good; long distance for road connecting | Alternative 1 is better |
| Engineering quantities | Open area which is convenient to set terrestrial area and water area | | Matched |
| Plan compatibility | Located between construction areas of Cihepu and Fuyang; is compatible | Near the Cihepu construction area | Alternative 1 is better |
| Recommendations | Alternative 1 | | |

Based on the comparison in Table 5-1, the alternatives have similar region environment conditions, environment impacts and engineering quantities. Alternative 2 takes 100.02 Mu more land than alternative 1, in which 70 Mu is beach land and 30 Mu is arable land. Therefore, alternative 2 will have greater impacts on regional eco-

environment. At the same time, alternative 1 is 5 km away from Fuyang City, can be connected to G105, can serve the Cihepu construction area and Fuyang construct area. Therefore, alternative 1 has advantage in social impact. From the aspects of eco-environment and social impact, alternative 1 is obviously superior to alternative 2. Alternative 1 is recommended in this assessment.

### 5. 1. 2. Alternatives of Sanshilipu Service Area

The project design company put forward two alternatives for the Sanshilipu Service Area, which located in Zhangzhuang in Xiangyang Subdistrict in Yingdong District (Left bank of the Shaying River K84+500~K85+250) and Laowo in Linying Village in Yingdong District□Right bank of the Shaying River K91+850~K92+700□. The location is shown in Fig. 5-2.


**Fig. 5-2 Location of alternatives for the Sanshilipu Service Area**

The assessment team compared the alternatives from aspects of environmental impact, demolition, social impact, engineering conditions and plan compatibility. The analysis results are listed in Table 5-2.

## Table 5-2 Comparison of alternatives for Sanshilipu Service Area

| Comparison content | Alternative 1 | Alternative 2 | Recommendation |
|---|---|---|---|
| Position | Zhangzhuang in Xiangyang Subdistrict in Yingdong District (Left bank of the Shaying River K84+500~K85+250) | Laowo in Linying Village in Yingdong District□Right bank of the Shaying River K91+850~K92+700□ | — |
| Environmental impact | Surrounding regions are mainly agricultural ecosystem; villages distribute dispersedly and have certain distance with the service area; Service area has little impact on natural ecology, regional acoustic environment and ambient air | | Matched |
| Demolition | Equals in demolition quantities | | Matched |
| Social impact | near urban area (5km away from Fuyang City□; Convenient transportation for fishermen to buy living good | Far away from Fuyang City(10km), not convenient for fishermen to buy living good; long distance for road connecting | Alternative 1 is a little better |
| Engineering quantities | Develop shoals into water area, dredging engineering quantities are large; Beach land area is open and not suitable for flood prevention | Open area which is convenient to set terrestrial area and water area | Alternative 2 is obviously better |
| Plan compatibility | Near the old construction area of Fuyang Port Area, which might be removed according to the General Plan of Fuyang Port and General Plan of Fuyang City□2004-2020□. Along with the open to operatioin of Sanshilipu Construction Area, the old Fuyang port construction area might be removed. By then, the service function of Fuyang Service Area will be greatly reduced | Near the Sanshilipu Construction Area | Alternative 2 is obviously better |
| Recommendation | Alternative 2 | | |

Considering the comparison results in Table 5-3, alternative 2 is superior to alternative 1 from aspects of engineering conditions and plan compatibility. Alternative 2 is recommended in this assessment.

## 5. 2. **Alternatives of Construction Technology**

For different engineering quantities, construction period, soil quality, treatment requirement of dredging sludge, constructive water level and dredging depth, cutter suction dredger or grab dredger can be used to dredge river channel. The process flows of them are:

(1) Cofferdam→cutter suction dredger→disposal areas

(2) Cofferdam→grab dredger→sludge barge→ cutter suction dredger→disposal areas.

### 5. 2. 1. **Introduction of Construction Technology of Dredgers**

#### 5.2.1.1. Cutter suction dredger

Cutter suction dredger is a kind of boat which is widely used in dredging projects. It use the rotating cutter knives installed in front of the water absorption tube to cut and disturb sludge and sand at the bottom of the river, and then transport the sludge and sand from the river to sand piled field through the water absorption tube. The process of sludge digging, transporting and disposal can be done continuously at one round. It is a kind of dredger with high efficiency and low cost. It is used widely in jetting-filling projects, and suitable for dredging the river bottom with porous soil.

When the dredger is working, the cutter knives are set into the sludge. The sludge is digged and mixed as slurry with water through the rotation of cutter knives. The Slurry is transported to the discharge tube through sludge absorption tube with function of dredge pump. Sludge discharge tube can be formed by connecting the floating tubes with onshore tubes, and can also be formed

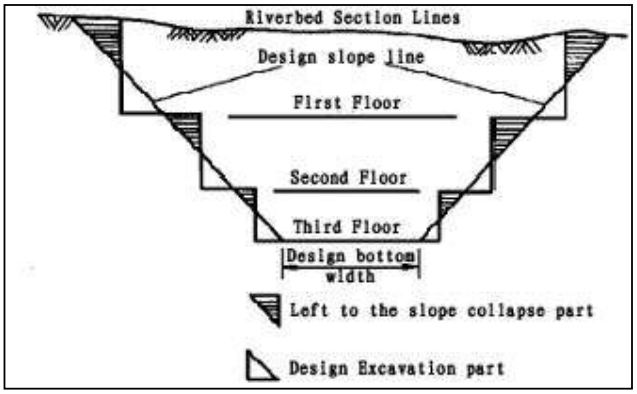



**Fig. 5-3 Technology of Cutter suction**

by connecting the floating tubes with underwater tubes, floating tubes and then onshore tubes. In order to dredge polluted sludge exactly, the DGPS is installed in the dredger, to make the location resolution of the dredger reach 30cm. The dredging depth is exactly controlled by the depth indicator. The sludge is transported to disposal areas through pressure tubes with dredger pump. The residential water is treated in the disposal area.

5.2.1.2. Grab dredger

Grab dredger uses the derricks and cable of the rotating dredger to grabs sludge. With the gravity of the grabs, it is placed into the bottom to grab sludge. By starting up the winch, the sling can close and uplift the grabs with pulley. Then the dreger is rotated to certain area (or dump dredge) to dump sludge. The dredger is rotated to the dredging area and grabs sludge. The grab dredger is mainly used to dredge clay, silt, yarn and mealy sand.

When the dredger is working, the grab dredgers grab sludge in certain area and dump it into the dump dredgers. Sludge is transported to the water area at the fringe of the disposal areas by dump dredgers. After that, sludge is refilled to the disposal areas with cutter suction dredgers. The maximum depth of the 2m3 is 20m. The water absorption depth of 60~100 dump dredger is 2.0m.

### 5.2.2. Comparison of Construction Technology

Table 5-3 listed the comparison of technical properties of the cutter suction dredger (200m3/h and 400m3/h) and the grab dredger.

**Table 5-3 Comparison of dredger technical properties**

| No. | Name and Size | Equipment performance | Suitable soil types |
|---|---|---|---|
| 1 | Cutter suction dredger 400m$^3$/h | Length 39.5m□depth 2.1m□maximum dredging depth 10m□maximum dredging width 16m□Maximum discharge distance 1700m□ | suitable for dredging the river bottom with porous soil, such as sand and silt |
| 2 | Cutter suction dredger 200m$^3$/h | Length 38m□depth 1.4m□maximum dredging depth 8m□maximum dredging width 40m□ | |

| | | | |
|---|---|---|---|
| 3 | 2m3 Grab dredger | Size□Length*Width*Height=33.4×10.8×1.5(m)□maximum dredging depth 20m□ | Dredging clay, silt, yarn and mealy sand |
| Note | 120HP anchorage boat, 45HP Communication boat, 28~33 beds dorm boat, 40~100 ton oil boat, tube boat, 240HP tug boat, 60 disposal boat, buoy, tubes and accessory equipment should be prepared for the dredgers. | | |

Cutter suction dredger combines the hydraulic and mechanical dredging methods. It uses the vacuum and pressure produced by the dredger pump, transport sludge with tubes, so there is no pollution caused by sludge scattering. Cutter suction dredger can be operated with one boat, and do not need cooperation of the tug boats. It has minimum disturbance to native sludge and minimum pollution by using the exact location system of DGPS. The cutter suction dredger is used in the national first large lake dredging project, i.e. the Dianchi Caohai polluted sludge dredging and treatment project. Results show that the boat is suitable for dredging works of Lake and river. Currently, the cutter suction dredger is widely used in lake and river dredging. It has relative mature process flows.

Grab dredger uses the mechanical dredging method. It uses the dredging machine (grab) to dredge, uplift and dump sludge underwater. It need the dump dredger and absorption dredger to finish the transportation and disposal of sludge in the process. Therefore, it needs several boats during operation. It needs corporation from the grab dredger, dump dredger and hopper dredger. It has higher environmental management requirement. The process of sludge transportation will have significant impacts on ambient air and water. It cannot be exactly located, and disturbs greatly to native soil. Its operation quality cannot be controlled.

The cutter suction dredger and grab dredger are compared from aspect of environmental impact, which is shown in Table 5-4.

It can be seen that the cutter suction dredgers are in good operational quality, widely used, have the outstanding eco-friendly operation capability, and can be combined with long distance sludge transportation technique, noise control technique as well as the disposal sludge treatment technique to attain the purpose of optimize environment. Therefore, 200~400m3/h cutter suction dredger is selected for channel dredging in this project. However, transportation distance and engineering condition are limited to some extent because of the single pump. The grab dredgers are used

assistantly in river section with small dredging volume or underwater barriers, such as river section near the urban area and bridge.

**Table 5-4 Environmental impacts of dredgers**

| Name | Advantage | Disadvantage |
|---|---|---|
| Cutter suction dredger | Closed operation with no sludge scattered; Single-boat operation, which operation quality can be easily controlled; Exactly located, having little disturbance on native soil; the depth of dredging slope can be easily controlled, to ensure the stable of embankments; Widely used with mature process flows | Transportation distance and engineering condition are limited on some exent by the single pump; Float tubes will have certain impacts on navigation and underwater tubes, because the discharge tubes need to be settled |
| Grab dredger | Flexible in operation works, not affected by transportation distance and regional environment | Open operation, transportation of sludge will have significant impacts on regions air and water environment; Disposal dredger is used to transport sludge, significant influence between the dredging, transporting and disposal facilities; Lower in production efficiency, and higher in environment management; The dredging depth cannot easily be controlled, the dredging places are not even; Construction quality is bad, and the liquid sludge cannot be cleaned; |

| | | |
|---|---|---|
| | | cannot be exactly located, and have great disturbance on native soil. |

## 5. 3. **Alternatives of Disposal Areas**

At the feasibility study stage, 37 disposal areas were proposed by the design unit. Four aspects were taken into account in this EIA, including:

(1) Borrow pits that were set by water conservancy sectors in recent Shaying River improvement projects will be effectively used as disposal areas in this project, on the basis of communication and coordination with water conservancy sector.

(2) It is suggested to select nearby river sections whose earthwork volume is large, to keep disposal sites within dredger's economic region.

(3) It is suggested to select low-lying land, abandoned pond and lands and reduce land occupation of good farmland.

(4) If no low-lying land or borrow pit can be used, low-yield farmland can be utilized for disposal. It should be restored after the construction.

Based on above-mentioned principles, this EIA considers environmental protection and reduction of land occupation. The EIA team communicated with the design unit and based on previous engineering feasibility study, 37 disposal areas are reduced to 34 areas and the area of land occupation is reduced from 10,9292.6 Mu to 9,831.3 Mu. The unreasonable siting of 13# disposal area (which has been surrounded by buidings) was adjusted. The environmental impact caused by sediment disposal is reduced through optimization of design.

This EIA demonstrates the environmental rationality of the 34 disposal areas proposed in preliminary design, in aspects of in aspects of land occupation, how close it is to nearby residential areas, average transport distance and impacts on visual landscape, etc (see details in Section 6.1.2.5).

# 6. Environmental Impact Prediction and Assessment

## 6. 1. Social Impacts

### 6. 1. 1. Social Impacts before the Construction

After the media release of this project, the public's attention will be drawn on. They might imagine what adverse and positive impacts this project may have on their lives and how much the government sectors will compensate for temporary land acquisition. During the land acquisition, some people might not be satisfactory with the compensation and bargain with the construction unit. There might even be conflicts and petition events. However, if the construction unit explains more information about this project and compensates in accordance with actual living standards in this region, most of the residents will understand and trust this project and support the land acquisition. Thus, there will be minor societal impacts before the construction phase.

### 6. 1. 2. Social Impacts during the Construction Phase

#### 6.1.2.1. Impacts on Cultural Heritage

According to EIA team's investigation of cultural heritage in the region that this project may affect, neither key cultural relics nor cultural heritage is detected in this region. Shaying River embankments include major and sub embankments. Most of the villages are located inside of sub-embankments. Generally speaking, the distance between major and sub embankments is 100-300m. This project will be implemented inside the major embankments, so the sub embankments will be barriers between construction sites and residential areas. This will further relive impacts on cultural

However, it is still possible to find underground cultural relics during earthwork. The development of Huaibei Plain region initiated simultaneously wit heritage and residential areas and the construction unit and management sectors should promote cultural relics protection. They should draw on construction staff's attention during dredging works and raise staff's awareness on this issue. Proper and protective construction principles should be imposed during the construction. Once cultural

relics are detected, the construction must be stopped. The construction unit should report to cultural heritage authorities and conduct effective protection measures.

6.1.2.2. Landscape Impacts

There is no scenic spot in the construction region. Current landscape is mainly plain village and urban landscape. The design of bridges on Shaying River and buildings by the river sides should take into account the consistency of landscape and local culture. In addition, ecological restoration and planting need to be carry out.

6.1.2.3. Impacts on Human Health

Regions along Shaying River are not major illness area of endemic. Prevention principle is essential. Before going into construction sites, the construction team can consult local health sector about endemic. After implementation of disease prevention measures under the guide of local health sector, endemic will not affect construction staff.

In terms of prevention of Infectious Diseases, it is important to cultivate good health habits. The infectious diseases can be controlled through health education and education of prevention of blood borne infections, good food hygiene habits and prevention measures of blood borne infections.

In terms of HIV/AIDS prevention, education and management during the construction phase are important. Billboard can be set to advocate HIV/AIDS prevention in residential area of construction staff. It is suggested that the contractor can provide healthy entertainment approaches for construction staff. It is also suggested that the construction unit requires blood test of the staff in recruitment to know about their health condition. In addition, it is necessary to forbid taking drug and using prostitutes, or the staff will be fired and taken to the police. After the channel improvement, floating population will increase at ports and docks along the river. The hotels, entertainments and restaurants will become prospering. Meanwhile, some social ills will emerge as well. This raises the potential spread of HIV/AIDS. Towns and countries should pay attention to this issue and assign publicity sectors to advocate prevention of HIV/AIDS through media like broadcast and billboard. The health and epidemic prevention stations and hospitals should strengthen the test of HIV/AIDS. The public security departments should improve registration and management of floating population. Meanwhile, periodical rectification of entertainments, hotels and hair saloons where HIV/AIDS is easy to spread is needed in order to make sure activities at these places are lawful.

6.1.2.4. Impacts on local traffic

Four bridges will be built in this project, including two in Jieshou City and two in Taihe City, viz. Jishou City Yumin Bridge, Jieshou (Old S204) Shahe Bridge, Taihe County Yinghe I Bridge and Taihe County Yinghe II Bridge.

(1) Impacts of Bridge works in Jieshou City on local traffic

According to site investigation, Shaying River goes through Jieshou City and divide the city into north and south urban areas. There exist three bridges to connect the two urban areas, viz. LinjieHan Highway Bridge, S204 Shayinghe Bridge and Yumin Bridge. Yumin Bridge is a dangerous bridge (where only light cars are allowed to pass). Linjinhan Highway Bridge is located at urban highway circle, so most of the traffic between cities concentrates on S204 Shayinghe Bridge.

According to initial design and “Letter on Relevant Issues of Shaying River Section in Jieshou Channel Improvement Project” signed by Jieshou People’s Government, S204 Shayinghe Bridge and Yumin Bridge will be rebuilt. In this project, the new bridge will be moved to Dongsheng Road after the old bridge is demolished. Local government will rebuild another bridge at the old bridge site. Jieshou (Old S204) Shahe Bridge will be rebuilt in situ after the old bridge is demolished. Thus, this project or local government will rebuild bridges in situ so the transport will not be blocked.

The transport arrangement plan submitted by the design unit is: Yinghe Road in Jieshou City located east of Daqiao South Road in Jieshou City and Dongsheng Road Bridge will be build simultaneously. The traffic can be diverged after the Dongsheng Road Bridge and its connection lines are being opened to traffic. The reconstruction of S204 Shayinghe Bridge can be facilitated as well. Yumin Bridge will be demolished after the completion of S204 Shayinghe Bridge.

Although construction of the new Yinghe Road and Dongsheng Road Bridge will have less impact on transport, attentions should be paid to impacts on residents’ traveling. Construction of sidewalks and earthwork piles and transport should be reasonable in order to minimize the impacts (see Section 8.1.6.1 for principles of sidewalk construction). Yumin Bridge is a dangerous bridge where only light cars are allowed to pass. During its demolition, vehicles and residents can use Dongsheng Road Bridge and rebuilt S204 Shayinghe Bridge as bypasses. The bypass distance is about 1.5km. Thus, demolition of Yumin Bridge will have minor impacts on transport after the reconstructions of Dongsheng Road Bridge and S204 Shayinghe Bridge.

In this context, this EIA focuses on assessment of transport arrangement plan for S204 Shayinghe Bridge (see Fig. 6-1). S204 Shayinghe Bridge will be closed during the construction. Heavy vehicles can use Linjiehan Highway Bridge and Dongsheng Road Bridge as bypasses. Light cars can use Yumin Bridge as bypass. Bypass distance is less than 1.5km.

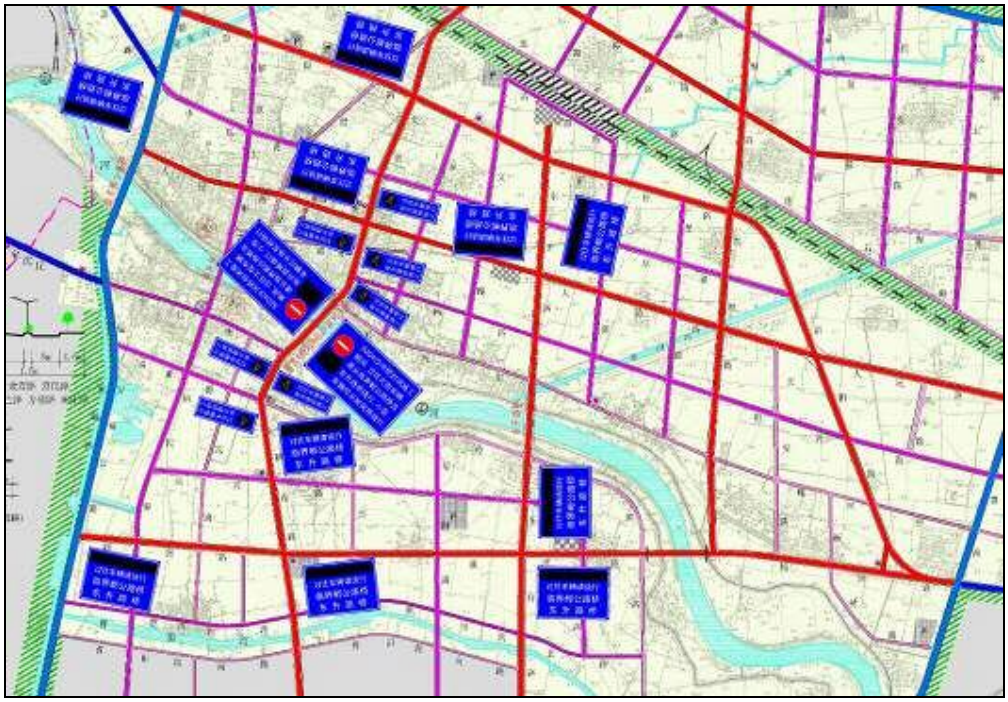


**Fig. 6-1 Transport Arrangement Plan of Jieshou S204 Shayinghe Bridge during its Construction**

(2) Impacts of Bridge works in Taihe County on Local Traffic

According to site investigation, Shaying River is situated south to Taihe County and blocks the connection of Taihe County with the outside. There exist three bridges on the river, viz. Yinghe I Bridge, Yinghe II Bridge and Yinghe III Bridge. Yinghe I Bridge is a controlled bridge (where only light cars are allowed to pass), so most of the traffic concentrates on Yinghe II Bridge and Yinghe III Bridge.

According to initial design and “Response Letter to the Shaying River Section in Taihe Channel Improvement Project” and “Revised Response Letter to the Shaying River Section in Taihe Channel Improvement Project” signed by Taihe People’s Government, Yinghe I Bridge and Yinghe II Bridge will be rebuilt. In this project, Taihe County Yinghe II Bridge will be demolished and rebuilt in situ. A new steel pedestrian bridge will be built at the original bridge site of Taihe County Yinghe I Bridge. A new vehicle bridge will be built at 1.6km downstream from G105 Taihe

Yinghe II Bridge (i.e. Taihe County Yinghe IV Bridge). Thus, bridges will be rebuilt in situ in this project so the transport will not be blocked.

The transport arrangement plan submitted by the design unit is: Taihe County Yinghe IV Bridge as well as the urban roads at both sides of this bridge will be built firstly by Taihe Government. The traffic can be diverged after the Yinghe IV Bridge and its connection lines are being opened to traffic. The reconstruction of Yinghe II Bridge can be facilitated as well. Yinghe I Bridge will be demolished and a pedestrian bridge will be built at the original site after the completion of Yinghe II Bridge.

Although construction of the new Yinghe IV Bridge will have less impact on transport, attentions should be paid to impacts on residents' traveling. Construction of sidewalks and earthwork piles and transport should be reasonable in order to minimize the impacts (see Section 8.1.6.1 for principles of sidewalk construction). Yinghe I Bridge is a dangerous bridge where only light cars are allowed to pass. During its demolition, vehicles and residents can use Yinghe IV Bridge and rebuilt Yinghe II Bridge as bypasses. The bypass distance is about 1.5-2km. Thus, demolition of Yinghe I Bridge will have minor impacts on transport after the reconstructions of Yinghe IV Bridge and Yinghe II Bridge.

In this context, this EIA focuses on assessment of transport arrangement plan for Yinghe II Bridge (see Fig. 6-2). Yinghe II Bridge will be closed during the construction. Heavy vehicles can use Yinghe III Bridge and Yinghe IV Bridge as bypasses. Light cars can use Yinghe I Bridge as bypass. Bypass distance is about 1.5-3 km.

(3) Conclusions

According to the above analyses, bridge works will have adverse impacts on regional transport and residents' traveling. However, most local residents found it acceptable that the bypass distance for their travel is less than 1.5 km and the bypass distance of motor vehicles is less than 3km. Furthermore, these impacts are limited to construction phase only.

In order to avoid traffic congestion, the traffic pressure can be relieved through release of road construction notices to inform drivers with the bypasses. Meanwhile, signs and signals should be set at related crossings during the construction phase. During the construction of bridges, construction vehicles and other vehicles are mixes, so the security management of construction vehicles is important.

In summary, the impacts of bridge works on regional transport can be minimized through reasonable arrangement of construction, informing vehicles with bypasses and construction site and period before the construction phase and setting signs at construction sties.

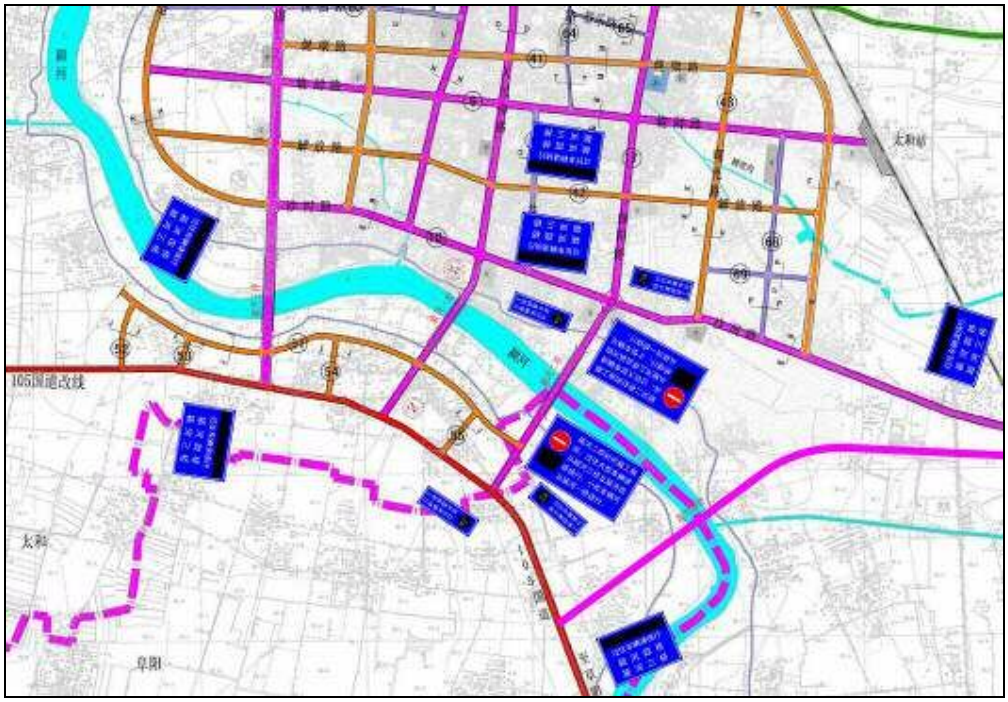


**Fig. 6-1 Transport Arrangement Plan of Taihe Yinghe II Bridge during its Construction**

6.1.2.5. Other Social Impacts

Adverse social impacts during the construction phase also include:

(1) Construction noise

If the construction phase is in summer, people that have nap habits are more sensitive to noise. The construction noise will affect people's nap and their normal lives. Some work that needs to be done at nights will affect residents' rest.

(2) Floating population

Life style of floating people is different from local residents. Conflicts due to different life habits might happen as floating population increases. Steal events might emerge. Unstable factors for social security exist.

(3) Odor of Sludge

Odor of dredged sludge can make nearby residents upset. It will also attract flies and mosquitoes and affect local sanitation.

(4) Construction Dust

Construction dust (including road dust during transportation and dust from loading and unloading, etc.) may have impacts on ambient air in the project region. People may be not willing to open windows and this consequently affect people's life and work.

To conclude, on the one hand, these impacts are temporary, which will end as the project is completed. On the other hand, the contractor and construction unit should improve education and publicity, to make nearby people informed with the project and construction staff and make them understand there will not be long-term adverse effects on local people' quality of life.

#### 6.1.3. Social Impacts after the Construction

After the complementation of this project, overall navigation at Shaying River will be realized. The improvement of navigation capacity of Fuyang waterway can promote construction and operation of ports and docks along the river, promote regional economic development and promote Fuying to integrate in to Yangtzs River Delta Region. To conclude, this project will significantly promote regional social and economic development.

## 6.2. Assessment of Ecological Environment

### 6.2.1. Impacts on Ecological Environment during the Construction Phase

At the construction phase, key impacts on ecological environment include:

(1) Land occupation: permanent land occupation focus on channel dredging and bridge reconstruction works. Land losses are mainly overflow land. Temporary land occupation are mainly located at construction machine sites, construction sites and dredging areas.

(2) Operation of machines: the impacts of the operation of machines include rolling vegetation, dust falling on leaves to affect photosynthesis and respiration.

(3) Soil erosion: works like dredging, chute cutoff and bridge reconstruction may induce soil erosion.

(4) Impacts on wild animals and aquatic organism: focusing on the construction phase.

6.2.1.1. Impacts on Vegetation

There will be two types of impacts of Shaying River Channel Improvement Project on vegetation. One is the losses of shrub lands and forestlands along Shaying River due to permanent land occupation. The other one is damage to vegetation due to temporary land occupation during construction phase at dredging areas. Restoration needs time (see details of impacts at dredging area in Section 6.2.1.5). This section mainly analyzes impacts on vegetation due to permanent land occupation.

According to site investigation, Shaying River has been artificially modified, improved and constructed for several times. Eco-systems along the river are almost artificial eco-systems. Most of the plants are cultivated, including farmlands, plantations, abandoned grasslands and shrub lands. Crop mainly includes wheat, corn, red taro, bean, cotton and peanut. Forest vegetation mainly includes cultivated warm temperate deciduous broad-leaved timber, and deciduous broad-leaved and coniferous mixed forest. The main tree species are Paulownia, Robinia, Salix and Populus, etc. Weed includes Po, reed, grass, wormwood and star grass, etc., which grows at road sides and on the embankment slope.

The permanent land take in this project is 1,780.4 Mu, including 708.4 Mu of land occupation by dredging, 973.4 Mu by anchorage area, 98.6 Mu by bridge works. Total area of overflow lands to be taken is 1,403.4 Mu, including 516.3 Mu by dredging, 887.4 Mu by service areas and anchorage areas. Table 6-1 presents land occupation in this project.

**Table 6-1 Permanent Land occupation in This Project**

| Land type | Administrative Division | Channel dredging | Service area & Anchorage area | Bridge | Total |
|---|---|---|---|---|---|
| Flowover land | Jieshou City | 13.4 | 167.9 | 0 | 181.3 |
| | Taihe County | 58.5 | 173.1 | 0 | 231.6 |
| | Urban area | 267.1 | 260.2 | 0 | 527.3 |
| | Yingshang Coungty | 177.3 | 286.2 | 0 | 463.5 |
| | Total | 516.3 | 887.4 | 0 | 1403.7 |
| Arable land | Jieshou City | 0 | 0 | 0 | 0 |
| | Taihe County | 0 | 0 | 0 | 0 |
| | Urban area | 69.1 | 86 | 0 | 155.1 |
| | Yingshang Coungty | 123 | 0 | 0 | 123 |
| | Total | 192.1 | 86 | 0 | 278.1 |
| Construction land | | 0 | 0 | 98.6 | 98.6 |

| | | | | |
|---|---|---|---|---|
| Total | 708.4 | 973.4 | 98.6 | 1780.4 |

According to site investigation and consultation with forest departments of district and county, land occupation in this project mainly include mixed and economic forests. Neither ecological forest nor rare species is disturbed. Impacts of this project on overflow land will focus on overflow shrub lands and grasslands and coastal forests. Some eco-system service functions and ecological benefits will be affected due to the loss of plants on overflow lands. Permanent land occupation focus on chute cutoff sections, service areas, anchorage areas and bridge construction sections. Map overlap analysis of project layout and natural wetlands along Shaying River indicates that most of the project components will not affect natural wetlands. Only some meadow wetlands may be occupied by three chute cutoffs at Fanying Village LaoZhuang Town Yingquan District, Liushilipu Xiawan Village Yingshang County and Jinyuzi Village Yanghu Town Yingshang County. The occupied area is 42.7 Mu. As affected vegetation on overflow lands (including vegetation in meadow wetlands) distribute broadly in this region and only a few meadow wetlands are occupied, this project on will have minor impact on biodiversity. After the construction, planting and vegetation restoration along the river can also compensate the loss of biomass and plant biodiversity.

As the implementation of slope protection works, planting will be carried out along Shaying River. Works like slope protection can relieve soil erosion at both sides of the channel. At the same time, ecological corridors can be built through the planting works. Regional ecological benefits of artificial eco-systems can be created. Regional ecological integrity and function and structure of eco-system can be further improved. Furthermore, the ecological compensation can be used for regional plating by water conservancy sector so that the loss of biomass can be further be compensated.

To conclude, permanent land occupation of this project will have impact on current eco-system due to loss of vegetation on overflow lands. However, as there will be only a little loss in regional context, slope protection works in the channel improvement project and planting compensation conducted by water conservancy sector can compensate the loss of biomass. Thus, destroyed vegetation due to the channel improvement project will not influence species richness of eco-system and its ecological functions along the river.

#### 6.2.1.2. Impacts on Terrestrial Animals

Impacts of Shaying Channel Improvement Project on terrestrial animals focus on the construction phase, including reduction of animals' activity areas and food resources due to vegetation destroy that is caused by land occupation, disturbance of animals' normal life by construction noise and lights, water and air pollution, etc.

(1) Impacts on Amphibian

Amphibian spawns in water, so they need water during breeding season. Their activities become frequent from dusk to dawn at secret places. They hibernate in hot summer or cold winter. Fish, snake, bird and animals may all be their natural enemies.

Many amphibians grow in beach by Shaying River and nearby ditches. Main impacts will be caused by dredging works, working staff's domestic wastewater and solid waste, construction machine maintenance and habitat pollution by running, gushing, dripping and leakage of wastewater and solid waste with oil from machines, and construction noise. Construction staff may kill amphibians. All of these might drive amphibians out of their habitat temporarily.

Amphibians in project region are mainly terrestrial amphibians, like *Bufo gararizans* and *Bufo raddei*, etc. Their habitats are farmland, stream and grass slope along Shaying River. Beside the construction noise that may drive them away, land occupation may occupy a few of their habitats. Such impacts are short-term. There are also similar habitats in this region that they can move to. In addition, this project will be implemented section by section. Therefore, amphibians can move to nearby areas. This project will not threat their living with temporary and reversible impacts. The amphibian's habitats will recover gradually after the construction is completed.

(2) Impacts on Reptile

Reptile spawns in shrubs and crevices. Breeding season is between spring and summer. Some of them grow in water and some live in cervices on land. Reptiles in this region are mainly the type that lives in forests by the water, including *Elaphe taeniura* and *Zaocys dhumnades*, etc., which distribute in shelterbelt forests and slope grass. The impact that this project will have on them is the loss of habitats due to land occupation of overflow lands and some forests. To conclude, the reptile tends to move to similar habitats that are far away from this project region. Such impacts are temporary and reversible.

(3) Impacts on Birds

According to site investigatin, human activities at both sides of banks of Shaying River are frequent. Birds in this region are mainly forest birds, which distribute in shelterbelt forests along Shaying River, agro-forestry and nearby lakes and wetlands (e.g. Bali River). It is easy for them to find alternative habitats during the construction phase. There will be minor direct impact of this project on them, including reduction of their activity areas and habitats, habitat pollution by construction noise and waste gas, land occupation of overflow lands and forests. The construction will influence amphibian and reptile, which may have indirect impacts on birds' food sources. However, these impacts are temporary and reversible. The major impact is impacts of construction noise during birds' breeding season.

Besides forest birds, there are also activities of some other birds in surrounding waters, like water birds, waterfowl and birds that live by the water. They include *Ardea cinerea*, *Tachybaptus ruficollis* and *Gallinula chloropus*, etc., which distribute on Shaying River and in slope grass along river banks. These birds may be disturbed by water pollution or high-level noise during the chute cutoff and dredging works. However, as this project will be carried out section by section, the birds can be driven to other sections during the construction.

There are also terrestrial birds in this project region, including *Phasanus colchicus*, *streptopelia chinensis*, *streptopelia orientalis* and *Vanellus vanellus*. They mainly distribute along Shaying River and in shrubs in nearby villages. This project will have more significant impacts on them than on other birds, e.g. hunting, noise and habitat loss. For activities of terrestrial birds are often on the ground, they will be affected more than birds of prey. However, similar habitats can be found in this project region, so these impacts are temporary and reversible.

(4) Impacts on Mammals

Mammals in this project region are mainly semi-underground type. They are often of small size and hunt food on the ground, shelter and avoid the enemies in the caves. Some of them look for food underground, including *Erinaceus amurensis* Schrenk, *Crocidura suaveolens* Pallas, *Nyctereutes procyonoides* Gray, *Mustela sibirica* Pallas, *Meles meles* Linnaeus, *Apodemus agrarius* Pallas, *Mus musculus* Linnaeus, *Rattus tanezumi* Temminck, *Rattus norvegicus* Berkenhout and *Lepus capensis* Linnaeus, etc. they distribute broadly in this project region. Minority of them like *Mus musculus* Linnaeus and *Rattus norvegicus* Berkenhout live close to human, which centralize in urban residential areas.

There will be temporary land occupation of farmland or abandoned land in this project. This will make some mice that live close to human move to other places. Mice density in those places will increase. In addition, construction staff's activities will attract these mice, especially those that are transmission source of Natural foci of disease. They may more frequently touch human and living stuff. The mice may become a threat to local residents and working staff and promote the spread of natural foci of disease.

There are many alternative habitats for mammals along Shaying River. It is easy for them to find habitats. The scope of channel improvement project is small, so the scope of affected wild animals is not large and impacts are short-term, which will be relieved after vegetation restoration. Animals will not be affected too much. They can come back to original habitats after vegetation restoration in this project region (e.g. chute cutoff sections and disposal areas, etc.).

(5) Impacts on Key Protected Wild Fauna

 Assessment method and Agent Species

Ecological mechanism method is applied. On the basis of environmental impact factors, ecological habits of species and community distribution status, ecological theory and methods are applied to predict and analyze the impacts.

In ecological, especially conservation biological research, it is often difficult to research all the species in the region due to financial, technical and time constrains. Given the similarity of ecological characteristics and habitat demand among different species, conservation biologists often select one species or a group of species as "agent species" to research issues of species conservation and habitat management (Wilcox, 1984; Bibby et al., 1992). Concepts related to agent species include indicator species, umbrella species and flagship species. The conservation of viable communities of umbrellas species, which is one kind of agent species, can also protect other species in the same area, the biota components at lower trophic levels and species that are key components of eco-sytem in this region. Flagship species can draw the public's attention to conservation. Concern on flagship species and its protection requirements can facilitate the management and control of large-area habitats. This is not only for concerned species, but also for other species that have less influence (Western, 1987). Flagship species are selected on the basis of their shrinking population and endangered status (Dietz et al., 1994). It is considered as an

effective approach to conserve species through agent species conservation. This approach is getting more and more attention in conservation biology.

In this project, according to historical information, in the project region there are two kinds of National protected wild fauna (Grade II): *Milvus lineaus, Cirus cyaneus*; four kinds of Provincial protected wild fauna (Grade I): *Dendrocopos major, Vulpes vulpes* Linnaeus, *Nyctereutes procyonoides* Gray, *Prionailurus bengalensis* Kerr; ten kinds of Provicial protected wild animals (Grade II): *Bufo raddei, Bufo bufo, Chinemys reevesii, Elaphe taeniura, Zaocys dhumnades, Rana plancyi, Phasanus colchicus, Lanius schach, Mustela sibirica Pallas, Meles meles Linnaeus.*

However, dur to long time intensive human activities and development in the region, those fauna are rarely seen. According to site investigation and secotor consultation, terrestrial animals along the Shaying River are mainly common species. The carnivores that need large living space, e.g. *Vulpes vulpes* Linnaeus, *Nyctereutes procyonoides* Gray, *Prionailurus bengalensis* Kerr, *Mustela sibirica* Pallas, *Meles meles* Linnaeus, etc, are not found in site investigation.

As a project EIA, the EIA team can not assess impacts on all of the protected animals due to technical, time and financial issues. Thus, it is essential to select a proper agent species. In this project, it needs large-area habitats to maintain the population of birds of prey like kite. They pertain to umbrella species. Ground birds like *Phasanus colchicus* are sensitive to change of habitats, so they can be selected as indicator species for change of ecological environment. Thus, these species are selected as agent species in this EIA. The assessment of these species can reflect impacts of the proposed project on other key protected species.

 Impacts on birds of prey (representative: *Milvus migrans*)

Protected *Milvus migrans* and *Cirus cyaneus* are birds of prey with small population. There sometimes only one bird in several square kilometers, but they can move broadly and live in jungles in low mountains and rugged mountain. The most suitable habitats are coniferous forest and broadleaf forest. According to historical information and site investigation, it is almost plain and human's activities are frequent along Shaying River. There mainly stands plantation and agro-forestry. This project will not influence habitats and breeding sites for birds of prey like *Milvus migrans*. This kind of birds can occasionally fly to banks of Shaying River to hunt food. This project region is just part of their activity area. This kind of birds has strong flying capacity, so this project will have few adverse impacts on them.

However, during the construction at sections where their activities are frequent, these species may be frightened by noise and fly away from places for hunting food. As there are similar habitats in around construction sites and this project will be carried out section by section, the birds can be driven to surrounding areas during the construction. After the construction, they can still come back to the original places for hunting food. The impacts are temporary and will disappear in a period after the completion of the construction.

To conclude, Shaying River Channel Improvement Project will not influence habitats and breeding sites for birds of prey like *Milvus migrans*. Impacts on these birds are minor and temporary.

 Impacts on ground birds like *Phasanus colchicus*

According to site investigation and review of historical information, there exist protected ground birds like *Phasanus colchicus* in the regions along Shaying River. *Phasanus colchicus* is provincial protected wild animal (Grade II) and distributes along banks of Shaying River and in shrubs in nearby villages. The impact of this project on these birds is caused by land occupation. Overflow land and shrub grassland will be occupied at chute cutoff and disposal areas. As the occupied area is relatively small, the habitat of *Phasanus colchicus* will not be affected. However, there will be significant impacts on them due to noise and vibration of machines like dredger and mud pump, etc. In comparison, current disturbance of human's activities are major around disposal areas, activities of *Phasanus colchicus* in these areas are less possible. Therefore, sections of chute cutoff should be concerned.

In summary, ground birds like *Phasanus colchicus* will be affected more than birds of prey, but they can find similar or same habitats. The impacts of this project are temporary and reversible. Sections of chute cutoff should be concerned during the construction.

(6) Conclusions

Most of this project region is farmland. Terrestrial animals in this region are common in Huaibei Plain, including birds, mammals and ground little animals. Wild mammals include raccoon, badger, weasels, rabbits and hedgehogs, etc. Wild birds include bustard, white stork, sparrow, turtledove and crow, etc. Impacts of this project on terrestrial animals focus on the construction phase. The habitats of these birds and mammals are destroyed. The animals may be frightened and driven away cause by construction noise, dust and frequent human activities. Bird will be affected first and

look for new temporary habitats. However, occupied area of land occupation is relatively small. It has become an artificial region along Shaying River and is not the main habitats, breeding sites and wintering sites of protected animals any more. In addition, most of the animals have strong ability to migrate. This project will be carried out section by section, they can move to safe areas nearby quickly during the construction. Thus, this project will have minor impacts on terrestrial animals. They will get back soon after the construction.

6.2.1.3. Impacts on Aquatic Organism

(1) Impacts on plankton

The temporal and spatial distribution of plankton and its population are closely related to water transparency. Some SS will be caused by bridge pier works and channel dredging works. SS will diffuse as the changes of water flow. An area with high-concentration SS will emerge and reduce water transparency. Consequently, growth of plankton will be influenced.

Foundation construction of bridge pier works is easy to disturb sediment. Based on engineering geological conditions, drilling pile foundations are applied to bridge construction in this project. All of the construction is carried out in casing. Mud slurry will be recycled and reused. Deposited wastes are discharged to mud slurry transport vessels and transported to disposal areas on land for landfill. Referencing experiences of similar bridge construction, there will be only 2-3 working sites that will cause SS during the foundation construction of bridge works. The SS concentration will significantly increase within the area 200m downstream of working sites of bridge pier construction. The construction will not cause SS belt across Shaying River. During the dredging works, suction and stirring may cause re-suspension and diffusion of contaminated sediment. Analogizing dredging works in Dianchi, SS concentration will significantly increase within the area with reamer of cutter suction dredger as the center and a radius of 15 m. Release rates of N and P contaminations are increased by 1-2 times of that in stationary situation. Effects on areas 15m away are not obvious. Thus, the impacts on water quality of Shaying River during dredging are limited.

To conclude, scope of construction impacts is small in the whole assessment scope. Bridge construction will be carried out only at 2-3 points, so the increase of SS is not significant. After the construction, disturbed sediment will deposit and be

diluted due to gravity and water flow. Thus, impacts of this project on plankton are minor.

(2) Impacts on benthos

Benthos is important aquatic organisms in aquatic ecosystems in Shaying River. As benthos' exercise capacity is low, their livings are affected significantly by environmental change. The direct impact is loss of benthos due to reduction of sediment in Shaying River during dredging works. However, in general, the disturbance to benthos focuses on dredging period. After the construction, as sediment becomes stable, surrounding benthos will gradually occupy damaged habitats. The number of species and biomass will also increase slowly. Although dredging will cause loss of benthos, all of the species in Shaying River are common ones. The impacts are temporary. The habitats of benthos will be restored as the sediment becomes stable after the channel improvement. Thus, impacts of this project on benthos are acceptable.

(3) Impacts on fish

Foundation construction of bridge pier works and dredging works will cause increase of sediment concentration and turbidity of water. The erosion may cause changes of sediment as well. These may destroy habitats of plankton and benthos in construction sites. In aspect of food chain, growth of fish in this area will be influenced. However, in accordance with above analyses, the scope of bridge works in this project is small and impacts of dredging are temporary. Habitats of plankton and benthos will not be changed. Thus, the impacts on fishery resources caused by loss of baits are minor.

Loss of baits like planktons and benthos caused by degradation of water quality, living, growing and breeding conditions for fish are changed. Fish will migrate to other water areas. The fish density at the construction sites will be significantly reduced. Stirred water and sediment will also destroy some habitats of fish during bridge pier construction and dredging works. Fish may be driven away from construction sites. However, given water pollution status in Shaying River, main fish species in this river are grass carp and other pollution-tolerant fish. There is no valuable or rare species. Impacts of channel improvement on fish are minor and temporary. The fish can come back to original habitats after the construction.

In site investigations, no national protected rare fish were detected. No spawning, feeding or wintering areas that are zoned by fishing sectors exist in the Shaying River.

According to the local fishery agency, fish spawning and breeding areas are located in several tributaries of the Shaying River. Thus, this project will not have significant impact on fish spawning and breeding.

6.2.1.4. Impacts on Agro-ecological Environment

(1) Impacts on regional land use

Current land use is relatively simple. The main land use type is agro-ecosystem, including farmland, grass and woodlands and reservoirs with a few country buildings. The farmlands are distributed regularly. The main crop includes economic crop and wheat.

In this channel improvement project, only partial land use in disposal areas will be changed after the improvement. Some borrow pits, abandoned lands or reservoirs will be changed to arable lands or economic forests. To conclude, there will not be major changes of land use in this region.

(2) Impacts of permanent land take on agro-ecological environment

The area of permanent land take in this project will be 1,780.4 Mu, including 278.1 Mu arable lands, which are located in chute cutoff section at Gaowan (20.7 Mu), chute cutoff section at Zhangdian Yuzi Village (48.4 Mu), chute cutoff section at Sanwan Village (55.3 Mu), chute cutoff section at Fangzhou Village (67.7 Mu) and service areas (86 Mu). Arable lands are limited and the amount of arable land per person is relatively low in Fuyang City, so permanent land take of arable lands in this project will increase the pressure on arable lands in this region. However, there will be only a few permanent land take. In addition, borrow pits that were set by water conservancy authorities in recent Shaying River improvement projects, current hollows or reservoirs will be effectively used as disposal areas in this project. These lands can be restored as farmland through proper ecological restoration approaches. Original borrow pits or abandoned lands can be re-cultivated to increase arable lands to some extent. The impacts of this project on agro-ecological environment can be minimized.

To conclude, although the amount of arable lands will be reduced, regional land use will not be changed. As farming methods or climate conditions will not change either, there will not be significant impacts on agro-ecosystems. In addition, the contractor should adjust land use and carry out land acquisition and compensation carefully jointly with local governments, in order to minimize adverse impacts.

(3) Impacts on Agriculture

In general, land occupation of this project will have minor impacts on agricultural structure, but production function of permanently occupied arable lands will be lost. Thus, this project will cause direct economic loss of local agriculture. As crop type and acreage change every year, estimation of the loss is not precise. Currently, the income from wheat cultivation is calculated as 800RMB/Mu and income from economic crop cultivation in dry lands is calculated as 600RMB/Mu, so income of land acquisition is calculated as 700RMB. In total, 278.1 Mu area arable lands will be occupied permanently, so the loss of agriculture due to permanent land take will be 195,000 RMB per year.

This is not a small income for farmers, but the economic loss can be compensated through other effects of channel improvement project. The farmers whose farmland is occupied can get compensation from the contractor and the government (see details in Resettlement Section).

Although this project will have short-term impacts on local agricultural economy, navigation will also facilitate the transportation of primary products, especially for those produced from unoccupied farmlands. This is good for its sale and output value per Mu will be increased. Furthermore, as ports along Shaying River will prosper after the open of navigation, retail will develop and many job opportunities will be provided, which will also promote local economic development. Thus, the loss of primary industry can be compensated by development of secondary and tertiary industries.

In general, the propose project will promote local agricultural economic development, which will be facing a new situation.

#### 6.2.1.5. Comprehensive Demonstration of Environmental rationality of Disposal Areas

(1) Utilization of sediment sludge

Sediment sludge in channel improvement project mainly comes from channel dredging and chute cutoff works. The sediment sludge can be utilized in various ways, especially for sludge from chute cutoff works.

 Program of resource for forest land

Sediment sludge of Shaying Rive comprises nutrients like nitrogen and phosphorus and various minerals as well as organic matters and trace elements that are lacking in common fertilizers. If sediment sludge is used as basal and top soil in forest lands, it can not only provide with nutrients that trees need and improve forestry

production, but can also improve soil fertility, texture and moisture holding ablity. Thus, it is feasible to utilize sediment sludge as fertilizer for forest land. It is an effective way to dispose sediment sludge.

 Reclamation program

Plating will be conducted along the river banks. Shrubs and forest will be mixed with grass planted on the ground, so that a 4m-high green corridor from the ground can be built. It can be treated as shelterbelt, conserve water and soil, improve landscaping and regulate micro-climate. Stable sediment sludge will not flow back into the river.

 Program of return to farmland

For the sludge comprises nutrients like nitrogen and phosphorus, if it is sent back to farmland as compost, it would help improve soil texture and nutrient contents and help enhance agricultural yields.

 Program of utilization for construction materials

The quality of waste soil that comes from chute cutoff works is very high. It can be tested by relevant units whether it can be utilized as raw material for brick plants. Thus, the waste soil can be disposed. It can be resolved that construction materials are lacking for new village construction

(2) Setting of disposal area

As for sediment sludge that can not be reused, it can be disposed in disposal areas. Setting principles of disposal areas are:

 Borrow pits that were set by water conservancy sectors in recent Shaying River improvement projects will be effectively used as disposal areas in this project, on the basis of communication and coordination with water conservancy sector.

 It is suggested to select nearby river sections whose earthwork volume is large, to keep disposal sites within dredger’s economic region.

 It is suggested to select low-lying land, abandoned pond and lands and reduce land occupation of good farmland.

 If no low-lying land or borrow pit can be used, low-yield farmland can be utilized for disposal. It should be restored after the construction.

On the basis of 1:10000 topographic map and site investigations, the project feasibility study team analyzed the topography, landscape, land use type, abandoned earthwork volume and rationality of earthwork transportation, and proposed 34 disposal areas.

(3) Comprehensive demonstration of rationality of siting of disposal areas

According to preliminary engineering design, the design unit reduce 37 disposal areas to 34 areas considering environmental protection and land occupation. Land occupation are reduced from 10,929.6 Mu to 9,831.3 Mu. The original siting of 13# disposal areas is unreasonable (which is surrounded by buildings). It has been adjusted and optimized to relieve environmental impacts of sediment disposition.

This EIA demonstrates the environmental rationality of siting of 34 disposal areas in aspects of land occupation, how close it is to nearby residential areas, average transport distance and impacts on visual landscape, etc. (see Table 6-2).

Table 6-2 indicates dredging areas are distributed outside the embankments of dredging areas. There are no adverse geological phenomena in this region, which can meet the demand of mud volume of this project and is in accordance with engineering design. All of the dredging areas are 50m away from the nearest residential areas. Impacts of odor pollutant emissions and noise of residual water pumping station on surrounding environmentally sensitive spots are minor. Siting of each pile yard can meet environmental protection requirements. Area of disposal areas is 9,831.3 Mu in total, which are mainly dry land. Original lands in disposal areas will be occupied temporarily and land use type will be changed. This will cause some loss of local agriculture. However, according to site investigations, borrow pits that were set by water conservancy sectors in recent Shaying River improvement projects will be effectively used for six of these disposal areas. Abandoned lands or ponds will be used for four of them. These account for 30% of all the disposal areas. The occupied arable lands or nurseries can be reduced by 1236.2 Mu, which account for 12.6% of all of the disposal areas. Low-yield farmlands are selected for disposal areas where no borrow pit or abandoned land nearby can be used. Combined with low-lying land transform program, disposal areas can be restored as arable lands after the construction through ecological restoration measures. To facilitate re-cultivation of borrow pits or abandoned lands can increase the area of arable lands or forest lands. The new soil erosion can be relieved. It is also restoration of habitats of wild animal.

(4) Impacts of disposal area

Disposal areas are set close to dredging areas in order to avoid inconvenience and pollution of long-distance transportation. Geo-membrane is used to prevent leakage of cofferdams around disposal areas, so original soil will not be influenced. Soil within dredging areas will be covered by dredged sediment sludge. The land use will be

totally changed. Reclamation, planting or landscaping will be carried out according to actual situation after the completion of construction. Given the changes of land use, original farmland or fish ponds will be transformed to ecological lands, like forest or agricultural land, etc. There will be no impact on human health.

Machine noise during the construction phase, discharge of residual water and odor pollutant emissions may have impacts on surrounding resident areas. According to the investigation, the nearest residential area is 50m away from the disposal area. Various impacts of disposal area are minor.

(5) Restoration approach of disposal areas

According to analysis of surface sediment conducted by Fuyang Environmental Monitoring Station, cumulative heavy metal pollutants are less in sediment of Shaying River. The concentrations of Pb, Zn, Cr and Cu are lower than standards of Grade II in “Environmental quality standard for soils” (GB15618-1995). No significant difference of concentration between the sediment and soil in disposal areas was detected.

Concentration of total nitrogen and total phosphorus in sediment of Shaying River ranges between 0.2-0.7 mg/kg and 0.15-0.56 mg/kg respectively. The concentrations are low.

To conclude, collection of surface soil should be strengthened. Sediment sludge of Shaying River should be covered by original surface soil after it is transported to and piled in disposal areas and gets air-dried. For a while, sediment would be melt and blent with surrounding soil. Consequently, the disposal area will be restored as farmland and orchard, etc. Trace heavy metals will not have significant impacts on crops or fruit in nurseries.

As arable lands are limited and the amount of arable land per person is relatively low in Fuyang City, so permanent land take of arable lands in this project will increase the pressure on arable lands in this region. Therefore, given actual situation of this project region, the primary option should be restore disposal areas as farmlands, in order to compensate arable land amount to some extent and minimize impacts on agro-ecological environment.

(6) Reclamation and low and medium-yield farmland transform program

Three plans should be prepared prior to the implementation of reclamation and low-yield farmland transform.

Firstly, plan of supporting measures for adjustment of ditch roads, buildings and field roads. As sediment of Shaying River has much water, discharge ditch should be prepared before disposal. Meanwhile, consolidation plan for contiguous land should be prepared before disposal. Design of field roads should be reasonable as well so that it is easy for machines to get into the farmland.

Secondly, mud transportation plan. Numbers of mud pump on river bed and relay pump on the banks should be determined before disposal according to the requirement that dredging and low-lying farmland transform need to be connected closely. Earthwork volume of each pump, requirements of dredging sections and areas for mud transportation should be made clear. Discharge system needs to be arranged.

Thirdly, power supply planning. In accordance with requirement of dredging and mud transportation plan and actual situations of power supply and power facilities, a reasonable layout of transformers and power lines is needed. Power for mud pump and relay pump needs to be arranged to ensure power demand and electrical safety in this project.

 Reclamation

As for ponds, the construction unit should drain the water in ponds before reclamation to avoid high soil moisture, which may affect land fertility and hinder crop growth. The construction unit is responsible for disposal in the pond, rolling flat timely, and digging drainage ditches. The rolled land can be delivered to village or individual who will be responsible for re-cultivation.

As for borrow pits and abandoned lands with water, the construction unit is responsible for digging drainage ditches. After residual water discharges, the construction unit dumps in the borrow pit or abandoned land and rolls flat timely. The rolled land can be delivered to village or individual who will be responsible for re-cultivation.

As sediment of Shaying River has much water, after the construction unit dumps and rolls plat the land, the affected village or villager should dig underground ditch after reclamation to reduce soil moisture. Meanwhile, farmers can select proper crop to cultivate based on actual situation to prevent the reduction of crop production due to high soil moisture.

The construction unit should take into account future demand on mechanized farming. Reasonable field roads should be reserved during disposal and rolling. Field

roads are often designed in shape of “□”, “□”, “□”, to make lands contiguous and easy for machine operation and transportation.

□ Low and medium-yield farmland transform

According to actual situation, collecting surface soil, building cofferdams, filling sediment and covering soil should be applied for low and medium-yield farmland transform.

Collecting surface soil and building cofferdams: low-lying lands are natural pond. 20-30 cm surface soil should be collected to build 0.5m-high and 0.3m wide cofferdams with slope ratio 1:1-1:1.5 around it, in order to meet the requirements of enough water depth of deposition and security of high waves, to avoid overflow of mud slurry and flooding surrounding farmlands, and to ensure transformed land can be as high as surrounding ground. As for uneven low-lying lands with slope, the height of the coffer dams should change as ground elevation changes to ensure the tops of cofferdams are at the same level with a height difference less than 5cm. Filling should start from the lowest spots. Filling, crushing flat, moving away trash and compacting should be carried out by layers. Special attention should be paid to the quality of compaction at original outlets, loopholes and lower spots, to ensure that no hidden dangers remain.

Filling sludge and covering: when earthwork from riverbed is transported to low-lying farmlands, deposited sludge in the farmland should be as high as farmlands outside the cofferdams. After the water is discharged and consolidation period is over, surface soil of cofferdams needs to be covered on sludge and be rolled flat to reach the transform objectives. Some low-lying farmlands are vertical narrow belt to the river. The water can only be discharged at distant spots. In order to improve soil structure and reduce rolling works, outlets of sludge should be moved from near to far spots according to actual situation. It is better to set a water tank and often stir the slurry in the tank.

After the above works are completed, the construction unit can deliver the lands to affected village or individual who will be responsible for re-cultivation.

In Shaying River Improvement Project, partial lands in disposal areas are transformed using sludge. The total reclaimed lands are 1,607.1 Mu. 3,080.4 Mu low and medium-yield farmlands are transformed. Reclaimed and transformed lands account for 46.67% of total temporary land occupation. Wheat and corn can be

cultivated in reclaimed and transformed lands. Reclamation and transform will have positive economic, social and ecological effects.

## Table 6-2 Siting Demonstration of Dredging Areas

| No. | Location | Source of sludge | Dredging volume (10,000 $m^3$) | Temporary land take (Mu) | Height( mm) | Type of land take | Nearby resident areas | Environmental sensitivity | Approach to restoration | Comprehensive assessment | Current status |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Renwan Village, Dongcheng Street, Jieshou City | Xuzhai Service and Anchorage Area | 67.23 | 368.4 | 2.5 | Nursery | Chengzhuang , 60m north | Low-lying, more sensitive | Farmland or nursery | Reasonable |  |
| 2 | Weiyao Village, Tianying Town, Jieshou City | K0+000-K10+000and anchorage area upstream of Genglou Lock | 42.48 | 219.9 | 2.5 | Hollow, dry | Weiyao Village, 80m northwest | Hollow, insensitive | Low and medium-yield farmland transform, restored as farmland | Reasonable |  |

| No. | Location | Source of sludge | Dredging volume (10,000 $m^3$) | Temporary land take (Mu) | Height( mm) | Type of land take | Nearby resident areas | Environmental sensitivity | Approach to restoration | Comprehensive assessment | Current status |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | Zhuzhuang Village, Daxin Town, Taihe County | K28+000-K33+000 and anchorage area downstream of Genglou Lock | 75.57 | 418.4 | 2.5 | Hollow, dry land | Zhuyaozhuang, 80m south | Hollow outside the embankment, insensitive | Restored as construction land, integrated in cultural plaza construction of wetland park | Reasonable |  |
| 4 | Daliu Village, Daxin Town, Taihe County | K36+000-K40+000 and Chengguan Anchorage Area, Taihe | 23.53 | 106.2 | 2.5 | Pond, abandoned land | Daliu Village, 60m east | Insensitive | Reclamation, restored as farmland | Reasonable |  |
| 5 | Datao Village, Yingdong District, Fuyang City | K40+000-K48+000 | 66.20 | 362.2 | 2.5 | Hollow, dry land | Datao Village, 110m north | Hollow outside the embankment, insensitive | Low and medium-yield farmland transform, restored as farmland | Reasonable |  |

| No. | Location | Source of sludge | Dredging volume (10,000 $m^3$) | Temporary land take (Mu) | Height(mm) | Type of land take | Nearby resident areas | Environmental sensitivity | Approach to restoration | Comprehensive assessment | Current status |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | Sanliqiao Village, Ninglaozhuang Town, Yingquan District, Fuyang City | K48+000-K62+000 | 35.30 | 176.8 | 2.5 | Dry land | Sanliqiao Village, 90m north | Low and flat, requiring proper restoration; more sensitive | Farmland | Reasonable |  |
| 7 | Fanying Village, Laozhuang Town, Yingquan District, Fuyang City | K62+000-K67+000 and Cihuaixinhe Service Area | 136.59 | 784.5 | 2.5 | Dry land | Fanying Viilage, 50m northwest | Hollow outside the embankment, insensitive | Low and medium-yield farmland transform, restored as farmland | Reasonable |  |
| 8 | Fanying Village, Ninglaozhuang Town, Yingquan District, Fuyang City | Connected with Cihuaixin River | 41.12 | 211.8 | 2.5 | Dry land | Xinzha Village, 50m north | Low and flat, requiring proper restoration; more sensitive | Farmland | Reasonable |  |

| No. | Location | Source of sludge | Dredging volume (10,000 $m^3$) | Temporary land take (Mu) | Height(mm) | Type of land take | Nearby resident areas | Environmental sensitivity | Approach to restoration | Comprehensive assessment | Current status |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9 | Baimiao Village, Ninglaozhuang Town, Yingquan District, Fuyang City | K67+000-K72+000 | 46.45 | 243.7 | 2.5 | Borrow pit | Zhuzhuang, 50m west; Baimiaoji Village, 80m east | Insensitive | Reclamation, restored as farmland | Reasonable |  |
| 10 | Wangzhuang Village, Yingquan District, Fuyang City | K72+000-K76+000 | 85.28 | 476.7 | 2.5 | Borrow pit | Luwan primary school, 80m north; Yangzhuang, 60m south. | Insensitive | Reclamation, restored as farmland | Reasonable |  |
| 11 | Dukou Village,Yingquan District, Fuyang City | K76+000-K80+000 and anchorage area upstream of Fuyang Lock | 55.24 | 296.5 | 2.5 | Borrow pit | Weizhuang Village, 60m north | Insensitive | Reclamation, restored as farmland | Reasonable |  |

| No. | Location | Source of sludge | Dredging volume (10,000 $m^3$) | Temporary land take (Mu) | Height( mm) | Type of land take | Nearby resident areas | Environmental sensitivity | Approach to restoration | Comprehensive assessment | Current status |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | Huanyuan Village, Yingzhou District, Fuyang City | K83+000-K86+000 and Sanshilipu Service Area | 187.33 | 1089.0 | 2.5 | Dry land | No sensitive spot in the surrounding area with a radius of 200m | Low and flat, requiring proper restoration; more sensitive | Farmland | Reasonable |  |
| 13 | Zhaozhuang Village, Yingdong District, Fuyang City | K86+000-K92+000 and anchorage area downstream of Fuyang Lock | 62.61 | 340.7 | 2.5 | Dry land | No sensitive spot in the surrounding area with a radius of 200m | Low and flat, requiring proper restoration; more sensitive | Farmland | Reasonable |  |
| 14 | Yuanzhai Village, Yingdong District, Fuyang City | K92+000-K95+000 | 37.13 | 187.8 | 2.5 | Dry land | No sensitive spot in the surrounding area with a radius of 200m | Low and flat, requiring proper restoration; more sensitive | Farmland | Reasonable |  |

| No. | Location | Source of sludge | Dredging volume (10,000 $m^3$) | Temporary land take (Mu) | Height( mm) | Type of land take | Nearby resident areas | Environmental sensitivity | Approach to restoration | Comprehensive assessment | Current status |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 | Gaowan Village, Yingzhou District, Fuyang City | K95+000-K102+000 | 107.09 | 607.6 | 2.5 | Dry land | No sensitive spot in the surrounding area with a radius of 200m | Hollow outside the embankment, insensitive | Low and medium-yield farmland transform, restored as farmland | Reasonable |  |
| 16 | Wushipu Liuxiao Village, Yingshang County | K102+000-K105+000 | 39.50 | 202.0 | 2.5 | Dry land | Liuxiao Village, 160m southeast | Low and flat, requiring proper restoration; more sensitive | Farmland | Reasonable |  |
| 17 | Liushipu Ningda Village, Yingshang County | K105+000-K108+000 | 86.48 | 483.9 | 2.5 | Hollow, abandoned land | Ningda Village, 80m southwest | Insensitive | Reclamation, restored as farmland | Reasonable |  |

| No. | Location | Source of sludge | Dredging volume (10,000 $m^3$) | Temporary land take (Mu) | Height( mm) | Type of land take | Nearby resident areas | Environmental sensitivity | Approach to restoration | Comprehensive assessment | Current status |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 18 | Liushipu Zhouzhuang Village, Yingshang County | K108+000-K112+000 | 42.90 | 222.4 | 2.5 | Dry land | Zhouzhuang Village, 100m east | Low and flat, requiring proper restoration; more sensitive | Farmland | Reasonable |  |
| 19 | Wanghai Village, Yingdong District, Fuyang City | K112+000-K115+000 and Kouzi Anchorage Area | 38.22 | 194.4 | 2.5 | Dry land | Wanghai Village, 120m south | Low and flat, requiring proper restoration; more sensitive | Farmland | Reasonable |  |
| 20 | Sugou Village, Xinji Town, Yingshang County | K115+000-K118+000 | 30.96 | 150.8 | 2.5 | Dry land | Wangzhuang zi Village, 80m north | Low and flat, requiring proper restoration; more sensitive | Farmland | Reasonable |  |

| No. | Location | Source of sludge | Dredging volume (10,000 $m^3$) | Temporary land take (Mu) | Height(mm) | Type of land take | Nearby resident areas | Environmental sensitivity | Approach to restoration | Comprehensive assessment | Current status |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 21 | Wangzhuang Village, Xinji Town, Yingshang County | K118+000-K121+000 | 22.78 | 101.8 | 2.5 | Dry land | No sensitive spot in the surrounding area with a radius of 200m | Low and flat, requiring proper restoration; more sensitive | Farmland | Reasonable |  |
| 22 | Huangying Village, Xinji Town, Yingshang County | K121+000-K124+000 | 19.91 | 84.5 | 2.5 | Dry land | No sensitive spot in the surrounding area with a radius of 200m | Low and flat, requiring proper restoration; more sensitive | Farmland | Reasonable |  |
| 23 | Fanzhuang Village, Xinji Town, Yingshang County | K124+000-K130+000 | 33.15 | 164.0 | 2.5 | Dry land | Fanzhuang Village, 50m northeast | Low and flat, requiring proper restoration; more sensitive | Farmland | Reasonable |  |

| No. | Location | Source of sludge | Dredging volume (10,000 $m^3$) | Temporary land take (Mu) | Height( mm) | Type of land take | Nearby resident areas | Environmental sensitivity | Approach to restoration | Comprehensive assessment | Current status |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 24 | Xiwan Village, Jianying Country, Yingshang County | K130+000-K135+000 | 26.37 | 123.3 | 2.5 | Dry land, parts of it are borrow pits | No sensitive spot in the surrounding area with a radius of 200m | Insensitive | Reclamation, restored as farmland | Reasonable |  |
| 25 | Chentaizi Village, Gucheng Country, Yingshang County | K135+000-K140+000 | 19.25 | 80.6 | 2.5 | Dry land, abandoned land | Chentaizi Village, 100m east; Xutaizi Village, 80m north | Insensitive | Reclamation, restored as farmland | Reasonable |  |
| 26 | Wanghaizi Village, Jianying Country, Yingshang County | K140+000-K143+000 | 18.80 | 77.8 | 2.5 | Dry land, abandoned land | No sensitive spot in the surrounding area with a radius of 200m | Insensitive | Reclamation, restored as farmland | Reasonable |  |

| No. | Location | Source of sludge | Dredging volume (10,000 $m^3$) | Temporary land take (Mu) | Height( mm) | Type of land take | Nearby resident areas | Environmental sensitivity | Approach to restoration | Comprehensive assessment | Current status |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 27 | Lianggang Village, Huangqiao Town, Yingshang County | K143+000-K147+000 and Liuzhuang Anhorage Area, Yingshang | 70.80 | 389.9 | 2.5 | Dry land | Hougang Village, 160m, northeast | Low and flat, requiring proper restoration; more sensitive | Farmland | Reasonable |  |
| 28 | Shibalipu Bianhai Village, Yingshang County | K147+000-K157+000 | 19.67 | 83.1 | 2.5 | Dry land | Lizhuang Village, 90m north; Zengzhuang Village, 70m south | Low and flat, requiring proper restoration; more sensitive | Farmland | Reasonable |  |
| 29 | Xiayuan Village, Balihe Town, Yingshang County | K157+000-K162+000 and anchorage area upstream of Yingshang Lock | 48.16 | 254.0 | 2.5 | Dry land, parts of it are borrow pits | No sensitive spot in the surrounding area with a radius of 200m | Hollow, insensitive | Combined reclamation with Low and medium-yield farmland transform, restored as farmland | Reasonable |  |

| No. | Location | Source of sludge | Dredging volume (10,000 $m^3$) | Temporary land take (Mu) | Height( mm) | Type of land take | Nearby resident areas | Environmental sensitivity | Approach to restoration | Comprehensive assessment | Current status |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 30 | Sanba Village, Balihe Town, Yingshang County | K162+000-K168+000 and anchorage area downstream of Yingshang Lock and Longwangmiao Anchorage Area | 146.06 | 841.3 | 2.5 | Dry land | No sensitive spot in the surrounding area with a radius of 200m | Hollow, insensitive | Low and medium-yield farmland transform, restored as farmland | Reasonable |  |
| 31 | Yantai Village, Balihe Town, Yingshang County | K168+000-K174+000 | 17.07 | 67.5 | 2.5 | Dry land | No sensitive spot in the surrounding area with a radius of 200m | Low and flat, requiring proper restoration; more sensitive | Farmland | Reasonable |  |
| 32 | Jiangliu Village, Xinliuji Town, Yingshang County | K174+000-K185+000 | 30.20 | 146.3 | 2.5 | Dry land | Jiangliu Village, 180m north | Low and flat, requiring proper restoration; more sensitive | Farmland | Reasonable |  |

| No. | Location | Source of sludge | Dredging volume (10,000 $m^3$) | Temporary land take (Mu) | Height(mm) | Type of land take | Nearby resident areas | Environmental sensitivity | Approach to restoration | Comprehensive assessment | Current status |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 33 | Zhoulou Village, Yanghu Town, Yingshang County | K185+000-K196+000 | 19.31 | 80.9 | 2.5 | Dry land, parts of it are borrow pits | No sensitive spot in the surrounding area with a radius of 200m | Insensitive | Reclamation, restored as farmland | Reasonable |  |
| 34 | Baliduo Village, Saijian Hui Ethnic Town, Yingshang County | K196+000-K205+000 | 37.88 | 192.3 | 2.5 | Dry land | Baliduo Village, 60m southeast | Hollow outside the embankment, insensitive | Low and medium-yield farmland transform, restored as farmland | Reasonable |  |

### 6.2.2. Impacts on Anhui Province Taihe County Shaying River National Wetland Park

Section k25-k38+500 of this project lies in Anhui Province Taihe County Shaying River National Wetland Park. Project components that refer to this wetland part include: 3# disposal area, dredging, reconstruction of G105 Taihe Shahe II Bridge (k38).

Ecological conservation area and wetland ecological function demonstration area of Anhui Province Taihe County Shaying River National Wetland Park are located at old riverway of Genglou Lock and near Wanfugou (k25-k26). Based on the analysis, concerned sections of this project focus on Section k30-k33 and Section k36-k38+500, which only refer to leisure area and service and management area and will not affect ecological conservation area and wetland ecological function demonstration area of this wetland park.

6.2.2.1. Consistency Analysis of this Project and Laws & Regulations

According to Article 17 and 25 in the "National Wetland Park Management Measures (on trial)" issued by State Administration of Forest on Feb. 28th, 2010, "relevant formalities should be processed after the consultation with related sectors if land occupation and acquisition in national wetland park are needed"; "ecological conservation area is the core protected area of national wetland park. Construction activities that are not related to wetland ecosystem protection and management are forbidden except necessary protection and monitoring… Activities about popular science like publicity and display of wetland functions and values to the public are conducted in demonstration area. Reasonably used/leisure area is constructed with the precondition of protection and reasonable use of resources in national wetland park, where ecological tourism is developed. Management area is the place where managers of the park are working. It may also be a service area for tourists."

Sections in this project that refer to this wetland park focus on Section k30-k33 and Section k36-k38+500. They lie in leisure area and service and management area and will not affect ecological conservation area and wetland ecological function demonstration area of this wetland park. Since disposal, dredging and bridge works will be carried out in the wetland park, Fuyang Port & Shipping Management Bureau formally sent "Consultation Letter About Shaying River Channel Improvement Project and Anhui Province Taihe County Shaying River National Wetland Park" to Taihe County Forest Bureau, and has got the agreement letter from the authority sector. Thus, this project is in accordance with the "National Wetland Park Management Measures (on trial)".

6.2.2.2. Notions of Relevant Authorities

Management Office of Anhui Province Taihe County Shaying River National Wetland Park is affiliated with Taihe County Forest Bureau and is under establishment. Currently, Taihe County Forest Bureau is responsible for routines of the wetland park. According to "Respond Letter on Relevant Issues About Shaying River Channel Improvement Project Passing Through Anhui Province Taihe County Shaying River National Wetland Park" (Forest Office (2010) No.5), Taihe County Forest Bureau agrees in principle the improvement project carried out in the wetland park. They also requires: environmental protection should be strengthened during the design and construction in compliance with national wetland park management requirements; protection of vegetation, ecosystem and water environment along the river should be improve; environmental protection should be strengthened during the construction and operation phases; and vegetation restoration should be implemented after the completion of related section construction.

6.2.2.3. Engineering Optimization

According to preliminary design, the design unit has taken into account the protection of the wetland park. A chute cutoff (original Datao Village chute cutoff section k35+350-k35+550) was cancelled on the basis of original project feasibility study with the precondition that technical indicators can meet the requirement. Chute cutoff work will change the natural flow of the river and cause loss of overflow lands at this section. Natural landscape and water dynamics will be changed a lot. After the optimization, no chute cutoff work will be carried out in the wetland park, so impacts of this project on the wetland park are significantly reduced.

According to the "Mater Plan of Anhui Province Taihe County Shaying River National Wetland Park", 3# disposal area is located in forest landscape area of leisure area in the wetland park. It is proposed to build a forest cultural plaza is proposed at the position of 3# disposal area is proposed (see the figure below). Thus, reclamation program of this project has been integrated into the construction plan of cultural plaza. After the land is rolled flat and transformed as construction land, it can be delivered to the wetland park who will build cultural plaza. Therefore, 3# disposal area will not have adverse effect on the wetland park. The integration of reclamation of disposal area and construction of cultural plaza will promote the development of the wetland park.

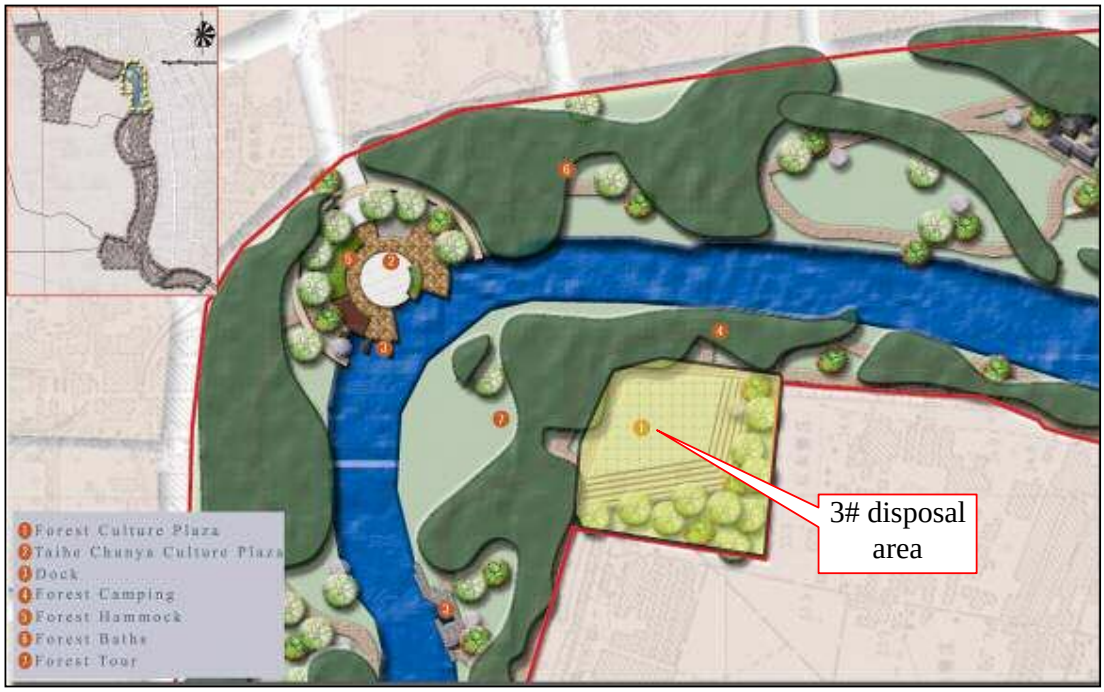



**Fig. 6-3 Position of 3# Disposal Area in the "Mater Plan of Anhui Province Taihe County Shaying River National Wetland Park"**

6.2.2.4. Analysis of Impacts on the Wetland Park

According to site investigation, sections that this project refer to in the wetland park (Section k30-k33and Section k36-k38+500) are mainly agro-ecosystems. It is overflow land inside the embankment with shrub grasslands and mixed forests. Wild animals are common species in Huaibei Plain. Provincial protected animals like *Lanius schach*, *Bufo raddei*, *Bufo gararizans* and *Chinemys reevesii* occasionally distribute in this area.

Project components that are located in this wetland part include: 3# disposal area, dredging, reconstruction of G105 Taihe Shahe II Bridge (k38). On the basis of above analyses, 3# disposal area will not have adverse impacts on the wetland park, so the impacts focus on dredging and bridge works during the construction phase.

G105 Taihe Shahe II Bridge will be demolished and rebuilt in situ. No land will be expropriated and no buildings will be demolished. According to above analyses, affected water area by bridge and dredging works is small. Increase of SS due to the construction is not significant. After the construction, disturbed sediment will deposit and be diluted due to gravity and water flow. Thus, impacts of this project on water quality and aquatic ecological environment in the wetland park are minor, temporary and reversible.

6.2.2.5. Positive Impacts on the Wetland Park

According to preliminary design, there will be bank and slope protection works at 5 sections within the wetland park (Section k25-k38+500), with a total length of 2,025 m (see details in Table 6-3). The slope protection work has positive effects on consolidation of riverway in the wetland park, maintenance of ecological security of Shaying River and ensuring ecological and cultural construction in the wetland park.

**Table 6-3 Slope Protection Works within Anhui Province Taihe County Shaying River National Wetland Park**

| Side of bank | Starting and end points at channel center | Length (m) |
|---|---|---|
| Right | K27+900□K28+300 | 400 |
| | K28+500□K29+100 | 600 |
| Left | K29+800□K30+250 | 450 |
| Right | K34+850□K35+250 | 400 |
| Left | K38+200□K38+375 | 175 |

Shaying River is also involved in the navigation plan of “Mater Plan of Anhui Province Taihe County Shaying River National Wetland Park (2009-2020)”. Rafting and cruising will be developed in the wetland park, given the convenient navigation at Shaying River in the future. New or rebuilt docks along Shaying River will be utilized as well. Thus, navigation plan of the wetland park and its water tour routes rely on Shaying River Channel Improvement Project. This project will promote the development of the wetland park.

As analyzed above, reclamation program of 3# disposal area can be combined with the construction of cultural plaza, which will promote the development of the wetland park. According to the plan, G105 Taihe Shahe II Bridge will be used as entrance of the wetland park. This area will be built as management area of the wetland park. This bridge is proposed to be rebuilt in this project, so construction of the entrance and management area of the wetland park can be designed simultaneously when reconstruction of the bridge is designed. Thus, the constructions of this project and the wetland park are consistent and impacts on the wetland park can be minimized.

In summary, this project will have minor impacts on Taihe County National Wetland Park. The impacts focus on the construction phase and are temporary and reversible. In addition, this project will promote the implementation of navigation plan of the wetland park, the development of water tour routes and the development of the whole wetland park. Construction of the entrance and management area of the wetland park will be designed simultaneously when reconstruction of the bridge is designed. Thus, the

constructions of this project and the wetland park are consistent and impacts on the wetland park can be minimized.

6.2.2.6. Key Measures

(1) Reasonable working time arrangements. During the construction in the wetland park (k25-k38+500), working time should be optimized to avoid peak of wild animals' activities. Morning, dusk and night are peak periods of wild animals' activities, breeding and feeding. Works like piling that cause high-level noise should be forbidden in the mornings, dusks or nights.

(2) Protection of birds on overflow lands. Publicity and education of environmental protection during the construction should be conducted. No hunting, fishing or collection of fauna is allowed. If animals are hurt by accident, wild animal protection sector should be informed and professionals will deal with the accident.

(3) Strengthening of construction management. Drilling residues from hole-drilling pile in bridge works should be well dealt with. Direct discharge into the river is forbidden. Construction machines and vessels for bridge and dredging works should be checked to prevent oil leakage. Disposal of waste water, refuses and bilge oil water into Shaying River is forbidden.

(4) Control the use of overflow lands. It is forbidden to build construction camps or piling yards on overflow lands. Discharge of construction wastewater and domestic wastewater on the overflow lands is forbidden.

### 6.2.3. Conclusions

River system is an important part of regional ecosystem, which is essential and irreplaceable to developmental biology and maintenance of ecological balance. The improved channel was a natural river before. Ecological environment along the river are complex ecosystem mixed by artificial eco-systems and natural ecosystem caused by several improvement and construction in the past. Artificial ecosystem dominates and the integrity of original natural ecosystem has been destroyed. This region is not the habitat, breeding area or wintering area for key protected wild animals.

This channel improvement project is carried out in compliance with ecological principles. Damages to the riverway and ecological environment along the river during the construction phase are temporary and its scope is limited. Artificial ecosystem will be established as water and soil conservancy plan is implemented and slope protection and planting works are carried out after the completion of the construction. Ecological effects of this project will emerge. The ecological integrity in this region and structure and

functions of ecological environment will not be reduced. On the contrary, they will be further improved.

## 6. 3. Assessment of Surface Water Environment

### 6. 3. 1. Prediction of Impacts on Surface Water Environment During the Construction Phase

#### 6.3.1.1. Impacts of Domestic Wastewater at the Construction Camps

The construction period of this project is long. Working staff are relatively centralized and stable. If, domestic wastewater is directly discharged into the river, pollution will be caused in surrounding water.

The number of working staff for dredging work is calculated as 400. Two bridges will be under construction at the same time. About 200 workers will be working on site per day. The average water consumption is 80 L per capita per day. Domestic wastewater discharge indicator is 0.8. In this context, domestic wastewater at construction camp will be 38.4 ton per day. The concentrations of key pollutants in domestic wastewater at construction camps are analogized in Table 6-4.

**Table 6-4 Analogical Concentration of Key Pollutants in Domestic Wastewater at the Construction Camps**

| Key pollutants | SS | $BOD_5$ | COD | TN | TP |
|---|---|---|---|---|---|
| Concentration (mg/L) | 55 | 110 | 250 | 20 | 4 |

According to the official reply to EIA standards from Fuyang Environmental Protection Bureau, standards of Grade II in the “Integrated wastewater discharge standard” (GB8978-1996) are based for this project. As above table indicates, the concentrations of key pollutants are higher than the standards. It is suggested to build latrines in construction camps. Septic tanks should also be built to treat the wastewater before it is discharged into surrounding abandoned lands or ditches. In addition, construction camps should be sited at 200m away from Shaying River. Direct discharge into the Shaying River is forbidden.

#### 6.3.1.2. Impacts of Bridge Works on Water Environment

Four bridges will be rebuilt in this project, viz. Jieshou City Yumen Bridge, Jieshou (Old S204) Shaying River Bidge, Taihe County Yinghe I Bridge and Taihe County Yinghe II Bridge.

According to site investigation and collected hydrological data, flood season at Shaying River basin is from May to August every year. Dry season lasts from December to next February. The best time for structures construction like bridges is dry season, so it is better to build river-crossing bridges at dry seasons to avoid pier construction in river

bed during flood season. At the inception period of bridge pier construction, SS will increase because cofferdam or island construction may disturb the sediment. Drilling pile foundations are applied to bridge pier construction in this project. Drilling is carried out in cofferdams, so water inside the cofferdams is separated with the river. Drilling will not affect water quality in the river. Water pollution from foundation construction is caused by drilling waste. Much waste will be produced in bridge construction. If it is discharged randomly, riverway block may be caused and water quality of downstream river will be degraded. Therefore, cofferdams should be removed after bridge pier construction according to regulations of Ministry of Transport and environmental protection sectors. Furthermore, the waste, waste slurry and construction waste should be transported out of the river region and be stored at disposal yards. Water and soil conservancy measures should be applied. In particular, waste, wastewater and waste slurry from bridge foundation construction should be deposited in sediment tanks first. Disposal into the river or randomly disposal is forbidden, in order to prevent water pollution, river bed raising or cross-section compressing and riverway block. Siting of disposal yards should be consulted with local water conservancy sector and environmental protection sector.

6.3.1.3. Impacts of Dredging works on Water Quality

During the dredging works, suction and stirring may cause re-suspension and diffusion of contaminated sediment. It is analogized the prediction results of SS for Huizhou Hydro Complex Project (dredging work at Dongjiang River) (Source: Environmental Impact Statement of Huizhou Hydro Complex Project) and monitoring results of SS at Dredging Site for Feilaixia Hydro Complex Project (Dredging work at Beijiang River). See Table 6-5 and Table 6-6 for details.

**Table 6-5 Prediction Results of SS for Huizhou Hydro Complex Project (mg/L) (Dredging work at Dongjiang River)**

| Environmental protection measure | Increase of SS concentration at 50m downstream of dredging spot | Increase of SS concentration at 1km downstream of dredging spot | Increase of SS concentration at 2km downstream of dredging spot |
|---|---|---|---|
| No prevention measures like anti-mud curtain | 89.99 | 4.13 | 0.55 |
| Prevention measures like anti-mud curtain | 54.00 | 2.48 | 0.33 |

**Table 6-6 Monitoring Results of SS at Dredging Site for Feilaixia Hydro Complex Project (mg/L) (Dredging work at Beijiang River)**

| Monitoring point | Dry season | Wet period | Normal flow period | Annual average |
|---|---|---|---|---|
| Upstream of the | 4.7 | 4.0 | 3.3 | 4.0 |

| | | | | |
|---|---|---|---|---|
| construction site | | | | |
| 1km downstream of the construction site | 4.7 | 5.7 | 3.7 | 4.7 |
| Increase of SS concentration | 0.0 | 1.7 | 0.4 | 0.7 |

The operation methods of dredging and hydrological conditions of this project are similar to that of the above projects. Thus, SS will significantly increase in the surrounding area of dredging site with a radius of 100m. The impact will gradually decrease as the distance increase. At the point 1km away from the construction site, concentration of SS is lower than 4.13 mg/L, so its impact is minor. As the construction is completed, such impact will disappear soon.

6.3.1.4. Impacts of Dredging Works on Water Intakes

According to site investigation and consultation with related sectors, there is no drinking water intake along the Shaying River channel. There exists only one industrial water intake (Zhoupeng Power Plant) in this region. Thus, dredging will affect water quality in area ranging from 500m upstream of the intake to 100m downstream of the intake. Smaller reamer should be used for dredging in this area. Meanwhile, working time needs to be discussed with the power plant, so that the plant can increase water storage or enhance its water treatment. Impacts of dredging works on water intake will be minimized through the above measures.

6.3.1.5. Impacts of Residual Water Discharge at Disposal Areas on Surface Water Environment

During the dredging, the volume of sediment sludge will increase 5-10 times when it is dreger by cutter suction dredger. Large amount of residual water will be discharged after the sludge is deposited at disposal areas. According to relevant engineering experiences and information, concentration of slurry is calculated as 20%. Volume of residual water that needs to be discharged at each sludge pile yard is shown in Table 6-7. Quality of 90% residual water is good at the inception period and quality of 10% will become worse at later periods. Quality of residual water may also exceed the standards under improper construction.

**Table 6-7 Residual Water Volume at Disposal Areas**

| No. | Source of sludge | Disposal volume (10,000 $m^3$) | Disposal height | Temporary land take ($hm^2$) | Residual water(10,000 $m^3$) |
|---|---|---|---|---|---|
| 1 | Xuzhai Anchorage Area | 67.23 | 3 | 368.4 | 268.93 |
| 2 | K0+000-K10+000 and Genglou Lock anchorage area (upstream) | 42.48 | 3 | 219.9 | 169.93 |
| 3 | K28+000-K33+000 and Genglou Lock anchorage area | 75.57 | 3 | 418.4 | 302.26 |

| No. | Source of sludge | Disposal volume (10,000 $m^3$) | Disposal height | Temporary land take ($hm^2$) | Residual water(10,000 $m^3$) |
|---|---|---|---|---|---|
| | (downstream) | | | | |
| 4 | K36+000-K40+000 and Taihe Chengguan Anchorage Area | 23.53 | 3 | 106.2 | 94.10 |
| 5 | K40+000-K48+000 | 66.20 | 3 | 362.2 | 264.80 |
| 6 | K48+000-K62+000 | 35.30 | 3 | 176.8 | 141.20 |
| 7 | K62+000-K67+000 and Cihuaixinh River Service Area | 136.59 | 3 | 784.5 | 546.35 |
| 8 | Cihuaixin River connected | 41.12 | 3 | 211.8 | 164.49 |
| 9 | K67+000-K72+000 | 46.45 | 3 | 243.7 | 185.80 |
| 10 | K72+000-K76+000 | 85.28 | 3 | 476.7 | 341.14 |
| 11 | K76+000-K80+000 and Fuyang Lock Anchorage Area (upstream) | 55.24 | 4 | 296.5 | 220.97 |
| 12 | K83+000-K86+000 and Sanshilipu Service Area | 187.33 | 3 | 1089.0 | 749.32 |
| 13 | K86+000-K92+000 and Fuyang Lock Anchorage Area (downstream) | 62.61 | 3 | 340.7 | 250.46 |
| 14 | K92+000-K95+000 | 37.13 | 3 | 187.8 | 148.50 |
| 15 | K95+000-K102+000 | 107.09 | 3 | 607.6 | 428.36 |
| 16 | K102+000-K105+000 | 39.50 | 3 | 202.0 | 158.00 |
| 17 | K105+000-K108+000 | 86.48 | 3 | 483.9 | 345.90 |
| 18 | K108+000-K112+000 | 42.90 | 3 | 222.4 | 171.59 |
| 19 | K112+000-K115+000 and Zikou Anchorage Area | 38.22 | 3 | 194.4 | 152.88 |
| 20 | K115+000-K118+000 | 30.96 | 3 | 150.8 | 123.84 |
| 21 | K118+000-K121+000 | 22.78 | 3 | 101.8 | 91.14 |
| 22 | K121+000-K124+000 | 19.91 | 3 | 84.5 | 79.63 |
| 23 | K124+000-K130+000 | 33.15 | 3 | 164.0 | 132.62 |
| 24 | K130+000-K135+000 | 26.37 | 3 | 123.3 | 105.49 |
| 25 | K135+000-K140+000 | 19.25 | 3 | 80.6 | 77.01 |
| 26 | K140+000-K143+000 | 18.80 | 3 | 77.8 | 75.19 |
| 27 | K143+000-K147+000 and Yingshang Liuzhuang Anchorage Area | 70.80 | 3 | 389.9 | 283.22 |
| 28 | K147+000-K157+000 | 19.67 | 3 | 83.1 | 78.69 |
| 29 | K157+000-K162+000 and Yingshang Lock Anchorage Area (upstream) | 48.16 | 3 | 254.0 | 192.65 |
| 30 | K162+000-K168+000, Yingshang Lock Anchorage Area (downstream) and Longwangmiao Anchorage Area | 146.06 | 3 | 841.3 | 584.22 |
| 31 | K168+000-K174+000 | 17.07 | 3 | 67.5 | 68.28 |
| 32 | K174+000-K185+000 | 30.20 | 3 | 146.3 | 120.81 |
| 33 | K185+000-K196+000 | 19.31 | 3 | 80.9 | 77.26 |
| 34 | K196+000-K205+000 | 37.88 | 3 | 192.3 | 151.51 |
| Tal. | - | 1836.64 | - | 9831.3 | 7346.54 |

Gate box outlet is applied in disposal area. Discharge rate and slurry concentration can be controlled by man. Thus, riverway block can be prevented by keeping muddy water from going into the river.

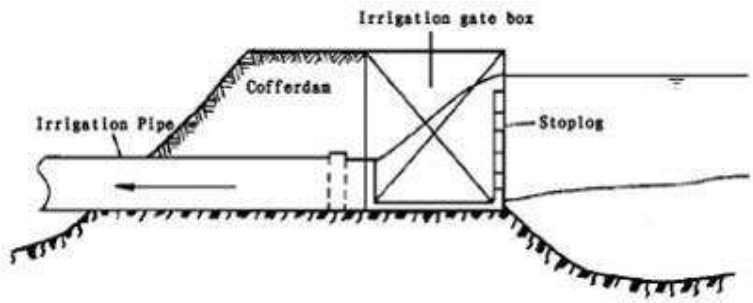



**Fig. 6-4 schematic Diagram of Gate box outlet**

Contamination of heavy metal, nitrogen and phosphorus is minor in sediment of Shaying River. Pollutant in residual water is mainly SS. At inception period of reclamation, 90% residual water goes into grit chamber for deposition and most of the SS can be removed. Most of the residual water is discharged into surrounding ditches after deposition and eventually flows into Shaying River.

After the reclamation phase, SS of about 10% residual water will exceed the standards. Flocculants can be added at the place where slurry goes into the cofferdam to control water quality. CPAM can be add and the added volume is 6mg/L. The treated residual water should meet the standards of Grade II in the “Integrated wastewater discharge standard” (GB8978-1996). Total residual water that needs to be discharged at sludge pile yards is 4 times of disposal volume. It is calculated that quality of 10% residual water will decrease. That is about 7,346,500 $m^3$. Dredging works are often carried out in dry seasons. If the dredging period is calculated as 400 days, the discharge volume of low-quality residual water is about 18,370 $m^3$.

Fig 6-5 is the flowchart of treatment process of residual water.

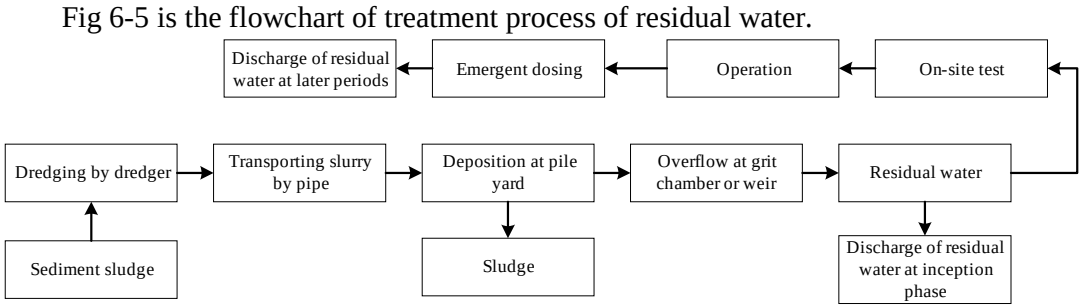



**Fig. 6-5 Flowchart of Treatment Process of Residual Water**

Cutter suction dredger is applied for dredging in this project and 34 disposal areas are set. According to engineering analysis, discharge volume of residual water at sludge pile yard is about 18,370 $m^3$ and flow is 0.16 $m^3$/s. The residual water should be treated through necessary methods before being discharged. The discharge concentration is 70mg/L. Residual water is discharged into nearby ditches and treated further. It flows into

Shaying River and eventually into Huai River with concentration of 50 mg/L. Annual average flow is about 112.7 $m^3/s$. Mixed mode was applied to predict concentration of SS at status monitoring section. The concentrations are shown in Table 6-8. It indicates that impacts of residual water at disposal areas on water quality of Shaying River are minor.

**Table 6-8 Impact Prediction of Residual Water at Disposal Areas on SS in Shaying River Surface Water (Unit: mg/L)**

| Monitoring sectioin | Status value | Predicted value | Value added |
|---|---|---|---|
| 100m downstream of the boundary of Henan and Anhui Provinces | 35 | 35.02 | +0.02 |
| Section in Jieshou City | 53 | 53.00 | +0.00 |
| Section in Taihe Shuipu Town | 47 | 47.00 | +0.00 |
| Section in old county market of Taihe County | 41 | 41.01 | +0.01 |
| Section in Taihe county seat | 38 | 38.02 | +0.02 |
| Water intake of Zhoupeng Power Plant | 50 | 50.00 | +0.00 |
| Section in urban area of Fuyang | 89 | 88.94 | -0.06 |
| Section in Kouzi market, Fuyang | 46 | 46.01 | +0.01 |
| Section in Jiangkou market, Fuyang | 37 | 37.02 | +0.02 |
| Section in Yingshang county seat | 40 | 40.01 | +0.01 |
| Sectioin in Wanggang, Yingshang | 40 | 40.01 | +0.01 |
| Section in Saijian | 37 | 37.02 | +0.02 |
| Section in Mohekou | 41 | 41.01 | +0.01 |

### 6.3.2. Assessment of Impacts on Water Environment during the Operation Phase

#### 6.3.2.1. Estimation of Wastewater Discharge during the Operation Phase

Wastewater in this project is mainly composed of wastewater on land and wastewater from vessels. Wastewater on land comes from service areas, i.e. the proposed Guozhuang Service Area and Sanshilipu Service Area. There will be about 20 managers in each service area. Wastewater from service area includes domestic wastewater, and wastewater from vessel maintenance and from gas station, etc. On the basis of analysis of freight traffic volume at the operation phase, it is estimated there will be 200 visitors to each service area per day in 2020. If the water consumption is calculated as 120L per person per day, total domestic wastewater at one service area will be around 26.4 ton per day. Annual increase rate of visitors to service areas will be 5% per. That is, in 2030, about 326 persons will visit each service area per day. If wastewater per capita is 120L per day, total domestic wastewater in each service area will be around 41.52 ton per day. Main components of the wastewater are COD and ammonia nitrogen. The COD concentration is 200-300 mg/L and concentration of ammonia nitrogen is 15-25 mg/L. On the basis of

analogy of similar service areas, wastewater from vessel maintenance and gas stations is calculated as 5 $m^3$ per day.

Table 6-9 shows details of wastewater at service areas.

**Table 6-9 Wastewater in Service Areas**

| Item | SS | COD | $BOD_5$ | Oil | Wastewater volume in 2020 | Wastewater volume in 2030 |
|---|---|---|---|---|---|---|
| Domestic wastewater | 100-350 | 200-300 | 110-250 | ------ | 52.8t/d | 83.04t/d |
| Wastewater from gas station | 35-50 | <150 | ------ | 24-57 | 2.5t/d | 2.5t/d |
| Wastewater from maintenance statioin | 180-240 | <150 | ------ | 24-68 | 2.5t/d | 2.5t/d |

6.3.2.2. Drainage at Service Areas

According to the investigation, there is no sewage in Guozhuang Service Area and Sanshilipu Service Area. It is suggested underground wastewater treatment equipment to be installed in every service area. In designs, oil water from restaurants, vessel maintenance and gas station needs to be treated by grease trap before discharged into sewage system. It then converges with domestic wastewater treated in septic tank and goes into underground wastewater treatment equipment. The treated wastewater can meet Grade II in GB8978-1996 and be discharged in nearby ditches.

6.3.2.3. Impacts of Wastewater from Vessels on Water Environment

In accordance with requirements in Article 28 in the “Management Provisions of Vessel Pollution of the Inland Water Environment” (Ministry of Communications, No. 5 Order, 2005), watermen’s domestic wastewater during navigation should be treated or stored properly. That is, treatment equipment or containers should be installed on the vessel according to wastewater volume. Discharge of domestic wastewater that can not meet the discharge standards is prohibited at inland water region. It also requires that bilge wastewater with oil should be treated by oil-water separator to meet standards in “Effluent standard for pollutants from ship” (GB3552-83) before discharge. It is suggested reception facilities are set for wastewater from vessels. Ships without an oil-water separator can go to specific ports so that water with oil and domestic wastewater can be collected to the port area by special equipment and be treated. Thus, local maritime sectors need to improve the supervision of domestic wastewater from vessels, in order to make sure the

discharge can meet the standards. There should be no pollution of Shaying River from domestic wastewater.

In light of the prediction of freight traffic volume at Shaying River at the operation phase, most of the vessels will transport coal and construction materials, which does not refer to oil pollution in ballast water. However, it is possible there will be ballast water with oil at the operation phase while the waterway is getting smooth. Since it is hard to predict the water volume, local maritime sectors are required to strengthen management. Once there come vessels with ballast water, maritime sectors should ask the ship-owners and cargo owners to treat the ballast water, washing water and bilge oil water and to make sure the discharge can meet relevant standards.

In summary, wastewater from service area and vessels will have minor impacts on water environment of Shaying River as long as environmental management of transport vessels and service area is strengthened and environmental protection measures are implemented.

## 6.4. Assessment of Ambient Air

### 6.4.1. Assessment of Ambient Air during the Construction Phase

Impacts on ambient air during the construction phase are mainly caused by odor pollutant emissions. When contaminated sediment with organic humus is stirred and disposed on the ground, it will cause release of malodorous substances (mainly including ammonia, hydrogen sulfide, volatile hydrogen, volatile alcohols and aldehydes), which will affect air quality. According to status investigation and monitoring of sediment of Shaying River, sediment pollution is minor. Little malodor can be felt. Degree of odor is about Grade 1-2. Influence scope is within the area with a radius of 20m. Affected downwind area will be larger when the wind is blowing. According to project feasibility study report and site investigation, all of the residential areas are located more than 50m away from proposed disposal areas. Odor emissions will not affect nearby residents. Malodor will disappear after the construction is completed, sediment sludge is consolidated and vegetation is restored.

### 6.4.2. Assessment of Ambient Air during the Operation Phase

Waste gas from vessels is the main sources of air pollution. Emission inventory of waste gas from vessels is calculated with methods recommended by Lloyd's Register, UK. The fuel emission factor of $NO_2$ is 7.2 kg per 1 ton fuel. That of $SO_2$ is 10 kg per ton fuel.

Fuel consumption of vessels at inland waterway is calculated as 3.71 kg per 1,000 ton per·km.

It is predicted the freight traffic volume at Shaying River at the operation phase will reach 14 million ton in 2020 and 18 million ton in 2030. If annual operation period is 330 days, daily $NO_2$ emission will reach 1.247 kg per km and daily $SO_2$ emission will be 1.731 kg per km in 2020. In 2030, daily $NO_2$ emission will reach 1.603 kg per km and daily $SO_2$ emission will be 2.225 kg per km in 2020. Dominant wind direction in Fuyang is east. Annual wind velocity is 2.8m/s. The plain terrain is flat. The pollution sources are mobile sources and dilution in ambient air is strong, so air pollutant emissions during the operation phase will have minor impacts on ambient air. In the context of development of science and technology and promotion of high-tech, vessels at inland waterway will be more environmentally friendly and energy-saving in the future. Thus, the air pollutant emissions may be reduced.

## 6.5. Assessment of Acoustic Environment

### 6.5.1. Noise Effect during the Construction Phase

Major noise sources during the construction phase are diesel engine of dredger, mud pump, and machine and transport vehicles for reconstruction of bridge, construction of cofferdams and pile yards and seed broadcast, etc. Noise sources are mainly wide band sound source of vibration from construction machines. Analogical investigation results of construction noise are shown in Table 6-10.

**Table 6-10 Key Construction Noise Sources**

| Item | Key noise sources | Noise level dB(A) |
|---|---|---|
| Dredging works | Dredger, mud pump | 85-100 |
| Reconstruction of bridge works | Drill, pump, transport vehicle | 80-95 |
| Disposal works | Bulldozers, loaders, dump truck, amphibious vehicle | 70-85 |

According to characteristics of acoustic superposition, it is predicted noise can be weakened to environmental standards at the point 20m away from the disposal area at day time and 60m away at nighttime. As for bridge reconstruction, it will not affect residential area 40m away at daytime and 200m away at nighttime. Residents at 100m away at daytime and 300 away at nighttime will not be affected significantly by dredger. Thus, noise standards can be met at areas 100 m away at daytime and 300 away at nighttime from the construction sites.

As the construction sites of Shaying Channel Improvement Project are moving, impacts on sensitive objects are temporary. It is suggested the construction unit to install moving sound barriers for big sensitive objects. In addition, construction at nights is forbidden. However, if continuous working like bridge works is necessary, measures to mitigate noise should be applied. Nearby residents should be informed with construction timing and locations, which need to be reported to and documented in Environmental Protection Bureau.

### 6.5.2. Noise Effect during the Operation Phase

Noise sources during the operation phase are mainly vessels on Shaying River. Vessel noise source strength is generally around 80 dB(A). Its influence scope is the area with a radius of 40m. According to investigation of sensitive objects, the nearest sensitive object along both river banks is 70m away. Furthermore, planting along the banks of the channel can not only conserve water and soil, but can also reduce the noise. Thus, noise effect during the operation phase is minor.

## 6.6. Assessment of Solid Waste

### 6.6.1. Solid Waste during the Construction Phase

During the construction phase, solid waste mainly comes from garbage on vessels, construction waste and working staff’s domestic refuses. All of these pertain to general solid waste.

Abandoned soil and waste in this project can not be dumped into ditches. Combined with new country and urban construction, the abandoned soil can be of full use for homestead leveling. Construction waste at urban area in Fuyang can be utilized for foundation leveling of comprehensive construction north to Fuyang Lock. Construction waste that comes from Jieshou, Yingshang and Taihe can also be used for foundation leveling in industrial areas.

Garbage on construction vessels and working staff’s domestic waste needs to be collected. Local municipal domestic wastewater treatment organizations can be commissioned to treat the wastes.

### 6.6.2. Solid Waste during the Operation Phase

Solid waste at the operation phase mainly comes from domestic waste on land and garbage from vessels. At the proposed Guozhuang Service Area and Weicixin River Service Area, there will be about 20 managers in each service area. On the basis of

analysis of freight traffic volume at the operation phase, it is estimated there will be 200 persons visiting each service area per day in 2020. If the solid waste is calculated as 0.8 kg per person per day, total solid waste at each service area will be about 176 kg per day. That is, 352 kg per day in the two service areas. Annual increase rate of visitors to service areas will be 5% per. That is, in 2030, about 326 persons will visit each service area per day. Then solid waste will be 276.8 kg per day in each service area and 553.6 kg per day in the two service areas. Solid waste is mainly domestic waste without hazardous components. One to two garbage bins can be installed to collect refuses and treated by local municipal domestic waste treatment organizations. Watermen's domestic waste can be stored in garbage bins installed on ships. Municipal domestic wastewater treatment organizations in cities along the river can be commissioned to treat the solid waste from vessels.

## 6. 7. Flood Control Analysis

### 6. 7. 1. Relations between this Project and Relevant Water Conservancy Plans and Its Impacts

The flood section of the river can be expanded in the Shaying River Channel Improvement Project. The flood capacity can be improved. This is in compliance with principles of flood control, viz. "Integrating the upstream and downstream, coordinating storage and discharge, mainly storing at upstream areas; comprehensive planning, integrated arrangement and reasonable allocation of water resources". It is in consistent with requirements in Huai River Basin Plan, Shaying River Improvement Plan and Urban Flood Control Plan of Fuyang City and Yingshang County. The highest navigable level is as high as the 10-year flood level and is no higher than the designed flood level of levee.

Improvement works of this project will be carried out at current riverway and inside the embankments. Ying Left Embankment and Ying Right Embankment will not be damaged by various works in this project. Urban levees in Fuyang City and Yingshang County are not affected either. However, some components that refer to adjustment of embankment and occupation of overflow land should be agreed by authority sectors and compensation measures should be implemented.

Dredging and chute cutoff works will be carried out in the main channel or on overflow land after the dismantlement of levee, which will not affect the consolidation and heightening of the levee. These works will influence slope and bank protection works either. Shaying River channel is connected with approach channel of Genglou Ship Lock.

Currently, the approach channel is Grade V. This can not meet the requirement to improve the channel to Grade IV. Shaying River Channel improvement, consolidation of Fuyang Lock and consolidation or new construction of other ditches, gates, culverts and locks will not have impacts.

### 6.7.2. Impacts on Riverbed Stability

Analysis of Shaying River evolution indicates that the riverbed maintained a stable trend and it generally stay in balance status of scour-and-fill without outside disturbance. Stable riverway is good for channel improvement project. Most of the original plane shape of the riverway is remained in this project. The channel will go along the thalweg of the river. Works like chute cutoff will be carried out where width or bend radius of partial channel is not enough.

Dredging and chute cutoff will be carried out where water depth and section is not enough. Such works will be carried out inside the embankments. The plane shape of riverway will not be changed much. There will not be major influence on originally stable riverway. As for sections whose bend radius is not enough, chute cutoff work can meet the navigation demands. The scour of concave bank will be impaired. Water flow will be gradually becoming smooth.

Slope and bank protection works are good for protection of embankments and stability of riverway. However, part of banks need to be extended. The channel improvement project will make the groove of the river and water flow smoother.

Dredging the main channel is good for flood flowing back to the channel. It helps to expand the scope of bank collapse control and reduce the scour of slopes at dangerous sections. This is good for slope stability.

Due to partial scour caused by bridge piers that block the water, underwashing will occur near the bridge. In addition, because of the change of water flow, decrease of flow area, and increase of flow velocity under the bridge and near the bank, slopes near the bridge and embankments will be scoured as well. This will have adverse impacts on river stability and embankment security.

### 6.7.3. Impacts on Flood Capacity

Shaying River Channel Improvement Project will carry out works like base expand, dredging, chute cutoff, etc. If it is calculated under the condition of the same water flow, water level will become lower. This indicates that after the improvement project, the water flow is smoother, flood section of the river is widened and flood capacity is strengthened.

To conclude, this project is good for flood control at Shaying Rive basin. Flood capacity is enhanced and flood distance is shortened, so flood peak can get to Huai River sooner.

Abandoned soil from dredging are piled at disposal areas that are located at the back side of embankments. It will not block the flood. It is carried out during dry season, which meet the requirement of flood control. According the progress of bridge work and flood control arrangement, the construction should be finished one month before the end of dry season. Necessary measures should be applied for those that can not be completed in dry season. Occupation of flood section of the river should be as little as possible, in order to ensure the security of bridge work and flood security and meet the flood control requirements.

### 6.7.4. Impacts on Embankments Stability

Most part of the channel centerline is the same as main channel of Shaying River. Dredging slope ranges from 1:3 to 1:5. The average dredging depth will be 0.25-1.2m and bottom-width of dredging will be 50m. This work will not influence the stability against sliding of the banks. As for river sections where dredging depth is more than 1.2m; soil in riverbed is mainly sandy soil and overflow is less wide, the seepage stability will be affected by dredging. Seepage-prevention will be applied for some sections in this project. It can meet the requirements after the treatment. There will be 12 chute cutoffs and the smallest distance from the embankment is 60m. Based on the calculation, stability against sliding and seepage stability of the embankments and banks can meet the designed requirements. The chute cutoff will not affect Ying Right Embankment and Ying Left Embankment. However, Levees at Gaowan Village Sanshilipu Town Yingzhou District, Sanwan Village Huangqiao Town Yingshang County and Fangzhou Village Balihe Town Yingshang County will be dismantled. The levee security will be influenced.

Soil in Shaying River is mainly sandy soil, with low impact-resistance capacity. On the basis of recent improvement projects of Shaying River, the embankment will be extended. This is good for the slope stability. Consequently, the bank stability is ensured.

### 6.7.5. Impacts on Existing Irrigation Facilities

In aspect of navigation, channel improvement will not affect existing irrigation facilities, because the guaranteed rate of designed lowest navigable level is 95% and guaranteed rate of lowest level for operation of pump station is 97%-99%. That is, the pump station can be operated at the lowest navigable level in order to guarantee the navigation at Shaying River.

In aspect of water volume, impacts on irrigation are minor. Taking banks along the section from Yingshang Ship Lock to Mohekou as examples, water is needed in normal situation. Even if Yingshang Ship Lock is not open for navigation, Yingshang control gate is also open to water demand at downstream. Since the open of Yingshang Ship Lock will not affect the water quality, the ship lock will have little impact on irrigation. The channel improvement project will not influence the water use for irrigation. The water demand for navigation at middle and downstream is balanced.

Therefore, Shaying River Channel Improvement Project will not affect existing irrigation facilities.

### 6.7.6. Impacts of Inundation on Bridges

Four rebuilt bridges are designed according to 100-year flood control standards. Long-term plan of levees at the bridge sited are in accordance with 50-year flood control standards. The standards for bridge are higher than that of river flood control. In addition, levee is designed 1.5-2m higher than flood level. Beam elevations of crossing-river bridges are higher than elevation of levees tops. In aspect of flood control standards for levees, bridge design is consistent with the river flood control. The standards of flood control for bridges are proper.

100-year flood control standards are not mentioned in current projects at Shaying River. Considering adverse conditions, if the flood level at the bridge site exceeds the planned 50-year flood level of the levee (over levee), as the beam elevations of the four bridges are higher than the 50-year flood level, designs of flood control of the bridges is safe and standards for flood control is proper in aspect of bridge being flooded.

### 6.7.7. Impacts During the Construction Phase

This project is divided into several sub-projects which will be carried out at different river sections simultaneously. Dredging and slope protection are integrated in a same sub-project, divided into I, II and III contract periods. Bridge work is one sub-project. Bridge pier work needs to be finished in one dry season. Infrastructure that blocks water flow like cofferdams and roads for construction should be dismantled before flood season. The channel improvement project will last four years and pass through four flood seasons. Flood control plans should be prepared in advance for large works that will affect the flood control. For example, these works should be arranged in dry seasons. Temporary buildings and construction facilities should be moved away before flood season to ensure safety.

Cutter suction dredger and grab dredger are jointly used for dredging. Cutter suction dredgers are used at sections with large dredging volume. Grab dredgers are used at small sections or sections at urban areas and bridge sites with underwater obstacles. Disposal areas are sited at back side of Ying Left Embankment and Ying Right Embankment. Low-lying lands, borrow pits and low-yield farmland are often selected. Disposal height is 3.0m. This will not have major impacts on slope stability of waterside embankments. Discharge rate and slurry concentration can be controlled by man at outlet of disposal areas. Thus, riverway block can be prevented by keeping muddy water from going into the river.

Earthwork on land will be carried out according to specifications of embankment construction. Hard slope protection is needed for embankments at both sides of banks or levees at river sections where distance is small. Excavation slope is 1:3-1:5, which will not affect slope stability.

Water and soil conservancy work should be conducted during the construction phase to prevent new soil erosion. The construction should be supervised by water conservancy sector.

### 6.7.8. Integrated Impacts on the Riverway

Recent Shaying River improvement projects provide good basis for Shaying River Channel Improvement Project. The main aim of this project is to resolve the problem that water depth is not enough during dry season. Main project components are dredging and chute cutoff of partial river sections. Bank and slope protection will also be carried out where deep groove is close to banks, and where beach is narrow.

The arrangement of this project depends on identification of channel axis. The channel axis is connected by series of straight lines and arc curves. Most of the original plane shape of the riverway is remained in this project. The channel will go along the thalweg of the river. Works like chute cutoff will be carried out where width or bend radius of partial channel is not enough. For river sections that are curved, curve cutoff is needed to meet navigation requirements of Grade IV. Bottom-width of the channel is 50m. Bank and slope protection is proposed be carried out where deep groove is close to banks, and where there is no or narrow beach in front of the banks. Impacts of this project on the riverway include:

1) Dredging will be carried out at narrow and deep sections. Chute cutoff and dredging sections of the river are located at deep incised river. Shape of the main channel section will not be changed much. Dramatic change of riverbed scour-and-fill will not

occur. After the chute cutoff and dredging works, partially stuck sections will disappear. Current back flow on beach will be impaired or removed. Flow in the whole channel is smooth.

2) Curve cutoff will impair the scour of concave bank. Water flow will be gradually becoming smooth. No adverse impacts on the whole channel in long term.

3) Bank and slop protection is good for embankment protection and riverbed stability.

4) Irregular pulse ship waves will be made by vessels. Ship waves will scour and impact the banks and levees, which will influence slope stability. Thus, it is suggested slope and embankments where channel is narrow and where mainstream line is near the bank.

## 6.8. Environmental Risk Analysis

### 6.8.1. Environmental Risks during the Construction Phase

The channel improvement project during construction phase may cause a small amount of soil erosion. The damage of slurry transported through pipeline may cause leakage or spilling of slurry into the water. The damage of cofferdams may also cause leakage of slurry direct into the river. All of above are likely to cause short-term water pollution in some sections of Shaying River.

Slurry transport pipelines are somewhat long, and pipelines withstand uneven pressure. Quality of the pipelines, problems in construction and other factors, may all cause pipeline breakage or slurry leakage. When accident happens, the slurry will go directly into Shaying River. The SS emission concentration is estimated as 200mg/L and emission rate as 0.4m$^3$/s. Hybrid model s applied to predict the water quality in Shaying River. The monitoring results of SS concentration at current monitoring sections are predicted in Table 6-11.

**Table 6-11 Impact Prediction of SS of Surface Water Quality of Shaying River Under the Condition of Transport Pipeline Accidents (mg/l)**

| Monitoring Section | Status value | Predictive value | Value added |
|---|---|---|---|
| 100m downstream of the boundary of Henan and Anhui Provinces | 35 | 35.58 | +0.58 |
| Section Jieshou Urban Area | 53 | 53.52 | +0.52 |
| Section in Taihe Shuipu Town | 47 | 47.54 | +0.54 |
| Section in old county market of Taihe County | 41 | 41.56 | +0.56 |
| Section in Taihe county seat | 38 | 38.57 | +0.57 |
| Water intake of Zhoupeng Power Plant | 50 | 50.53 | +0.53 |
| Section in urban area of Fuyang | 89 | 89.39 | +0.39 |
| Section in Kouzi market, Fuyang | 46 | 46.55 | +0.55 |

| | | | |
|---|---|---|---|
| Section in Jiangkou market, Fuyang | 37 | 37.57 | +0.57 |
| Section in Yingshang county seat | 40 | 40.56 | +0.56 |
| Sectioin in Wanggang, Yingshang | 40 | 40.56 | +0.56 |
| Section in Saijian | 37 | 37.57 | +0.57 |
| Section in Mohekou | 41 | 41.56 | +0.56 |

Table 6-11 indicates that once the slurry transport pipelines are broken, slurry will be discharged directly into the river, which will make SS in Shaying River increase by 0.58mg/L in maximum, accounting for 1.7% of status monitoring value. Thus, once the pipelines are broken, slurry leakage will have impacts on water quality of Shaying River. During the construction phase mechanical inspection should be strengthened. Accident prevention measures and other measures should be carried out. Once the leakage occurs, the pipeline can be stopped immediately, and be replaced promptly, which can reduce discharging time in the accident and minimize impacts on the water quality.

### 6.8.2. Environmental Risks during the Operation Phase

The channel improvement project will effectively improve the navigation capacity of Shaying River, but sometimes incidental factors may cause unexpected situation like ship crash or sinking. According to cargo forecasts at the operation phase and related statistics, most vessels will carry coal, construction materials, chemical materials, etc. Coal and building materials have little effect on water quality once they sink into the water. However, chemical materials may cause a greater impact on water quality. Therefore, this EIA focuses on risk analysis of chemical material transportation.

The probability of ship collision in the channel shows that ship crash is less likely to happen. However, according to the principles of probability theory, the small probability events are possible. Once such accident happens, it may cause devastating effects on water environment, such as killing fish in the river, poisoning organisms, threatening the safety of downstream water intakes, so in case of chemical material accidents, their impact would be major.

#### 6.8.2.1. Impacts on Aquatic Ecosystem and Fish Resources

Once chemical leakage due to crash accident happens, the impacts on the aquatic ecological environment are multiple.

Baits are the basis of the fishery. It also exists as the basic conditions for biological survival. Plankton would be the first affected aquatic organisms for their moving capacity is not strong. Chemicals will do toxic harm to them. Plankton is the producer of the aquatic communities, which is the basis of baits in the water, so the chemicals will affect plankton and consequently affect other bait organisms indirectly.

In addition, chemicals have more severe toxic effects on juvenile fish and larval fish, especially the floating eggs. High concentration of chemicals will make eggs and larvae poisoned in a short time and low concentrations of long-term sub-acute toxicity can interfere with fish feeding and breeding. Its toxicity differs by components of chemicals.

6.8.2.2. Impacts on Water Intake

According to field investigation and consultation with relevant authorities, there is no drinking water intake along the Shaying River, there only exists an industrial water intake (water intake of Zhoupeng power plant), so chemicals leakage near the water intake might influence the water quality, but since the water intake is for industrial use, such impacts are minor.

The impacts of oil spill or soluble chemical accidents on water intake depend on the amount of leakage and the speed of emergency response. If leakage rate are low or quick emergency response and prompt pollution control measures are taken, the impacts on water intake can be greatly reduced or eliminated. Thus, management measures should be strengthened and multiple instruments should be utilized to reduce such accidents. Meanwhile, emergency plans should be prepared to minimize the damage to water environment. Both prevention and rescue are important.

6.8.2.3. Risk Prevention Measures

(1) Vessels that transport flammable, explosive, corrosive, toxic and radioactive substances should carry out necessary safety and pollution prevention measures. They should hang the required signals and comply with the "Supervision and Management Regulations of Ships Carrying Dangerous Goods" by Ministry of Transport.

(2) Shipping vessels must be inspected by organizations approved by the maritime administration, hold a qualified vessel inspection certificate, be registered according to law by the maritime administration and hold a Certificate of Registry, with the crew in compliance with the provisions of the Ministry of Transport and with necessary navigational information. Ships which should be scrapped in accordance with state regulations should not travel or work.

Shipping vessels must meet requirements about ship strength, stability, draft, fire control and rescue and other safety requirements of Ministry of Transport.

Crew shall take professional training about waterway transport safety. The crew of ships carrying dangerous goods should take special training and pass the examinations by the maritime administration to obtain the appropriate certificate of competency or any

other appropriate documents before they take a position on vessels. It is prohibited crew work without obtaining the appropriate certificate of competency.

(3) Emergency Facilities for Discharge Accident

As the emergency response system in Fuyang Maritime Bureau has been equipped with large vessels and equipments for rescue and salvage, maritime sector should be in charge of dealing with the accident and rescue in the channel, the project owner should collaborate with Fuyang Maritime Bureau to develop emergency response plan, in order to facilitate the use of emergency response teams and facilities.

For the accidents in the channel, the project owner should equip necessary emergency rescue facilities in the two service areas and Genglou Ship Lock, which is located in Anhui Province Taihe County Shaying River National Wetland Park. The facilities include emergency protective and handling vehicles, detoxification drug, liquid and solid materials cleaning equipment, rubber plugs and sand bags. Necessary emergency facilities in this project are shown in Table 6-12.

**Table 6-12 Recommended Emergency Facilities in Shaying River Service Area and in Management Room of Genglou Ship Lock**

| No. | Name of facility | Number | Cost (million RMB) |
|---|---|---|---|
| 1 | Chemical drug | some | 12.0 |
| 2 | Gas mask | 12 | 0.48 |
| 3 | Wheeled fire extinguishers | 3 | 3.0 |
| 4 | Rubber plug and sandbags | some | 1.0 |
| 5 | Other emergency recovery equipment (cleaning equipment, etc) | 3 | 30.0 |
| 6 | Emergency ambulance | 1 | 20.0 |

(4) To ensure the emergency situation in water environment can be relieved, Fuyang Maritime Bureau, the Marine Department of Jieshou, Taihe, Yingshang should respectively set up a special water emergency office, designate a principle person. Patrol boats should also be set, once emergency happens in water, it shall be promptly reported to the local government, Fuyangc Marine Bureau and Environmental Protection Bureau. Salvaging of sunken objects and rescue should be carried out timely, to ensure the safety of aquatic environment and maintain channel smooth.

(5) The chemical materials transported in the channel are mainly methanol, urea, ammonia, etc. According to the survey, these chemicals are sealed in containers. Generally speaking, they will not wreck after the sinking, but they must be salvaged in time to prevent being washed away. Once the leakage happens, the effects area should be immediately drawn and residents nearby must be informed that water intake from

Shaying River is forbidden. After the incident handling, surrounding residents should be informed again.

6.8.2.4. Environmental Risk Emergency Plan

In order to effectively deal with pollution accidents, to strengthen emergency response responsibilities and to maximize the control of pollution hazards, accident emergency plan should be formulated according to “Environmental Protection Law of The People's Republic of China”, “Inland Waterway Traffic Management Regulations of The People's Republic of China”, “The Overall National Public Emergency Response Plan” (2006.1.8) issued by the State Council, “Management Measures for Environmental Protection Authority Departments of Information about Emergent Environmental Incidents (on trial)” issued by the State Environmental Protection Administration, “Management Provisions of Control of Inland Waterway Pollution from Vessels of The People's Republic of China” issued by the Ministry of Transport, and other relevant laws and regulations. Emergency plan for this project should be defined as the local public emergency plans and sectoral public emergency plan. According to emergency requirements on vessels and regulations for emergency plans issued by State Maritime Safety Administration, appropriate emergency response agencies should be established, including the emergency command center, emergency rescue team, emergency reserve, and emergency maintenance team. The institutional settings and working process are shown in Fig. 6-6.

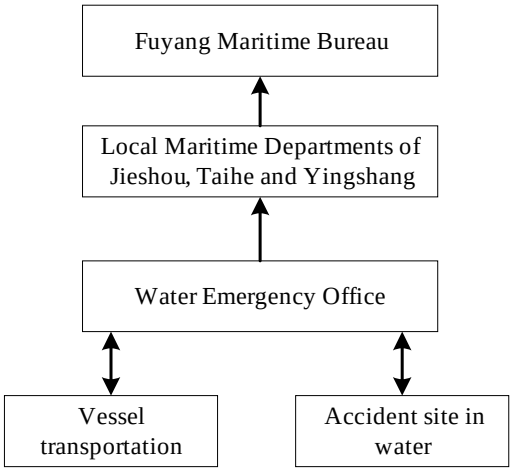



**Fig. 6-6 Emergency Institutional Settings and Working Process**

The Water Emergency Office should carry out regular water traffic safety promotion works and accident prevention works, organize relevant experts to prepare and improve the “Water Emergency Response Plan for Major Accidents”. These works can make the

rescue work more quickly, orderly and effective. People, vessels, facilities, goods at risk can get timely and effective rescue. Consequently, loss of people's lives and property and water pollution can be avoided or relieved. Finally, the safety of navigable waters can be guaranteed.

## 6. 9. Analyses of Positive Environmental Impacts

### 6. 9. 1. Developing Inland Waterway Transportation at Huai River and Promoting Regional Economic Development

The Shaying River is the largest tributary of the Huai River. Current navigation class is significantly low and the overall navigation has not been open, so waterway transportation at Huai River has been extremely constrained. In this context, Shaying River Improvement Project is essential to the construction of main channel of inland waterway in China and channel network in Huai River basin. This is a strategic and key project.

In addition, Shaying River, passing through Anhui Province, connects mining area in central Henan Province and advanced economic areas like Jiangsu and Zhejiang Provinces and Shanghai. Natural condition for navigation is good, but large-volume and low-cost waterway transportation in hinterland area is still lacking because there has been no overall navigation at Shaying River. This has constrained the exploitation and use of mineral resources in this region and regional economic development to some extend. Thus, Shaying River Improvement Project can contribute to regional communication and resource transportation from middle China to the eastern region, and promote industry transfer between middle China and the eastern region.

### 6. 9. 2. Improving Regional Integrated Transportation System

Currently, transportation in hinterland in this region mainly relies on railway and highway. Railway lines from east to west include LongHai Line, LuoFu Line and FuHuai Line. Railway lines from south to north include JingJiu Line and JingGuang Line. The above railway lines are all constrained by the transportation network with low transport capacity. Bypass transport is also an issue. In addition, transportation demand of cargo like coal in the hinterland has not been considered. Therefore, part of the coal in this region can just be transported via highway or be transported through highway to downstream of Shaying River and then goes through Weicixin River, Huai River, Subei Canal and into Yangtze River, with very high transport cost.

Shaying River Channel Improvement Project can open the door of inland waterway transportation at the southeast of Henan Province. Pressure on LoangHai Line and JiangGuang Line can be relieved. Material exchanges between the southeastern region of Henan Province and Yangtze River Delta region. An economic waterway transport channel can be built to transport coal in the north to the south and coal in the west to the east. Furthermore, as transport pressure can be relieved after the navigation capacity is improved, this project can provide positive contribution to regional integrated transportation system.

### 6.9.3. Developing Resource-saving and Environmentally Friendly Transportation Mode to Achieve Sustainable Development

Modern transportation system is composed by highway, railway, waterway, aviation and pipeline transport. Compared with highway and railway transportation, inland waterway performs better in aspects of land take, energy consumption and environmental protection. Its advantages include:

(1) Reduction of carbon emissions and good for climate change

After the open of navigation, mineral resources and construction materials in Fuyang City along Shaying River can be transported directly by vessels to Fuyang, Taihe, Jieshou, Luohe and Zhoukou. Coal can be transported from nearby ports to Yangtzs River Delta region through Shaying River. Thus, this project will change the transportation mode along the river. That is, land transport will be changed to waterway transport.

According to relevant materials [5], the weight of cargo that can be transported 1km by different transportation modes with 1L fuel is respectively: 50 ton by highway, 97 ton by railway and 127 ton by inland waterway. The oil consumption per ton cargo per 100 km of different transportation modes is respectively: 35.4 kg aviation fuel for aviation, 6.9 kg gasoline and 5.2 kg diesel for highway, 0.64 kg diesel for railway and 0.6 kg diesel for waterway. In this context, compared with other transpiration modes, energy consumption per km of inland waterway can be reduced greatly because the load of vessels and fleet is high, towing capacity is high and it can take advantage of buoyancy. Thus, inland waterway transport can reduce carbon emissions and is good for climate change. Saved energy in this project is estimated (see Table 6-13).

**Table 6-13 Saved Energy of Shaying River Channel Project**

| Transpiration mode without this project | | Shaying River Channel Improvement Project | 2015 | 2020 | 2030 |
|---|---|---|---|---|---|
| Saved diesel and coal for cargo e.g. mineral and construction material (upstream) | Highway-waterway connected | Saved diesel (ton) | 8784 | 13680 | 19560 |
| | | Saved standard coal (ton) | 12543.55 | 19535.04 | 27931.68 |
| | Highway | Saved diesel (ton) | 2120.16 | 4543.2 | 7572 |

| Transpiration mode without this project | | Shaying River Channel Improvement Project | 2015 | 2020 | 2030 |
|---|---|---|---|---|---|
| | | Saved standard coal (ton) | 3027.59 | 6487.69 | 10812.82 |
| Effect on coal in Anhui (downstream) | | Saved diesel (ton) | 6030 | 17100 | 24300 |
| | | Saved standard coal (ton) | 8610.84 | 24418.8 | 34700.4 |
| Saving effect of coal and other cargo in Henan (downstream) | Highway-waterway connected | Saved diesel (ton) | 2160 | 21600 | 31860 |
| | | Saved standard coal (ton) | 3084.48 | 30844.8 | 45496.08 |
| | Highway-railway connected | Saved diesel (ton) | 440 | 990 | 1320 |
| | | Saved standard coal (ton) | 628.32 | 1413.72 | 1884.96 |
| Promotion effect | | Saved diesel (ton) | 40997.88 | 54003.39 | 60947.04 |
| | | Saved standard coal (ton) | 58544.973 | 77116.84 | 87032.37 |
| Total | | Saved diesel (ton) | 60532.04 | 111916.59 | 145559.04 |
| | | Saved standard coal (ton) | 86439.753 | 159816.89 | 207858.31 |

$Q_{2015}$=60352.04□ton diesel□=86439.753 ton standard coal□215494.3 ton $CO_2$□reduction□=14,718,200 RMB

$Q_{2020}$=111916.59□ton diesel□=159816.89 ton standard coal□398423.5 ton$CO_2$□reduction□=27,212,300 RMB

$Q_{2030}$=145559.04□ton diesel□=207858.31 ton standard coal□518190.8 ton $CO_2$□reduction□=35,392,400 RMB

It can be seen that carbon emissions can be reduced by 215,494.3 ton by 2015. Direct economic benefits would be about 14,718,200 RMB. By 2020, reduction of carbon emissions will reach 398,423.5 ton and direct economic benefits would be about 27,212,300 RMB. By 2030, reduction of carbon emissions will reach 518,190.8 ton and direct economic benefits would be about 518190.8 RMB.

(2) Less land occupation

According to the “Construction Land Use Indicators for New Railway Project” issued on April 8th, 1996 and the “Land Use Indicators for Highway Construction Project” issued on Nov. 11th, 1999 (see Table 6-13), land take of railway construction is 74-91 Mu per km and land take of highway construction is 96-123 Mu per km.

**Table 6-13 Land Use Indicators for Railway and Highway (Unit: $hm^2$/km )**

| Land use indicator for railway construction | | Land use indicator for highway construction | |
|---|---|---|---|
| Single line diesel locomotive | 4.9192ha□73.79 Mu□ | Class I Highway | 6.3843 ha□95.76 Mu□ |

| | | | |
|---|---|---|---|
| Single line electric locomotive | 4.9770 ha□74.66 Mu□ | 4-lane expressway | 7.4004 ha□105.06 Mu□ |
| Dual lines diesel locomotive | 5.9796 ha□89.69 Mu□ | 6-lane expressway | 8.2122 ha□123.18 Mu□ |
| Dual lines electric locomotive | 6.0426 ha□90.64 Mu□ | | |

Permanent land take of this project is 1,780.4 Mu, including 278.1 arable land which accounts for 15.6%. Land take per km is 8.64 Mu. Thus, original riverway is of full use in this project and land take is less. Pond filling and foundation consolidation and transform of low-lying lands will be carried out during dredging works, which will increase the area of arable lands. According to “Statistics Yearbook of Fuyang 2009”, the area of arable land in Fuyang is 8,621,500 Mu, accounting for 58.8% of total area of the city. Arable land per capita is 0.873 Mu. It is much less than that of Anhui Province, which is 1.0031 Mu per capita. Therefore, arable land resource is limited in Fuyang.

Thus, Anhui Shaying Channel Improvement Project can effectively save and project land resources in this region and help to increase arable land per capita in Fuyang city.

(3) Less environmental pollution

Environmental impacts of transport include various emissions and discharges, e.g. fuel emissions from vehicles, domestic waste and oil pollution from vessels and noise, etc. According to relevant materials [6], pollution densities caused by different transportation modes are different. Pollution density of both passenger (person km) and freight (ton km) highway transportation is the highest, which is 1- -2 times of that of aviation and 10 times of that of railway or waterway transport. In aspect of noise, noise of vessels is much lower than that from highway, railway and aviation transport. According to Planco’s (1996) research on costs of pollution of different transportation modes, cost of pollution of waterway is lower than that of highway and aviation.

**Table 6-14 Cost of Pollution per Traffic Volume of Different Transportation Modes (Unit: 0.01 Euro)**

| Transportation mode | Highway (person km/ ton km) | | | Railway | | Aviation | Waterway |
|---|---|---|---|---|---|---|---|
| | Car | Bus | Truck | Person km | Ton km | Person km | Ton km |
| Cost of pollution | 0.11~0.27 | 0.02~0.05 | 0.07~0.17 | 0.01 | 0.01~0.02 | 0.04~0.1 | 0.01~0.02 |

In summary, Shaying River Channel Improvement Protection will occupy fewer lands, consume less energy and cause less environmental pollution. This project is a

resource saving and environmentally friendly mode. It is a necessary option to achieve sustainable development.

### 6.9.4. Improving Water Environment and Landscaping the Banks

(1) Improving the water environment

Sediment sludge and trashes in water will be removed in this project. Water dynamics will change (water depth and flow rate increase), so energy and material exchanges in Shaying River are accelerated. Water environmental capacity will be increased, so water quality is improved.

In addition, the change of water dynamics is good for living and breeding of aquatic organisms, for their effective living areas will be expanded. In long term, remove of sludge and trashes in water is good for organisms' breeding. In addition, the migration and enrichment of some contamination through food chain are cut off. Habitats of aquatic organisms are improved.

(2) Consolidating Shaying River Channel and relieving soil erosion

On the basis of recent Shaying River improvement projects initiated by water conservancy sector, slope protection will be carried out and embankments will be extended. Bank and slope protection is proposed will be carried out for river sections where distance between embankments is small, where deep groove is close to banks, where there is no or narrow beach in front of the banks, where chute cutoff is needed and where sub-embankment is dropped back and constructed. Thus, this project is good for consolidation of Shaying River channel and slope stability. The risk of soil erosion will be reduced further.

(3) Building ecological corridor and landscaping the banks

As the implementation of slope protection works in this project, planting and slope protection will be carried out long Shaying River. On the one hand, soil erosion at both sides of the river can be relieved. On the other hand, ecological corridor will be built as the planting is carried out. Landscape along Shaying River will be significantly improved, which can satisfy watermen on vessels and residents along the river.

### 6.9.5. Improving Ferry Environment and Making Residents' Traveling Convenient

More than 120 ferries will be set along Shaying River. Among others, traffic volume of 23 will be big. Fig. 6-7 shows the distribution of ferries. Boats are currently docked by the slope along the bank at most of the ferries. The roads to the ferries are mainly grave pathes (see Fig. 6-8).

**Fig. 6-8 Status of Ferry along Shaying River**

According to preliminary design of this project, shipping density will increase as the channel grade will be upgraded. In order to ensure ferry security, all of the ferries along the river will be modified. Structures where ferry can be docked and people can embark and disembark and stepping connection for people embark and disembark will be built. Width of connection line will be 7m, which will be connected with county or country roads. The cost of modification is calculated as 150,000 RMB for ferry with low traffic volume and 250,000 for ferry with high traffic volume.

Thus, ferry security will be enhanced. Ferry environment and transport condition will be improved. Surrounding residents' traveling will be more safe and convenient.

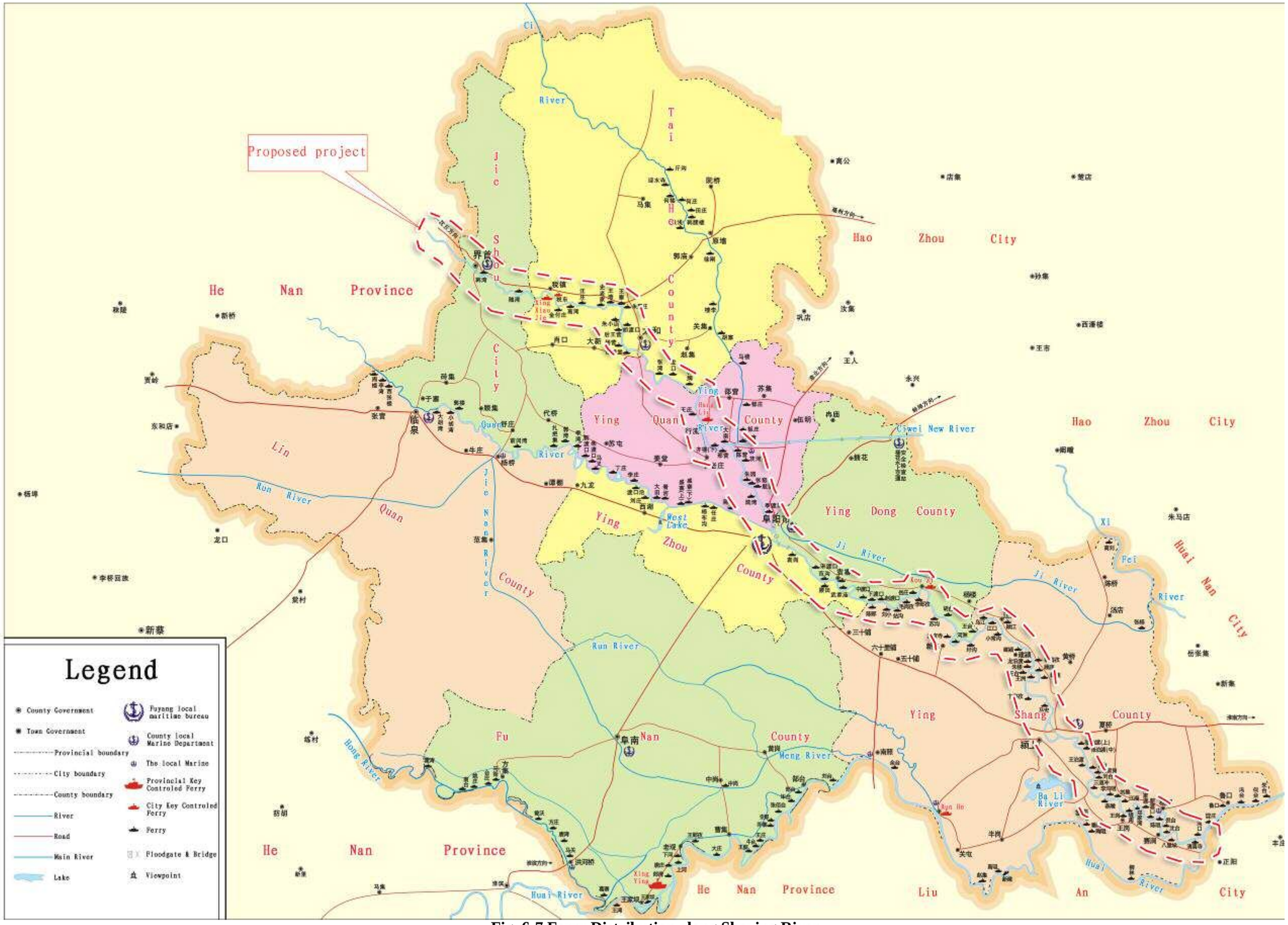



**Fig. 6-7 Ferry Distribution along Shaying River**

### 6.9.6. Ensuring Navigation Safety and Promoting Societal Harmony

Navigation condition will be improved after the completion of this project to ensure navigation safety. This project also has social benefits in aspects of local employment, public health and flood control.

(1) Ensuring navigation safety

Grade of parts of channels in Shaying River is currently low. Headroom of some bridges can not meet the standards. Some bridges are even dangerous ones. These have affected navigation safety at Shaying River. In addition, there is no service area or anchorage area along the river. Vessels berth at main channel and influence normal navigation. Referencing No. 027 document (Jiaoshuifa) issued by Ministry of Transport, service areas and anchorage areas will be set in this project. Thus, occupation of main channel and traffic accidents can be reduced. This can effectively ensure the navigation safety.

(2) Increasing job opportunities

Job opportunities can be increased in two phases of this project. During the construction phase, more than 2,000 job opportunities will be created per year. Given the demand of project operation, it is estimated that around 200 manager will be needed during the operation phase. Their jobs are mainly about navigation service and tourism business.

(3) Improve public health

Natural environment along Shaying River will be gradually improved due to this project. On the one hand, water quality will be enhanced for water depth and water flow will be increased. On the other hand, the environment where disease transmission medium like flies and mosquitoes would grow will be improved. Thus, residents' living environment can be protected and improved. Disease rate may decrease. This project will have positive impacts on public health.

(4) Good for flood control

Dredging work in this project will increase water capacity of the river. This is good foe flood and irrigation. This project will have positive effects on regional flood control and urban security.

# 7 Analysis of Indirect Impacts and Cumulative Impacts

With the implementation of channel improvement project, the Shaying river will be fully navigable, and river ports and terminals shall enter into a period of rapid growth. According to *Fuyang Port General Plan*, Seven new operation areas □from upper to lower: Xuzhai, Sanqiao, Sanshilipu, Kouzi, Tanggou, Liuzhuang, and Shabei operation area) are to build, two operation areas □from upper to lower: Jiuxian, the Two estuaries operation area) to be rebuilt and expanded, and about fifty berths to be built or restoref along the Shaying river. As a result, the waterway project implementation will make an inductive effect on the terminals and carriers along the river. With the Shaying river becoming navigable, a large number of terminals and carriers will put into operation, while the greatly increasing amounts will bring new environmental pressure to this region, and then a cumulative effect on the water quality and regional environment. In order to assess the environmental impacts of *Fuyang Port General Planning* that might incur after it is carried out, and mitigate the negative impacts on the environment during the process of port development, construction and operation, Hehai University, entrusted by Fuyang Port and Channel Administration Bureau has complied *Fuyang Port General Planning Environmental Impact Statement*, which was examined and approved by Anhui Environmental Protection Bureau in early 2008.

At the same time, there are three ship locks in the river. They are Genglou, Fuyang and Yingshang from the upstream to the downstream. Genglou and Fuyang ship lock are invested into construction and operation by Anhui Port Construction Group and Huaihe water sector. Genglou was navigate in June 1st, 2009, while Fuyang lock will be constructed in December 2009, with total construction period of 2 years. Yingshang Lock was invested by Anhui Port Construction Group, the navigation of which is on December 25, 2008. There will be a cumulative impact on the regional environment during the construction operation. *Environmental Impact Statement of Fuyang Ship Lock Reconstruction Project* was made by Anhui Water Resources and Hydropower Survey and Design Institute, entrusted by Gateway management commission of Shaying River in Fuyang in August 2005. And the EIS was approved by Anhui Environmental Protection Bureau in April 2006

The waterway project itself has limited environmental impact on the area along Shaying River, but with the comprehensive navigation of the river, the construction of ports and docks along will have more environmental impact. These impacts will form the cumulative effect on the regional environment. The cumulative impacts identified of ports and docks construction are specified in Table 7-2.

## 7. 1. **Scope**

Cumulative impact is from the crowding effect that is increased by environmental interference in space (geography) and time. If the eco-system has not recovered from the impact of the first interference, and encounters the second interference in the same location, the effects of human activities will be accumulated.

□1□Definition of cumulative impacts

The report “Consider Cumulative Effect under State Policy”, issued by Council of Environmental Quality□CEQ□in 1997, suggests that there are eight types of cumulative impact. See in Table 7-1.

**Table 7-1 Types of cumulative impacts**

| Tape | | Main Features | Example |
|---|---|---|---|
| 1 | Time Crowd | Environment is influenced frequently and repeatedly | Deforestation rate is faster than tree regeneration. |
| 2 | Time Delay | Impact lags | Contact with carcinogen. |
| 3 | Space Congestion | The influence space of an environment system has a high density | The way of discharging pollutants into river is non-point source |
| 4 | Over the Border | The influence appears in the place far from the source | Acid rain |
| 5 | Fragmentation | Landscape type changes | Fragmentation of old city |
| 6 | Compound Effect | The influence are increased by sorts of influence sources and approaches | The Synergistic effect of different insecticides |
| 7 | Indirect Effect | Secondary effect | Commercial development increased by highway construction |
| 8 | Trigger and Threshold | System behavior and structure have radical changes | Global climate change |

The environmental impact of this project during construction period is temporary, partial and recoverable, so the cumulative impact in this region will mainly appear after the full navigation of Shaying River. The influences mainly include: the permanent occupation of this waterway project on the floodplain (especially wetland meadow) may result in the natural habitat reduction along Shaying River and make an impact on wildlife (especially amphibians, birds) in this region; waste gas($NO_2$□$SO_2$) from fuel burning of vessel in this channel, ship machinery noise, domestic wastewater discharged by the crew, and wastewater as well as domestic waste generated by the channel administrative staff in each service area.

The waterway project implementation will make an inductive effect on the terminals and carriers along the river. A large number of terminals and carriers will put into operation, while the greatly increasing amounts will bring new environmental pressure to this region, and then make an indirect impact on the water quality and regional environment. According to *Fuyang Port General Planning Environmental Impact Statement*, the environmental impact of this project during construction period is temporary, partial and recoverable, so the cumulative impact in this region will mainly appear after the full navigation of Shaying River, including: the permanent occupation of this waterway project on the floodplain (especially wetland meadow) may result in the natural habitat reduction along Shaying River and make an impact on wildlife (especially amphibians, birds) in this region; automobile exhaust gas, road rust, mineral dust of building materials, grain dust and so on which are generated in port road and yard, watering and sewage as well as the ship sewage; ship machinery noise, domestic wastewater and so on.

According to *Environmental Impact Statement of Fuyang Ship Lock Reconstruction Project* and field survey on Genglou and Yingshang ship lock, the domestic sewage in lock management district has been incorporated into municipal sewage network, and made an unified treatment by the municipal sewage treating system. As a result, it has little impact on water environment of Shaying River. Except the impact made by underway ship that is considering in the operation phrase, the main cumulative impact that ship locks made on environment are as follows: ship locks barrier may make an impact on Shaying River hydrology and sediment, thereby affecting aquatic life and migratory; noise of loudspeakers to direct operations and ships whistle.

This assessment will make a comprehensive analysis on the environmental impact of channel improvement project, ports and terminals and ship locks along Shaying River, so as to identify the possible cumulative environmental impacts caused by this project. See Table 7-2.

## Table 7-2 Identification of Cumulative Impacts of This Project

| Impact Factor | | Ecological Environment | Water Environment | Ambient air | Acoustic Environment | Societal Issues |
|---|---|---|---|---|---|---|
| Channel improvement Project | Pollutant Source | Permanent occupied | Inland sewage of each services are | Oil waste gas | Vessels in the channel | - |
| | object | Flood land (especially meadow wetlands) | Water quality | Air Quality | sound environment | Promoting economic development |
| | Environmental impact | the natural habitat reduction along Shaying River and make an impact on wildlife (especially amphibians, birds) in this region□ | After the compliance focus into nearby ditches around the end to enter Shaying River | The main pollutant factor is NO2 and SO2 | Running vessels, the basic limitations of the embankment in between the two sides□ | |
| | Degree | middle | low | low | low | middle |
| Ports and terminals | Pollutant Source | Permanent occupied | Sewage (terrestrial and marine) and rain water yard | Port transport vehicle exhaust, road dust, mineral dust materials, grain dust and coal dust | Port machinery and equipment, Port-channel traffic noise | - |
| | object | Flood land (especially meadow wetlands) | Water quality | Air Quality | sound environment | Promoting economic development |
| | Environmental impact | the natural habitat reduction along Shaying River and make an impact on wildlife (especially amphibians, birds) in this region□ | After the compliance focus into nearby ditches around the end to enter Shaying River | The greatest impact of dust generated by a variety of bulk, but the car transport will result in the cumulative regional atmospheric NOx | Range of the noise of the port loading and unloading area or yard away from the noise source within the geometric center in the 200m; Port in the range of the noise impact of vehicles on both sides of the road within 40m | |
| | Degree | middle | low | low | low | middle |

| **Impact Factor** | | **Ecological Environment** | **Water Environment** | **Ambient air** | **Acoustic Environment** | **Societal Issues** |
|---|---|---|---|---|---|---|
| Ship locks | Pollutant Source | Lock block | Domestic sewage | - | broadcast command trumpet and ship horns | - |
| | object | Aquatic life and migratory | Water quality | - | sound environment | Promoting economic development |
| | Degree | the ship locks may have an barrier lock effect on Shaying River, which will make an impact on migratory and other aquatic ecosystems | Into urban sewage pipe network centrally | - | Less extensive, confined to lock around | |
| | degree | low | Very low | - | Very mild | middle |
| Identification of Cumulative environmental impact | | yes | yes | yes | no | yes |

On the basic of analysis above, the cumulative impact on environmental impact of this project mainly includes:

□ On ecological environment□the permanent occupation of this waterway project on the floodplain (especially wetland meadow) may result in the natural habitat reduction along Shaying River and make an impact on wildlife (especially amphibians, birds) in this region；also the ship locks may have an barrier lock effect on Shaying River, which will make an impact on migratory and other aquatic ecosystems.

□ On atmospheric environment: the waste gas from fuel burning of vessel in this channel and automobile transportation may cause the accumulation of NOx.

□ On water environment: the wastewater discharge of channel service area and the ports as well as terminals along has an cumulative impact on Shaying River water environment

□On social environment□With the implementation of the waterway project and the construction of ports, terminals along, it will make an a great boost on the regional economy.

□2□Spatial scope and time range of assessment

The spatial scope and time range of assessment on the cumulative impact lists out in Table 7-3.

**Table7-3 Spatial and temporal scope of cumulative impact assessment**

| Cumulative impact | Spatial Scope | Temporal scope |
|---|---|---|
| Ecological Environment | Shaying River Coastal | after the completion of the project and operation of ports, terminals along |
| Atmospheric Environment | Fuyang amd districts or counties along | after the port operating (about 2015) to the medium-term plan (2020) |
| Water Environment | Shaying River | |
| Social Environment | Fuyang amd districts or counties along | after the completion of the project and operation of ports, terminals along |

According to *Fuyang Port General Planning*, until long-term planning (2025 or 2030), the inland ships and automobiles will update to environmental protecting energy-saving, its emissions of air pollutants will be getting littler, with the development and promotion of science and technology. And with the navigation of Yinghe River and the ports and terminals becoming flourishing, the urbanization process along the river will greatly accelerate. Until the long-term time, that the channel service area and along the port has gradually have sewer conditions, the sewage will be discharged into the municipal pipe network centrally.

Therefore, the assessment will focus on analyzing the cumulative environmental impacts from the implementation of the ports along Shaying River (about 2015) to the medium-term planning (2020).

## 7. 2. Analysis on Cumulative Impacts

### 7. 2. 1. Analysis on Cumulative Impacts on Ecological Environment

□1□Impacts on Wetland by the Shore

According to analysis of Section 6.2.1□the project the permanent land occupation mainly is section of beach, service areas, anchorages and bridge-building section. After making an overlay analysis on the project arrangement plans and natural wetland distribution along with Shaying River, it suggests that most of the projects are not related to natural wetland, and only three sections of beach may occupy meadow wetland with 42.7 acres. As there are little meadow wetland occupied, and plants of river banks occupied (including wetlands meadow plants) are widely distributed in the surrounding areas, as well as many similar habitat along for amphibians and birds to migrating, so the waterway project has little impact on the wetland plant and wildlife habitats.

According to *Fuyang Port General Planning* and *Environmental Impact Statement of Fuyang Ship Locks Reconstruction Project*, and the layout, covers of the ports along have. not yet been determined, therefore, if each port optimizes the layout, minimizing the occupation of river banks (especially meadow wetlands) in the planning design process,, it will reduce the impact on the river bank plants and wildlife habitats at the maximum degree.

According to the field survey, as Shaying River has been artificially modified, renovation and construction for many times in history, and frequent human activities, the ecological environment along mainly is manmade ecological system, terrestrial animals in this region are mainly the common species. From the view of biological species, the terminal project will not result in reducing the populations of animals and plants, land animals, plants.

So, if each port optimizes the layout, minimizing the occupation of river banks (especially meadow wetlands) in the planning design process, the waterway project and the construction of ports and ship locks will have little cumulative impact on the river bank plants and wildlife habitats.

□2□Cumulative Impacts on Aquatic Organisms

With the operation of each ship lock along Shaying River, the original natural river will be divided into several segments, which results in the flow slowing, water level change amplitude decreasing and river discharge changing. According to the relent analysis on *Environmental Impact Statement of Fuyang Ship Locks Reconstruction Project*, the river can maintain a fairly steady flow through the constant lock gate off, so there will be less impact on the hydrodynamic environment of Shaying River hydrology, such as sediment and hydrodynamic.

Generally, for the migratory fish or fingerling with big activity space, the construction of ship locks may block in their migratory or active passageways. But the barrier effect in the operating process is temporary, since fish can go through the lock while the gate constantly off for ship passing and drainage. As a result, ship locks have little barrier effect on fish migration. At the same time, on one hand, the watery project will deepen and widen the river, which will promote the growth of algae living in the depth water; on the other hand, due to the river bottom sediment and water waste is cleared so as to change the hydrodynamic conditions (water depth increases, flow speed), thus it will speeding up the physical flow of water and logistics of the exchange, being conducive to the survival of aquatic life and reproduction.

As a result, the locks along has less barrier influence on fish migratory. While in the long run, channel dredges removes the bed sediment and water garbage, cut off migration and enrichment of some pollutants in the food chain, so it will be conducive to the growth and reproduction of aquatic organisms, improving the living environment of aquatic organisms at some degree.

### 7.2.2. Analysis on Cumulative Impacts on Ambient Air

According to cumulative environmental impact identification, the cumulative atmospheric environment impact in the counties in Fuyang City, made by waterway project and the ports and terminals, are mainly the emissions from vessels and and automobile transportation at ports and terminals.

According to *Fuyang Port General Planning*, cargo traffic along Shaying River will be 14 million tons by 2020. Correspondingly, NOx emission will be 1.247kg/km • d by 2020. Shaying River (Anhui Section) channel length is 205.6km; if there are 330 days of operation per year, the total NOx emissions will be 84.61t /year by vessels Shaying River (Anhui Section). .

According to the analogy investigation with *Environmental Impact Statement of Fuyang Port General Planning*, until 2020□NOx exhaust emissions from automobile transport will be 3.53 t/year, in Fuyang Port, 1.99 t/year in Taihe Port□4.97 t/year in Yingshang Port, 0.88 t/year in Jieshou Port and the total NOx emissions of automobile transport will be 11.37 t/year in the ports and terminals along Yinghe River.

As a result, by 2020 the regional NOx emissions may accumulate to 95.98 t /year caused by vessels in the channel (in Anhui Province) and automobile transport of the ports and terminals. According to the environmental status survey, NO2 concentration range in the built-up area in Fuyang, Jieshou and Yingshang Counties is between 0.028 ~ 0.032mg/m3 in 2007, and the second standard is 0.04 mg/m3 in "Ambient Air Quality Standard" (GB3095- 1996), so the atmospheric environment quality of Fuyang City and Shaying River is better in this region, with more remaining environmental capacity of NOx. The perennial dominant wind direction for the Fuyang area is east with 2.8 m / s of annual average wind speed, and the air dilution here is relatively strong, as well as the pollution sources are mobile sources whichi is located in rural areas far away from populated areas, so the influence of the channel navigation and operation of the ports and terminals along will not cause significant increase in the regional cumulative NOx (especially along the county and the city of Fuyang), and have less impact on regional atmospheric environment. With the science and technology development and high-tech promotion, inland marine vehicles will update to environmental friendly and energy-saving, their emissions of air pollutants will be limited.

### 7.2.3. Analysis on Cumulative Impacts on Water Environment

According to cumulative environmental impact identification, the cumulative impact of waterway project and the ports and terminals along on water environment mainly is sewage discharged by channel service area and the ports and terminals.

Sewage mainly includes terrestrial and marine sewage related to navigation of Shaying River. There should be treatment plants or storage containers.

Treatment equipment or containers should be installed on vessels according to wastewater volume. Water with oil and domestic wastewater can be collected to the port area by special equipment and treated before discharge to minimize the impacts to Shaying River. According to preliminary design, wastewater volume at each of the service areas by 2020 at Fuyang Guozhuang Sanshilip, the domestic sewage will be about 26.4t/d. Service Area wastewater will be treated to secondary standard

GB8978-1996 before discharge into the surrounding open ditches, and then into the Shaying River. At Service Area 2, the total discharges of major pollutants are estimated to be: COD 2.62t/year and SS 2.62t/year.

According to *Environmental Impact Statement of Fuyang Port General Plan* there will be four ports sewage treatment plants to receive and process land and landing ship sewage, with sewage treated to secondary standard GB8978-1996 before discharge into the surrounding ditches. It is calculated that the total discharges of major pollutants after sewage treatment in the four ports will be: COD 5.81 t/year, and SS 6.25t/year by 2020.

Based on the above, the total discharges to Shaying River ports by 2020 will be: COD about 8.43t /year, SS about 8.87t/year. According to Fuyang City Environmental Monitoring Station, on April 23 and 24, 2008 Shaying River monitoring results showed that the river water quality with average concentrations of COD about 19.84mg / L, and SS about 45.7 mg / L, meeting GH3838-2002 "Surface Water Environmental Quality Standard" Class IV standards (COD standard value of 30 mg / L, SS standard value of 80 mg / L). At average flow at Shaying River of 112.7m3 / s the river has assimilative capacity of COD 36 100 t /year, SS 121,900 t /year. In comparison Shaying River vessel service area and port discharges would generate an accumulated pollutants (COD and SS) at 0.02% and 0.0073% of available capacity. This shows that accumulative impacts of navigation channel at the ports and terminals to the water environment of Shaying River will be acceptable.

### 7.2.4. Analysis on Cumulative Impacts on Societal Issues

With the implementation of the waterway project and the construction of locks as well as full navigation of Shaying river, a large number of ports and terminals will be subsequently invested in building operations, which will contribute to mineral resource development in Fuyang City and surrounding areas, especially promoting the economic construction and development. Thereby it will increase the employment rate of the regional community, and promote regional economic development.

## 7.3. Conclusions

In summary, the waterway project and the construction operations of the ports terminals and locks along will have cumulative impact on the regional ecological atmospheric, and water environment. However, the negative impacts are manageable.

Meanwhile, in the long run, channel dredging may also improve the aquatic survival environment to some extent.

# 8. Pollution Control and Ecological Protection Measures

## 8. 1. Environmental Protection Measures During the Construction Phase

The negative impacts on the environment of the project are mainly in the construction period. There should be an environmental protection management system established, to ensure the responsibilities and effective operation. The environmental management, prevention and control measures for dust, noise, and water pollution should be examined. Regular staff training and examination of environmental protection laws and regulations should be carried out. This section mainly discusses the pollution prevention and control measures of this project during the construction period.

### 8. 1. 1. Ecological Protection Measures

(1) Make a reasonable arrangement on working time. While construction in the wetland, especially in the section of Taihe Shaying River National Wetland Park (k25 ~ k38 +500), construction time should be preferred to avoid the peak hours of wildlife activity. Morning, evening and night is the peak period for wildlife activating, breeding and feeding, so high noise works like piling should be prohibited in the morning, evening and night;

(2) Protection of birds on overflow lands. Publicity and education of environmental protection during the construction should be conducted.No hunting, fishing or collection of fauna is allowed. If animals are hurt by accident, wild animal protection sector should be informed and professionals will deal with the accident.

(3) Control the use of overflow lands. It is forbidden to build construction camps or piling yards on overflow lands. Discharge of construction wastewater and domestic wastewater on the overflow lands is forbidden.

(4) The greening of slope should be considered with priority after the channel improvement and be combined with the concrete and masonry construction

reasonably. The greening of the slope and that on the shore should form the ecological corridor together.

### 8.1.2. Air Pollution Control Measures

The main environmental impact on ambient air of this project is the odor generated by dredging sediment and dust caused by bridge works during the construction period.

(1) Odor pollution control measures

a. While designing, disposal area should be sited to avoid the area where the density of villages is high. According to cite investigation, the distance between disposal area and the nearest village is more than 50m, which can effectively avoid the impacts of sediment odor on the surrounding residents.

b. Dredging works should be conducted in the dry season, preferably in winter, when the spread of smell is difficult, so it can reduce the impact of odor on the surrounding residents. At the same time, construction should be carried out section by section. The dredged sludge should be timely delivered to sediment piling yard. Ecological restoration should be carried out in time.

c. If the sludge is utilized, it should be transported in sealed tanker, in order to prevent odor pollutant emissions on the way.

d. The protective equipments should be disseminated to workers and be checked periodically.

(2) Dust control measures

a. Barriers with height not less than 1.8m should be set around bridge reconstruction sites. During demolishment of bridge pier, watering on the ground should be carried out in order to reduce dust. Barriers for collecting residue should be set in waters in order to ensure that residue can be transported in three days after the construction.

b. Earthwork, residue and construction waste should be transported by sealed vehicles. Washing facilities of vehicles should be set at the entrance and vehicles should be washed before getting out of the construction site. Mud and sand should not be carried out of the construction site.

c. Main construction roads must be hardened through covering, consolidating, greening, sprinkling and other effective measures. A sprinkler is required to be equipped at construction site for each subproject.

d. Cement and other particle building materials which are easy to flying, should be stored sealedly. Lime and sand in the construction site should be piled and covered.

e. Ready-mixing should be adopted for mixing of lime and inorganic materials. Watering is needed to reduce dust during the rolling process. Hangar of the mixer at the construction site must be closed and dust-proof device should be equipped. Selection of temporary cement mixing site should be far away from residential buildings.

f. In case of wind stronger than Grade IV, the construction such as earth filling and transporting and so on, which may cause dust, is forbidden.

g. Vegetation restoration is needed to prevent soil erosion after temporary land using.

(3) Others

Low energy consumption and low emission construction machinery and vehicles need to be used. For vehicles with excessive emissions, exhaust gas purification device should be installed. The management and maintenance of machinery and vehicles should be strengthened to reduce air pollution in poor condition of machinery and vehicles.

### 8.1.3. Noise Control Measures

During construction period, using time of devices causing noise must be strictly controlled and managed. High noise at night is prohibited to use. At the same time, select the location and orientation, which can make use of natural conditions and construction (structures) for noise reduction, so as to minimize the noise impact.

(1) Low-noise devices should be used, such as hydraulic machinery instead of fuel oil machinery and high-frequency vibrators. As for fixed machinery, excavators and bulldozers, noise can be reduced by using exhaust muffler and isolation of vibration engine. Idle equipment should be turned off. Vehicles should slow down in construction site and use of whistle should be reduced.

□2□Make a scientific construction program and a reasonable arrangement of construction time. It should be avoided to use a lot of noisy equipment at the same time. In addition, high noise equipment (such as excavators, mixers) should be scheduled at daytime and avoid nighttime (22:00~06:00).

Pouring concrete and disposal of large scale materials should be reduced at night. If continuous working like bridge works is necessary, measures to mitigate noise

should be applied. Nearby residents should be informed with construction timing and locations, which need to be reported to and documented in Environmental Protection Bureau.

(3) The construction unit to install mobile sound barriers for big sensitive objects.

(4) Operating machinery and equipment should be in accordance with the provisions. Dismantling baffle and bracket shall be subject to operational requirements. Noise should be reduced when loading and disposal materials.

(5) Use of power machinery at the same location should be avoided in order to reduce local noise level. Use of whistle and bell etc. should be reduced. Modern communications equipment can be used.

(6) Closed hangar should be set for strong-noise equipment like power saws, planers, mixers, stationary concrete pumps, large air compressors and other equipments at the construction site. They should be set at the side away from the residential area.

(7) The project owner should jointly with construction unit inform the surrounding residents with the construction period. Good communication and relations with surrounding units and residents are essential. Disturbed units and residents should be notified before the construction. The construction unit should keep informing them of construction progress and applied noise control measures. In addition, during the construction phase, complaint telephone hotline should be set to receive complaints of noise nuisance and active management should be conducted according to complaint.

### 8.1.4. Water Pollution Control Measures

The wastewater during the construction period is mainly domestic wastewater, cleaning water of vehicles and equipments, which needs to be treated before being discharged.

(1) It is suggested to build latrines in construction camps. Septic tanks should also be built to treat the wastewater before it is discharged into surrounding abandoned lands or ditches. In addition, construction camps should be sited at 200m away from Shaying River. Direct discharge into the Shaying River is forbidden.

(2) Smaller reamer should be used for dredging in this area, which will reduce the disturbance of the radius during dredging, so as to minimize the impact on water quality caused by river sediment SS.

(3) As heavy metals in sediment, N and P content is very low, main pollutant is SS. Most can be removed after the natural deposition at the later period of reclamation. When SS of residual water exceeds the standards at later period of reclamation, flocculants can be added at the place where slurry goes into the cofferdam to control water quality. The treated residual water should meet the standards of Grade II in the “Integrated wastewater discharge standard” (GB8978-1996). It discharged into the nearby ditches directly and goes into the Shaying Rive finally.

(4) Sedimentation tanks should be set at front mixer, concrete pumps, and transport vehicles cleaning place. Wastewater should not be directly discharged into the river. After the secondary precipitation, it can be recycled and reused for water spraying to reduce dust.

(5) As for on-site storage of oil, the storeroom must take anti-seepage treatment. Proper measures should be taken for storage and use to prevent oil leakage, soil contamination and water pollution.

(6) Scattered materials in construction sites should be cleaned up in time. Measures against water scouring and leaching should be taken for materials piling to avoid being rushed into the river and polluting the water.

### 8.1.5. Solid Waste Control Measures

(1) Sediment pollution control measures

 Sediment dredging will be distinguished from excavation undisturbed soil, with dredging at first and then excavation.

 Transport vehicles for external sediment must be sealed to prevent the leakage on the way which may affect the landscape and health.

 When sludge is used for agriculture or river bank greening, the use per land area should be controlled and uniformly applied in the soil.

(2) Other measures

 The construction waste must be transported in special sealed garbage pipe or be lifted in sealed container. Volley throw-away is forbidden. Sealed garbage station e should be set at the construction sit. Construction waste, domestic solid waste should be classified and stored.

 Construction Waste

a. Abandoned gravel, building materials, steel and packaging materials should be recycled by professionals and the working face should be timely cleaned up.

b. Construction waste will also be generated during bridge works and slope protection due to the loss and abandonment of stone, ash and construction materials. Construction waste should not be dumped into ditches. It can be of full use combined with foundation leveling in villages and towns. Construction waste at urban area in Fuyang can be utilized for foundation leveling of comprehensive construction north to Fuyang Lock. Construction waste that comes from Jieshou, Yingshang and Taihe can also be used for foundation leveling in industrial areas.

 Domestic waste

Domestic waste should be collected and treated in time by local sanitation department.

### 8.1.6. Mitigation Measures for Social Impacts

#### 8.1.6.1. Traffic impact mitigation measures

In order to effectively reduce the impacts on the traffic, effective measures should be carried out, including:

(1) Reasonable settings of construction detours

- To make full use of existing rural roads and properly consolidate the road and drainage system
- To avoid passing through villages and towns with high population;
- Planned detours should be considered as connecting roads for local villages and remote villages;
- To avoid sensitive areas, such as nature reserves, scenic spots, forest parks, and basic farmlands.
- Roads damaged by construction vehicles should be promptly maintained, to ensure good traffic condition. The narrow roads can be widened combined with the road planning.
- The construction of detour should be reviewed / approved by the environmental supervision engineer.

(2) Design of Construction and Scientific Management

- Notice of construction of relevant road should be made. The vehicle should be informed to select bypass according to actual traffic situation;

- To Set sign boards and temporary signals at related crossing during the construction;
- During the bridge construction, construction vehicles and other vehicle are mixed. Safety management should be carried out for construction vehicles;
- To make a scientific construction program by accelerating the bridge construction in order to relieve impacts on the traffic. To build approach bridge in advance making use of the space due to demolition of green belt.
- To improve control and management of construction vehicles. To select reasonable routes in order to avoid traffic peak hours and reduce congestion caused by construction vehicles.

(3) multi-sectoral coordination

Organized by the local government, consultation with the urban traffic management agency, planning agency, municipal construction management agency, environmental protection sector and other government agencies should be carried out to acquire their support so as to distribute vehicles and pedestrians properly. Then traffic problems can be resolved with administrative guarantee.

(4) Strict management of construction sites

To draw the construction site boundaries clearly. To pile residue, sand, stone and materials reasonably. To park machinery and vehicles reasonably in order to reduce traffic blocks. To build temporary detour and set warning signs. To designate persons to direct the traffic.

(5) Education of relevant personnel

To conduct education of construction staff to ensure their activities do not impede the surrounding traffic. To conduct education of drivers to ensure non-overload and timely clean up of spilled materials.

8.1.6.2. Protection of Cultural Relics

(1) Basis of the protection of cultural relics during the construction phase

Construction of this project should be carried out according to the "Law of the Cultural Relics Protection" and "Regulations for the Implementation of Law of the Cultural Relics Protection".

(2) Construction should be stopped and the site should be protected immediately once any cultural relics are found, to prevent damage. It should be timely reported to local government and cultural relics protection department.

(3) To develop emergency plan for cultural heritage protection. The project owner consults with the local government, cultural relics protection department and other sectors to develop detailed plans for cultural heritage protection, in principles of "If it is found, early isolation, early protection" and "protection is essential and rescue comes first".

8.1.6.3. The measures for protecting human health

(1) Public health

According to the Article 19 of "Law of the Peoples Republic of China on the Prevention and Treatment of Infections Diseases", construction camps, construction sites and original toilet, cesspool, new tombs in a decade should be cleaned up and disinfected before leveling in order to prevent and control the prevalence of various infectious diseases. Permanent, semi-permanent and temporary facilities will be set according to the layout of public facilities combined with actual situations of project management and personnel. The construction of latrine should be placed according to the "Sanitary Standard for Industrial Enterprise Design" issued by the Ministry of Health and State Labor Administration. It should be equipped with tap water and lighting system.

(2) Hygiene and quarantine

The construction staff has to take quarantine before entering the site. The patients with infectious diseases should not enter the construction sites in order to prevent disease spread and prevalence among the local residents and working staff. 10% of the construction workers will be selected for quarantine twice during the construction phase.

(3) Food Sanitation Management

For workers will have meals at the construction sites during the construction phase, food sanitation should be supervised and strengthened to prevent accidental poisoning. The staff working in food and beverage industry must hold a health certificate.

The "drinking water health supervision and management measures" and "Hygienic Standard for Drinking Water" will be based for domestic water. The well water should be tested and hot water supply points should be established.

(4) Propaganda about health

Health propaganda (e.g. HIV/AIDS prevention and control) should be strengthened. Contractor and construction management unit should assign a principle

to conduct propaganda through lectures, blackboard and other means to spread the prevention and control knowledge and prophylactic immunization knowledge of dysentery, typhoid and other intestinal infectious diseases. It will help to raise people's awareness of health protection and to reduce the diseases incidence.

## 8.2. Environmental Protection Measures during the Operation Period

The waterway navigation capacity and water quality will be both improved after the project, but how to ensure waterway navigation and water quality is a main issue. With technology advancing, the navigation capacity and water quality will be furtherly enhanced through various measures. In addition, other aspects such as water management and the management of green belt along the river should be paid attention to with the purpose of maintaining the effect of channel improvement.

### 8.2.1. Environmental Protection Measures for Navigation

(1) Examination of vessels on Shaying River should be strengthened. Vessel that can not meet standards in the "Effluent standard for pollutants from ship" should be prevented from traveling on Shaying River. Furthermore, watermen should be educated that solid waste should not be arbitrarily thrown into the river, so it can prevent pollution at the source.

(2) Environmental management of service areas along Shaying River should be improved. It must be ensured that the discharged of wastewater at service area can meet the standards. Garbage from vessels should be collected and taken harmless treatment thereby reducing the impact on the environment.

(3) Supervision and inspection of vessels should be improved. The vessels which fail to meet the requirements and which are with service expiration are not allowed to engage in shipping so that accident risk can be reduced.

(4) The vessels must use strong directional speakers, with limit of using time. Lights should be used instead of speakers at night when ships enter into urban areas with dense population, so as to solve the noise problem.

### 8.2.2. Water Environment Protection Measures

#### 8.2.2.1. Water Environment Protection Measures

(1) Channel management should be strengthened. Disposal of solid waste within the area with a radius of 100m is not allowed. The units and residents who dump garbage randomly would be punished.

(2) The floating objects which are carried into the river by the wind should be regularly salvaged and cleaned up.

(3) In accordance with the relevant provisions of inland shipping, set up navigation signs and other facilities in the channel to ensure maritime safety, while enhancing the daily maritime patrol, so as to eliminate the risk of accidents avoiding water pollution.

#### 8.2.2.2. Mitigatory Measures for Wastewater from Service Areas

It is suggested underground wastewater treatment equipment to be installed in every service area. Oil water from restaurants, vessel maintenance and gas station needs to be treated by grease trap before being discharged into sewage system. It then converges with domestic wastewater treated in septic tank and goes into underground wastewater treatment equipment. The treated wastewater can meet Grade II in GB8978-1996 and be discharged in nearby ditches.

#### 8.2.2.3. Mitigatory Measures for Wastewater from Vessels

(1) Management of vessels should be strengthened. Treatment equipment or containers should be installed on the vessel according to wastewater volume. Discharge of domestic wastewater that can not meet the discharge standards is prohibited at inland water region. Bilge wastewater with oil should be treated by oil-water separator to meet standards in “Effluent standard for pollutants from ship” (GB3552-83) before discharge.

(2) Ships without an oil-water separator can go to specific ports so that water with oil and domestic wastewater can be collected to the port area by special equipment and be treated. After port areas are constructed, ships without an oil-water separator can also go to specific ports to have water with oil and domestic wastewater collected and treated.

### 8.2.3. Ecological Environment Protection Measures

The project will carry out local river embankment slope protection, including water project has been the extension of protection embankment, embankment away

from the narrow, deep channel close to banks, not in front of seawalls or Narrow River beach slope, beach or cutting section and cutting Beach retired construction sub-embankment slope protection, a total of 22.5km, the project at the lowest navigable level (or channel bottom margin) to 0.5m above the highest navigable level of Sloping bank revetment using solid concrete interlocking blocks, the slope above green recovery plan will be implemented: in Solid concrete block revetment chain of more than soil slope with grass slope protection, the levee (or argent) located on both sides of road protection forest, and to the dam (or argent) located outside the greenbelt. 1:1 million, according to field surveys and topographic maps, river's embankment slope protection works (or argent) generally away from the river about 50m, therefore, the project's green recovery plan will be solid concrete block revetment chain of more than 10m of soil slope planting turf, and the dam (or argent) is about 50 meters outside the setting of protective forest belts, according to estimates, the project will be planted with grass green recovery plan about 0.23km2, planted about 280,000 trees.

### 8.2.4. Solid Waste Mitigation Measures

(1) The management of solid waste should be strengthened. Solid waste should be classified, piled, sorted before disposal and recycled. Unrecoverable waste should be properly disposed.

(2) The service area should be equipped with waste reception facilities to collect garbage from arriving ships.

(3) Garbage on land and from vessels should be transported after the collection periodically and sent to municipal solid waste disposal center by the local sanitation department.

### 8.2.5. Capacity Building for Navigation Management

#### 8.2.5.1. Legislation of Ship and Navigation Management

(1) Channel Management

"Administration Regulations of Navigable Waterways of The People's Republic of China" was released on December 27th, 2008 and came into force on January 1st 2009, but its implementation rules and the channel management measures in Anhui Province is still under development. The regulations require classified channel management, channel planning and construction, and clarify channel protection and

maintenance as well as financial issues. According to the regulations, "the national channel and the channel facilities are managed in accordance with the sea area and inland waterway by the Ministry of Communications or provincial, autonomous regional, municipal sectors authorized by the Ministry of Communications directly. Local channel and channel facilities are managed by the provincial, autonomous regional and municipal transport authorities", Shaying River Channel and channel facilities should be under management of Anhui Provincial Transport Department.

(2) Vessel Management

Relevant provisions about market access for inland waterway shipping focus on “Provisions on the Administration of Operational Qualification for Domestic Vessel Transportation" (Ministry of Transport, came into force on August 1, 2008). According to Article 6, inland waterway transportation market access conditions is that “except operating a single vessel with less than 600 gross tonnage cargo for inland waterway transportation, the corporate legal personality should be obtained for operating domestic inland waterway transportation. Operating a single vessel with less than 600 gross tonnage cargo for inland waterway transportation should be registered as individual business”. Detailed requirements on operational qualifications and transportation capacity of domestic waterway transportation enterprises are included in Article 7 and Article 8. The process of domestic waterway shipping market access includes application, review and decision, certification and registration. Among others, application materials should be submitted to transport authorities according to the competence required in the “Implementation Rules of Administration Regulations of Waterway Transportation” and “Provisions on the Administration of Approval of Inter-provincial Waterway Transportation Enterprises”.

The latest amendment of the “Provisions of the Domestic Vessel Management Business” came into force on July 1st, 2009, which further refines the operational access to vessel management business. In accordance with Article 5 and Article 6 of the provisions, market access conditions of operating domestic vessel management industry are: (a) the registered capital in line with national requirements; (b) full-time management staff in compliance with this provisions; (c) corresponding business equipment and facilities; (d) the safety and pollution prevention management system of vessels in accordance with national requirements; (e) other conditions in laws and administrative regulations. Article 6 presents requirements on domestic enterprises that are engaged in vessel management business.

Current mechanisms for withdrawal of vessels and inland transportation policies and regulations include the “Administration Regulations of Waterway Transportation” issued by former Ministry of Communications in 1993, and since 1999, the “Provisions of Administration of Standardization of Inland Waterway Transportation Vessels” and “Dimensions Series of Inland Waterway Transportation Vessels” jointly researched and developed by former Ministry of Communications and provincial transport sectors, “Notions on Adjustment of Shipping Industry” and “Strategy of Structural Adjustment of transportation capacity” in 2001 and “Provisions on Management of Old Vessels" in 2006. Being Aware of the importance of inland waterway transportation for transport in China and problems of domestic inland waterway vessels, like inadequate transportation capacity and old technology, former Ministry of Communications issued "Notice of the Promulgation of Development Outline of National Standardization of Inland Waterway Transportation Vessels" on June 14$^{th}$, 2006. According to Article 4 and Article 12 in the “Administration of Standardization of Inland Water Transportation Vessels” (The Ministry of Transport, came into force since December 1$^{st}$, 2001), “any organization or individual shall not build or renovate cement ships or wooden ships longer than 5 meters for inland waterway transportation. No organization or individual shall build or renovate motor ships hanging oar engines longer than 20 meters for inland waterway transportation”, “for those cement ships, wooden ships and has been put into operation on the quality of cement ships, wooden ships and motor ships hanging oar engines should be phased out within deadlines.” The “Provisions on the Administration of Old Vessels" (Ministry of Transport, came into force since August 1$^{st}$, 2006) defines the old transportation vessels and scrap vessels. Article 6 requires “classified technology supervision and management system is implemented for old transportation vessels. Mandatory retirement system is implemented for the transportation vessels that have reached the mandatory retirement age of ship.”

(3) Pollution management for Vessel and Channel

In order to strengthen the supervision and management of prevention and control of pollution from vessels on the inland water environment, according to “Law of the People's Republic of China on Prevention and Control of Water Pollution”, “Implementation Rules of Law of the People's Republic of China on Prevention and Control of Water Pollution” and other laws and administrative regulations, Ministry of Transport issued the “The Provisions of the People’s Republic of China on the Prevention and Control of Pollution from Vessels on the Inland Water Environment” on August 20$^{th}$, 2005 which came into force since January 1$^{st}$, 2006. The provisions

apply to vessels sailing, parking, working and conducting other activities that affect the river water environment.

As the "Channel Law" and "Shipping Law" will be promulgated, China's laws and regulations about vessel and shipping will be further improved.

8.2.5.2. Status of Channel Management of Shaying River

In August 2002, the merge of former Anhui Provincial Shipping Management Bureau (Anhui Provincial Port & Shipping Supervision and Ship Survey Bureau) was approved by No. 91 [2002] Document of "JingWanBianBan" and renamed as Local Maritime Bureau of Anhui Province (Anhui Provincial Port & Shipping Management Bureau and Anhui Provincial Ship Survey Bureau). This Anhui provincial water transport agency is one organization with three brands affiliated with Anhui Provincial Transport Department. Its main responsibilities include: to implement relevant policies, regulations and technical specifications and standards about water safety supervision; to organize the registration of vessels, to confirm its ownership and to approve the navigational rights to hang a national flag; to develop management systems for crew skills training and certificate examination and to implement follow-up supervision and management; to supervise the shipment of hazardous cargoes and to prevent water pollution from vessels; to maintain traffic order on water, to implement traffic control on main water areas, to approve underwater and on-water works and set non-navigation areas and to organize search and rescue for major accidents; to implement administrative punishment for activities that violate water safety supervision and management order according to its administrative jurisdiction; to organize water safety inspection in the province and inter-provincial safety management activities and to coordinate inter-provincial industrial relations; and to make and manage maritime uniform and signs.

Currently, water transport agencies in Anhui Province are set in provincial, city, county and primary levels. Local Maritime Bureaus (Port and Shipping Management Bureau) are set in 17 cities in the province., It is one organization with two brands. Fuyang Local Maritime (Port & Shipping Management) Bureau is responsible for traffic safety supervision, management of ports, channels and water transportation market in 660km-long water area (including Shaying River). Currently, local maritime departments in cities, counties, and districts have established local maritime stations along Anhui Shaying River Channel. Responsibilities of maritime administration in Anhui Province include channel and port administration,

construction and operation to meet the requirements on daily management of the channel. There is no need to establish a separate administrative organization for management of Shaying River channel. It can rely on existing routine maritime management. Channel maintenance is relatively weak in administrative agencies for Shaying River channel. After the channel grade is advanced, Grade I maintenance with high maintenance requirements will be needed and the workload will be larger. Professional maintenance team should be established. It is suggested to set three channel management offices in Jieshou, Fuyang and Yingshang, responsible for daily maintenance, observation and maintenance of navigation aids of the Shaying River channel, with 6 to 10 staff in each office.

Anhui Provincial Port & Shipping Construction Investment Group will carry out the construction and operation of Shaying River Channel Improvement Project. The establishment of this group was approved by the Anhui Provincial People's Government in December 22$^{nd}$, 2006 and funded by the Anhui Provincial Transport Department as a provincial state-owned enterprise. It is mainly engaged in investment, construction and operation and management of channels, ship locks, river ports and other inland waterway transport infrastructure. It also has modern logistics, maritime services, crew training, sales and maintenance of vessels, shipping agents and other professional qualifications.

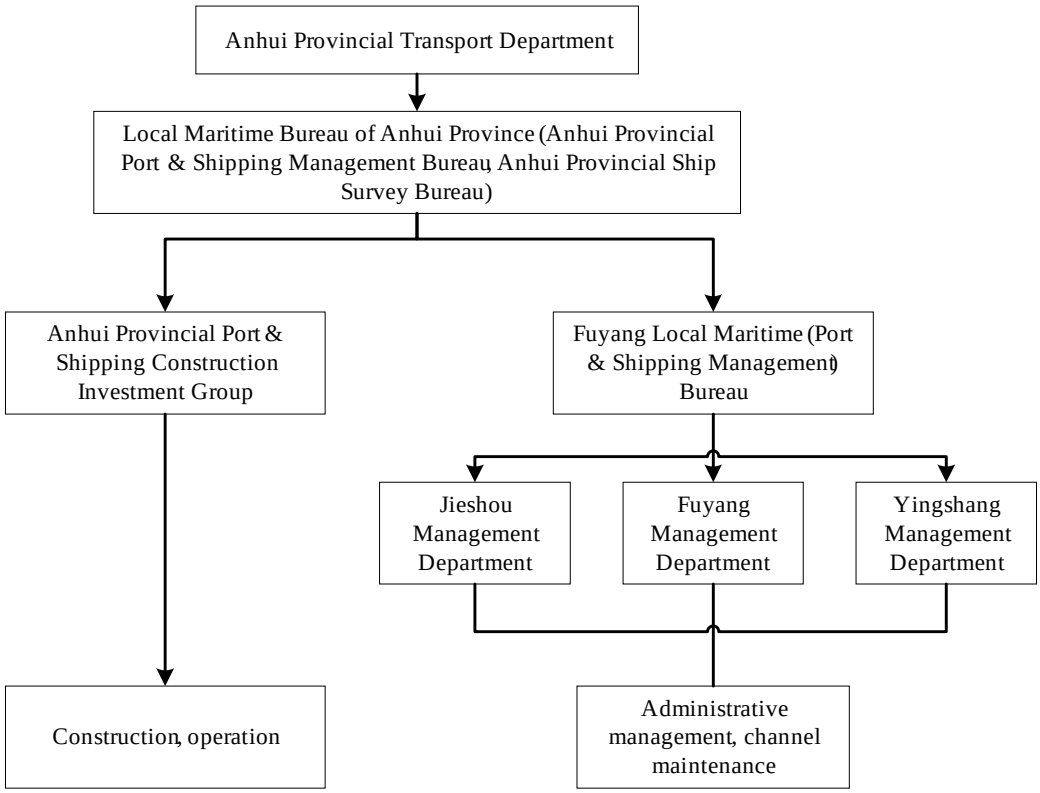



Fig.8-1Management Institutions of Shaying River Channel

8.2.5.3. Problems

(1) Multi-sectoral management but no cooperation of law enforcement

Several departments related to channel management, e.g. water conservancy sector, fishery sector and environmental department are involved in the existing administrative law enforcement and management for shipping. These departments have their own laws and regulations as the basis for management respectively, which causes overlapping functions. There are many policies in this field promulgated by different sectors and they are implemented by different sectors respectively. It often appears in specific work that several sectors manage easy issues at the same time, whereas when the violation occurs, no sector manages the situation actively. Not managed in effective period, the illegal incident has already occurred. It is difficult to resolve it.

(2) A large number of private docks and temporary docks influence the navigation safety and are hidden dangers to the water environment.

As the open of navigation at the Weicixin River, the reopening of navigation at Shaying River (Henan Section) and the completion of Genglou Navigation Hub, perennial navigation at Shaying River section from Henan Zhoukou to Jieshou has

been realized. Currently, the berths along Shaying River belong to the transport authorities and the cargo owner. Only the structures of docks owned by port and navigation sectors are good. The majority of berths owned by private enterprises concentrate in Taihe and Yingshang. They are not of high degree of mechanization and are merely simple terminals with poor facilities, rough construction and poor security. Some cargo owners set loading place without permission at banks of Shaying River. There is no formal basin or no fixed berths in these loading places, which fully relies on original channel slope and floating crane vessel for operation. This has significantly affected the navigation of other vessels. In addition, dumping, spilling and leaking happen at these loading places during the operation, which blocks the channel and threatens flood control and navigation safety.

(3) Large proportion of motor ships hanging oar engines along the Shaying River and unadvanced vessel technology

Although the vessels have developed rapidly along Shaying River, but generally speaking, the current structure of transportation vessels is not reasonable. The proportion of motor ships hanging oar engines is still large. Vessel technology is unadvanced. Vessel type and materials are disordered. The average tonnage of vessels is small. Motor ships hanging oar engines can be noisy and cause pollution from oil spill and discharge. This type of vessels is difficult to control or operate with poor security and high energy consumption.

8.2.5.4. Capacity Building for Navigation Management

(1) To strengthen on-site supervision and horizontal communication in order to cooperate in law enforcement

Channel management is a comprehensive and difficult work with a large amount, particularly for dumping garbage into the channel and housing by the river. Although requirements in laws and regulations are clear, there are still repeated violations. One of the major reasons is that on-site supervision is weak so it can not be managed within effective period. Therefore, on-site supervision should be of high priority in channel management. “Mechanism of three-class obligations” should be implemented. At the first class, channel station has the on-site supervision responsibility. They should report to the channel section at a higher level when discovering violations. At the second class, channel section has obligations of on-site supervision, on-site management and administrative law enforcement. They should deal with violations timely when they are discovered. At the third class, channel

department has responsibilities of on-site supervision and arranging the law enforcement of each channel section. They should guide law enforcement at lower levels. Furthermore, periodical patrol mechanism should be established. Activities that destroy the channel or navigation aids should be punished and dealt with timely. Channel station, section and department need to form an effective management system, to ensure smooth information flow, to respond quickly and to conduct effective management, so that on-site supervision can be put in place.

Currently, horizontal communication among law enforcement sectors should be strengthened who need to cooperate to punish illegal activities like occupation of channel. Navigation sector, water conservancy sector and fishery sector should keep in contact and establish periodical cooperation of operation and law enforcement. They can maximize law force through rectification of a series of illegal activities that have significant effects, e.g. illegal facilities that occupy the channel and riverway and waste dumping into the riverway, in order to effectively stop these illegal activities.

(2) To implement Shaying River Port Plan and to strengthen management of channel and docks.

In January 2008, Fuyang Port and Shipping Management Bureau prepared the “Master Plan of Fuyang Port”. It is proposed to construct or expand tow main ports at Fuyang and Yingshang and two general ports at Jieshou and Taihe. After the completion of this project, the overall navigation at Shaying River will be opened. According to “Master Plan of Fuyang Port”, four ports will be established along Shaying River with 12 operational areas in total. As the implementation of this plan, ports that belong to cargo owner with poor structure and loading places without terminals will be merged. The disordered status will be changed. Occupation of the channel during the loading and unloading can be relieved to ensure the maximum improvement of navigation conditions.

In addition, channel management should be strengthened. Regular education and propaganda for owners should be carried out to raise their awareness of channel protection. Training and education of administrative management staff of navigation should be improved in order to get navigation news in time, to correct or prevent illegal activities at the beginning and to avoid new illegal activities.

(3) To strengthen the management of access to vessel market and promote the process of vessel standardization at Shaying River.

In order to enhance the competence of inland waterway navigation, the primary tasks are to strengthen the management of access to vessel market, to control access and withdrawal of vessels and to improve standardization at Shaying River. New or modified ships that will enter in the market should meet standards about ship age and ship type. Motor ships hanging oar engines should be limited to enter in Shaying River in short-term. In long-term, such boats should be forbidden at Shaying River.

The “Outline of Development of Standardization of National Inland Waterway Vessel Type” (hereinafter “the outline”) was promulgated. It requires the management of access to inland navigation market, proposes requirements of standardization, and plans withdrawal of old vessels, but guarantee measures and establishment of related funds are not detailed in the outline. Compared with the outline, in terms of the mechanisms of “trading in old vessels with new ones” and “ship-breaking fund” of EU, relevant provisions are in great detail, including the ratio of “trading in old vessels with new ones” and sources of ship-breaking fund. These mechanisms have not only effectively resolved the problem of excess transportation capacity in inland waterway in EU, but also promoted the standardization of vessels and development towards large-scale vessels. Although these two mechanisms are not implemented in EU any more, they are still backups in order to adjust the transportation capacity timely in case of excess transportation capacity in inland waterway.

Adjustment fund shall be established. Detailed arrangements of mechanisms of “trading in old vessels with new ones” and “ship-breaking fund” of EU can be drawn on for the management of Shaying River. Total transportation capacity and its structure can be adjusted through economic policies. The fund can be collected in multi ways. The fund can be used to encourage ship owners to renovate vessels and to dismantle old ones in order to control total transportation capacity and optimize its structure., The return part of the tax reformed from traffic fees or other funds can be collected and used for the update of transportation capacity every year. Specific fund for transportation capacity adjustment can be established for the renovation of transportation vessels and the ship-breaking subsidies. Proper economic compensation should be paid to enterprises with withdrawal of transport capacity. The enterprises update new transportation capacity shall pay proper money to the adjustment fund to ensure the sustainable development of the fund. Renovation fund shall be established for vessels on Shaying River. Local matching funds should be put into place on the

basis of existing fund for promotion of standardization of vessel type, in order to promote the standardization process.

Shaying River Navigation Management Information System shall be set up. The competent departments can grasp the changes of market along Shaying River timely through the Navigation Management Information Systems so that they can adjust and prepare relevant policies and regulations. At the same time, they can understand the trends of inland waterway transportation, improve the management, timely release navigation market information, including information about the supply and demand of transportation capacity, changes in market supply and freight index, and released navigation development report, in order to guide the market development with accurate and timely navigation information, to make effective use of vessels and to enhance competitiveness.

# 9. Soil and water conservation

Anhui Shaying River (between Changshenggou and Mohekou) channel improvement project is a construction project. In the course of engineering construction, as channel excavation dregs and the bridge construction, the original surface configuration is serious disturbed, ground vegetation, land, soil structure are damaged in varying degrees, so that the corrosion resistance of the soil surface is reduced, then resulting in new soil erosion. Therefore, according to the survey results and engineering data, we need to determine the amount of land occupied, the amount of soil and water conservation facilities destructed, and the distribution of dregs; Evaluate the extent of soil erosion, its damage and impact on the surrounding area; predict potential soil erosion of project construction; Based on the baseline study and impact analysis, the EIA presents mitigation plans including construction management, soil erosion control, specifications for dredging operation, disposal site management, risk response, and a monitoring and supervision plan.

The project covers an area of 706.68 $hm^2$ which 147.47$hm^2$ is permanent covering and 562.21$hm^2$ is temporary covering. Permanent covering contains cut beach project area, cutoff project area, revetment project area, slope protection project area, dredging area, bridge reconstruction area and management service area; Temporary covering disposal area, temporary works area. The main types of covering contains 388.79$hm^2$ land area, 112.24$hm^2$ flood land, 26.48$hm^2$ construction land and 182.16$hm^2$ waters.

**Table 9-1 land occupation and covering type**

| zoning | Land area ($hm^2$) | Flood land ($hm^2$) | Construction land($hm^2$) | Water ($hm^2$) | Total ($hm^2$) | Nature |
|---|---|---|---|---|---|---|
| Waterway Project Area | 12.81 | 33.47 | | | 46.28 | permanent covering |
| bridge reconstruction area | | | 12.21 | | 12.21 | permanent covering |
| disposal area | 371.78 | | | 182.16 | 553.94 | Temporary covering |
| management service area | | 75.9 | 13.07 | | 88.97 | permanent covering |
| Temporary Works Area | 4.2 | 2.87 | 1.2 | | 8.27 | Temporary covering |
| Total | 388.79 | 112.24 | 26.48 | 182.16 | 709.66 | |

Anhui Water Resources Consulting Co., Ltd is commissioned by Construction units to finish The Soil and Water Conservation Report of Anhui Shaying River

Channel Improvement Project□. this chapter refers to some relevant content of the reports. Analyzes the findings were as follows.

## 9. 1. Soil Erosion Status

### 9. 1. 1. Soil Erosion Control District

According to □Notice on the division of soil erosion control area and strengthening water and soil conservation□[1993-53] and “key protection region, key supervision region and key rehabilitation region of water and soil conservation area in Anhui ”,we determine this region as non-erosion protection area.

### 9. 1. 2. Soil erosion status

According to□Bulletin of Soil and Water Conservation in Anhui□(Anhui Water Resources Department , 2005-12), Fuyang city, which shaying river located, is covering 10081km$^2$ no significant erosion zone.

According to□Standards for classification and gradation of soil erosion□(SL1190-96), the type of soil erosion in this project area belongs to the north mountain area, water erosion is the major erosion, allowable value of water and soil erosion is 300 t/km$^2$·a. Along the Shaying River, farmland ecosystem is the basic and important ecosystem with large area of field crops such as wheat, corn and peanuts. With flat ground and crop covering, erosion in this area is not serious; besides, the area does not have major soil and water conservation engineering measures, water conservancy and transportation projects in the area along with tree planting, grassing and other measures to maintain water and soil and beautify the environment.

The project area is mainly water-eroded region, under the effect of precipitation, surface runoff, and ground water runoff, soil and other surface material composition is destroyed, transported and deposited. The intensities of soil erosion in the project area is slight and the mean soil erosion modulus of this area is 300t/km$^2$·a.

## 9. 2. Factor analysis of soil erosion

### 9. 2. 1. Soil erosion in Construction period

In the construction period, earth excavation, temporary stacking dregs and housing demolition, all these practices will cause the destruction of vegetation and the surface structure, changing the existing topography; under the external force by gravity, raindrop and water erosion, it will easily lead to new soil erosion.

(1) excavation and filling on the impact of soil erosion

Topsoil stripping, soil unloading and spoil in the excavation process will result in some bad impact on the soil: destroy original topography and vegetation, reduce surface resistance to corrosion, damage the original stable state of nature, loss the function of original vegetation erosion control and soil stabilization. Under the external force by gravity, raindrop and water washing, it will easily lead to new soil erosion.

Reclamation engineering will lead to the change of terrain and landscape, the filling slope formed in the construction period will cause changes of the original slope convergence conditions, and easily cause water erosion which will lead changes from surface erosion to gully erosion. In addition to geological structure and soil type, the new slope is also easily to cause soil erosion (soil slip) under the force by gravity.

(2) Borrow on the impact of soil erosion

Earth borrowing will cause serious damage to vegetation and soil structure, making the underlying soil exposed, reduce the ability to resist erosion, therefore, the erosion will occur when torrential rain hit.

(3) Construction spoils on the impact of soil erosion

Construction spoil on the impact of soil erosion contains: tie up the land, natural vegetation and other soil and water conservation facilities, reduce the existing soil and water conservation features. Spoil is the loose deposit, failure to take appropriate protective measures will likely cause the surface soil erosion, even cause soil landslide and additional soil erosion, besides, spoil has reshaping of the original topography and it will affect the soil conditions surrounding the areas.

(4) Other temporary covers

In the construction process, such as temporary construction site within an area will have a certain degree of damage to vegetation and surface soil, this will also increase or create conditions for the occurrence of soil erosion.

(5) Demolition works

Project construction will cause a certain amount of demolition, in the resettlement process, human activities such as housing will result in destruction of vegetation and land, and in that case, soil erosion will occur as a new risk.

### 9.2.2. Soil erosion in project operation period

(1) River bank erosion caused by ship wave

In project operation period (during the ships sailing in the canal), the water around excluded by the hull makes the cross section deformed, and then ship waves are formed by the wave velocity changes. When the ship wave propagates to the shore, waves climb along the bank slope and break into pieces, large hydrodynamic pressure impact the slope. When the ship wave climbs along the bank slope, part of the water infiltrates below the slope, part of the water climbs up to the slope surface. After the stray energy all gone, water begins to flow down along the slope, and takes away part of loose soil particle, while the water within the slope begins to return. The flow rate along the slope is much faster than the returned rate. Because of the buoyancy, small particles will be taken away by the waves, the regular repeated actions by the ship wave at last leads to cracking and slope collapse.

(2)Other factors

The major impact of other factor usually performs in the early stage of the project operation period. During the test run period, plant measure has not yet fully play it’s role on the water and soil conservation, some engineering units which use plant protection measures will have soil erosion problem. However, with the plants growth, soil erosion will be gradually under control.

## 9.3. Time division of soil erosion prediction

**Table 9-2 Time division of soil erosion prediction**

| No. | Stage | Prediction zoning | Prediction time | Years(a) |
|---|---|---|---|---|
| 1 | construction preparatory stage | Temporary Works Area | Nov,2008-Dec,2008 | 0.5 |
| 2 | construction period | bridge reconstruction area | Jan,2009-Oct,2012 | 4.0 |
| | | cutoff project area, revetment project area, slope protection project area, dredging area, | Mar,2009-Oct,2012 | 4.0 |
| | | management service area | Mar,2009-Aug,2012 | 3.5 |
| | | Temporary Works Area | Jan,2009-Oct,2012 | 4.0 |
| 3 | natural recovery period | bridge reconstruction area | Oct,2012- | 2.0 |
| | | cutoff project area, revetment project area, slope protection project area, dredging area, | Oct,2012- | 2.0 |
| | | management service area | Aug.2012- | 2.0 |

According to the characteristics of soil erosion, prediction time is divided into three periods: preparation stage of construction, construction period and natural recovery period. Between November 2008 and December 2008 is the preparation stage of construction, and construction period is the most important period which starts on January 2009 and will be finished on December 2012. After the completion of the project, the role played by plants still need some time to measure, and the natural recovery period will last one year.

## 9. 4. **Soil erosion prediction**

### 9. 4. 1. **Determination of soil erosion modulus**

(1) Soil erosion modulus of native landscapes

Through filed investigation and information collection, we conclude that the intensity of soil erosion in the project area is relative light, and multi-year average soil erosion modulus is 300t/km$^2$·a

(2) Soil erosion modulus after disturbance

The analogy works for this project is Huaihe Linhuanggang flood control project. Linhuanggang flood control project started to construct in December, 2001 and finished in June, 2006 which lasted for 55 months. The project construction mainly includes: Embankment dams 8.54km, south and north auxiliary dams 8.41km and 60.54km, reinforcement and alteration of the auxiliary dams, build new deep gates, Linhuangang gates and Jiangtanghu gates, reinforcement of the original lock gates and build new closure dick, and dig 1.38km of irrigation channel. Since 2001, in accordance with the requirement of □Technical Specification for Soil and Water Conservation Monitoring□(SL277-2002), Huaihe River Water Resources Commission and Water Conservation Monitoring Center has used ground-based observations and investigation of monitoring method to monitor the soil erosion of Linhuangang project construction area and management area.

According to the monitor result, we conclude that soil erosion modulus on temporary roads and soil of construction area is 2300t/km$^2$·a, while soil erosion modulus on building area is 4033 t/km2·a. Finally, combined with the average value of the entire project, topography, soil types and climatic conditions between Shaying River project and Linhuangang flood project, we find these two projects have similar

situation. Based on the soil erosion modulus of Linhuanggang flood project, we get the amended value of soil erosion modulus.

**Table 9-3 disturbed soil erosion modulus of Anhui Shaying river (t/km$^2$·a)**

| project | construction preparatory stage | construction period | natural recovery period |
|---|---|---|---|
| bridge reconstruction area | | 4000 | 600 |
| cutoff project area, revetment project area, slope protection project area, dredging area, | | 12000 | 600 |
| management service area | | 2000 | |
| Temporary Works Area | 2000 | 2000 | |
| Note: 1. in the construction period, soil loss is predicted by sediment concentration in spoil area<br>2. Silt content is counted by 1% of the total amount | | | |

### 9.4.2. Prediction method

According to the project background information on soil erosion and construction features, water erosion dominates soil erosion. New water and soil loss is predicted by the following Formula:

$$W_1 = \sum_{i=1}^{n} \left[ F_i \times \left( M_{2i} - M_{1i} \right) \times T_i / 100 \right]$$

Note: $W_1$—the amount of soil erosion after disturbance□t□

$F_i$—disturbed area，hm$^2$；

$M_{1i}$—native soil erosion modulus，t/(km$^2$·a)；

$M_{2i}$—disturbed soil erosion modulus，t/(km$^2$·a)；

$T_i$—predict stage；

$I$—prediction units

According to the formula, the prediction of the amount of native soil erosion and disturbed soil erosion at every stage can be obtained; the difference between the two is the new increased soil erosion.

## 9.5. Prediction results of soil erosion

### 9.5.1. Prediction of soil erosion at the construction preparatory stage

The total amount of soil erosion at the construction preparatory stage is 662t, in which the amount of native soil erosion is 99t, and new soil erosion is 563t.

**Table 9-4 Prediction of soil erosion at the construction preparatory stage**

| project | F($hm^2$) | native soil erosion modulus($t/km^2 \cdot a$) | disturbed soil erosion modulus($t/km^2 \cdot a$) | Prediction stage(a) | Native soil erosion(t) | Total soil erosion(t) | new soil erosion (t) |
|---|---|---|---|---|---|---|---|
| Temporary project area | 8.27 | 300 | 2000 | 4.0 | 99 | 662 | 563 |
| Total | 8.27 | | | | 99 | 662 | 563 |

### 9.5.2. Prediction of soil erosion at the construction stage

The total amount of soil erosion at the construction stage is 290755t in which the amount of native soil erosion is 9206t, and new soil erosion is 281549t.

**Table 9-5 Prediction of soil erosion at the construction stage**

| Project | | F($hm^2$) | Native soil erosion ($t/km^2.a$) | disturbed soil erosion modulus($t/km^2 \cdot a$) | Prediction stage(a) | Native soil Erosion (t) | Total soil erosion (t) | new soil erosion (t) |
|---|---|---|---|---|---|---|---|---|
| bridge reconstruction area | | 1.11 | 300 | 4000 | 4.0 | 13 | 178 | 164 |
| cutoff project area, cutting infiltration area and spoil area | slope | 91.61 | 300 | 12000 | 4.0 | 1099 | 43973 | 42873 |
| | Fill surface | 633.72 | | | 4.0 | 7605 | 243348 | 235744 |
| Management and service area | | 37.06 | 300 | 2000 | 3.5 | 389 | 2594 | 2205 |
| Temporary project area | | 8.27 | 300 | 2000 | 4.0 | 99 | 662 | 562 |
| Total | | 771.77 | | | | 9206 | 290755 | 281549 |

### 9.5.3. Prediction of soil erosion at the natural recovery stage

The total amount of soil erosion at the natural recovery stage is 9162t in which the amount of native soil erosion is 4581t, and new soil erosion is 4581t.

**Table 9-6 Prediction of soil erosion at the natural recovery stage**

| Project | | F($hm^2$) | Native soil erosion ($t/km^2.a$) | disturbed soil erosion modulus($t/km^2 \cdot a$) | Prediction stage(a) | Native soil Erosion (t) | Total soil erosion (t) | new soil erosion (t) |
|---|---|---|---|---|---|---|---|---|
| bridge reconstruction area | | 1.11 | 300 | 600 | 2.0 | 6.7 | 13.3 | 6.7 |
| cutoff project area, cutting infiltration area and spoil area | slope | 91.61 | 300 | 600 | 2.0 | 549.7 | 1099.3 | 549.7 |
| | Fill surface | 633.72 | | | 2.0 | 3802.3 | 7604.6 | 3802.3 |
| Management and service area | | 37.06 | 300 | 2000 | 3.5 | 389 | 2594 | 2205 |
| Temporary project area | | 37.06 | 300 | 600 | 2.0 | 222.4 | 444.7 | 222.4 |
| Total | | 763.5 | | | | 4581 | 9162 | 4581 |

Above all, the construction of this project will cause soil erosion with the total amount of 300578t, in which the amount of native soil erosion is 13886t, and new soil

erosion is 286692t. Soil erosion in spoil area occupies the most important part, and it accounts for 98.71% of the total erosion.

**Table 9-7 soil erosion in different areas**

| Project | | Native soil erosion ($t/km^2.a$) | Total soil erosion (t) | new soil erosion (t) | Proportion of the total (%) |
|---|---|---|---|---|---|
| bridge reconstruction area | | 20 | 191 | 171 | 0.06 |
| cutoff project area, cutting infiltration area and spoil area | slope | 1649 | 45072 | 43423 | 15.15 |
| | Fill surface | 11407 | 250953 | 239546 | 83.56 |
| Management and service area | | 611 | 3039 | 2427 | 0.85 |
| Temporary project area | | 198 | 1323 | 1125 | 0.39 |
| Total | | 13886 | 300578 | 286692 | 100.00 |

## 9. 6. **Hazard prediction of soil erosion**

During the construction and production processes, the permanent use or occupation of land by Shaying River channel improvement project will cause destruction of the original topography and vegetation, increase the exposed land, and lead attenuation or loss of land productivity by digging, peeling and burring the cultivation layer and vegetation growth layer. Living on the periphery, agricultural growth and reservoirs, rivers and lakes would be adversely affected by the damage. The impacts concentrate mainly in the following areas:

(1) Increasing river siltation, affecting river discharge

During the construction and production processes, the original soil layer and landform have been destroyed, and the increasing exposed lands will create conditions for the soil erosion. Unless take timely and effectively measure to prevent and treat the construction spoil (slag), the sand will directly flow into the river under the effect of rainfall runoff, and this movement will dramatically increase the sediment in the river which resulting in second sediment deposition.

(2) Accelerating the loss of soil fertility, reducing soil fertility

Vegetation cover in the project area is 14%, but during the construction process, vegetation and land soil no longer exist because of the original soil layer and landform being destroyed; spoiled area gradually turns into bare land and results in the loss of organic matter, the content of nitrogen, phosphorus, and inorganic salt in the soil decreases rapidly, this reduction also reduces the number of microorganisms and its derivatives, in that case, deterioration of site conditions not only affects the

agriculture production, but also makes it more difficult for the vegetation restoration and land reclamation.

(3) Serious soil erosion in spoil area

Waste soil and residue has occupied the original surface cause some management to the original vegetation. In the case of heavy rainfall, the steep slope and loose structure will lead to serious soil erosion and cause some harm to the surrounding water and farmland.

(4) Ecological damage

With the occurrence of soil erosion, the amount of water suspended solids and other organic pollutants will increase, and it is conducive to algae growth, at the same time reduces the oxygen content in the water. Ultimately, water self-purification and regulatory function are decreased, causing negative impact on the local ecological environment.

## 9. 7. **Evaluations of soil and water conservation on the main project**

(1) Slope protection works

The amount of revetments along the Anhui Shaying River is very small. With most rivers having a wider beach and wave break forest, storm waves have little damage to the dike when the water level is lower, and the river bank is stable. To protect the stability of dike project, slope protection works should be taken along the narrow dike and narrow point bar.

The top elevation of revetments is 0.5m higher than the maximum navigation design water level, and the bottom elevation of the revetments is equal to the lowest navigable designed level. Below the ordinary water lever, it is recommended to use the interlocking concrete blocks; above the ordinary water lever, it is recommended to use the eco bags and planting to protect the slope.

Implementation of slope protection works can effectively prevent splash erosion and surface erosion to the newborn surface, and it plays an important role in keeping the stability of the slope. By calculating and some experiences of slope protection, we consider it can meet the technical requirement. Slope protection works can effectively control the changes of river regime and reduce the incidence of bank collapse phenomenon. So the project can meet the requirement of erosion control.

(2) Bridge Reconstruction

Embankment slopes and river slope can use mortar and stone embankment. The thickness of mortar and stone is 0.3m, and laying 0.1m gravel cushion.

(3) Environmental protection and plant engineering

Though the engineering design process, measures such as environmental protection and plant engineering have been considered in the management and service area.

(4) Arrange for relocation household

Control measures to resettlement area mainly concern on greening and beautification measures which includes establishing road green belt and green groups. Around the village and some main streets some green belts will be built.

Based on□Town planning standards□□GB50188-93□and the actual situation of resettlement area, green area will take 1-2% of the total construction land.

□Road Green Belt: Trees are planted along the internal traffic road, plant Magnolia and grand flora along the Main Street, and plant Ligustrum quihoni and Buxus sinica var. parvifolia.

□Green groups: Planning about 50 green groups around in city and center town residential settlement; planning about 30 green groups in rural concentrated residential settlement, each green area is about 80$m^2$

□Drainage Works: Drainage works should meet the requirement of sewage discharges and emissions of natural precipitation. The main drains will be layout both sides along the main street, the branch drains will be layout along the branch street, and the drainage will be layout outside the settlements.

(5) Temporary covering

After finishing the construction, for temporary coving, formation and rehabilitation measures have been taken.

According to comprehensive analysis, the main project has taken soil erosion and environmental protection into account, basically meets the requirements of water and soil conservation. Table 9-8 summarizes the engineering quantity and investment about the main project.

**Table 9-8 volume of the project and investment about the main project (thousand-s)**

| No. | area | Control measures | Control content | unit | engineering quantity | Investment(s) | Water Conservation Investment (s) |
|---|---|---|---|---|---|---|---|
| 1 | slope protection area | Engineering measures | Concrete | s-$m^3$ | 43.5 | 14486 | 14486 |
| | | | stone blocks with cement mortar | s-$m^3$ | 579.5 | 148565 | 148565 |
| | | Planting measures | grassing | s -$m^2$ | 240.5 | 1046.1 | 1046.1 |
| 2 | bank protection area | Engineering measures | riprap | s-$m^3$ | 394.0 | 53799 | 53799 |
| | | | interlocking concrete blocks | s -$m^3$ | 91.0 | 33167 | 33167 |
| | | | Gravel Cushion | s -$m^3$ | 358.6 | 44135 | 44135 |
| 3 | Bridge Reconstruction area | Engineering measures | M7.5 stone blocks with cement mortar | $m^3$ | 1767 | 377.7 | 377.7 |
| | | | M7.5 cement mortar Tooth stem | $m^3$ | 144 | 29.1 | 29.1 |
| | | | Gravel Cushion | $m^3$ | 588 | 64.5 | 64.5 |
| | | Temporary measures | Cofferdam filling | $m^3$ | 32598 | 132.3 | 132.3 |
| | | | Cofferdam demolition | $m^3$ | 32598 | 273.3 | 273.3 |
| Total | | | | | | 296075 | 296075 |

## 9. 8. Control measures of soil erosion

### 9. 8. 1. Soil and Water Conservation

In the construction stage, based on soil erosion characteristics, degree of damage and soil erosion control goals, protective measures are evaluated. Combined with the soil erosion control area, construction characteristics and existing control measures, we propose some other soil and water conservation measures; form a complete prevention system with engineering measures as a guide, measures of land remediation and planting as a combination. To do this we can not only effectively control region soil erosion and protect ecological environment, but also can guarantee the project construction and operation safely.

(1) Prevention measures

On the basis of careful study on the design proposal of the main construction, and combined with soil conservation suggestions and requirement, we further optimization the main construction design and give some advances about

standardizing construction, especially suggestions on how to take effective soil conservation measures.

At the construction stage, earth excavation and filling should be kept in a balance state; shorten the construction period, reduce the exposed time of loose ground, reasonable arrange the construction process and try to avoid the rainy season and flood season.

Temporary stockpiling of soil material should be protected carefully; stockpile slope should have interim measures and drainage facilities and stack height should not exceed 4m.

Construction personnel should operate in accordance with planning, should not have unauthorized occupation of land, and construction machinery, earth stone and other building materials can not be misplaced.

Local water administrative departments of the Soil and Water Conservation should actively cooperate with the implementation of the soil and water conservation program, take up the coordination and supervision and implement the “prevention first and combining prevention with control”approach.

(2) Control Measures

The program mainly includes the following aspects of measures:

Area Ⅰ (main construction prevention zone): prevention zone has considered some soil conversation measures, according to analysis and discussion, supply some measures such as slope protection, drainage works, land remediation and drainage measure.

Area Ⅱ (management and service zone):added managements about drainage work, temporary drainage and water conservation measures.

AreaⅢ (temporary project prevention zone):measures about additional drainage, land remediation, bagged soil temporary blocked, late sowing of alfalfa, and additional road drainage.

### 9.8.2. **Additional measures to soil conservation**

#### 9.8.2.1. Plants selection

According to the specific characteristics of local natural conditions, greening purposes and protection objectives, select tress and grasses. We must not only take into account the soil conservation faction, but also take the green landscaping

requirement into account. Therefore, selecting plants should take the following principles:

(1) To improve the success rate of greening, we should give preference to native trees and grass seeds. These native vegetations have strong adaptability on climatic conditions and soil conditions so it is easily to manage after transportation.

(2) Follow the principles of environment protection and environment beautifying; keep evergreen grasses in a certain proportion.

(3) Selection of tree species should be “act according to local circumstances”, and full consideration the resistance of tree species, ensuring sustained and stable benefit of the forestation projects; selecting beautiful and healthy tree species, and take notice the level coordination.

According to the above principles, the program options for trees, shrubs, grass and flowers contain nearly 10 species. Table 9-9 describes the biology and ecology characteristic of these species.

**Table 9-9 main biological and ecological characteristic of some important plants**

| Name | Families and genera | Ecological characteristics |
|---|---|---|
| Camphor | Lauraceae | Evergreen tree, bark brown, leaves are alternate, oval, crown umbrella, growth is slow |
| Magnolia grandiflora | Magnoliaceae | large Flowers, white, fragrant, 5 to 8 months, the crown broad, conical |
| Cedar | Pinaceae | Large evergreen tree, hi sunny, and quiet shade, can adapt in acidic soil and slightly alkaline soil |
| Orientalis | Cupressaceae | Evergreen tree, bark reddish-brown, longitudinal. Branchlets flattened. Scale-like leaves, small form |
| Day Lily | Liliacea Hemerocallis | Cold resistance, shade tolerance, drought resistance, ridge |
| Bermudagrass | Gramineae | Heat and Cold Tolerance, Strong spreading stolons |

9.8.2.2. Soil prevention measures at the preparation construction stage

The main work at the preparation construction stage is to ensure flat of the site preparation, to prevent soil erosion, soil excavation should try to avoid in rainy season, if not, temporary protective measures should be taken and to prevent destruction of natural vegetation and drainage system outside the land covering boundary. Make reasonable planning on the temporary drainage system; at the construction stage make sure that land leveling project has been designed, and avoid the scattered pole.

9.8.2.3. Bridge Reconstruction area

(1) Engineering measures

To ensure the stability of the slope near the water, and avoid causing slope destroyed by bridge construction, stone pitching is done 50m upstream and 100m downstream of the bridge center line, the bottom is covered with gravel (0.1m thick). To avoid some negative impact on the river bed and banks caused by bridge construction, around the bridge piers within 2m, M5 masonry pitching is done and the bottom is covered with gravel (0.1m thick).

(2) Temporary measures

In construction process, work mainly focus on the temporary protection of the pier construction, the main task is building a cofferdam with 1m width, 3m height, and slope1:2. In the process of cofferdam, prevention measures should be taken into account. To ensure the stability of cofferdam, bags of soil protection is necessary.

(3) Construction quantities

The following table 9-10 is added soil conservation construction quantities in bridge reconstruction area.

**Table 9-10 Added construction quantities in bridge reconstruction area**

| Preventive measure | Content | Unit | quantities | Note |
|---|---|---|---|---|
| Engineering measure | M5 masonry | $m^3$ | 8139 | |
| | Gravel cushion | $m^3$ | 2712 | |
| Temporary measure | Cofferdam | 10s $m^3$ | 2.22 | |
| | Soil bags | $m^3$ | 1062 | 0.135m3/bag |

9.8.2.4. Disposal Areas

This project will set up 34 spoil areas. Cofferdam is generally built of local earth fill with the 0.5m height, 2.5m width, and insidebank of 1:2.5 slope of 1:3.

(1) Engineering measure

① Seepage control measures

Spoil area is chosen in Sub-clay layer and well planned region, after clearing, flatting, rolling and compacting, the site still have good permeability, regional permeability coefficient is less than 10-7cm/s, and will prevent sediment pollutants into groundwater. Seepage control measures in spoil area mainly include site flat, selection of impervious material, and reclamation dam layer settings.

② Design requirements of reclamation dam

a. The determination of reclamation dam top elevation should consider some parameters such as design of hydraulic fill elevation, the amount reserved for soil security high, precipitation level

b. Seeping control performance of reclamation dam. Leaking through geomembrane to prevent mud contaminants polluting the environment.

c. Have enough buffer zone for overflow weir to ensure water quality

d. Plant reeds and other higher aquatic plants as biological buffer zone, and biological purify the remaining water.

③ Drainage and flood control project

Good results are obtained by building a floodwater catching channel and setting a zoned separate sewage system, realizing the distributary of rainwater and sewage. The drainage system is designed by 20-year flood and flow calculation is designed by 24-hour rainfall and 24-hour discharge.

Along the back side of cofferdam, every 100m will excavate a slope drain with a rectangular cross section of 0.2*0.2; besides, outside and inside the cofferdam excavate two drainage ditches, and the lateral drainage ditch cross section has a width of 2.5m, depth of 1.0, slope of 1:1, and the inside one has a width of 0.3m, depth of 0.5m and slope of 1:1.

For surface drainage, considering the sediment deposition, in the construction process we first should form a slope of 4%. Set the guide drainage ditch around the slope angle with mortar and stone revetment, and form right-angle trapezoidal open channel slope 1:1.5. The drainage ditches are collected in the catchpit, and then discharged into surrounding drainages which eventually discharged into the Shaying River.

Good results were obtained by building a floodwater catching channel around spoil area, and design the flood intercepting trench along the sediment pile boundary line of 20-years flood occurrence, 50-year flood protection standard.

Drainage ditches should use "L" shaped precast concrete, and isolate the plate and membrane with geotextile. In case of sediment landfill, the drainage ditches can be transformed into remaining water guide row ditch.

④ Land remediation

Considering the overall layout of soil and water conservation, status of land type and the direction of land use after transformation, after construction is complete, cover soil should be improved to meet the minimum requirement for crop cultivation.

First of all, rolling the spoil area with tractor or other compaction tool and form impermeable layer; secondly, covering the surface with 0.3m thick earth soil. The surface should be down slope after land remediation.

(2) Planting measures

After the construction, plant cash crops (day lily) to improve soil quality with 50cm row spacing, 30cm planting spacing and 3 plants per hole.

(3) Temporary measure

Before the construction, 30cm thick topsoil stripping should be taken into account and setted at the corner with bermudagrass seed covering, the heap is no more than 3m slope 1:1.5. Compared with soil bag, this method is economical and operable.

Before filling the cofferdam, along the outside of the cofferdam we should build ridges (0.3m of height, 0.3m of top width, 0,75m of bottom width and slope 1:0.75). To ensure the drainage in spoil area connected with existing irrigation and drainage canal; system, connected drain should be excavated (0.5m of the bottom width, 2.5m of top width, 1.0 of height and slope 1:1). Soil heap is settled on both sides of the drain and with topsoil is at the bottom.

**Table 9-11 Added construction quantities in spoil area**

| Preventive measure | Content | Unit | quantities | Note |
|---|---|---|---|---|
| Engineering measure | Drain length | km | 14.32 | |
| | Earth excavation | $km^3$ | 42.8 | |
| | Land remediation | $hm^2$ | 507.22 | |
| Planting measure | Day lily | k | 2340 | Row spacing 50cm plant spacing 30cm |
| Temporary measure | Topsoil stripping | $km^3$ | 1795.4 | |
| | Bermudagrass Seed | kg | 929 | $45kg/hm^2$ |
| | Ridge filling | $m^3$ | 4966 | |
| | Drain length | km | 16.73 | |
| | Earth excavation | $km^3$ | 50.1 | |
| | Mortar | $m^3$ | 41.3 | |
| | Mortar brick | block | 1803 | |

9.8.2.5. Management and service area

(1) Engineering measure

Around the management and service area and office should set drains, the length of external drains is about 800m, and 30m width, slope 1:1.05, and 30m depth. Inside the drain use M7.5 Mortar brick. The drain in the management service area in rectangular shape is 200m length, cross section 30*30, and use M7.5 Mortar brick.

(2) Planting measure

This project suggest planting combined trees, shrub and grass in the management service area, specific measures include: group greening around the building, planting trees on both sides of the road, center greening (including planting grass and flowers). Chose plants such as bermudagrass, camphor trees, arborvitae, and Magnolia grandiflora, etc. on one hand, planting can prevent new soil erosion, improve the surrounding environment, on the other hand, it can also create good working and living environment for staff.

(3) Temporary measure

In the construction process, topsoil stripping and ridge filling will cause soil erosion. In order to reduce duplication of earth moving, according to temporary earthwork and the construction schedule, temporary dump field should be assigned in primary service area and secondary service area which covering 0.25hm$^2$ and 0.14hm$^2$**.** Around blocked with color plates, in the mound surface covered with straw to prevent water and wind erosion.

Excavate temporary ditch around the temporary dump filed and outside the management and service area. The ditch has trapezoidal cross section, and it is 560m length, 0.2m bottom-width, 0.2m depth and slope 1:1.

**Table 9-12 Added construction quantities in management and service area**

| Preventive measure | Content | Unit | quantities | Note |
|---|---|---|---|---|
| Engineering measure | Drain length | m | 1000 | |
| | Earth excavation | m$^3$ | 162 | |
| | M5 Mortar brick | m$^3$ | 117 | |
| Planting measure | camphor | n | 70 | |
| | Magnolia grandiflora | n | 70 | |
| | arborvitae | n | 35 | |
| | bermudagrass, | kg | 16 | Grass seed 45kg/hm$^2$ |
| Temporary measure | Drain length | m | 560 | |
| | Earth excavation | m$^3$ | 44.8 | Grass seed 45kg/hm$^2$ |
| | Color steel plate | m | 360 | |
| | Bedding | km$^2$ | 3.9 | |

9.8.2.6. Temporary engineering control area

(1) Construction site

Construction process brings a certain degree of damage to around vegetation and surface soil, which creates conditions for the occurrence and development of soil erosion, in that case, protection measures must be taken.

 Engineering measure

a. Drain project: digging drainage ditches around the construction site with trapezoid cross section 50cm*50cm, slope 1:1, and inside wall compaction.

b. Land remediation: clearing 10cm of harden layer in construction site, improving land remediation, and returning rehabilitation.

 Planting measure: Sowing Alfalfa seeds on the surface soil before construction.

(2) Construction road

① Engineering measure

To prevent runoff erosion on the road, we should set convenience drainage ditches with 50m width, 50m depth and slope 1:1.

② Planting measure: Sowing Alfalfa seeds on the surface soil before construction.

 Major construction quantities(table 9-13)

**Table 9-13 Added construction quantities in temporary engineering control area**

| Preventive measure | Content | Unit | quantities | Note |
|---|---|---|---|---|
| Engineering measure | Earth excavation | $km^3$ | 20.5 | Drain excavation |
| | Land remediation | $hm^2$ | 4.07 | |
| Planting measure | Alfalfa | kg | 20.0 | $45kg/hm^2$ |

9.8.2.7. Arrange area for relocation household

(1) Resettlement housing construction should be unified planning, centralized arrangement, and strictly prohibited random occupation of farmland. Spoil and debris caused in the construction process should not be arbitrarily dumped, and the remaining spoil should be uniformed stacking according to the construction of town and village.

(2) Reasonably laying drainage system to prevent soil erosion caused by runoff.

(3) After the completion of demolition works, we should provide green environment to residents, actively carry out “all around” tree planting and greening program, protect the village and develop the courtyard economy. We should plant some evergreen trees, shrubs and the layout of flowers, lawn, so as to realize the goal of soil and water conservation and landscape improvement.

# 10. Resettlement Action Plan

## 10. 1. **Project Impacts**

### 10. 1. 1. **Affected areas**

Land acquisition and house demolition activities of the World Bank Financed Anhui Shaying River Channel Improvement Project (hereinafter referred to as the "Project") affect one city (Jieshou), three districts (Yingquan, Yingzhou and Yingdong) and two counties (Yingshang and Taihe) of Fuyang Municipality. In particular, the navigation works affect three districts (Yingzhou, Yingquan and Yingdong), two counties (Yingshang and Taihe) and Jieshou City of Fuyang Municipality; the bridge works affect two districts (Yingdong and Yingzhou), Jieshou City and Taihe County of Fuyang Municipality; the supporing works affect Yingquan District, Yingdong District, Jieshou City, Yingshang County and Taihe County of Fuyang Municipality; the Project affects 20 villages/communities in 16 townships/sub-districts in total. See **Error! Reference source not found.**.

**Table10-1 Schedule of affected areas**

| Component | City/ district/ county | Township/ sub-district | Village/ community |
|---|---|---|---|
| Channel works | Jieshou City | Tianying Town | Houwei |
| | Taihe County | Zhaoji Xiang | Xiazhangwan |
| | Yingquan District | Wenji Town | Dongxiaotao, Datao |
| | | Xingliu Town | Chenying |
| | | Zhoupeng Sub-district | Fengzhuang |
| | | Ninglaozhuang Town | Fanying |
| | Yingzhou District | Sanshilipu Town | Gaolou |
| | Yingshang County | Xinji Town | Xiawan |
| | | Huangqiao Town | Sanwan |
| | | Ying River Xiang | Sanba |
| | | Yanghu Town | Jinyuzi |
| Supporting works | Jieshou City | Xuzhai Town | Xiaowan |
| | Yingquan District | Ninglaozhuang Town | Chenying |
| | Yingzhou District | Sanshilipu Town | Wuzhai |
| | Taihe County | Xingzhai Town | Houzhuang |
| | | Jiuxian Town | Xijie |
| | | Chengguan Town | Dongzou Garden, Xizou Garden |
| | Yingshang County | Shencheng Town | Shibei Area |

### 10. 1. 2. **Affected population**

The land acquisition and house demolition work of the Project involves 20 villages/communities in 16 townships/sub-districts of one city (Jieshou), three districts (Yingquan, Yingdong and Yingzhou) and two counties (Taihe and

Yingshang), affecting 788 households with 3,140 people permanently (directly). In particular, 424 households with 1,651 people are affected by land acquisition only, 346 households with 1,406 people are affected by house demolition only, and 18 households with 83 people are affected by both land acquisition and house demolition. In addition, the Project affects 2,891 households with 10,316 people temporarily.See **Error! Reference source not found.**.

**Table 10-2 Summary of affected population**

| Type | | Unit | Project | | | |
|---|---|---|---|---|---|---|
| | | | Channel works | Bridge works | Supporting works | Subtotal |
| Directly affected population | Households affected by land acquisition only | / | 192 | 0 | 232 | 424 |
| | Population affected by land acquisition only | / | 714 | 0 | 937 | 1,651 |
| | Households affected by house demolition only | / | 0 | 346 | 0 | 346 |
| | Population affected by house demolition only | / | 0 | 1,406 | 0 | 1,406 |
| | Households affected by both land acquisition and house demolition | / | 12 | 0 | 6 | 18 |
| | Population affected by both land acquisition and house demolition | / | 56 | 0 | 27 | 83 |
| Temporarily affected population | Households | / | 2,887 | 1 | 3 | 2,891 |
| | Population | / | 10,302 | 4 | 10 | 10,316 |

### 10.1.3. **Demolition of residential houses**

The Project involves demolition of residential houses of 26,637.37 $m^2$ only, including urban residential houses of 23,381.34 $m^2$, affecting 296 households with 1,121 people, and rural residential houses of 3,256.03 $m^2$, affecting 32 households with 138 people.

(1)Demolition of rural residential houses

Demolition of rural residential houses affects 3 villages in 3 townships of Yingshang County, Yingzhou District and Taihe County, caused by avulsion in the channel works and the supporting works. Rural residential houses of 1,802.2 $m^2$ will be demolished, including storied buildings of 1,288.5 $m^2$ (71.5%) and single-storied buildings with brick wall and tile roof of 513.7 $m^2$ (28.5%), affecting 18 households with 83 people. See **Error! Reference source not found.**.

**Table 10-3 Rural residential houses demolished for the Project**

| No. | Component | City/ district/ county | Township/ sub-district | Village/ community | Rural residential houses ($m^2$) | | | Affected households | Affected population |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Storied building | Single-storied building with brick wall and tile roof | Subtotal | | |
| 1 | Channel improvement works | Yingshang County | Ying River Xiang | Sanba | 834.2 | 322.3 | 1,156.5 | 12 | 56 |
| 2 | Management service zone | Yingzhou District | Sanshilipu Town | Wuzhai | 356.8 | 89.1 | 445.9 | 4 | 19 |
| 3 | Anchorage | Taihe County | Jiuxi Community | Xijie | 97.5 | 102.3 | 199.8 | 2 | 8 |
| *Total* | | | | | 1,288.5 | 513.7 | 1,802.2 | 18 | 83 |
| *Proportion* | | | | | 71.50% | 28.50% | 100.00% | \ | \ |

(2)Demolition of urban residential houses

Demolition of urban residential houses affects 6 villages and communities in Jieshou City and Taihe County, caused by the bridge works. Urban residential houses of 27,884 $m^2$ will be demolished, including houses in masonry-concrete structure (Grade 1) of 20,771.35 $m^2$, accounting for 74.49%, and houses in reinforced concrete structure (Grade 1) of 7,112.65 $m^2$, accounting for 25.51%, affecting 346 households with 1,406 people. See **Error! Reference source not found.**.

**Table10-4 Urban residential houses demolished for the Project**

| Component | | City/ district/ county | Township/ sub-district | Village/ community | Demolition of urban houses | | | Affected population | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Subtotal | Masonry concrete Grade 1 | Reinforced concrete Grade 1 | Households | Population |
| Bridge works | Jieshou Yumin Bridge | Jieshou City | Xicheng Sub-district | Shengli Community | 2800 | 1251 | 1549 | 36 | 144 |
| | | | Chengdong Sub-district | Shangzhuang | 2885 | 2308 | 577 | 29 | 103 |
| | Jieshou (old S204) Shaying River Bridge | Jieshou City | Yingnan Sub-district | Taihe Community | 8545 | 7519.6 | 1025.4 | 115 | 506 |
| | | | | Gangzhuang | 8204 | 4924 | 3280 | 91 | 352 |
| | Taihe County Ying River Bridge IV | Taihe County | Wenji Town | Datao | 2725 | 2452.5 | 272.5 | 36 | 147 |
| | | | Chengguan Town | Taoqiao | 2725 | 2316.25 | 408.75 | 39 | 154 |
| *Total* | | | | | 27,884 | 20,771.35 | 7,112.65 | 346 | 1,406 |
| *Proportion* | | | | | 100.00% | 74.49% | 25.51% | \ | \ |

### 10. 1. 4. **Demolition of attachments**

Some attachments will be demolished during the construction of the Project, including trees (with diameter of less than 10cm, greater than 10cm and greater than 20cm), tombs and telegraph poles. The Project affects 86,005 trees, 2,213 tombs and 101 telegraph poles. The attachments affected by the Project are shown in **Error! Reference source not found.**.

**Table 10-5 Schedule of affected attachments**

| Trees | | | | Tombs | Telegraph poles |
|---|---|---|---|---|---|
| <10cm | >10 cm | >20 cm | Subtotal | | |
| 17,757 | 14,207 | 54,041 | 86,005 | 2,213 | 101 |

## 10. 2. **Legal Framework and Compensation rates**

### 10. 2. 1. **Policy framework**

The policy framework of the Project is shown in **Error! Reference source not found.**.

**Table 10-6 List of policies applicable to the Project**

| | Policy document | Effective date |
|---|---|---|
| State | Land Administration Law of the PRC | 2004-8-28 |
| | Regulations on the Implementation of the Land Administration Law of the PRC (Decree No.256 of the State Council) | 1998-12-27 |
| | Decision of the State Council on Deepening the Reform and Rigidly Enforcing Land Administration (Guo Fa [2004]28) | 2004-10-21 |
| | Interim Regulation of the PRC on Farmland Occupation Tax | 2008-1-1 |
| | Guidelines on Improving Compensation and Resettlement Systems for Land Acquisition (MLR Fa [2004] No.238) | 2004-11-3 |
| | Circular of the State Council on Intensifying Land Control (Guo Fa [2006] No.31) | 2006-8-31 |
| | Measures on Public Announcement of Land Acquisition | 2002-1-1 |
| | Circular of the Ministry of Land and Resources on Carrying out Proper Compensation for Land Acquisition Practically | 2004 MLR Fa No.58 |
| | Decision of the State Council on Amending the Regulation of the Regulation of the PRC on the Administration of Navigable Waterways | 2009-1-1 |
| Anhui Province | Measures of Anhui Province for the Implementation of the Land Administration Law of the PRC | 2000-9-22 |
| | Circular on Regulating Compensation and Resettlement for Land Acquisition and Arbitrating Disputes over Land Acquisition Properly (ALRD [2007] No.54) | 2007-2-15 |
| | Uniform Annual Output Value and Compensation Standard for Land Acquisition of Anhui Province (APG [2009] No.132) | 2010-1-1 |
| | Circular on Issuing the Interim Rules for the Appraisal of Demolished urban Houses of Anhui Province (Jian Fang [2004] No.142) | 2004-7-1 |
| Fuyang Municipality | Measures of Fuyang Municipality for the Administration of Urban House Demolition (FMG Fa [2002] No.3) | 2002-9-21 |
| | Announcement on Benchmark Rates of Cash Compensation for House Demolition on State-owned Land within the Urban Planning Area of Fuyang Municipality in 2009 (FMG Mi [2009] No.20) | 2010-1-1 |
| | Announcement on Benchmark Rates of Cash Compensation for House Demolition on State-owned Land within the Planning Area of the Five Counties and Cities in 2008 (FMG Mi [2008] No.29) | 2008-1-1 |

| | Policy document | Effective date |
|---|---|---|
| | Circular on Issuing the Measures of Fuyang Municipality for the Implementation of Land Acquisition and House Demolition for Non-agricultural Construction (FMG Fa [2000] No.18) | 2000-3-10 |
| | Measures of Fuyang Municipality for the Basic Endowment Insurance of Land-expropriated Farmers | 2009-5-20 |
| World Bank | Operational Policy OP4.12 Involuntary Resettlement and appendixes | 2002-1-1 |
| | Bank Procedure BP4.12 Involuntary Resettlement and appendixes | 2002-1-1 |
| | | |

### 10.2.2. **Compensation rates**

(1) Compensation rates for acquisition of rural collective land

The uniform annual output values and compensation rates of the rural collective land acquired for the Project are shown in **Error! Reference source not found.**. The compensation rates for rural housing sites shall be based on those for farmland.

(2) Compensation rates for permanent occupation of state-owned land

The land for construction of the Project is state-owned land for public infrastructure, which is obtained by allocation.

(3) Compensation rates for temporary land occupation

According to the provisions of the state, Anhui Province and Fuyang Municipality on temporary land occupation, compensation fees for temporary land occupation include young crop/ground attachment compensation fees and land reclamation fees. The compensation rates for temporary land occupation are shown in **Error! Reference source not found.**.

Table 10-8 Compensation rates for temporary land occupation

| Item | Young crop/ground attachment compensation fees (yuan/mu·year) | Land reclamation fees (yuan/$m^2$) |
|---|---|---|
| Compensation rates for temporary land occupation | 1500 | 6 |
| Remarks | Based on 2 years | |

(4) Compensation rates for demolition of houses

① Compensation rates for demolition of houses on collective land

The replacement cost rates for different types of houses have been fixed according to the relevant provisions of Anhui Province and Fuyang Municipality, and by reference to the replacement cost analysis of the main types of affected houses and the compensation rates of similar past projects, as shown in **Error! Reference source not found.**.

Table 10-9 Compensation rates for demolition of rural residential houses

| Type | Unit | Compensation rate (yuan/unit) | Remarks |
|---|---|---|---|
| 1) House compensation | | | |

| | | | |
|---|---|---|---|
| Storied buildings | $m^2$ | 410 | |
| Single-storied building with brick wall and tile roof | $m^2$ | 260 | |
| 2) Other costs | | | |
| Moving subsidy | Household | 200 | |
| Temporary resettlement subsidy | Month ·$m^2$ | 2 | Based on the actual period, estimated to be 6 months in this report |

**Table 10-7 Uniform annual output values and compensation rates for land acquisition**

| No. | City/ district/ county | Township/ sub-district | Village/ community | Output value of P3Y (yuan/mu) | Farmland | | | | | | | Unused land | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Multiple | | | Compensation rate (yuan/mu) | | | | Multiple | | | Compensation rate (yuan/mu) | | | |
| | | | | | Land compensation fees | Resettlement subsidy | Subtotal | Land compensation fees | Resettlement subsidy | Young crop compensation fees | Subtotal | Land compensation fees | Resettlement subsidy | Subtotal | Land compensation fees | Resettlement subsidy | Young crop compensation fees | Subtotal |
| 1 | Jieshou City | Tianying Town | Houwei | 1480 | 7 | 14 | 21 | 10360 | 20720 | 740 | 31820 | 6 | 6 | 12 | 8880 | 8880 | 740 | 18500 |
| 2 | | Xuzhai Town | Xiaowan | 1430 | 7 | 14 | 21 | 10010 | 20020 | 715 | 30745 | 6 | 6 | 12 | 8580 | 8580 | 715 | 17875 |
| 3 | Yingdong District | Kouzi Town | Zhangdianweizi | 1400 | 8 | 15 | 23 | 11200 | 21000 | 700 | 32900 | 6 | 6 | 12 | 8400 | 8400 | 700 | 17500 |
| 4 | Yingzhou District | Sanshilipu Town | Wuzhai | 1400 | 8 | 15 | 23 | 11200 | 21000 | 700 | 32900 | 6 | 6 | 12 | 8400 | 8400 | 700 | 17500 |
| 5 | | | Gaolou | 1400 | 8 | 15 | 23 | 11200 | 21000 | 700 | 32900 | 6 | 6 | 12 | 8400 | 8400 | 700 | 17500 |
| 6 | Yingquan District | Wenji Town | Datao | 1400 | 8 | 15 | 23 | 11200 | 21000 | 700 | 32900 | 6 | 6 | 12 | 8400 | 8400 | 700 | 17500 |
| 7 | | | Chendian | 1400 | 8 | 15 | 23 | 11200 | 21000 | 700 | 32900 | 6 | 6 | 12 | 8400 | 8400 | 700 | 17500 |
| 8 | | Ninglaozhuang Town | Fanying | 1400 | 8 | 15 | 23 | 11200 | 21000 | 700 | 32900 | 6 | 6 | 12 | 8400 | 8400 | 700 | 17500 |
| 9 | | Zhoupeng Sub-district | Fengzhuang | 1580 | 9 | 15 | 24 | 14220 | 23700 | 790 | 38710 | 6 | 6 | 12 | 9480 | 9480 | 790 | 19750 |
| 10 | | Xingliu Town | Chenying | 1580 | 9 | 15 | 24 | 14220 | 23700 | 790 | 38710 | 6 | 6 | 12 | 9480 | 9480 | 790 | 19750 |
| 11 | Yingshang County | Shencheng Town | Shibei Area | 1500 | 7 | 15 | 22 | 10500 | 22500 | 750 | 33750 | 6 | 6 | 12 | 9000 | 9000 | 750 | 18750 |
| 12 | | Xinji Town | Xiawan | 1370 | 6 | 14 | 20 | 8220 | 19180 | 685 | 28085 | 6 | 6 | 12 | 8220 | 8220 | 685 | 17125 |
| 13 | | Huangqiao Town | Sanwan | 1460 | 7 | 14 | 21 | 10220 | 20440 | 730 | 31390 | 6 | 6 | 12 | 8760 | 8760 | 730 | 18250 |
| 14 | | Ying River Xiang | Sanba | 1370 | 6 | 14 | 20 | 8220 | 19180 | 685 | 28085 | 6 | 6 | 12 | 8220 | 8220 | 685 | 17125 |
| 15 | | Yanghu Town | Jinyuzi | 1370 | 6 | 14 | 20 | 8220 | 19180 | 685 | 28085 | 6 | 6 | 12 | 8220 | 8220 | 685 | 17125 |
| 16 | Taihe County | Xingzhai Town | Houzhuang | 1780 | 6 | 12 | 18 | 10680 | 21360 | 890 | 32930 | 6 | 6 | 12 | 10680 | 10680 | 890 | 22250 |
| 17 | | Jiuxian Town | Xijie | 1780 | 6 | 12 | 18 | 10680 | 21360 | 890 | 32930 | 6 | 6 | 12 | 10680 | 10680 | 890 | 22250 |
| 18 | | Chengguan Town | Dongzou Garden | 2000 | 10 | 16 | 26 | 20000 | 32000 | 1000 | 53,000 | 6 | 6 | 12 | 12000 | 12000 | 1000 | 25000 |
| 19 | | | Xizou Garden | 2000 | 10 | 16 | 26 | 20000 | 32000 | 1000 | 53,000 | 6 | 6 | 12 | 12000 | 12000 | 1000 | 25000 |
| 20 | | Zhaoji Xiang | Xiazhangwan | 1780 | 6 | 12 | 18 | 10680 | 21360 | 890 | 32930 | 6 | 6 | 12 | 10680 | 10680 | 890 | 22250 |

② Compensation rates for demolition of houses on state-owned land

Urban house demolition for the Project involves Jieshou City and Taihe County; the compensation rates have been fixed based on actual market appraised prices according to the benchmark rates of Fuyang Municipality and the affected districts and counties, and by reference to the geographic location and building area of each house. The compensation rates for residential houses are shown in **Error! Reference source not found.**.

Table 10-10 Compensation rates for demolition of urban residential houses

| Type | Unit | Compensation rate (yuan/unit) | | Remarks |
|---|---|---|---|---|
| | | Jieshou City | Taihe County | |
| 1)House compensation | | | | |
| Reinforced concrete Grade 1 | $m^2$ | 1430 | 1480 | Tier-1 areas |
| Masonry concrete Grade 1 | $m^2$ | 1250 | 1300 | |
| 2) Other costs | | | | |
| Moving subsidy | $m^2$ | 4 | 4 | |
| Temporary resettlement subsidy | Month ·$m^2$ | 5‰ | 5‰ | 1) 5‰ of the benchmark rate (unit price) of demolished houses per month-$m^2$<br>2) Based on the actual period, estimated to be 6 months in this report<br>3) The demolisher shall resettle the displaced person or lessee within the specified transition period (not more than 18 months). |

(5) Compensation rates for ground attachments

Special facilities affected by the Project will be compensated for or rebuilt as required according t the former function, size and standard. All ground attachments affected by the Project will be compensated for directly to their owners at replacement cost. The compensation rates for affected ground attachments are shown in **Error! Reference source not found.**.

**Table 10-11 Compensation rates for ground attachments**

| No. | Type / feature | Unit | Compensation rate (yuan/unit) |
|---|---|---|---|
| 1 | Arbor tree less than 10cm in diameter | / | 4 |
| 2 | Arbor tree 10cm-20cm in diameter | / | 12 |
| 3 | Arbor tree over 20cm in diameter | / | 20 |
| 4 | Tomb | / | 240 |
| 5 | Telegraph pole | / | 30 |

## 10. 3. Production and Livelihood Restoration Programs for Displaced Persons

### 10. 3. 1. Resettlement program for permanent land acquisition

According to most focus group discussions and interviews with affected people, all affected households ask for cash compensation with or without land reallocation in the village. The affected households will use the remaining land to cultivate cash crops and obtain a secure source of income. The main livelihood restoration measures of the Project include: (1) The affected households use compensation fees received and the remaining land to cultivate cash crops, deal with sideline operations or do small commodity business; (2) Eligible land-expropriated farmers will be covered by the basic endowment insurance of land-expropriated farmers after receiving compensation; (3) The spoil grounds are used to improve medium and low yield land, increase agricultural income and reduce the impact of land acquisition; and (4) The affected labor receives free technical training and job information. The resettlement program for those affected by land acquisition is shown in **Error! Reference source not found.**.

**Table 10-13 Resettlement program for acquisition of collective land**

| Affected population | Resettlement program | |
|---|---|---|
| | Agricultural (with remaining land) or nonagricultural resettlement (people) | Endowment insurance of land-expropriated farmers (people) |
| 1,734 | 1,684 | 50 |

### 10. 3. 2. Demolition of residential houses

(1) Resettlement for demolition of rural residential houses

In the 3 affected villages, 4 households in Wuzhai Village and 2 in Xijie Village are affected. These households will be reallocated a housing site by the village collective for resettlement. In addition, the relocated households will receive replacement cost and a moving subsidy. The Task Force has learned from interview that the relocated households are willing to accept this mode of resettlement.

In Sanba Village, 12 households with 56 people are affected. This village has been acquired of land for channel, dyke and dam works before project implementation. The demolition range includes old sites of dyke and dam works. These villagers have been compensated and resettled in dyke and dam works, and already have housing elsewhere, so they will not be resettled under the Project.

However, to ensure the livelihood of these villagers and help them improve their standard of living, their houses will be compensated for at replacement cost. The Task Force has learned through interview that these villagers are satisfied with the mode of resettlement.

(2) Resettlement for demolition of urban residential houses

The Project involves demolition of urban residential houses of 27,884 $m^2$, affecting 346 households with 1,406 people, involving Jieshou City and Taihe County respectively. The demolition area of Jieshou City is 22,434 $m^2$, affecting 271 households with 1,105 people, and that of Taihe County 5,450 $m^2$, affecting 75 households with 301 people. The mode of compensation for house demolition is cash compensation or property swap.

### 10.3.3. **Restoration program for temporarily occupied land**

The navigation works, bridge works and supporting works of the Project will occupy 31 mu of state-owned roads and channels temporarily. Such land is within the road and channel planning boundary lines, avoiding construction on densely populated streets and reducing the impact on pedestrian and road traffic. Therefore, no land occupation fees will be incurred.

Land occupied temporarily by the spoil grounds is mostly hollow farmland, its level may be increased by spoil produced during dredging to prevent land inundation by floods. It has been confirmed by the EIA agency that fertile river bottomland can improve the fertility of the temporarily occupied land and can be used directly for farming after the temporary occupation period. In the land occupied temporarily by the Project, except the land occupied temporarily by the spoil grounds, the restorer shall be determined by representatives of affected households, the village collective and the implementing agencies together.

To minimize the impact of temporary land occupation, the key principles of restoration are as follows:

- The affected households will have priority. Thus, not only the affected people will receive job opportunities and increase their family income, but also the quality of land restoration will be ensured. If the affected households and the village collective are unwilling to restore the occupied land themselves, the land will be reclaimed by the implementing agencies.

- Strict measures will be taken to protect surface soil during construction to avoid irrecoverable impacts. During excavation, surface soil (recommended thickness 30-50cm) will be gathered and piled separately, and water loss and soil erosion prevention measures taken. After construction, subsurface soil will be backfilled first, then surface soil laid evenly on the surface, and the site leveled to mitigate the impact on farmland quality. Land that hardens temporarily during construction will be plowed immediately after construction to restore its looseness.
- For some barren land and old borrow pits, the construction agency may fill fertile channel silt to turn them into arable land and increase land resources.

To improve the economic, social and ecological benefits of the Project, and reduce the impact of temporary land occupation on farmers, the PMO has entrusted the Task Force to prepare a plan for land reclamation and medium and low yield land improvement of the spoil grounds.

# 11. Environmental Management and Environmental Monitoring

The implementation of environmental management and monitoring plan will guarantee the technology, methods and resources, and amend the deviation of environmental pollution prevention in time, so that it will be more targeted and effective to achieve the aim of preventing the pollution and protect the environment.

## 11. 1. **Agencies and Responsibilities**

Anhui Provincial Port & Shipping Construction Investment Group Co. Ltd (APPSCIG), contractor and environmental supervision engineers, external environment consultants (EEC) are responsible for the environmental management during the construction phase (see Figure 4-1). During the operation period, the responsibility of environmental management lies in APPSCIG.

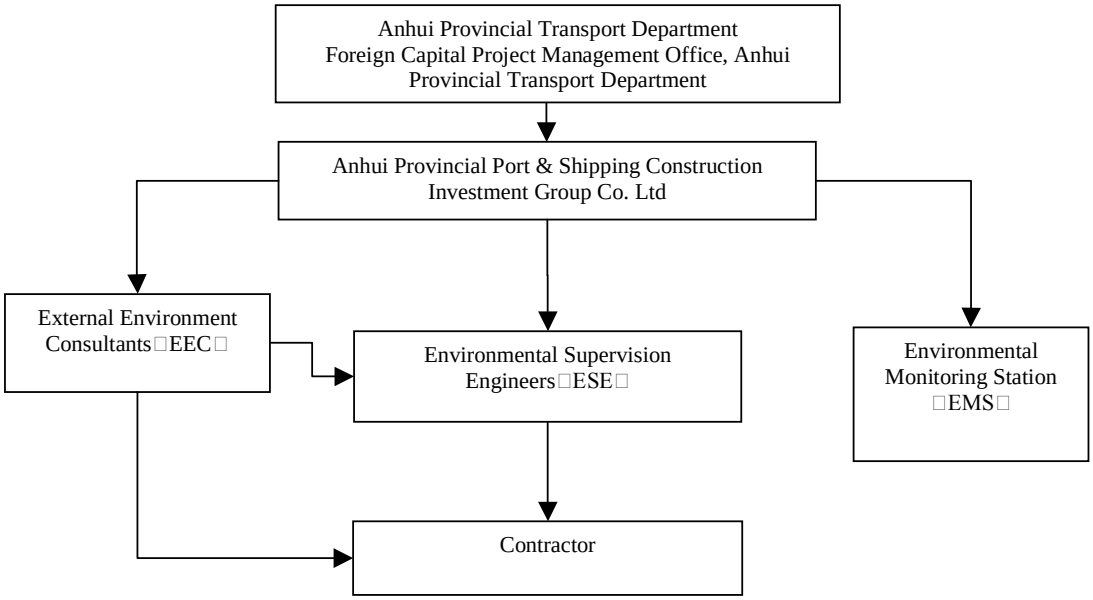



**Figure 4-1 Environmental Management System During The Construction Phase**

These environmental management responsibilities of the above agencies mainly include:

(1) Anhui Provincial Transport Department (Forgein Capital Project Management Office)

Anhui Provincial Transport Department is generally responsible for the implementation and management of environmental protection work of this project. Forgein Capital Project Management Office is responsible for supervision of the implementation of environmental protection work and coordination with the World Bank.

(2) APPSCIG

APPSCIG is in charge of the overall environmental management during the construction phase. It sets up a department of environmental protection which is responsible for an environment commissioner. There are 1-2 environment principles in the department of environmental protection in APPSCIG. The responsibilities are as the following:

- Under the management of the project office and the supervision and guidance of provincial, local (municipal) Environmental Protection sector, Forestry and Water Conservancy Bureau, APPSCIG is responsible for overall environmental management during the construction phase, submitting the environmental management report and compiling the environment monitoring report.
- Committing the monitoring agency to conduct the environment monitoring during the construction phase and provide support for the environmental monitoring.
- Ensuring the tender documents and construction contracts contain "program of environmental management". Supervising the construction unit to take pollution prevention measures. If the construction team violates the environmental regulations or doesn’t adopt the pollution prevention and control measures, APPSCIG should immediately inform them of their violation of the rules, and report to the project office. APPSCIG should assist to deal with the environmental pollution when pollution incident appears.
- Ensuring the tender documents and contract with supervision engineers contain "program of environmental management". APPSCIG should supervise and participate in the environmental supervision of the project.
- Hiring external environmental consultant (EEC) to provide the technical support for environmental protection during the construction phase, the guidance of environmental protection to the contractor and the job training of environmental protection for project managers, supervisors and contractors.

(3) Contractor

Contractor is responsible for implementing "program of environmental management," and specific environmental mitigation measures regulated in the contract. Contractor should establish the environmental protection work plan for contract, report the new environmental problems and accidental discovery of cultural sites during the construction phase to the supervision engineer, and carry out ongoing public consultation of the project. 1-2 full-time environmental staff are requested for environmental management according to the contract.

(4) External supervision engineer (ESE)

The project supervision company should appoint a environmental supervision engineer in accordance with the contract. The responsibilities of the ESE are following:

- Reviewing the design of the project accord with the requirements of “EIA” and “program of environmental management” on behalf of the project office. Especially the requirements of on-site environmental management and measures for impact mitigation.
- Supervising the on-site environmental management system of the contractor, including the performance, experience, dealing with on-site environmental problems and rectification guidance.
- Reviewing the implementation of the contractor’s “program of environmental management”, inspecting and confirming the procedures of environmental supervision, parameters, monitoring locations, equipment and results.
- Reporting the implementation of the “program of environmental management” to the project office.
- Approving the invoice or payment according to the implementation of “program of environmental management” is part of the responsibilities of supervision engineer.

(5) External environmental consultant (EEC)

The project office of APPSCIG will hire external environmental consultant□EEC□ to supervise the implementation of “program of environmental management”. EEC will contract with the project owners and be independent of the contractor and the supervision engineer. The responsibilities of the EEC are following:

- External environmental consultant will assist the project owners to carry out the training and consulting services.

- Reviewing the environmental measures of the contractor and supervision engineer.
- Assisting to compile the semi-annual report and submitting it to the project and World Bank.

(6) Environmental monitoring station

The project office of APPSCIG will entrust the environmental monitoring station to implement the environmental monitoring plan of the "program of environmental management".

(7) Anhui Provincial Environmental Protection Bureau/ Environmental Protection Bureau of counties

Ahnhui Provincial Environmental Protection Bureau is responsible for the superviaion and management of environmental protection of construction project, organization and coordination with relevant agencies to work for environmental protection, review of Environmental Impact Statements, supervision of the implementation of Environmental Action Plan and final acceptance of environmental protection of this project. The Environmental Protection Bureau should also make sure the project is in compliance with environmental laws and regulations and instruct envionrmental protection bureaus of cities and conties the environmental supervision and management of during the construction and operation phases.

Environmental protection bureaus of Fuyang City, Jieshou City, Taihe County and Yingshang County are instructed by Anhui Provincial Enviornmental Protection Bureau. They will supervise the owner to implement environmental action plan and relevant environmental management laws and regulations. They should coordinate with relevant agencies to carry out environmental protection work and be responsible for examing and supervising the construction, completion and operation of environmental protection facilities.

## 11. 2. Environmental supervision agencies and plan

### 11. 2. 1. Environmental supervision agencies

The Channel improvement project is useful for improving the navigation capacities of the channel and the environmental quality of the surface water in the region. The project will take some adverse environmental impact to the area along the river inevitably, so it is essential to set the environmental management agency, which should inspect the production process which is easy to pollute the environment

regularly or irregularly according to the national and local environmental laws and regulations so as to find the environmental problems early and take the appropriate measures.

After the completion of the project, APPSCIG who is the project owners unit is responsible for the environmental management. The Bureau of Local Marine (Port & Shipping Management) of Fuyang City will be in charge of administrational management and channel maintenance. The supervision will be carried out by Environmental Protection Agency of Fuyang City. The environmental monitoring station is commissioned to implement the environmental monitoring related to the project.

### 11. 2. 2. **Environmental supervision plan**

The supervision plan includes the design phase, construction phase and operation phase. The supervision plan of each phase can be seen in Table 11-1.

**Table 11-1 Environmental protection supervision plan**

| Phase | Supervision Agency | Supervision detail | Supervision aim |
|---|---|---|---|
| Design phase | Environmental protection Agency and Development and Reform Commission | 1.Approving the environmental management plan<br>2. Approving the preliminary design of environmental protection | 1. Ensuring the EIA is comprehensive and focus as well as appropriate topics. 2. Ensuring the significant environmental problems which may result from the project should be reflected. 3. Ensuring there is specific and feasible plans to take measures for impact mitigation. |
| Construction phase | Environmental Protection Agency and Cultural Relics Agency | 1. Inspecting the recovery of temporary occupied land, restoration of vegetation and environment.2. Inspecting the control measures for dust and noise pollution, then deicing the construction time. 3. Inspecting the treatment and disposal of the sewage and wastewater with oil.<br>4. Treatment of spoil ground. 5. The disposition of sediment.6. Inspecting for underground cultural relics | 1. Implementing Three simultaneities strictly. 2. Reducing the impact of the construction on the surrounding environment, and implementing the relevant environmental laws, regulations and standards. 3. Ensuring the water quality of the river will not be polluted. 4. Ensuring the landscape and land resources are not being damaged seriously. Preventing the soil erosion. 5. Ensuring the sediment will be disposed properly. 6. Ensuring the cultural relics will not be destroyed. |
| Operation phase | Environmental Protection Agency | 1. Inspecting the implementation of the environmental protection plan during the operation phase2. Inspecting the implementation of the monitoring plan during the operation phase. 3. Inspecting the environmental quality of the sensitive points whether meet the requirements of the environmental criterion. | 1. Putting the environmental protection plan into effect. 2.Putting the monitoring plan into effect.3. Strengthening the environmental management and protect the human health effectively. |

## 11. 3. Environmental management plan

## Table 11-2 The implementation plan of environmental protection measures during the design phase

| Activity | Potentialı impact / Problem | Mitigation measures | Implementation schedule | Budget □10,000 RMB□ | Responsibilities of implementation | Responsibilities of supervision | Monitoring indicators | Monitoring frequency |
|---|---|---|---|---|---|---|---|---|
| Land expropriation and resettlement | | ⌘ Choosing the disposal area reasonably, optimizing the design of the chute cutoff and reducing the amount of land expropriation and resettlement as much as possible.<br>⌘ Preparing “Resettlement action plan” | Design and EIA/ Preparation phase of Resettlement action plan | — | Design unit, EIA team, and consultant of resettlement plan | APPSCIG, Anhui Provincial Transport Department (APTD), World Bank, Land and Resources Bureau | Resettlement action plan according to the policies of the WB | The regular meeting among the design unit, EIA team and agency of resettlement action plan. |
| Design of soil erosion control plan | The soil erosion caused by dredging, chute cutoff and disposal area. | ⌘ Determining 12 chute cutoff sections and 34 disposal areas.<br>⌘ Report of the soil and water conservation program of Shaying River Channel Improvement Project which is established on the basis of “Law of the People's Republic Soil and Water Conservation” is a legal document and the component of comprehensive environmental management system. The report includes the measures for soil erosion control measures in the construction preparation phase, bridge reconstruction, disposal area, management and service area, temporary construction works, demolition and resettlement areas, etc. It also provides the supervision plan (incorporated in the bidding documents /contracts), and the implementation of supervision and budget. | Design and EIA preparation phase | 60 | Design unit, water conservancy assessment agency and EIA team | APPSCIG, APTD, World Bank, Water Conservancy Agency | Report of the soil and water conservation program of Shaying River Channel Improvement Project approved by Water Conservancy Agency□incorporated in the design and bidding documents□ | The regular meeting among the design unit, water conservancy assessment agency and EIA team |
| Program of bridge | Traffic blocked | ⌘Lieshou City: Construcing the Yinghe Road and Dongsheng Road Bridge | Design and EIA preparation | — | Design unit, and EIA team . | APPSCIG, APTD, World | Included in the preliminary design | The regular meeting |

| Activity | Potentialı impact / Problem | Mitigation measures | Implementation schedule | Budget □10,000 RMB□ | Responsibilities of implementation | Responsibilities of supervision | Monitoring indicators | Monitoring frequency |
|---|---|---|---|---|---|---|---|---|
| reconstruction | | simultaneously. After the opening of Dongsheng Road Bridge, the Shaying River Bridge S204 will be rebuilt. After the completion of that, demolishing the Yumin Bridge. ⌘Taihe County: constructing the Yinghe IV Bridge and municipal road at the north and south firstly. Rebuilding the Yinghe II Bridge then, after the completion of the reconstruction, demolishing the Yinghe I Bridge and constructing the pedestrian bridge in situ. | phase | | | Bank, | and detailed design | among the design unit, local government and EIA team. |
| Design of service area | Wastewater discharge and solid waste disposal | ⌘Secondary biological sewage treatment plant in the service area (including the device for grease trapping and pretreatment of grit deposition) | Design and EIA preparation phase | 70 | Design unit and environmental protection design unit. | APPSCIG, APTD, World Bank, | Included in the detailed design. | The regular meeting between the design unit and environmental protection design unit. |

## Table 11-3 The implementation plan of environmental protection measure during the construction phase

| Activity | Potentialı impact / Problem | Mitigation measures | Implementation schedule | Budget □10,000 RMB□ | Responsibilities of implementation | Responsibilities of supervision | Monitoring indicators | Monitoring frequency |
|---|---|---|---|---|---|---|---|---|
| Channel improvement project, disposal area and detour construction | Occupying the overflow wetland<br><br>Loss of vegetation and arable land<br><br>Soil erosion | ⌘Forest land expropriation will be carried out in accordance with legal procedures of relevant laws.<br>⌘The determined disposal area will be used. The new disposal areas should be reviewed/approved by the environmental supervision engineer<br>⌘Strengthening the collection of surface soil before disposal for future reclamation.<br>⌘Arranging the working time reasonably. During construction at overflow wetland, especially in National Wetland Park (k25 ~ k38 +500), working time should be optimized to avoid peak of wild animals' activities. Morning, dusk and night are peak periods of wild animals' activities, breeding and feeding. Works like piling that cause high-level noise should be forbidden in the mornings, dusks or nights. The piling and other operations with high noise should be prohibited in the morning, evening and night.<br>⌘Publicity and education of environmental protection during the construction should be | Construction phase | Water conservation measures and greening□2674 | Contractor | APPSCIG and environmental supervision engineer□ESE□. | Implementing "the water conservancy program" and the measures proposed in the EIA documents. | Supervised by the ESE everyday. |

| Activity | Potentiaı impact / Problem | Mitigation measures | Implementation schedule | Budget □10,000 RMB□ | Responsibilities of implementation | Responsibilities of supervision | Monitoring indicators | Monitoring frequency |
|---|---|---|---|---|---|---|---|---|
| | | conducted. The staff should not hurt provincial protected animals, like Lanius schach, Bufo raddei, Bufo gararizans and Chinemys reevesii if detected. If animals are hurt by accident, wild animal protection sector should be informed and professionals will deal with the accident.<br>⌘⌘Controlling the occupation of overflow lands. It is forbidden to build construction camps or piling yards on overflow lands.<br>⌘⌘The greening of slope should be considered with priority after the channel improvement and be combined with the concrete and masonry construction reasonably. The greening of the slope and that on the shore should form the ecological corridor together. | | | | | | |
| Chute cutoff works, disposal area and detour construction | Damage to cultural property | ⌘⌘Complying with the occasional procedures□<br>-Stopping digging immediately after the discovery and protecting the scene.<br>-Reporting to the ESE/project office. Then ESE/project office reports to the local Cultural Relics agency.<br>-Only after the Cultural Relics Agency carries out necessary survey and rescue protection, and provides with the approval, the construction can restart.<br>⌘⌘Education for the construction | Construction phase | — | Contractor | APPSCIG, Fuyang Cultural Relics Administration and ESE. | *"Law of the People's Republic of China Cultural Relics Protection"* | Supervised by the ESEr everyday. |

| Activity | Potentiaı impact / Problem | Mitigation measures | Implementation schedule | Budget □10,000 RMB□ | Responsibilities of implementation | Responsibilities of supervision | Monitoring indicators | Monitoring frequency |
|---|---|---|---|---|---|---|---|---|
| | | workers about protecting cultural property and knowledge about the occasional procedures.□ | | | | | | |
| Channel improvement and bridge construction | Impact of dredging and bridge construction on the water quality,<br><br>Discharge of waste water into the surface water<br><br>Discharge of residual water at disposal area. | ⌘□Building latrines in construction camps. Septic tanks should also be built to treat the wastewater before it is discharged into surrounding abandoned lands or ditches. Construction camps should be 200m away from the Shaying River. Direct discharge into the Shaying River is forbidden.<br>⌘□Smaller reamer should be used for dredging in this area so as to reduce the disturbed radius when dredging and reduce the impact of river sediment SS on water quality.<br>⌘□When SS of residual water exceeds the standards at later period of reclamation, flocculants can be added at the place where slurry goes into the cofferdam to control water quality so as to control the water quality of the remained water. The treated residual water should meet the standards of Grade II in the "Integrated wastewater discharge standard" (GB8978-1996). It discharged into the nearby ditches directly and goes into the Shaying Rive finally.<br>⌘□Sedimentation tanks should be set at front mixer, concrete pumps, and | Construction phase | 448 | Contractor | APPSCIG and ESE | The surface water quality meets the requirements of "*Environmental Quality Standard for Surface Water" (GB3838-2002)"* | Supervised by the ESE everyday.<br><br>Supervised by the environmental monitoring station periodically.□Table 11-5□ |

| Activity | Potentialı impact / Problem | Mitigation measures | Implementation schedule | Budget □10,000 RMB□ | Responsibilities of implementation | Responsibilities of supervision | Monitoring indicators | Monitoring frequency |
|---|---|---|---|---|---|---|---|---|
| | | transport vehicles cleaning place. Wastewater should not be directly discharged into the river. After the secondary precipitation, it can be recycled and reused for water spraying to reduce dust.<br>⌘□As for on-site storage of oil, the storeroom must take anti-seepage treatment. Proper measures should be taken for storage and use to prevent oil leakage, soil contamination and water pollution.<br>⌘□Scattered materials in construction sites should be cleaned up in time. Measures against water scouring and leaching should be taken for materials piling to avoid being rushed into the river and polluting the water. | | | | | | |
| Construction site and materials transportation. | Impact of the noise on the nearby communities. | ⌘□Utilizing the low-noise equipment and methods of noise reduction and isolation. Maintaining regularly. Transport vehicles should slow down in construction site and use of whistle should be reduced. when entering the site.<br>⌘□Make a reasonable arrangement of working time. It should be avoided to use a lot of noisy equipment at the same time. In addition, high noise equipment should be scheduled at daytime and avoid nighttime | Construction phase | 50 | Contractor | APPSCIG and ESE | Implementing proper mitigation measures. | Supervised by the ESE everyday.<br><br>Supervised by the environmental monitoring station periodically.□Table 11-5□ |

| Activity | Potentiali impact / Problem | Mitigation measures | Implementation schedule | Budget □10,000 RMB□ | Responsibilities of implementation | Responsibilities of supervision | Monitoring indicators | Monitoring frequency |
|---|---|---|---|---|---|---|---|---|
| | | (22:00~06:00).<br>⌘Setting the mobile sound barrier for the noise-sensitive points.<br>⌘Use of power machinery at the same location should be avoided in order to reduce local noise level. Modern communications equipment can be used.<br>⌘Closed hangar should be set for strong-noise equipment. They should be set at the side away from the residential area.<br>⌘The project owner should jointly with construction unit inform the surrounding residents with the construction period. Disturbed units and residents should be notified before the construction. In addition, during the construction phase, complaint telephone hotline should be set to receive complaints of noise nuisance and active management should be conducted according to complaint.<br>⌘If construct at night is needed□<br>- consulting with the nearby communities prior,<br>- getting the approval from local government.<br>- posting the announcement to notify the nearby communities<br>- carrying out noise monitoring | | | | | | |
| Bridge demolition and | Impact on the local traffic and safety. | ⌘Implement the traffic arrangement program in the construction phase proposed by the design | Construction phase | See contract | Contractor | APPSCIG and ESE | Implementing proper mitigation | Supervised by the ESE everyday. |

| Activity | Potentialı impact / Problem | Mitigation measures | Implementation schedule | Budget □10,000 RMB□ | Responsibilities of implementation | Responsibilities of supervision | Monitoring indicators | Monitoring frequency |
|---|---|---|---|---|---|---|---|---|
| reconstruction, construction site and materials transportation | | unit.<br>⌘Contractor will prepare reasonable construction program, including the reasonable transportation routes and change plans of goods transportation.□<br>⌘The construction of detour should be reviewed/approved by ESE.<br>⌘Notifying the specific time and place for bypassing, and setting the signboard in the construction site before the project starts.<br>⌘Organized by the local government, consulting with the urban traffic management agency, planning agency, municipal construction management agency, environmental protection sector and other government agencies to acquire their support so as to distribute vehicles and pedestrians properly. | | | | | measures. | |
| Disposal area, construction site and materials transportation | Odor from disposal area and the impact of construction dust on the nearby communities. | ⌘Dredging works should be conducted in the dry season, preferably in winter, when the spread of smell is difficult, so it can reduce the impact of odor on the surrounding residents.<br>⌘Construction should be carried out section by section. The dredged sludge should be timely delivered to sediment piling yard. Ecological restoration should be carried out in time.<br>⌘If the sludge is utilized, it should be transported in sealed tanker, in | Construction phase | 20 | Contractor | APPSCIG and ESE | Implementing proper mitigation measures. | Supervised by the ESE everyday. |

| Activity | Potentiali impact / Problem | Mitigation measures | Implementation schedule | Budget □10,000 RMB□ | Responsibilities of implementation | Responsibilities of supervision | Monitoring indicators | Monitoring frequency |
|---|---|---|---|---|---|---|---|---|
| | | order to prevent odor pollutant emissions on the way.<br>⌘Barriers with height not less than 1.8m should be set around bridge reconstruction sites. During demolishment of bridge pier, watering on the ground should be carried out in order to reduce dust. Barriers for collecting residue should be set in waters in order to ensure that residue can be transported in three days after the construction.<br>⌘Main construction roads must be hardened through covering, consolidating, greening, sprinkling and other effective measures.<br>⌘Cement and other particle building materials which are easy to flying, should be stored sealedly. Lime and sand in the construction site should be piled and covered.<br>⌘Cement and other particle building materials which are easy to flying, should be stored sealedly. Lime and sand in the construction site should be piled and covered.<br>⌘In case of wind stronger than Grade IV, the construction such as earth filling and transporting and so on, which may cause dust, is forbidden.<br>⌘Vegetation restoration is needed to | | | | | | |

| Activity | Potentialı impact / Problem | Mitigation measures | Implementation schedule | Budget □10,000 RMB□ | Responsibilities of implementation | Responsibilities of supervision | Monitoring indicators | Monitoring frequency |
|---|---|---|---|---|---|---|---|---|
| | | prevent soil erosion after temporary land using. | | | | | | |
| Bridge demolition and construction of construction camps | Domestic waste and construction waste | ⌘The construction waste must be transported in special sealed garbage pipe or be lifted in sealed container. Sealed garbage station e should be set at the construction sit. Construction waste, domestic solid waste should be classified and stored.<br>⌘Abandoned gravel, building materials, steel and packaging materials should be recycled by professionals and the working face should be timely cleaned up.<br>⌘The waste of bridge reconstruction should be filled in the designated locations. It should not be dumped into the ditches. It can be of full use combined with foundation leveling in villages and towns. Construction waste at urban area in Fuyang can be utilized for foundation leveling of comprehensive construction north to Fuyang Lock. Construction waste that comes from Jieshou, Yingshang and Taihe can also be used for foundation leveling in industrial areas.<br>⌘The domestic waste generated by construction should be collected and treated in time by local sanitation department. | Construction phase | 100 | Contractor | APPSCIG and ESE | Implementing the proper mitigation measures. | Supervised by the ESE everyday. |

| Activity | Potentialı impact / Problem | Mitigation measures | Implementation schedule | Budget □10,000 RMB□ | Responsibilities of implementation | Responsibilities of supervision | Monitoring indicators | Monitoring frequency |
|---|---|---|---|---|---|---|---|---|
| Construction camps and workers | Spread of disease | ⌘Contractor consults with the local government and the public to set the camps.<br>⌘Providing adequate sanitation facilities in the camps.<br>⌘The layout of public facilities should be based on the general layout of the construction combined with actual situations of project management and construction personnel. To build permanent, semi-permanent and temporary facilities.<br>⌘The construction personnel should be quarantined before entering the construction site. 10% of the construction workers will be selected for quarantine twice during the construction phase.<br>⌘Strengthening the supervision and management of food hygiene. The staff working in food and beverage industry must hold a health certificate.<br>⌘Educating the nearby residents about safety in advance, including prevention and control of infectious diseases (such as: HIV / AIDS) | Construction phase | See contract | Contractor | APPSCIG and ESE | Implementing the proper mitigation measures. | Supervised by the ESE everyday. |

**Table 11-4 The implementation plan of environmental protection measures during the operation phase**

| **Activity** | **Potentialı impact / Problem** | **Mitigation measures** | **Implementation schedule** | **Budget □10,000 RMB□** | **Responsibilities of implementation** | **Responsibilities of supervision** | **Monitoring indicators** | **Monitoring frequency** |
|---|---|---|---|---|---|---|---|---|
| Sailing vessels, service area operation | The discharge of wastewater from vessels and domestic wastewater may pollute the Shaying River. | ⌘Installing underground wastewater treatment equipment Guozhuang and Sanhilipu service areas. Oil water being treated by grease trap before being discharged into sewage system. It then converges with domestic wastewater treated in septic tank and goes into underground wastewater treatment equipment. The discharge should meet the standards.<br>⌘Equipping the collection facilities for wastewater from vessels in service areas. | Before the operation<br><br>During the operation phase | 160 | APPSCIG | APPSCIG and local environmental protection sector. | Permanganate index, SS, oil pollutants | Once a month, see Table 11-5. |
| Sailing vessels, service area operation | Problems of solid waste treatment | ⌘Equipping the collection facilities for garbage from vessels to collect the waste that arrive the port<br>⌘The domestic waste on land and from the vessels should be collected and cleaned by the local sanitation agency. Then the waste will be sent to the municipal domestic refuse plant. | During the operation phase | 20 | APPSCIG | APPSCIG and local environmental protection sector. | Collection and disposal of waste | Cleaning regularly |
| Sailing vessels | The impact of noise on the residents along the channel | ⌘The vessels must use strong directional speakers, with limit of using time. Lights should be used instead of speakers at night when ships enter into urban areas with dense population, so as to solve the noise problem. | During the operation phase | — | APPSCIG | Fuyang Port & Shipping Management Bureau (FPSMB) and local environmental protection sector. | Leq | Twice a year, see Table 11-5 |
| Ecological environment restoration | The survival of the plants in the green area. | ⌘Maintaining the green area along the channel and service areas.<br>⌘The restoration of disposal area | During the operation phase | See the operation costs | APPSCIG | APPSCIG and water conservancy sector | Soil erosion control program | Once a year, see Table 11-5 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sailing vessels | Collisions, oil spills and other environmental risks | ⌘Vessels that transport flammable, explosive, corrosive, toxic and radioactive substances should hang the required signals and comply with the "Supervision and Management Regulations of Ships Carrying Dangerous Goods" by Ministry of Transport.<br>⌘Propose emergency response plans<br>⌘Equipping necessary emergency rescue facilities in the two service areas and Genglou Ship Lock, which is located in Anhui Province Taihe County Shaying River National Wetland Park. The facilities include emergency protective and handling vehicles, detoxification drug, liquid and solid materials cleaning equipment, rubber plugs and sand bags, etc. | During the operation phase | 66.48 | APPSCIG, and FPSMB | APPSCIG, FPSMB and local environmental protection sector. | Implementing the risk prevention measures correctly. | |

## 11. 4. **Environmental supervision**

The project of Channel improvement of Shaying River which is a large construction may cause significant ecological environmental impact. So the construction must follow the requirements of documents of Ministry of Communications *"Notice of carrying out the environmental supervision in traffic project"* to carry out environmental supervision so as to promote the cleaner production and "minimum damage and maximize recovery of the ecological environment during the construction phase", as well as making the project construction meet the demands of environmental protection which means the noise and the discharge of waste gas and sewage should up to the relevant standards. Ensuring the adequate investment for environmental protection and constructing and operating the environmental facilities for environmental protection, ecological restoration and water environment protection at the same time with the main project. Environmental supervision is very important for implementing every environmental protection measures, the supplement for project supervision and the basis for final acceptance of environmental protection of the planed project.

Environmental supervision engineer (ESE) plays an important role in the system of management and supervision. The environmental supervision engineer of the project should be ensured to integrate into the system of project supervision engineer, which means to assign the supervision responsibilities to the whole contract of the project supervision engineer.

Meanwhile, the external environmental consultant should be taken into the supervision system. External environmental consultants who are independent on the contractors and supervision engineers sign the contract with the project owners directly. External environmental consultants will assist the project owners to carry out training and consulting, review the environmental measures of the contractor and supervision engineer and assist to compile the semi-annual environmental supervision report which required by World Bank during the implementation period.

## 11. 5. **Environmental monitoring plan**

### 11. 5. 1. **Objectives**

Environmental monitoring covers construction phase and operation phase. It aims to know the dynamic pollution situation of the project, impact of the project puts on the local environmental quality and its degree and extent during the operation phase comprehensively and timely. Reporting the information to the competent department in order to provide the basis for environmental management.

### 11. 5. 2. **Monitoring agency**

The environmental monitoring covers noise, water, ecology and other aspects, so the monitoring professionals and instrument are very complicated. The construction unit is advised to entrust the monitoring agency with certification.

### 11. 5. 3. **Monitoring program**

#### 11.5.3.1. Monitoring of Surface Water Quality at Dredging Areas

(1) Objectives: monitoring impacts of dredging works

(2) Object: Since impacts of dredging works are the focus of this monitoring, pollutants in water in dredging area are the objects of water quality monitoring.

(3) Items: SS, TN, TP, COD, permanganate value, pH, oil pollutants, ammonia nitrogen, etc. Water temperature and depth are monitored simultaneously.

(4) Sampling sites: 4 sampling sites will be set at urban area sections in Jieshou, Fuayng and Yingshang.

(5) Sampling time and frequency

① Sampling will be carried out once before and after the dredging respectively. It will be used as background value for monitoring at the construction phase.

② During the construction phase, if dredging is carried out at the sampling site, it should be sampled once every ten days. It should be sampled once a quarter at other sampling sites.

(6) Sampling and monitoring techniques

Techniques should be selected in accordance with “Technical Specifications of Environmental Monitoring”.

11.5.3.2. Monitoring of Discharged Water at Service Areas

(1) Monitoring sites: sewage outlets at Fuyang Guozhaung and Sanshilipu Service Area

(2) Monitoring item: permanganate value, SS, oil pollutants

(3) Frequency: once per month, continuous 3 days per time, once per day

11.5.3.3. Monitoring of Residual Water at Disposal Areas

(1) Objectives: checking effectiveness of residual water treatment to ensure that residual water discharged outside the area can meet the standards and to avoid secondary pollution.

(2) Sampling sites and sampling

Sampling sites are set at outlets of each disposal area. Sampling will be carried out once per month. Continuous sampling time is no less than 5 hours.

(3) Item: SS, TN, TP

11.5.3.4. Noise monitoring

Construction noise sources are mainly construction vessels, mud pump, transport vehicles and machines for ground leveling at disposal areas. The noise level ranges from 80 to100 dB (A). Noise monitoring sites can be set at sensitive points near the operation sites. Monitoring time includes daytime and nighttime.

Noise sources during the operation phase are mainly vessels. Noise monitoring sites can be set at urban areas in Jieshou, Taihe, Fuyang and Yingshang.

11.5.3.5. Ecological monitoring

(1) Investigation of the situation of ecological restoration

① Objectives

Research the situation of ecological restoration for the channel through investigation of the restoration of terrestrial and aquatic ecosystems in the project region.

② Item: Terrestrial, wetland, emergent, floating and submerged plants and relevant animal species

a. 3 investigation points are set in Taihe Shaying River National Wetland Park (k26 near Genglou Ship Lock), urban area section in Fuayng City (k80 near Fuyang Ship Lock ) and Mohekou (k202+700).

b. Contents: species, composition, dominant species and biomass of terrestrial, wetland, emergent, floating and submerged plants and relevant animals.

(2) Monitoring of plants at disposal area

For plants like trees and flowers cultivated in disposal areas, the soil and heavy metals in fruit, flower and leaves should be monitored. Monitoring time is once a year and continuous 3 years.

(3) Methods

Monitoring should be carried out in accordance with “Technical Specifications of Environmental Monitoring” and “Order of Environmental Standard Analysis Methods”.

**Table 11-5 Monitoring Program at Each Phase**

| Phase | Content | Time and frequency | Site | Item |
|---|---|---|---|---|
| Construction phase | Water quality of the river | ① Once before and after the dredging respectively. It will be used as background value for monitoring at the construction phase. ②During the construction phase, if dredging is carried out at the sampling site, it should be sampled once every ten days. It should be sampled once a quarter at other sampling sites. | urban area sections in Jieshou, Fuayng and Yingshang. | SS, TN, TP, COD, permanganate value, pH, oil pollutants, ammonia nitrogen, etc. Water temperature and depth are monitored simultaneously. |
| | Residual water at disposal areas | Once per month. Continuous sampling time is no less than 5 hours. | Outlets of each disposal area | SS□TN□TP |
| | Noise | Rush hour of construction: one day half year, once at daytime and once at nighttime | Sensitive points near dredging and disposal areas | Leq |

| Phase | Content | Time and frequency | Site | Item |
|---|---|---|---|---|
| Operation phase | Quality of discharged water at service area | Once per month, continuous 3 days per time, once per day | sewage outlets at Fuyang Guozhaung and Sanshilipu Service Area | Permanganate value, SS, oil pollutants |
| | Noise | Twice per year, one day per time; once at daytime and once at nighttime | Urban areas in Jieshou, Taihe, Fuyang and Yingshang | Leq |
| | Ecological monitoring in the channel | Once per year, continuous tree years | Taihe Shaying River National Wetland Park (k26 near Genglou Ship Lock), urban area section in Fuayng City (k80 near Fuyang Ship Lock ) and Mohekou (k202+700). | Species, composition, dominant species and biomass of. terrestrial, wetland, emergent, floating and submerged plants and relevant animals |
| | Ecological monitoring at disposal areas | Once per year, continuous tree years | 1□□3□□4□□11□□19□□29□□34□ disposal areas | Soil and heavy metals in fruit, flower and leaves of plants like trees, flowers and crop cultivated in disposal areas |

11.5.3.6. Approval and Archiving of Monitoring Materials

Monitoring materials during the construction phase should be analyzed. Suggestions to improve original environmental protection measures should be

proposed on the basis of monitoring data. Various data should be stored in computer. Annual collation and assessment of the monitoring data should be conducted.

Approval mechanism should be established for quality of the monitoring report. Materials should be documented for inquiry after the approval. Periodical report should be submitted to local environmental sector during the project process in order to implement the check of environmental protection measures and effectively control unexpected adverse environmental impacts. This is the basis for future environmental management and research in the region.

## 11. 6. **Environmental Protection Investment**

This project can improve navigation capacity of Shaying River channel, reduce aggradations and scouring. It is also good for water quality, water conservancy, air quality and landscape. However, it will also cause some environmental impacts during the construction phase and operation phase, referring to investment on residual water treatment, ecological restoration at disposal areas and chute cutoff sections and environmental monitoring, etc. Environmental protection investment is estimated in Table 11-5. Total investment for environmental protection in this project is about 40.0848 million RMB. Total investment of this project is 1905.8055 million RMB. Environmental protection investment accounts for 2.1%.

**Table 11-6 Estimation of Environmental Protection Investment (Unit: 10,000 RMB)**

| No. | Item | Cost | Other cost | Total | Note |
|---|---|---|---|---|---|
| | Part I: engineering cost | | | | |
| 1 | Air pollution control during the construction phase | 20 | | 20 | |
| | 200m barrier | 5 | | | |
| | Temporary road hardness | 5 | | | |
| | Spraying to control dust | 4 | | | |
| | Temporary factory shed | 6 | | | |
| 2 | Noise control during the construction phase | 50 | | 50 | |
| | Mobile sound barrier | 35 | | | |
| | Closed hangar | 15 | | | |
| 3 | Water pollution control during the construction and operation phases | 200 | | 200 | |
| | Septic tanks, grit chamber | 40 | | | Calculated as 20,000RMB at one site. 20 sites in total |
| | Secondary biological treatment equipment at service area | 160 | | | Calculated as 800,000RMB/equipment, including grease trap and grit deposition pre-treatment equipment. |
| 4 | Solid waste control during the construction and operation phases | 120 | | 120 | |
| | Temporary pile yard of construction waste | 100 | | | |
| | Garbage bin and transfer station | 20 | | | |
| 5 | Residual water treatment at disposal area | 408 | | 408 | Calculated as 120,000RMB at one site |

| | | | | | |
|---|---|---|---|---|---|
| | 34 grit chamber | 340 | | | Calculated as 100,000RMB at one site |
| | Drug added in residual water | 68 | | | Calculated as 20,000RMB at one site |
| 6 | Emergency facilities | 66.48 | | 66.48 | See Table 6-12 |
| 7 | Ecological restoration at disposal areas and chute cutoff sections | 1000 | | 1000 | |
| | Surface soil transferring, storage and covering | 300 | | | |
| | Planting | 700 | | | |
| 8 | Environmental monitoring | 120 | | 120 | |
| | Water environmental monitoring | 40 | | | |
| | Acoustic environmental monitoring | 30 | | | |
| | Ecological monitoring | 50 | | | |
| 9 | Training | | 40 | 40 | |
| | Part II: preliminary work and investigation and design costs | | | | |
| 1 | Environmental protection design | | 120 | 120 | |
| | EIA | | 50 | | |
| | Design of environmental treatment project | | 70 | | |
| 2 | Environmental supervision | | 130 | 130 | |
| | Part III: water and soil conservancy | | | | |
| 1 | Design of water and soil conservancy program | 60 | | 60 | |
| 2 | Ecological restoration except that for disposal areas and chute cutoff sections | 1514 | | 1514 | |
| 3 | Greening | 160 | | 160 | |
| | Total | 3718.48 | 290 | 4008.48 | |

# 12. Public Participation

## 12. 1. **Objectives**

Any construction will cause good or bad effects to the natural and social environment around it and also will affect the public benefits in the neighborhood directly or indirectly. This EIA is a communication approach between the EIA team and the public. It helps the public to know more about the project and the environmental problem caused, so that the public can get a proper chance to express our opinions and provide helpful suggestions to mitigate the environmental pollution and loss, which is essential to the construction decision and implementation.

Through the investigation among the public, we can get public recognition, attitude and requirement to the project, so that we can think about the overall suggestions and make the project planning more reasonable. Also the environmental protection measures can be made be in line with the requirements of environmental protection and economic development to enhance the environmental and social benefits to ensure the sustainable development. The purpose of public participation lies in:

(1) To help the public understand the basic information and the potential environmental effects of this project, and collect their opinions, suggestions and requirements to the project;

(2) To improve the communication among the public, the project owner and other stakeholders, letting the public get involved into the EIA;

(3) Combined with the public participation, to make up the negligence that may happen within the EIA, in order to make the whole project more perfect and reasonable, and get the optimization of environmental, social and economic benefits.

## 12. 2. **Approaches and Stages**

According to the “Interim Procedure on the Public Participation in Environmental Impact Assessment’ (No. 28 document, 2006 Huanfa) issued by State Environmental Protection Administration on Feb. 14$^{th}$, 2006 and related requirements of the World Bank, the approaches of public participation of this EIA include media

announcement, interview with related department, public notice and questionnaire, in order to get the feedback from the public, particularly the people affected directly by this project and explain their problems.

In order to know well about the public's attitude towards the project and the satisfaction rate of the environmental protection strategy, the public participation of this project can be divided into two stages.

□1□The first stage: from April to May, 2008, while Anhui Provincial Environmental Science Institute published "Environmental Impact Statement of Channel Improvement Project at the Shaying River Section in Anhui Province", they conducted three times of public participation through media announcement, related department interview and questionnaire. The first was carried out at the inception phase of EIA (April 7$^{th}$ – 16$^{th}$, 2008), the media announcement on the website of Fuyang Local Maritime Bureau. The second was carried out before the report being published through related department interview, public notice and questionnaire. They interviewed the government departments and residents along the river. Altogether 150 copies of questionnaire were sent out and actually 136 copies were got back. The recovery rate is 90.7%. The investigation scope covers nearby residential areas, units and possibly affected people. The third investigation was carried out after the draft environmental impact statement was completed (May 14- 24, 2008). The media announcement on the website of Fuyang Local Maritime Bureau and Yingzhou Evening Paper was conducted.

(2) The second stage: from December 2009 to March 2010, after being commissioned, the EIA team carried out twice public participation with residents and units along the river, according to the related requirements of the WB and based on the "Environmental Impact Statement of Channel Improvement Project at the Shaying River Section in Anhui Province" through media announcement, related department interview, questionnaire and meetings. The aim was to get the public's opinions about the environmental impacts and their requirement on the environmental protection measures. Altogether 100 copies of questionnaire were sent out and 94 copies were got back. The second participation was carried out after the draft EIA report was completed. It was announced on the websites of Anhui Provincial Transport Department, Fuyang Local Maritime Bureau, Anhui Provincial Port & Shipping Construction Investment Group Co. Ltd and Fuyang Daily. Copies of the report were

also put in Fuyang, Jieshou, Taihe County and Yingshang County Port & Shipping Management Bureaus for the convenience of citizen to read.

The process of public participation is shown in Table 12-1.

**Table 12-1 Process of public participation**

| Stage | Time | Object | Approach | Content |
|---|---|---|---|---|
| 1st phase | 2008.4.7□4.16 | Residents along the river | Media announcement | Project situation and EIA process were announced on the website of Fuyang Local Maritime Bureau to gain the opinions and suggestions of affected residents on the project and advices from stakeholders |
| | 2008.4 | Government sectors in Fuyang City and relevant counties and cities | Interview, questionnaire survey | Investigation of environment, water conservancy, forestry resources, sensitive areas, wild animals, urban planning and land use. Consulting opinions on project engineering and relevant aspects. |
| | 2008.4 | Residents along the river | Notice | Notice at government billboard at Jieshou, Taihe, Fuyang and Yingshang to make the public know more about this project |
| | 2008.4 | Residents along the river | Individual interview, questionnaire survey | Attitudes to this project and thoughts of possible environmental impacts; expected environmental protection measures; and requirements on land expropriation, building demolition and resettlement. |
| | 2008.5.14□5.24 | Residents along the river | Media announcement | Project overview and EIA conclusions were announced on the website of Fuyang Local Maritime Bureau to gain the opinions and suggestions of affected residents on the project and advices from stakeholders |
| | 2008.5.15 | Residents along the river | Media announcement | Project overview and EIA conclusions were published on the Yingzhou Evening (issue 3548, 3rd edition) to gain the opinions and suggestions of affected residents on the project and advices from stakeholders. |

| Stage | Time | Object | Approach | Content |
|---|---|---|---|---|
| | 2009.12 | Government sectors in Fuyang City and relevant counties and cities | Interview, questionnaire survey | Make-up investigation of fishery resources, forestry resources, sensitive areas, wild animals, cultural heritage, etc. Consulting opinions on project engineering and relevant aspects. |
| 2nd phase | 2009.12 | Residents along the river | Iinterview, questionnaire survey | Attitudes to this project and thoughts of possible environmental impacts; how much they can accept the proposed environmental protection measures; and requirements on land expropriation, etc. |
| | 2009.12.5 | Residents in Xinzha Village | Meeting | Attitudes to chute cutoff works of this project; how much they can accept the proposed environmental protection measures; and requirements on land expropriation, building demolition and resettlement. |
| | 2009.12.6 | Residents in Fangzhou Village | | |
| | 2010.4 | Residents along the river | Media announcement | Project overview, EIA conclusions and proposed measures were announced on the websites of Anhui Provincial Transport Department, Fuyang Local Maritime Bureau, Anhui Provincial Port & Shipping Construction Investment Group Co. Ltd to gain the opinions and suggestions of affected residents on the project and advices from stakeholders |
| | 2010.4.13 | Residents along the river | Media announcement | Project overview and EIA conclusions and proposed measures were published on the Fuyang Daily (issue 11784, 4th edition) to gain the opinions and suggestions of affected residents on the project and advices from stakeholders |
| | 2010.3~4 | Residents along the river | Taking and reading Report | Copies of the report were also put in Fuyang, Jieshou, Taihe County and Yingshang County Port & Shipping Management Bureaus for the convenience of citizen to read. |

## 12. 3. **Results and Analyses**

### 12. 3. 1. **Results of the 1st Round Public Participation and Survey**

(1) The first media announcement

Media announcement was mainly through the website of Fuyang Local Maritime Bureau (April 7th – 16th, 2008) to announce the project procedure and EIA process, to collect the public and other stakeholders' suggestions widely.

(2) Dissemination of questionnaire and notice

After editing the EIA outline and analyzing the situation of pollution and soil erosion, questionnaire of public participation was composed. Family or individual interviews mainly focus on the village residents and enterprises nearby. The details are shown in table 12-1. At the same time, the project owner and EIA team placed the notice of the project at Jieshou, Taihe, Fuyang, and Yingshang, so that the public can know more about the procedure. Fig. 12-1 shows picture of the notice. During the investigation, in order to let the public know more about the project and come up with the proper suggestions, the investigators tried to answer the problems raised by the public in detail and improved the environmental protection measures in this EIA report.


□Notice in Jieshou□

□Notice in Taihe□

□Notice in Fuyang□

□Notice in Yingshang□

**Fig. 12-1 Pictures of Notice**

(3) The second media announcement

After the draft EIA report is completed. The second media announcement was initiated. It was announced on the website of Fuyang Local Maritime Bureau (May 14th -24th, 2008), the notice announced the project procedure and EIA conclusions, widely collecting the suggestions to the project from different social parties.

12.3.1.1. Statistic Results

The announcement on the website of Fuyang Local Maritime Bureau published the "Announcement of Environmental Impact Statement of Channel Improvement Project at the Shaying River Section in Anhui Province" (1) (2). It is also published on the Yingzhou Evening Paper on May 15th, 2008 (issue 3548, 3rd edition), in order to let the public know the overview, purpose and possible environmental impacts of this project and ask for the public's advice. It achieved the purpose to announce the information and during the period of announcement, either the EIA team or the project owner did not receive any feedback.

Therefore, this public participation evaluation mainly based on the questionnaire.

The investigation group sent out 150 copies of questionnaire in April 2008, actually collected back 136 copies. The recovery rate is 90.7%. The investigation covers the residential areas and units in the neighborhood. The detailed information is shown in table 12-2.

**Table 12-2 Component of Public Participation Objects**

| Iterm | Content | Number | Rate |
|---|---|---|---|
| Sex | Male | 109 | 80.15% |
| | Female | 27 | 19.85% |
| Age | 0□25 | 5 | 3.68% |
| | 26□40 | 79 | 58.09% |
| | 41□55 | 42 | 30.88% |
| | □55 | 10 | 7.35% |
| Occupation | Civil Servant | 15 | 11.03% |
| | Worker | 46 | 33.83% |
| | Farmer | 20 | 14.70% |
| | Unemployed | 2 | 1.47% |
| | Others | 53 | 38.97% |
| Educational backgroud | Bachelor degree above | 7 | 5.15% |
| | College | 70 | 51.47% |
| | Middle school | 47 | 34.56% |
| | Primary school below | 12 | 8.82% |

## Table 12-3 Questionnaire of Public Participation of Channel Improvement Project at the Shaying River Section in Anhui Province

| | | | | | |
|---|---|---|---|---|---|
| **Name** | | **Sex** | | **Tel** | |
| **Address** | | | | | |
| **Age** | A.0—25 B.26—40 C.41—55 D.□55 | | | | |
| **Occupation** | A. Civil servant B. Worker C. Farmer D. Unemployed E. Others | | | | |
| **Educational background** | A. Bachelor degree and above□ B. College□ C. Middle school□<br>D. Primary school and below. | | | | |

The Shaying River is the largest tributary of the Huai River and located at its left bank. It originates from Funiu Mountain in Henan Province and formed by the confluence of the Sha River and the Ying River at Zhoukou City. It goes from the northwest to the southeast, passes through the central area of Henan Province and enters into Changshenggou in Jieshou City on the Henan-Anhui border. It flows through Jieshou City, Taihe County, Fuyang City, and joins the Huai River at Mohekou in Yingshang County. The total length of the Shaying River is 620km, with 206km located in Anhui Province. The basin area of the Shaying River is 36,651 $km^2$, with 4,112 $km^2$ located in Anhui Province.

Improvement of Shaying River channel can promote the development of waterway transportation at Huai River and open up the channel for coal transportation from Henan to the east. It can also improve the development of integrated transport system and local economic development. According to the "Layout Plan of National Inland Waterway Channel and Port (2006-2020)", Shaying River channel is one line of the "one longitudinal and two lines"; together with the JingHang Canal and Huai River system. The channel is proposed as Grade V-IV. Shaying River is also proposed as one branch of the "two trunks and three branches" in the "Navigation Development Plan of Anhui Inland Waterway (2005-2020)", and is proposed as Grade IV.

According to relevant requirements, EIA should be carried out for this project. This questionnaire survey of public participation is conducted to know stakeholders' requirements, wishes and suggestions to this project in order to make it more reasonable, maximize its positive social, environmental and economic benefits.

Your opinion is essential. Thanks for your cooperation!

**1□Do you know the "Channel Improvement Project at the Shaying River Section in Anhui Province"?**

A.Yes □. No

**2□How do you think of the water quality of the Shaying River?**

□. Good B. Acceptable □. worse D. worst

**3□What environment problems do you concern most now? (**multiple choice**)**

A. Water Pollution B. Air Pollution C. Noise D. Solid Waste and domestic waste

**4□What environmental problems do you concern most during the construction?**□multiple choice□

A. Water pollution B. Vegetation destroy, odor of sludge C. Soil erosion D. Disposal of sludge E. Noise

**5□What environment problems do you concern most during the operation phase?**□multiple choice□

A. Water pollution B. Sediment contamination C. Air pollution D. Groundwater and soil contamination

**6□What impacts do you think will the construction bring to you?** □multiple choice□

□. Nothing □. Better life □.worse living condition

**7□What is your attitude towards the "Channel Improvement Project at the Shaying River Section in Anhui Province"?**

A. Agree B. Disagree C. Don't care

**8□What are your suggestions and requirements to this project□**

Notes: Please express the detailed suggestions and requirements in writing.

Interviewer_____ Date□

The statistic results of the survey are shown in Table 12-4.

## Table 12-4 Statistic results of the questionnaire survey

| Content | Result | |
|---|---|---|
| | Number | Proportion（%） |

| Content | Result | |
|---|---|---|
| | Number | Proportion（%） |
| **1 Do you know the "Channel Improvement Project at the Shaying River Section in Anhui Province"?** | | |
| ① Yes | 106 | 77.94 |
| ② No | 30 | 22.06 |
| **2 what do you think of the water quality of the Shaying River?** | | |
| ① Good | 1 | 0.74 |
| ② Acceptable | 58 | 42.65 |
| ③ Worse | 61 | 44.85 |
| ④ Worst | 16 | 11.76 |
| **3 What environmental problems do you concern most ?** | | |
| ① Water pollution | 98 | 72.06 |
| ② Air pollution | 39 | 28.68 |
| ③ Noise | 33 | 24.26 |
| ④ Solid Waste and domestic waste | 65 | 47.79 |
| **4 What environmental problems do you concern t most during the construction?** | 47 | 34.56 |
| ① Water pollution | 54 | 39.71 |
| ② Vegetation destroy, odor of sludge | 49 | 36.03 |
| ③ Soil erosion | 50 | 36.76 |
| ④ Disposal of sludge | 20 | 14.71 |
| ⑤ Noise | | |
| **5 What environment problems do you concern most during the operation phase?** | 81 | 59.56 |
| ① Water pollution | 50 | 36.76 |
| ② Sediment contamination | 23 | 16.91 |
| ③ Air pollution | 28 | 20.59 |
| ④ Groundwater and soil contamination | | |
| **6 What impacts do you think will the construction bring to you?** | | |
| ① Nothing | 23 | 16.91 |
| ② Better life | 117 | 86.03 |
| ③ worse living condition | 1 | 0.74 |
| **7 What is your attitude towards the "Channel Improvement Project at the Shaying River Section in Anhui Province"** | | |
| ① Agree | 131 | 96.32 |
| ② Disagree | 0 | 0 |
| ③ Not care | 5 | 3.68 |

12.3.1.2. Results Analysis of 1st Round Survey

(1) The composition of the survey sample

From the results in Table 12-2, it can be seen that males took the majority of the whole sample, accounting for 80.15%. The age majority was 26-40 (accounting for 58.09%), 41-55 (accounting for 30.88%), and above 55 (accounting for 7.35%). Major occupation was others accounting for 38.97%. Workers accounted for 33.83% and farmer 14.7%. Major educational backgrounds were colleague (51.47%) and middle school (34.56%). The primary school and bachelor and above were 8.82% and 5.15%. This proved that the sample can meet the requirement and ideas from most affected stakeholders were got.

(2) Knowledge of this project

While answering the question “Do you know the “Channel Improvement Project at the Shaying River Section in Anhui Province”, 106 people chose yes, accounting for 77.94%. There were 30 people who don’t know about the project, accounting for 22.06%. They knew this project before they read the questionnaire. Majority of citizens who answered yes live near the project site. They know this project from the previous site investigation, which indicates that this project is known by the majority of the public.

(3) The water quality in the project region

While answering the question “What do you think of the water quality of the Shaying River?”, 61 people chose worse, accounting for 44.84%; 58 chose acceptable, accounting for 42.65%; 16 people chose worst, accounting for 11.76%. Only one person chose good, accounting for 0.74%. This survey shows that the public are aware of water quality of Shaying Rive is bad and cannot meet the requirement of function zoning.

(4) The environmental problems in the project region

While answering the question “What environmental problems do you concern most now?”, 98 people chose water pollution, accounting for 72.6%; 65 people chose Solid Waste and domestic waste, accounting for 47.79%. There were 39 people choosing air pollution, accounting for 28.68%. 33 people chose noise, accounting for 24.26%. This reflects the main local environmental problems are water pollution and solid waste and domestic waste, and the most concerned one is the water pollution, which raises a high requirement for the project.

(5) The major environmental impacts during the construction phase

While answering the question “What environment problems do you concern most during the construction?”, 54 people chose vegetation destroy and odor of

sludge□accounting for the rate of 39.71%. 50 people chose disposal of sludge, accounting for 36.76%. 49 people chose soil erosion□accounting for 36.03%. There were 47 people chose water pollution, accounting for 34.56%. 20 people chose noise accounting for 14.17%. This indicates what the public care about are the same as the environmental impacts in this project. This also reflects public's environmental awareness is increasing.

(6) The major environmental impacts during the operation phase

While answering the question "What environment problems do you concern most during the operation phase?", there were 81 people choosing water pollution, accounting for 59.56%.50 people chose sediment contamination accounting for 36.76%. 28 people chose groundwater and soil contamination account for 20.59%. Besides, 23 people chose air pollution, accounting for 16.91%. This indicates the majorities of the public have strong awareness of environmental protection and got involved into the environmental decision.

(7) The impacts on the surrounding residents

While answering the question "What impacts do you think will the construction bring to you?" 117 people chose better life, accounting for 86.03%. 23 people chose nothing, accounting for 16.91%. One person chose worse living condition.

(8) The attitude towards the construction

The public expressed their support to this construction, 131 people chose to support, accounting for 96.32%. 3.68% of the public chose not to express their opinion. No one disagreed with this project.

(9) Suggestions and requirements

The major advice and suggestions from the public mainly include:

a. Deepen the channel and make the new ship lock spacious;

b. Conserve the water and vegetation during the construction phase and prevent water pollution and vegetation destroy;

c. Punish illegal sand mining.

### 12.3.2. **Results of the 2nd Round Public Participation and Survey**

(1) Interview, questionnaire and meeting

Based on the "Environmental Impact Statement of Channel Improvement Project at the Shaying River Section in Anhui Province" (provincial edition), according to related requirements of the WB, the EIA team analyzed the need of site investigation

and information, and conducted a new round of public participation based on the proposed environmental measures and conclusions in the EIS. The public's advices and suggestions to the construction, EIA conclusions and measures were widely collected. The sample mainly consists of the government departments of Fuyang, the affected residents and enterprises through department interview, individual interview and questionnaire. Two villages (Xinzha Village and Fangzhou Village) were chosen to hold the meetings (see pictures in Fig. 12-2).

□Meeting in Xinzha Village□ □Meeting in Fangzhou Village□

**Fig. 12-2 Pictures of meetings**

(2) Media Announcement

After the draft EIA Report (WB version) was completed, it is announced on the websites of Anhui Provincial Transport Department, Fuyang Local Maritime Bureau, Anhui Provincial Port & Shipping Construction Investment Group Co. Ltd and Fuyang Daily. At the same time, the copies of the report were placed at Fuyang, Jieshou, Taihe County and Yingshang County Port & Shipping Management Bureaus for the convenience of citizen to read, which increases ways for the public to know about this project. This announcement mainly includes the EIA conclusions and environmental protection measures proposed in EIA Report (WB version) in order to collect the advices and suggestions from all stakeholders.

Two public participations were held through media announcement, department interview, questionnaire and meetings. The first was at the beginning of Decemeber 2009, connected with the resettlement survey and social evaluation, mainly through department interview, questionnaire and meetings to collect the suggestions of the government departments and the public. Altogether 100 copies of questionnaire were sent and 86 copies were got back.


(Announcement on the website of Anhui Provincial Port & Shipping Construction Investment (Group Co. Ltd) (Fuyang Local Maritime Bureau)

(Anhui Provincial Transport Department) (Fuyang Daily)

**Fig. 12-3 Announcements on media**

12.3.2.1. Statistic Results

(1) The results of the survey

The EIA team sent 100 copies of questionnaire within the construction region in December 2009 and got back 94 copies. The recovery rate is 94%. The survey range concerns with the government departments, village residents and enterprises nearby. The statistic results of this survey are shown in Table 12-5.

(2) The suggestions from media announcement

During the period of media announcement, the EIA team and project owner did not receive any feedback.

**Table 12-5 Statistic results of the 2nd round questionnaire survey**

| No. | Content | Answers | Number | Proportion□%□ |
|---|---|---|---|---|
| 1 | **What do you think of the water quality of the Shaying River□** | Good | 8 | 8.51 |
| | | So-so | 67 | 71.28 |
| | | Worse | 15 | 15.96 |
| | | Worst | 0 | 0 |
| 2 | **What are the main environmental problems in your neighborhood?** | Air pollution | 0 | 0 |
| | | Water pollution | 62 | 65.96 |
| | | Noise | 6 | 6.25 |
| | | Ecological damage | 11 | 11.70 |
| | | None | 18 | 19.15 |
| 3 | Is there cultural relics or heritage in your neighborhood? | Yes | 0 | 0 |
| | | No | 89 | 94.68 |
| | | Not clear | 5 | 5.32 |
| 4 | Where does the drinking water in your community come from? | Groundwater | 86 | 91.49 |
| | | Municipal water supply | 8 | 8.51 |
| | | Shaying River | 0 | 0 |
| 5 | Do you know about the policy of land expropriation, compensation and resettlement? | Yes | 0 | 0 |
| | | A little | 13 | 13.83 |
| | | No | 49 | 52.13 |
| 6 | In aspects of land expropriation of arable lands and forest lands, you hope: | Reasonable economic compensation | 62 | 65.96 |
| | | No expropriation | 0 | 0 |
| | | Compensate with other lands | 0 | 0 |
| 7 | What issues will affect your live during the construction phase? | Noise of construction vessels | 57 | 60.64 |
| | | Construction wastewater | 21 | 22.34 |
| | | Vegetation destroy and odor of sludge | 8 | 8.51 |
| | | Soil erosion | 0 | 0 |
| | | Increase of job opportunities | 15 | 15.96 |
| | | Others | 0 | 0 |
| 8 | Is the quality of life will be improved after this project? | Much improvement | 52 | 55.31 |
| | | So-so | 38 | 40.43 |
| | | No improvement | 4 | 4.26 |
| 9 | What is your attitude to this project? | Support | 86 | 91.49 |
| | | Agree with conditions | 8 | 8.51 |
| | | Not care | 0 | 0 |
| | | Nay | 0 | 0 |
| Other advices and suggestions□<br>Try to protect the ecological environment and serve the residents. | | | | |

12.3.2.2. Result Analysis of 1st Round Survey

(1) The suggestions from nearby residents

According to the results of the second round survey, during the process of meetings and individual interviews, the EIA team explained the major conclusions and environmental protection measures in detail. It can be seen that majority of the nearby residents support this project and think it is good for the economic development. They also think the conclusions and environmental protection measures are reasonable. According to the survey, no obvious environmental problems exist in this region. If resettlement is needed in this project, most of the residents hope they can get appropriate compensation and relocation. The interviewed majority think that the noise of construction noise, construction wastewater and odor of sludge during the construction phase will have major impacts. In addition, they think the environmental protection measures suggested by the EIA team are reasonable.

The statistic results in the above table shows:

 The attitude towards the project

About 91% masses support the project, and think the channel improvement will do good for regional development and external communication.

Besides, about 8% masses support the project with conditions, mainly because the living income of the local people comes from planting and the project will occupy small amount of arable lands, and they don’t know well about the land expropriation policy. That’s why they worry about this;

② Land expropriation and housing demolition due to chute cutoff and temporary land take

The masses care very much about the land expropriation and housing demolition, because the land is their basic living factor. They hope they can get reasonable compensation and proper resettlement. The investigated masses support the project actively. Nobody shows the reluctance to the land expropriation and housing demolition.

③ Environmental impact of channel improvement

During the period of channel improvement, because of the adverse impacts of construction vessels, disposal and chute cutoff, most masses think that noise of construction vessels, construction wastewater and odor of sludge are the main environmental problems. Key problem they concerned most is the time conflict between the construction and residents’ rest as well as the smell of sludge. After the EIA team explained the environmental protection measures in detail, most residents think the environmental impacts are acceptable.

(2) The suggestions of the related departments

Department interviews (with staff in government sectors) were conducted on the basis of conclusions and environmental protection measures proposed in EIA Report (WB version). Sectors (e.g. forest, water, cultural relics and fishery sectors) in Fuyang and relevant counties and cities were consulted.

① The suggestions of Fuyang Cultural Relics Administration

Fuyang Cultural Relics Administration thinks that the Shaying upstream is the key location of cultural relics investigation, so selecting of disposal areas should be careful. Before the construction starts, the local cultural relics sectors should investigate the area first, if there is cultural relics discovered, the project should avoid it in time.

② The suggestions of the forest department

The Fuyang City and related forest departments support the project actively. They think that the project has already tried to take as less forest as possible in designs. Only some chute cutoff works will occupy small area of forest, which is mainly mixed forest. They also mentioned that the construction should protect the forest along the river and reduce vegetation destroy.

## 12.4. Conclusions

According to the two stages of the public participation and survey results, the mass nearby mainly hold the supportive attitude to this project. They think that the project will help to improve the water quality of the Shaying River and enhance the navigation capacity of the river. The project itself will not cause great impacts on their living and working. In addition, the masses clearly recognized the environmental problems caused by the project and all showed great concern with the impacts of noise of construction vessels, construction wastewater and odor of sludge during the construction phase. Besides, they think the environmental pollution caused by the project is acceptable if the proposed environmental protection measures are implemented. The masses hope that during the construction environmental pollution control and management should be well carried out to maximize the environmental, social and economical benefits and to achieve sustainable development.

# 13. Conclusions

## 13. 1. **Project Overview**

The Shaying River is the largest tributary of the Huai River and located at its left bank. It originates from Funiu Mountain in Henan Province and formed by the confluence of the Sha River and the Ying River at Zhoukou City. It goes from the northwest to the southeast, passes through the central area of Henan Province and enters into Changshenggou in Jieshou City on the Henan-Anhui border. It flows through Jieshou City, Taihe County, Fuyang City, and joins the Huai River at Mohekou in Yingshang County. The total length of the Shaying River is 620km, with 206km located in Anhui Province. The basin area of the Shaying River is 36,651 $km^2$, with 4,112 $km^2$ located in Anhui Province.

Shaying River channel is the 12th line among the 18 lines listed in the "Layout Plan of National Inland Waterway Channel and Port (2006-2020)", which proposes that the main channel network in the whole country should be composed of "two latitudinal lines", "one longitudinal line", "two networks" and "18 lines". The channel is proposed as Grade V-IV. Shaying River is also proposed as one branch of the "two trunks and three branches" (two trunks are Yangtzs River and Huai River and three branches are Heyu Line, Wushen Canal and Shaying River) in the "Navigation Development Plan of Anhui Inland Waterway (2005-2020)", and is proposed as Grade IV. Shaying River Channel will be improved to Grade IV, which is consistent with national and Anhui Provincial navigation plan and national industrial policy. It is the kind of encouraged projects. In February 2008, Anhui Development and Reform Committee agreed to start preliminary work of this project by promulgating the "Response Letter to the Proposal of Channel Improvement Project at Shaying River in Anhui Province" (FaGaiJiaoTongHan[2008]No. 87).

The proposed project will re-open and upgrade the 205.6km long channel of the Shaying River. The designed width of channel is 50m. The minimum designed water depth is 2.8m. The minimum bend radius is 330m. The location of this project is shown in Figure 1. Project components include waterway dredging, rebuilding of bridges that block the navigation, embankment seepage prevention, bank protection, service areas, anchorage areas and navigation aids, etc. Total investment is 1,905,805,500 RMB.

## 13. 2. **Environmental Baseline**

**(1) Ecological Environment**

The project region at the Shaying River Section in Anhui Province is generally plain, where is densely populated and has a long history of aerial farming. It pertains to the typical agricultural ecosystem. According to field investigation, the Shaying River was reconstructed, improved and developed many times in the past. Influenced by human activities, the eco-environment along the Shaying River is basically artificial ecosystem. The primary vegetations are farmland, plantation forest, grass land, abandoned land and shrub vegetation.

According to site investigation and sector consultation, terrestrial fauna along the Shaying River are mainly common species. There are few rare species. In particular, the carnivores that need large living space, e.g. *Vulpes vulpes* Linnaeus, *Nyctereutes procyonoides* Gray, *Prionailurus bengalensis* Kerr, *Mustela sibirica* Pallas, *Meles meles* Linnaeus, etc, are not found in site investigation.

Cyanophyta and Bacillariophyta are the dominant species of phytoplankton along the Shaying River. The amout of Rotifer is the largest among zooplankton, and it is widely distributed. Mollusks and Annelida are the dominant species of zoobenthos. Cyprinidae is dominant fish resources. No State Special Protection wild fish is found. There are also no spawning areas, feeding areas and wintering areas for fishes.

The Section k25-k38+500 of this project is located in the Anhui Province Taihe County Shaying River National Wetland Park. The main works within the wetland park include: 3# disposal area, channel dredging, and G105 Taihe Shahe □ Bridge rebuilding (K38). The construction of service area and anchorage areas, disposal area and chute cutoff are not involved. The construction sections of this project mainly focus on Section k30~k33 and k36~k38+500, both of which are located in the Shaying River Leisure Zone and Management Zone of the Anhui Taihe County Shaying River National Wetland Park.

**(2) Ambient Air Quality**

According to monitoring results of ambient air provided by Fuyang Environmental Monitoring Station, the annual average concentration of $SO_2$ in Fuyang City, Jieshou City, Taihe County and Yingshang County ranges from 0.021 to 0.024mg/m3 in 2007. The annual average concentration of $NO_2$ ranges from 0.028 to 0.032mg/m3. PM10 ranges from 0.096 to 0.123mg/m3. TSP ranges from 0.138 to

0.172mg/m3. Among them, $SO_2$, $NO_2$ and TSP have met Grade II standard of "Ambient Air Quality Standard" (GB3095-1996). PM10 is over the standards in Jieshou City and Taihe County, because there are many construction sites around the monitoring points. Generally speaking, the ambient air quality is good along the Shaying River.

**(3) Surface Water Quality**

According to monitoring results of water quality provided by Fuyang Environmental Monitoring Station, the current surface water quality at the Shaying River Section in Anhui Province (Fuyang Section) cannot meet Grade IV in "Environmental Quality Standard for Surface Water" (GB3838-2002). The Huai River section in Anhui cannot meet Grade □.

According to the calculated results of single factor index in Table 4-23, the factors which are over the standards are mainly TN, TP and BOD. Among them, TN is beyond the standards as high as 5.15 times at the Fuyang City monitoring section. TP is beyond the standards as high as 0.65 at the Jieshou City monitoring section. BOD is beyond the standards as high as 0.17 at the two monitoring section in Jieshou. It can be seen that, in the 13 monitoring sections at the Shaying River Section in Anhui (Fuyang Section), monitoring items TN and TP are serious over the standards, especially at the Jieshou Section, also are BOD and oil pollants. In the two monitoring section at the Huai River, TN and TP are also over the standards.

It can be seen that the municipal networks have basically covered the county level or above. Most of the industrial wastewater and municipal wastewater can be centralized treated by the sewage treatment plants. Therefore, one of the major pollution sources at the Shaying River section in Anhui Province come from the non-point pollution from agriculture in countryside. The pollutions also may come from the Shaying River upstream section in Henan Province.

**(4) Ground Water Quality**

According to monitoring results of ground water quality provided by Fuyang Environmental Monitoring Station, all the monitoring items at the sampling points of Jieshou, Taihe and Fuyang have met Grade III in "Quality Standard for Groundwater" (GB/T14848-93), many of which meet Grade□. The total water hardness at the Yingshang Saijian Town sampling point does not attain the water quality of Grade III in "Quality Standard for Groundwater" (GB/T14848-93). Other monitoring items at this points all meet the Standards of Grade□and □. Therefore, it is better to abate

some hardness before drinking groundwater at Yingshang Saijian Town, so as to reach water quality of Grade III.

**(5) Soil Quality at Disposal Areas**

All the monitoring items in the 7 sampling monitoring points in Jieshou, Taihe, Fuyang and Yingshang disposal areas have met Grade II in "Environmental quality standard for soils" (GB15618-1995). The soil quality in project regions is good which will not threaten crop growth and human health. It can be seen from the comprehensive assessment, the soil pollution grade at the Shaying River is excellent and the pollution level is clean. Therefore, reasonable and effective pollution prevention measures should be taken during the construction of this project, in order to prevent the soil quality descending caused by the construction of projects.

**(6) Sediment Sludge Environmental Quality**

According to the monitoring results of sediment sludge provided by the Fuyang Environment Monitoring Station, amount of heavy metal pollutants in the sludge is small, which is far lower than the control value in "Control Standards for Pollutants in Sludge from Agricultural Use" (GB4284-84). There are no obvious differences between the heavy metal concentrations in sludge at the river and that of soil in the disposal areas. The sludge is piled at the disposal areas and gets air dried. Consequently, the disposal area can be restored as farmland. The heavy metal will not have serious impact on crop growth and human health.

The concentration of total Nitrogen and Phosphorus in sediments of the Shaying River is low. When dredging works disturb the contaminated sediments, the release of Nitrogen and Phosphorus will be small and have little impacts on the whole water quality.

**(7) Acoustic Environmental Quality**

According to the monitoring results of acoustic environment and assessment standards, the status noise level at all the points in daytime and nighttime meet Class II of the "Environmental Quality Standards for Noise" (GB3096-2008), meaning that the acoustic environment along the Shaying River is good.

**(8) Cultural Relics**

According to investigation, no key cultural relics or heritage was found in this project region.

## 13. 3. Impacts During the Construction Phase

### 13. 3. 1. Impacts on Ecological Environment

(1) According to site investigation and consultation with forest departments of district and county, land takes in this project mainly include mixed and economic forests. Neither ecological forest nor rare species is disturbed. Permanent land takes focus on chute cutoff sections, service areas, anchorage areas and bridge construction sections. Impacts of this project on overflow land will focus on overflow shrub lands and grasslands and forests by shore. Only some meadow wetlands may be occupied by three chute cutoffs at Fanying Village LaoZhuang Town Yingquan District, Liushilipu Xiawan Village Yingshang County and Jinyuzi Village Yanghu Town Yingshang County. The occupied area is 42.7 Mu. This project will have minor impact on biodiversity. After the construction, planting and vegetation restoration along the river can also compensate the loss of biomass and plant biodiversity.

(2) Most of this project region is farmland. Terrestrial animals in this region are common in Huaibei Plain. Impacts of this project on terrestrial animals focus on the construction phase. The habitats of the birds and mammals will be destroyed. The animals may be frightened and driven away cause by construction noise, dust and frequent human activities. Bird will be affected first and look for new temporary habitats. However, area of land takes is relatively small. It has become an artificial region along Shaying River and is not the main habitats, breeding areas and wintering areas of protected animals any more. In addition, most of the animals have strong ability to migrate. This project will be carried out section by section, so they can move to safe areas nearby quickly during the construction. Thus, this project will have minor impacts on terrestrial animals. They will get back soon after the construction.

(3) Plankton, benthos and fish will be affected by bridge pier and dredging works, but the impacts are temporary and reversible. In addition, sediment sludge and trashes in water will be removed in this project. Water dynamics will change (i.e. water depth and flow rate increase), so energy and material exchanges in Shaying River are accelerated. It is good for living and breeding of aquatic organisms, for their effective living areas will be expanded.

### 13. 3. 2. Impacts on Anhui Province Taihe County Shaying River National Wetland Park

According to the “Respond Letter on Relevant Issues”, Taihe County Forest Bureau agrees in principle the improvement project to be carried out in the wetland park. This project will have minor impacts on Taihe County Shaying River National Wetland Park. The impacts focus on the construction phase and are temporary and reversible. In addition, this project will promote the implementation of navigation plan of the wetland park, the development of water tour routes and the development of the whole wetland park. The entrance and management area of the wetland park will be designed simultaneously when reconstruction of the bridge is designed. Thus, the constructions of this project and the wetland park are consistent and impacts on the wetland park can be minimized.

### 13. 3. 3. Impacts on Water Environment

The construction phase of this project lasts long. Working staff are relatively centralized and stable. If domestic wastewater is discharged directly into the river, pollution will be caused in surrounding water.

During the dredging works, suction and stirring may cause re-suspension and diffusion of contaminated sediment. It is analogized the prediction results of SS for dredging work at Dongjiang River and monitoring results of SS at dredging site for Feilaixia Hydro Complex Project. SS will significantly increase in the surrounding area of dredging site with a radius of 100m. The increase of SS concentration is generally more than 80mg/L. The impact will gradually decrease as the distance increases. At the point 1km away from the construction site, concentration of SS is lower than 4.13 mg/L, so its impact is minor. As the construction is completed, such impact will disappear soon.

Cutter suction dredger is applied for dredging in this project and 34 disposal areas are set. According to engineering analysis, discharge volume of residual water at sludge piling yard is about 18,370 $m^3$ and flow is 0.16 $m^3/s$. The residual water should be treated through necessary methods before being discharged. The discharge concentration is 70mg/L. Residual water is discharged into nearby ditches and treated furtherly. It then flows into Shaying River and eventually into Huai River with concentration of 50 mg/L. Predictive concentration of SS at status monitoring sections

indicates that impacts of residual water at disposal areas on water quality of Shaying River are minor.

### 13. 3. 4. **Impacts on Ambient Air**

Impacts on ambient air during the construction phase are mainly caused by odor pollutant emissions. When contaminated sediment with organic humus is stirred and disposed on the ground, it will cause the release of malodorous substances (mainly including ammonia, hydrogen sulfide, volatile hydrogen, volatile alcohols and aldehydes), which will affect air quality. According to status investigation and monitoring of sediment of Shaying River, sediment pollution is minor. Little malodor can be felt. Degree of odor is about Grade I-II. Influence scope is within the area with a radius of 20m. Affected downwind area will be larger when the wind is blowing. According to preliminary design of this project and site investigation, the nearest residential area is located more than 50m away from proposed disposal areas. Odor emissions will not affect nearby residents. Malodor will disappear after the completion of construction; consolidation of sediment sludge and vegetation restoration.

### 13. 3. 5. **Impacts on Acoustic Environment**

Major noise sources during the construction phase are diesel engine of dredger, mud pump, and machine and transport vehicles for reconstruction of bridge, construction of cofferdams and piling yards and seed broadcast, etc. The noise level will range from 70 to 100 dB(A).

According to characteristics of acoustic superposition, it is predicted that noise can be weakened to environmental standards at the point 20m away from the disposal area at daytime and 60m away at nighttime. As for bridge reconstruction, it will not affect residential area 40m away at daytime and 200m away at nighttime. Residents at 100m away at daytime and 300 away at nighttime will not be affected significantly by dredger. Thus, noise standards can be met at areas 100 m away at daytime and 300 away at nighttime from the construction sites of this project.

### 13. 3. 6. **Impacts of Solid Waste**

During the construction phase, solid waste mainly comes from garbage on vessels, construction waste and working staff’s domestic refuses. All of these pertain to general solid waste. Construction waste at urban area in Fuyang can be utilized for

foundation leveling of comprehensive construction north to Fuyang Lock. Construction waste that comes from Jieshou, Yingshang and Taihe can also be used for foundation leveling in industrial areas. Garbage on construction vessels and working staff's domestic waste need to be collected. Local municipal domestic wastewater treatment organizations can be commissioned to treat the wastes.

## 13. 4. **Impacts During the Operation Phase**

### 13. 4. 1. **Impacts on Water Environment**

Wastewater in this project during the operation phase is mainly composed of wastewater on land and wastewater from vessels. Wastewater on land comes from service areas, i.e. the proposed Guozhuang Service Area and Sanshilipu Service Area. Wastewater from service area includes domestic wastewater, and wastewater from vessel maintenance and from gas station, etc. Diversion of rain and sewage should be applied for water discharge system in service areas. In designs, oil water from restaurants, vessel maintenance and gas station needs to be treated by grease trap before discharged into sewage system. It then converges with domestic wastewater treated in septic tank and goes into underground wastewater treatment equipment. The treated wastewater can meet Grade II in GB8978-1996 and be discharged in nearby ditches.

In accordance with requirements in Article 28 in the "Management Provisions of Vessel Pollution of the Inland Water Environment" (Ministry of Communications, No. 5 Order, 2005), watermen's domestic wastewater during navigation should be treated or stored properly. That is, treatment equipment or containers should be installed on the vessel according to wastewater volume. Discharge of domestic wastewater that can not meet the discharge standards is forbidden in inland water region. Thus, local maritime sectors need to improve the supervision of domestic wastewater from vessels, in order to make sure the discharge can meet the standards. There should be no pollution of Shaying River from domestic wastewater from vessels.

In light of the prediction of freight traffic volume at Shaying River at the operation phase, most of the vessels will transport coal and construction materials, which does not refer to oil pollution in ballast water. However, it is possible there will be ballast water with oil during the operation phase while the channel is getting

smooth. Since it is hard to predict the water volume, local maritime sectors are required to strengthen management. Once there come vessels with ballast water, maritime sectors should ask the ship-owners and cargo owners to treat the ballast water, washing water and bilge oil water and to make sure the discharge can meet relevant standards.

In summary, wastewater during the operation phase will have minor impacts on water environment of Shaying River..

### 13. 4. 2. **Impacts on Ambient Air**

Waste gas from vessels is the main sources of air pollution during the operation phase. It is predicted the freight traffic volume at Shaying River at the operation phase will reach 14 million ton in 2020 and 18 million ton in 2030. If annual operation period is 330 days, daily $NO_2$ emission will reach 1.247 kg per km and daily $SO_2$ emission will be 1.731 kg per km in 2020. In 2030, daily $NO_2$ emission will reach 1.603 kg per km and daily $SO_2$ emission will be 2.225 kg per km in 2020. Dominant wind direction in Fuyang is east. Annual wind velocity is 2.8m/s. The plain terrain is flat. The pollution sources are mobile sources and dilution in ambient air is strong, so air pollutant emissions during the operation phase will have minor impacts on ambient air. In the context of development of science and technology and promotion of high-tech, vessels at inland waterway will be more environmentally friendly and energy-saving in the future. Thus, the air pollutant emissions may be reduced.

### 13. 4. 3. **Impacts on Acoustic Environment**

Noise sources during the operation phase are mainly vessels on Shaying River. Vessel noise source strength is generally around 80 dB(A). Its influence scope is the area with a radius of 40m. According to investigation of sensitive objects, the nearest sensitive object along both river banks is at 70m away. Furthermore, planting along the banks of the channel can not only conserve water and soil, but can also reduce the noise. Thus, noise effect during the operation phase is minor.

### 13. 4. 4. **Impacts on Flood Control**

According to “Flood Control Assessment Report of Anhui Shaying River Channel Improvement Project”, recent Shaying River improvement projects provide good basis for the Shaying River Channel Improvement Project. The main aim of this project is to resolve the problem that water depth is not enough during dry season.

Main project components are dredging and chute cutoff of partial river sections. Bank and slope protection will also be carried out where deep groove is close to banks, and where beach is narrow.

The arrangement of this project depends on identification of channel axis. The channel axis is connected by series of straight lines and arc curves. Most of the original plane shape of the riverway is remained in this project. The channel will go along the thalweg of the river. Works like chute cutoff will be carried out at sections where width or bend radius of partial channel is not enough. For river sections that are curved, curve cutoff is needed in order to meet navigation requirements of Grade IV. Bottom-width of the channel is 50m. Bank and slope protection is proposed be carried out at sections where deep groove is close to banks, and where there is no or narrow beach in front of the banks. Impacts of this project on the riverway include:

(1) Dredging will be carried out at narrow and deep sections. Chute cutoff and dredging sections of the river are located at deep incised river. Shape of the main channel section will not be changed much. Dramatic change of riverbed scour-and-fill will not occur. After the chute cutoff and dredging works, partially stuck sections will dispear. Current back flow on beach will be impaired or removed. Flow in the whole channel is smooth.

(2) Curve cutoff will impair the scour of concave bank. Water flow will be gradually becoming smooth. There will be no adverse impacts on the whole channel in long term.

(3) Bank and slope protection is good for embankment protection and riverbed stability.

(4) Irregular pulse ship waves will be made by vessels. Ship waves will scour and impact the banks and levees, which will influence slope stability. Thus, it is suggested that slope and embankments where channel is narrow and where mainstream line is near the bank should be strengthened to relieve the impacts on slope stability.

### 13.4.5. **Environmental Risk**

(1) According to cargo forecasts at the operation phase and related statistics, most vessels will carry coal, construction materials, chemical materials, etc. Coal and building materials have little effect on water quality once they sink into the water. However, chemical materials may cause a greater impact on water quality. The probability of ship collision in the channel shows that ship crash is less likely to

happen. However, according to the principles of probability theory, the small probability events are possible. Once such accident happens, it may cause devastating effects on water environment, such as killing fish in the river, poisoning organisms, threatening the safety of downstream water intakes, so in case of chemical material accidents, the impact would be major.

(2) Vessels that transport flammable, explosive, corrosive, toxic and radioactive substances should carry out necessary safety and pollution prevention measures. They should hang the required signals and comply with the "Supervision and Management Regulations of Ships Carrying Dangerous Goods" by Ministry of Transport.

(3) To ensure the emergency situation in water environment can be relieved, Fuyang Maritime Bureau, the Marine Department of Jieshou, Taihe, Yingshang should respectively set up a special water emergency office, designate a principle person. Patrol boats should also be set, once emergency happens in water, it shall be promptly reported to the Fuyangc Marine Bureau. Salvaging of sunken objects and rescue should be carried out timely, to ensure the safety of aquatic environment and maintain channel smooth.

(4) For the accidents in the channel, the project owner should equip necessary emergency rescue facilities in the two service areas and Genglou Ship Lock, which is located in Anhui Province Taihe County Shaying River National Wetland Park. The facilities include emergency protective and handling vehicles, detoxification drug, liquid and solid materials cleaning equipment, rubber plugs and sand bags.

## 13.5. Pollution Control and Ecological Environment Protection Measures

### 13.5.1. Ecological Environment Protection Measures

Anhui Water Resources Consulting Co., Ltd was commissioned by the project owner to finish the “Soil and Water Conservation Report of Anhui Shaying River Channel Improvement Project (for review)”. Various soil and water conservation measures should be implemented during the construction phase to effectively relieve soil erosion. In addition, working time should be arranged properly. Measure for protecting birds on overflow lands should be carried out. Planting on slopes should be strengthened. Occupation of overflow land should be controlled. These measures can relieve adverse impacts on ecological environment and compensate and restore the eco-system.

### 13. 5. 2. **Water Environment Protection Measures**

Construction phase: It is suggested to build latrines in construction camps. Septic tanks should also be built to treat the wastewater before it is discharged into surrounding abandoned lands or ditches. Direct discharge into the Shaying River is forbidden. Smaller reamer should be used for dredging in this area. When SS of residual water exceeds the standards at later period of reclamation, flocculants can be added at the place where slurry goes into the cofferdam to control water quality. The treated residual water should meet the standards of Grade II in the "Integrated wastewater discharge standard" (GB8978-1996). Sedimentation tanks should be set at front mixer, concrete pumps, and transport vehicles cleaning place. Wastewater should not be directly discharged into the river. After the secondary precipitation, it can be cycled and reused for water spray to reduce dust. As for on-site storage of fuel, the storeroom must take anti-seepage treatment. Proper measures should be taken for storage and use to prevent oil leakage, soil contamination and water pollution. Scattered materials in construction sites should be cleaned up in time. Measures against water scouring and leaching should be taken for materials piling to avoid being rushed into the river and polluting the water.

Operation phase: channel management should be strengthened. Disposal of solid waste within the area with a radius of 100m is not allowed. The units and residents who dump garbage randomly would be punished. The floating objects which are carried into the river by the wind should be regularly salvaged and cleaned up. In accordance with relevant provisions of inland shipping, navigation signs and other aids in the channel should be installed to ensure maritime safety. Meanwhile daily maritime patrol should be strengthened so as to eliminate accident risk and to avoid water pollution. It is suggested underground wastewater treatment equipment to be installed in every service area. Oil water from restaurants, vessel maintenance and gas station needs to be treated by grease trap before being discharged into sewage system. It then converges with domestic wastewater treated in septic tank and goes into underground wastewater treatment equipment. The treated wastewater can meet Grade II in GB8978-1996 and be discharged in nearby ditches. Treatment equipment or containers should be installed on the vessel according to wastewater volume. Discharge of domestic wastewater that can not meet the discharge standards is prohibited at inland water region. Bilge wastewater with oil should be treated by oil-water separator to meet standards in "Effluent standard for pollutants from ship"

(GB3552-83) before discharge. It is suggested that reception facilities are set for wastewater from vessels. Ships without an oil-water separator can go to specific ports so that water with oil and domestic wastewater can be collected to the port area by special equipment and be treated. After port areas are constructed, ships without an oil-water separator can also go to specific ports to have water with oil and domestic wastewater collected and treated.

### 13. 5. 3. **Protective Measures for Ambient Air**

Odor pollution control measures: dredging should be conducted in the dry season, preferably in winter. At the same time, construction should be carried out section by section. The dredged sludge should be timely delivered to sediment piling yard. Ecological restoration should be carried out in time. If the sludge is utilized, it should be transported in sealed tanker, in order to prevent odor pollutant emissions on the way. Pay attention to the personal protection of construction workers. The protective equipments should be disseminated to workers and be checked periodically.

Dust control measures: Barriers with height not less than 1.8m should be set around bridge reconstruction sites. During demolishment of bridge pier, watering on the ground should be carried out in order to reduce dust. Barriers for collecting residue should be set in waters in order to ensure that residue can be transported in three days after the construction. Earthwork, residue and construction waste should be transported by sealed vehicles. Washing facilities of vehicles should be set at the entrance and vehicles should be washed before getting out of the construction site. Mud and sand should not be carried out of the construction site. Main construction roads must be hardened through covering, consolidating, greening, sprinkling and other effective measures. Selection of construction sites should be far away from residential buildings. In case of wind stronger than Grade IV, the construction such as earth filling and transporting and so on, which may cause dust, is forbidden. Vegetation restoration is needed to prevent soil erosion after temporary land using.

### 13. 5. 4. **Acoustic Environment Protection Measures**

Construction phase: low-noise devices should be used. Working time should be arranged reasonably. Use of high-noise equipment (such as excavators, mixers) should be scheduled at daytime and avoid nighttime (22:00~06:00). Pouring concrete

and disposal of large scale materials should be reduced at night. The construction unit should install mobile sound barriers for noise sensitive objects. Closed hangar should be set for strong-noise equipments at the construction site. They should be set at the side away from the residential area. Modern communications equipment can be applied. The project owner should jointly with construction unit inform the surrounding residents with the construction period. Disturbed units and residents should be notified before the construction. During the construction phase, complaint telephone hotline should be set to receive complaints of noise nuisance and active management should be conducted according to complaint.

Operation phase: The vessels must use strong directional speakers, with limit of using time. Lights should be used instead of speakers at night when ships enter into urban areas with dense population, so as to solve the noise problem.

### 13. 5. 5. **Solid Waste Prevention Measures**

Construction phase: Sediment dredging will be distinguished from excavation undisturbed soil, with dredging at first and then excavation. When sludge is used for agriculture or river bank greening, the use per land area should be controlled and uniformly applied in the soil. The construction waste must be transported in special sealed garbage pipe or be lifted in sealed container. Volley throw-away is forbidden. Sealed garbage station e should be set at the construction sit. Construction waste, domestic solid waste should be classified and stored. Abandoned soil from bridge reconstruction should be filled at designated sites. It can also be used for cofferdam at disposal areas. Planting should be carried out on site to prevent soil erosion. Abandoned gravel, building materials, steel and packaging materials should be recycled by professionals and working face should be timely cleaned up. Domestic waste should be collected and treated in time by local sanitation department.

Operation phase: The management of solid waste should be strengthened. Solid waste should be classified, piled, sorted before disposal and recycled. Unrecoverable waste should be properly disposed. The service area should be equipped with waste reception facilities to collect garbage from arriving ships. Garbage on land and from vessels should be transported after the collection periodically and sent to municipal solid waste disposal center by the local sanitation department.

### 13. 5. 6. **Environmental Protection Measures for Navigation**

Examination of vessels on Shaying River should be strengthened. Vessel that can not meet standards in the “Effluent standard for pollutants from ship” should be prevented from traveling on Shaying River. Furthermore, watermen should be educated that solid waste should not be arbitrarily thrown into the river. Environmental management of service areas along Shaying River should be improved. It must be ensured that the discharged of wastewater at service area can meet the standards. Garbage from vessels should be collected and taken harmless treatment. Supervision and inspection of vessels should be improved. The vessels which fail to meet the requirements and which are with service expiration are not allowed to engage in shipping so that accident risk can be reduced.

## 13. 6. **Public Participation**

In order to know the public’s opinion on this project and how they are satisfied with environmental impact mitigation measures, two stages of public participation were conducted, viz. the first stage (provincial stage: April.-May, 2008) and second stage (WB process stage: Dec. 2009-Mar. 2010). According to the two stages of the public participation and survey results, the massed nearby mainly hold the supportive attitude to this project. They think that the project will help to improve the water quality of the Shaying River and enhance the navigation capacity of the river. The project itself will not cause great impacts on their living and working. In addition, the masses clearly recognized the environmental problems caused by the project and all showed great concern with the impacts of noise of construction vessels, construction wastewater and odor of sludge during the construction phase. Besides, they think the environmental pollution caused by the project is acceptable if the proposed environmental protection measures are implemented. The masses hope that during the construction environmental pollution control and management should be well carried out to maximize the environmental, social and economical benefits and to achieve sustainable development.

## 13. 7. **Environmental Protection Investment**

Total investment for environmental protection in this project is about 40.0848 million RMB. Total investment of this project is 1905.8055 million RMB.

Environmental protection investment accounts for 2.1%. It will be invested mainly on residual water treatment, ecological restoration, environmental protection design, wastewater treatment at service areas, risk management and environmental monitoring, etc. Environmental protection projects can effectively control environmental pollution, reduce soil erosion, accelerate ecological restoration and relieve impacts on ecological environment.

## 13. 8. **General Conclusions**

In summary, Shaying River Channel will be improved to Grade IV, which is consistent with national and Anhui Provincial navigation plan and national industrial policy. It is the kind of encouraged projects. In February 2008, Anhui Development and Reform Committee agreed to start preliminary work of this project by promulgating the “Response Letter to the Proposal of Channel Improvement Project at Shaying River in Anhui Province” (FaGaiJiaoTongHan[2008]No. 87). This project will improve navigation capacity of Shaying River and promote economic development in this region. Furthermore, as internal pollution sources of Shaying River can be removed, the water quality can be improved. Thus, this project will have significant economic, social and environmental benefits.

Impacts of the Shaying River Channel Improvement Project on various environmental factors are predicted in this EIA Report. Practical environmental pollution control measures are proposed to mitigate environmental impacts of this project. In aspect of environmental protection, the Shaying River Channel Improvement Project is feasible. This EIA recommends the implementation of various environmental protection measures in order to maximize the economic and environmental benefits of this project.

# Annexes

## Annex 1 Plant Community Survey

### Annex Table 1-1 Sample Survey of Arbor at Genglou Ship Lock

| Types of Vegetation | Plantation | Environmental Characteristics | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Position | Position 1 north of Genglou Ship Lock | Terrain | Height above sea level (m) | Relative height (m) | Slope position | Slope aspect | Gradient (°) | Soil |
| | | Plain | 15 | 0 | N/A | N/A | N/A | Lime concretion black soils |
| Level | Characteristics | Species composition and growth situation (Species, average height, Average DBH, Biomass) | | | | | | |
| Arbor layer | Canopy density 28% | Simon poplar, paulownia; Dominant species: Simon poplar;<br>Total density: 924 per ha;<br>Average height: 13.5m<br>Average DBH: 26cm<br>Biomass: 185kg/m$^2$ | | | | | | |
| Updated level | N/A | | | | | | | |
| Shrub layer | Cover degree 8% | Wolfberry | | | | | | |
| Herb layer | Cover degree 7% | Sage Herb, wild carrot, veronica, capsella bursa pastoris, cardamine | | | | | | |

### Annex Table 1-2 Sample Survey of Arbor at Fuyang Ship Lock

| Types of Vegetation | Plantation | Environmental Characteristics | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Position | Position 2 Fuyang South Bridge | Terrain | Height above sea level (m) | Relative height (m) | Slope position | Slope aspect | Gradient (°) | Soil |
| | | Plain | 18 | 2 | underneath | Northwest | 15 | Lime concretion black soils |
| Level | Characteristics | Species composition and growth situation (Species, average height, average DBH, Biomass) | | | | | | |
| Arbor layer | Canopy density 26.5% | Simon poplar; Dominant species: Simon poplar;<br>Total density: 1100 per ha;<br>Average height: 13.2m<br>Average DBH: 23.5cm<br>Biomass: 181kg/m$^2$ | | | | | | |
| Updated level | N/A | N/A | | | | | | |
| Shrub layer | Cover degree 10% | Broussonetia papyrifera | | | | | | |
| Herb layer | Cover degree 12% | Rumex, sage herb, eleusine indica (Linn.) Gaertn., wild carrot, dandelion | | | | | | |

## Annex Table 1-3 Sample Survey of Arbor at Mohekou

| Types of Vegetation | Plantation | Environmental Characteristics | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Position | Position 3 Mohekou | Terrain | Height above sea level (m) | Relative height (m) | Slope position | Slope aspect | Gradient (°) | Soil |
| | | Plain | 16 | 0 | N/A | N/A | N/A | Lime concretion black soils |
| Level | Characteristics | Species composition and growth situation (Species, average height, average DBH, Biomass) | | | | | | |
| Arbor layer | Canopy density 27% | Simon poplar; Dominant species: Simon poplar;<br>Total density: 1037 per ha<br>Average height: 13.8m<br>Average DBH: 27.0m<br>Biomass: 192kg/m$^2$ | | | | | | |
| Updated level | N/A | N/A | | | | | | |
| Shrub layer | N/A | N/A | | | | | | |
| Herb layer | Cover degree 7% | Rumex, erigeron canadensis, zoysia | | | | | | |

## Annex Table 1-4 Sample Survey of Shrub at Genglou Ship Lock

| Types of Vegetation | Shrubbery | Environmental Characteristics | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Position | Position 1 north of Genglou Ship Lock | Terrain | Height above sea level (m) | Relative height (m) | Slope position | Slope aspect | Gradient (°) | Soil |
| | | Dam slope | 10 | 0 | N/A | N/A | N/A | Lime concretion black soils |
| Level | Characteristics | Species composition and growth situation (Species, average height, average DBH, Biomass) | | | | | | |
| Shrub layer | Total cover degree 55% | Wolfberry; Dominant species: Wolfberry;<br>Average height: 0.8m<br>Biomass: 1.1kg/m$^2$ | | | | | | |
| Updated level | Shrub seedlings | Wolfberry seedlings | | | | | | |
| Herb layer | Cover degree 3% | Wild carrot, zoysia, rubia argyi, cephalanoplos segetum | | | | | | |

## Annex Table 1-5 Sample Survey of Shrub at Fuyang Ship Lock

| Types of Vegetation | Shrubbery | Environmental Characteristics | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Position | Position 2 Fuyang South Bridge | Terrain | Height above sea level (m) | Relative height (m) | Slope position | Slope aspect | Gradient (°) | Soil |
| | | Dam slope | 16 | 5 | Upside | South | 45 | Brown soil |
| Level | Characteristics | Species composition and growth situation (Species, average height, average DBH, Biomass) | | | | | | |
| Shrub layer | Total cover degree 85% | Broussonetia papyrifera; Dominant species: Broussonetia papyrifera; Average height: 2.2m Biomass: 2.3kg/$m^2$ | | | | | | |
| Updated level | No shrub seedlings | | | | | | | |
| Herb layer | Cover degree 3% | Imperata, zoysia, artemisia lavandulaefolia, eleusine | | | | | | |

## Annex Table 1-6 Sample Survey of Herb at Genglou Ship Lock

| Types of Vegetation | Grass land | Environmental Characteristics | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Position | Position 1 north of Genglou Ship Lock | Terrain | Height above sea level (m) | Relative height (m) | Slope position | Slope aspect | Gradient (°) | Soil |
| | | Riverside | 11 | 0 | N/A | N/A | N/A | Brown soil |
| Level | Characteristics | Species composition and growth situation (Species, average height, average DBH, Biomass) | | | | | | |
| Herb layer | Dominant species: zoysia; Total cover degree: 41% | Sage herb, veronica, setaria, imperata, zoysia; Biomass: 149g/$m^2$ | | | | | | |

## Annex Table 1-7 Sample Survey of Herb at Fuyang Ship Lock

| Types of Vegetation | Grass land | Environmental Characteristics | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Position | Position 2 Fuyang South Bridge | Terrain | Height above sea level (m) | Relative height (m) | Slope position | Slope aspect | Gradient (°) | Soil |
| | | Riverside | 11 | 0 | N/A | N/A | N/A | Brown soil |
| Level | Characteristics | Species composition and growth situation (Species, average height, average DBH, Biomass) | | | | | | |
| Herb layer | Total cover degree 38% | Equisetum, zoysia, setaria, amaranthus spinosus; Dominant species: Equisetum□ Biomass□138g/$m^2$ | | | | | | |

## Annex Table 1-8 Sample Survey of Herb at Mohekou

| Types of Vegetation | Grass land | Environmental Characteristics | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Position | Position 3 Mohekou | Terrain | Height above sea level (m) | Relative height (m) | Slope position | Slope aspect | Gradient (°) | Soil |
| | | Riverside | 16 | 0.7 | underneath | Southeast | 15 | Brown soil |
| Level | Characteristics | Species composition and growth situation (Species, average height, average DBH, Biomass) | | | | | | |
| Herb layer | Total cover degree 45% | Galium aparine, eleusine, imperata, kalimeris; Dominant species: imperata; Biomass: 160g/m$^2$ | | | | | | |

## Annex Table 1-9 Sample Survey of Reed at Genglou Ship Lock

| Types of Vegetation | Grass land | Environmental Characteristics | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Position | Position 1 north of Genglou Ship Lock | Terrain | Height above sea level (m) | Relative height (m) | Slope position | Slope aspect | Gradient (°) | Soil |
| | | Riverside | 15 | 1 | underneath | Southeast | 15 | Brown soil |
| Level | Characteristics | Species composition and growth situation (Species, average height, average DBH, Biomass) | | | | | | |
| Herb layer | Total cover degree: 68% | Reed, zoysia; Dominant species: Reed; Biomass: 237g/m$^2$ | | | | | | |

## Annex Table 1-10 Sample Survey of Reed at Fuyang Ship Lock

| Types of Vegetation | Grass land | Environmental Characteristics | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Position | Yuanzhai | Terrain | Height above sea level (m) | Relative height (m) | Slope position | Slope aspect | Gradient (°) | Soil |
| | | Coastal wetlands | 14 | 0 | N/A | N/A | N/A | Brown soil |
| Level | Characteristics | Species composition and growth situation (Species, average height, average DBH, Biomass) | | | | | | |
| Herb layer | Total cover degree: 72% | Reed; Dominant species: Reed; Biomass:248g/m$^2$ | | | | | | |

## Annex Table 1-11 Sample Survey of Reed at Mohekou

| Types of Vegetation | Grass land | Environmental Characteristics | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Position | Mohekou | Terrain | Height above sea level (m) | Relative height (m) | Slope position | Slope aspect | Gradient (°) | Soil |
| | | Riverside | 15 | 1 | underneath | Southeast | 15 | Lime concretion black soils |
| Level | Characteristics | Species composition and growth situation (Species, average height, average DBH, Biomass) | | | | | | |
| Herb layer | Total cover degree: 77% | Reed, zoysia, vetch, galium aparine; Dominant species: Reed; Biomass: 221g/m$^2$ | | | | | | |

## Annex Table 2 List of Amphibians and Reptiles

| Family | Chinese name | Scientific Name | Habitat | Type of fauna |
|---|---|---|---|---|
| Bufonidae | □□□□ | *Bufo raddei* | Marsh, farmland | Palearctic realm |
| | □□□□ | *Bufo bufo* | Near the marsh, shore and village | Cosmopolitan species |
| Ranidae | □□□□□ | *Kaloula borealis* | Next to the soil hole, stone and house | Palearctic realm |
| | □□□□ | *Microhyla ornata* | | Oriental |
| | □□□ | *Rana nigromaculata* | Near the marsh, swamp and farmland | Cosmopolitan species |
| | □□ | *Rana limnocharis* | Near the marsh, farmland and village | Oriental |
| | □□□ | *Rana plancyi* | Near the pond, ditch, bush, etc. | Cosmopolitan species |
| Emydidae | □□ | *Chinemys reevesii* | Ditch, pond, paddy field, etc. | Cosmopolitan species |
| Gekkonidae | □□□□ | *Gekko swinhonis* | Village eaves and crack | Palearctic realm |
| Scincidae | □□□ | *Eumeces chinensis* | Ridge of farmland, marsh and beach | Oriental |
| Lacertidae | □□□□ | *Eremias brenchleyi* | Farmland, river beach and grass | Palearctic realm |
| Colubridae | □□□ | *Dinodon rufozonatum* | Near the village | Cosmopolitan species |
| | □□□□ | *Elaphe dione* | Near the village | Palearctic realm |
| | □□□□ | *Elaphe rufodorsata* | Farmland, pond and lakeside | Cosmopolitan species |
| | □□□□ | *Elaphe taeniura* | Near the village | Cosmopolitan species |
| | □□□ | *Zaocys dhumnades* | Near the farmland and village | Cosmopolitan species |

## Annex Table 3 List of Birds in Field Investigation

| Order/Family | Chinese name | Latin name | Type of fauna | Type of residence | Protection grade |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| **Podicipedifomes** Podicipedidae | □□□ | *Tachybaptus ruficollis* | Cosmopolitan species | Resident birds | |
| **Ciconiiformes** Ardeidae | □□ | *Ardea cinerea* | Cosmopolitan species | Resident birds Wintering birds | |
| **Falconiformes** Accipitridae | □□ | *Milvus lineaus* | Cosmopolitan species | Resident birds | National, Grade Ⅱ |
| | □□□ | *Cirus cyaneus* | Species of ancient North | Wintering birds | National, Grade Ⅱ |
| **Galliforms** Phasianidae | □□□ | *Phasanus colchicus* | Species of ancient North | Resident birds | Provincial, Grade Ⅱ |
| Rallidae | □□□ | *Gallinula chloropus* | Oriental species | Resident birds Summer residents birds | |
| **Charadriiformes** Charadriidae | □□□□ | *Vanellus vanellus* | Species of ancient North | Wintering birds | |
| | □□□ | *Charadrius dubius* | Species of ancient North | Resident birds | |
| Scolopacidae | □□□□ | *Gallinago gallinago* | Species of ancient North | Wintering birds | |
| **Columbiformes** Columbidae | □□□ | *Streptopelia orientalis* | Cosmopolitan species | Resident birds | |
| | □□□□ | *Streptopelia chinensis* | Oriental species | Resident birds | |
| **Coractiiformes** Alcedinidae | □□□□ | *Alcedo atthis* | Cosmopolitan species | Resident birds | |
| | □□□ | *Ceryle rudis* | Oriental species | Resident birds | |
| **Piciformes** Picidae | □□□□□ | *Dendrocopos major* | Cosmopolitan species | Resident birds | Provincial, Grade Ⅰ |
| **Passeriformes** Alaudidae | □□ | *Alauda arvensis* | Species of ancient North | Wintering birds | |
| Motacillidae | □□□□□ | *Motacilla alba* | Species of ancient North | Resident birds | |
| | □□ | *Anthus trivialis* | Species of ancient North | Wintering birds | |
| Pycnontidae | □□□ | *Pycnonotus sinensis* | Species of ancient North | Resident birds | |
| Laniidae | □□□□ | *Lanius schach* | Oriental species | Resident birds | Provincial, Grade Ⅱ |
| Sturnidae | □□□ | *Sturnus cineraceus* | Species of ancient North | Resident birds | |
| | □□ | *Acridotheres cristatellus* | Oriental species | Resident birds | |
| Corvidae | □□ | *Pica pica* | Species of ancient North | Resident birds | |
| Muscicapidae | □□□□ | *Phoenicurus auroreus* | Species of ancient North | Wintering birds | |
| | □□ | *Turdus merula* | Cosmopolitan species | Resident birds | |
| Paridae | □□□ | *Parus major* | Cosmopolitan species | Resident birds | |
| Ploceidae | □□ | *Passer domesticus* | Cosmopolitan species | Resident birds | |
| Fringillisae | □□□□□ | *Eophona migratoria* | Species of ancient North | Resident birds | |
| | □□□ | *Carduelis sinica* | Species of ancient North | Resident birds | |
| Emberizidae | □□□ | *Emberiza elegans* | Species of ancient North | Wintering birds | |
| | □□□□□ | *Emberiza cioides* | Species of ancient North | Resident birds | |
| | □□ | *Emberiza pusilla* | Species of ancient North | Wintering birds | |

## Annex Table 4 List of Birds that are possibly distributed around the assessment region

| Order/Family | Chinese name | Latin name | Type of fauna | Type of residence | Protection grade |
|---|---|---|---|---|---|
| **Podicipedifomes** | □□□ | *Tachybaptus ruficollis* | Cosmopolitan species | Resident birds | |

| Order/Family | Chinese name | Latin name | Type of fauna | Type of residence | Protection grade |
|---|---|---|---|---|---|
| Podicipedidae | | | | | |
| **Ciconiiformes** Ardeidae | □□ | *Ardea cinerea* | Cosmopolitan species | Resident birds Wintering birds | |
| | □□ | *Ardeola bacchus* | Oriental species | Summer residents birds | |
| | □□□ | *Egretta garzetta* | Oriental species | Summer residents birds | |
| | □□ | *Nyticorax nyticorax* | Cosmopolitan species | Summer residents birds | |
| | □□□ | *Egretta alba* | Cosmopolitan species | Wintering birds | |
| **Anseriformes** Anatidae | □□ | *Anser fabalis* | Species of ancient North | Wintering birds | Provincial, Grade Ⅱ |
| | □□□ | *Todorna ferruginea* | Species of ancient North | Wintering birds | Provincial, Grade Ⅱ |
| | □□□ | *Anas platyrhynchos* | Species of ancient North | Wintering birds | Provincial, Grade Ⅱ |
| | □□□ | *Anas poecilorhyncha* | Cosmopolitan species | Resident birds Wintering birds | Provincial, Grade Ⅱ |
| | □□ | *Aix galericulata* | Species of ancient North | Wintering birds Resident birds | National, Grade Ⅱ |
| **Falconiformes** Accipitridae | □□□ | *Accipiter soloensis* | Oriental species | Summer residents birds | National, Grade Ⅱ |
| | □□ | *Milvus migrans* | Cosmopolitan species | Resident birds | National, Grade Ⅱ |
| | □□□ | *Cirus cyaneus* | Species of ancient North | Wintering birds | National, Grade Ⅱ |
| Falconidae | □□ | *Falco tinnunculus* | Cosmopolitan species | Resident birds | National, Grade Ⅱ |
| **Galliforms** Phasianidae | □□□ | *Phasanus colchicus* | Species of ancient North | Resident birds | Provincial, Grade Ⅱ |
| | □□ | *Coturnix coturnix* | Cosmopolitan species | Wintering birds Resident birds | Provincial, Grade Ⅱ |
| Jacanidae | □□ | *Hydrophasianus chirurgus* | Cosmopolitan species | Summer residents birds | |
| Rallidae | □□□ | *Gallinula chloropus* | Oriental species | Resident birds Summer residents birds | |
| **Turniciformes** Turnicidae | □□□□□ | *Turnix tanki* | Species of ancient North | Resident birds | |
| **Charadriiformes** Charadriidae | □□□□ | *Vanellus vanellus* | Species of ancient North | Wintering birds | |
| | □□□ | *Pluvialis squatarola* | Species of ancient North | Wintering birds | |
| | □□□ | *Charadrius dubius* | Species of ancient North | Resident birds | |
| | □□□ | *Charadrius alexandrinus* | Cosmopolitan species | Summer residents birds | |
| Scolopacidae | □□□□ | *Tringa ochropus* | Species of ancient North | Wintering birds | |
| | □□□□ | *Gallinago gallinago* | Species of ancient North | Wintering birds | |
| | □□ | *Tringa erythropus* | Species of ancient North | Wintering birds | |
| | □□□ | *Tringa nebularia* | Species of ancient North | Wintering birds | |
| **Lariformes** Laridae | □□□ | *Larus ridibundus* | Species of ancient North | Wintering birds | |
| **Columbiformes** Columbidae | □□□ | *Streptopelia orientalis* | Cosmopolitan species | Resident birds | |
| | □□□□ | *Streptopelia chinensis* | Oriental species | Resident birds | |
| **Cuculiformes** Cuculidae | □□□□ | *Cuculus micropterus* | Cosmopolitan species | Summer residents birds | Provincial, Grade Ⅰ |
| | □□□ | *Cuculus canorus* | Cosmopolitan species | Summer residents birds | Provincial, Grade Ⅰ |
| **Strigiformes** Strigidae | □□□ | *Asio otus* | Species of ancient North | Wintering birds | National, Grade Ⅱ |
| | □□□ | *Asio flammeus* | Species of ancient North | Wintering birds | National, Grade Ⅱ |
| **Coraciiformes** Alcedinidae | □□□□ | *Alcedo atthis* | Cosmopolitan species | Resident birds | |
| Upupidae | □□□ | *Ceryle rudis* | Oriental species | Resident birds | |
| | □□ | *Upupa epops* | Cosmopolitan species | Resident birds | |
| **Piciformes** Picidae | □□□□□ | *Dendrocopos major* | Cosmopolitan species | Resident birds | Provincial, Grade Ⅰ |

| Order/Family | Chinese name | Latin name | Type of fauna | Type of residence | Protection grade |
|---|---|---|---|---|---|
| **Passeriformes** Alaudidae | □□ | *Alauda arvensis* | Species of ancient North | Wintering birds | |
| Hirundinidae | □□ | *Hirundo rustica* | Species of ancient North | Summer residents birds | Provincial, Grade Ⅰ |
| Motacillidae | □□□□□ | *Motacilla alba* | Species of ancient North | Resident birds | |
| | □□ | *Anthus trivialis* | Species of ancient North | Wintering birds | |
| | □□ | *Anthus novaeseelandiae* | Oriental species | Summer residents birds | |
| | □□ | *Anthus spinolstta* | Species of ancient North | Wintering birds | |
| Pycnontidae | □□□ | *Pycnonotus sinensis* | Species of ancient North | Resident birds | |
| Laniidae | □□□□ | *Lanius schach* | Oriental species | Resident birds | Provincial, Grade Ⅱ |
| | □□□□ | *Lanius sphenocercus* | Species of ancient North | Wintering birds | Provincial, Grade Ⅱ |
| | □□□□ | *Lanius cristatus* | Species of ancient North | Summer residents birds | Provincial, Grade Ⅱ |
| Oriolidae | □□□□ | *Oriolus chinensis* | Oriental species | Summer residents birds | Provincial, Grade Ⅰ |
| Dicruridae | □□□ | *Dicrurus macrocercus* | Oriental species | Summer residents birds | |
| | □□□ | *Dicrurus leucophaeus* | Oriental species | Summer residents birds | |
| Sturnidae | □□□ | *Sturnus cineraceus* | Species of ancient North | Resident birds | |
| | □□□□ | *Sturnus sericeus* | Oriental species | Resident birds | |
| | □□ | *Acridotheres cristatellus* | Oriental species | Resident birds | |
| Corvidae | □□ | *Pica pica* | Species of ancient North | Resident birds | |
| | □□□ | *Cyanopica cyana* | Species of ancient North | Resident birds | |
| | □□□□ | *Corvus macrorhynchus* | Cosmopolitan species | Resident birds | |
| | □□□□□ | *Corvus monedula* | Species of ancient North | Wintering birds | |
| Muscicapidae | □□□□□ | *Tarsiger cyanurus* | Species of ancient North | Wintering birds | |
| | □□□□ | *Phoenicurus auroreus* | Species of ancient North | Wintering birds | |
| | □□□□ | *Saxicola torquata* | Species of ancient North | Migratory birds | |
| | □□ | *Turdus merula* | Cosmopolitan species | Resident birds | |
| | □□ | *Garrulax canorus* | Species of ancient North | Wintering birds | |
| | □□□□ | *Paradoxornis webbianus* | Oriental species | Resident birds | |
| | □□□□ | *Cettia diphone* | Species of ancient North | Summer residents birds | |
| | □□□ | *Acrocephalus arundinaceus* | Cosmopolitan species | Summer residents birds | |
| Muscicapidae | □□□□ | *Acrocephalus bistrigiceps* | Species of ancient North | Migratory birds | |
| | □□□□ | *Phylloscopus inornatus* | Species of ancient North | Migratory birds | |
| | □□□□ | *Phylloscopus borealis* | Species of ancient North | Migratory birds | |
| | □□□□ | *Cisticola juncidis* | Oriental species | Summer residents birds | |
| Paridae | □□□ | *Parus major* | Cosmopolitan species | Resident birds | |
| Ploceidae | □□ | *Passer domesticus* | Cosmopolitan species | Resident birds | |
| Fringillisae | □□□□□ | *Eophona migratoria* | Species of ancient North | Resident birds | |
| | □□□ | *Carduelis sinica* | Species of ancient North | Resident birds | |
| | □□ | *Fringilla montifringilla* | Species of ancient North | Wintering birds | |
| Emberizidae | □□□ | *Emberiza elegans* | Species of ancient North | Wintering birds | |
| | □□□ | *Emberiza spodocephala* | Species of ancient North | Wintering birds | |
| | □□□□□ | *Emberiza cioides* | Species of ancient North | Resident birds | |
| | □□ | *Emberiza rustica* | Species of ancient North | Wintering birds | |
| | □□ | *Emberiza pusilla* | Species of ancient North | Wintering birds | |
| | □□□ | *Emberiza chyrsophrys* | Species of ancient North | Wintering birds | |

## Annex Table 5 List of mammals

| Order | Family | Species | Scientific Name | Type of fauna | Protection grade |
|---|---|---|---|---|---|
| □□□Insecetivora | □□□ Erinaceidae | □□□□ | *Erinaceus amurensis* Schrenk | Cosmopolitan species | |
| | □□□ Soricidae | □□□ | *Crocidura suaveolens* Pallas | Cosmopolitan species | |
| □□□Chiroptera | □□□ Vespertilionidae | □□□ | *Pipistrellus minus* Gray | Oriental species | |
| □□□ Lagomorpha | □□ Leporidae | □□ | *Lepus capensis* Linnaeus | Cosmopolitan species | |
| □□□ Rodentia | □□□ Cricetidae | □□□□ | *Cricetulus barabensis* Pallas | Species of ancient North | |
| | | □□□ | *Tscheskia triton* (de Winton) | Species of ancient North | |
| | □□ Muridae | □□□ | *Mus musculus* Linnaeus | Species of ancient North | |
| | | □□□□ | *Apodemus agrarius* Pallas | Species of ancient North | |
| | | □□□ | *Rattus tanezumi* Temminck | Oriental species | |
| | | □□□ | *Rattus norvegicus* Berkenhout | Species of ancient North | |
| □□□ Carntivora | □□ Canidae | □□ | *Vulpes vulpes* Linnaeus | Species of ancient North | Provincial, Grade Ⅰ |
| | | □ | *Nyctereutes procyonoides* Gray | Species of ancient North | Provincial, Grade Ⅰ |
| | □□ Mustelidae | □□ | *Mustela sibirica* Pallas | Species of ancient North | Provincial, Grade Ⅱ |
| | | □□ | *Meles meles* Linnaeus | Species of ancient North | Provincial, Grade Ⅱ |
| | □□ Felidae | □□ | *Prionailurus bengalensis* Kerr | Oriental species | Provincial, Grade Ⅰ |

## Annex Table 6 List of plankton

| Group | Chinese name | Scientific |
|---|---|---|
| □□□ Bacillariophyta | □□□ | *Navicula* sp. |
| | □□□ | *Synedra* sp. |
| | □□□□□ | *Melosira varians* |
| | □□□ | *Cyclotella* sp. |
| | □□□ | *Fragilaria* sp. |
| | □□□□□□□□□ | *Melosira granulata* var. *angustissima* |
| | □□□ | *Surirella* sp. |
| | □□□ | *Cymbella* sp. |
| □□□ Chlorophyta | □□□ | *Ankistrodesmus* sp. |
| | □□□□□ | *Selenastrum gracile* |
| | □□□□ | *Scenedesm quadricauda* |
| □□□ Euglenophyta | □□□□□ | *Phacus orbicularis* |
| | □□□□□ | *Colacium vesiculosum* |
| □□□ Chrysophyta | □□□□□ | *Dinobryon divergens* |
| | □□□□□ | *Dinobryon sertularia* |
| | □□□□□ | *Dinobryon cylindricum* |
| □□□ Cryptophyta | □□□□□ | *Chroomonas caudata* |

| | | |
|---|---|---|
| | □□□□ | *Cryptomonas ovata* |
| | □□□□ | *Cryptomonas crosa* |
| □□□ Pyrrophyta | □□□□□ | *Aphanizomenon flos-aquae* |
| □□□ Cyanophyta | □□□□□ | *Uroglena volvox* |

## Annex Table 7 List of Zooplankton

| Group | Chinese name | Scientific |
|---|---|---|
| □□□□Protozoan | □□□□□ | *Askenasia volvox* |
| | □□□ | *Difflugia* sp. |
| □□ Rotifer | □□□□□□ | *Asplanchna pridonta* |
| | □□□□□□ | *Polyarthra euryptera* |
| | □□□□□□ | *Branchionus urceus* |
| | □□□□□□ | *Branchionus calyciflorus* |
| | □□□□□□ | *Branchionus budapestierisis* |
| | □□□□□□ | *Keratella quadrata* |
| | □□□□□□ | *Chromogaster ovalis* |
| | □□□□□□ | *Branchionus angularis* |
| | □□□□□□ | *Keratella cochlearis* |
| □□□ Copepoda | □□□□□□ | *Eucyclops macrurus* |

## Annex Table 8 List of Benthos

| Order | Family | Species | Scientific name |
|---|---|---|---|
| □□□ Oligochaeta | □□□ Tubificidae | □□□□□ | *Branchiura sowerbyi* |
| | | □□□□ | *Tubifex sinicus* |
| | | □□□□□□ | *Limnodrilus claparedianus* |
| | | □□□□□ | *Aulodrilus prothecatus* |
| □□□ Rhyachobdellida | □□□ Glossiphonidae | □□□□ | *Glossiphonia complanata* |
| □□□□ Mesogastropoda | □□□ Viviparidae | □□□□□ | *Bellamya quadrata* |
| | | □□□□□ | *Bellamya aeruginosa* |
| | | □□□□□ | *Bellamya purificata* |
| | | □□□□□ | *Cipangopaludina cahayensis* |
| | | □□□□□ | *Cipangopaludina chinensis* |
| | | □□□ | *Parafossarulus striatulus* |
| | | □□□□ | *Alocinma longicornis* |
| | | □□□ | *Parafossarulus eximius* |
| | | □□□ | *Bulimus thynia fuchsisana* |
| □□□ Basommatophore | □□□□ Lymnaeidae | □□□□□ | *Radix plicaml* |
| | | □□□□ | *Radix auricularia* |
| | | □□□□ | *Radix ovata* |
| | | □□□□□ | *Hippeutis umbilicalis* |

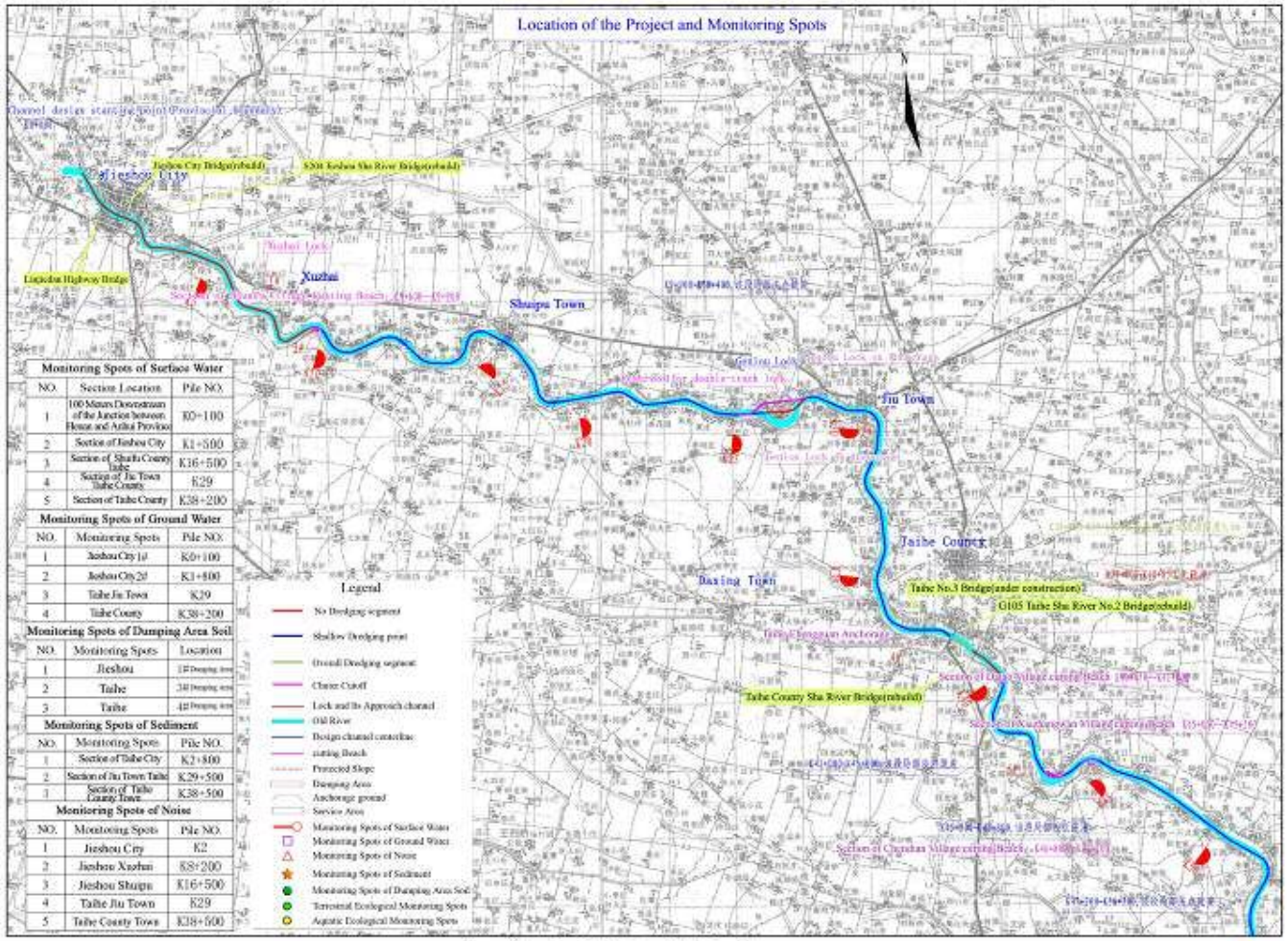
| | | | |
|---|---|---|---|
| | | □□□□□ | *Semisulcospira cancelata* |
| □□□ Anisomyaria | □□□ Mytilidae | □□□□ | *Limnoperna lacustris* |
| | □□ Unionidae | □□□□ | *Unio douglasiae* |
| | | □□□□□ | *Anodonta woodiana* |
| | | □□□□□ | *Anodonta globosula* |
| | □□ Corbiculidae | □□ | *Corbicula fluminea* |
| □□□ Decapoda | □□□□ Palaemonidae | □□□□ | *Macrobrachium nipponensis* |
| | □□□ Astacidae | □□□□□ | *Procambarus clarkii* |
| □□□ Diptera | □□□ Chironomidae | □□□□□ | *Cryptochironomus* digitatus |
| | | □□□□□□ | *Procladius choreus* |
| | | □□□□□□ | *Polypedilum scalaenum* |
| | | □□□□□□ | *Micropsectra logani* |
| | | □□□□□ | *Tendipes* sp. |

## Annex Table 9 List of fish

| Order | Family | Chinese name | Scientific name |
|---|---|---|---|
| □□□ Clupeiformes | □□ Clupeidae | □□ | *Coilia ectenes* |
| | | □□□ | *Coilia brachygnathus* |
| □□□ Salmoniformes | □□□ Salangidae | □□□□□ | *Neosalanx tangkahkeii* |
| | | □□□ | *Protosalanx hyalocranius* |
| | | □□□ | *Hemisalanx prognathus* |
| □□□ Anguilliformes | □□□ Anguillidae | □□□□ | *Anguilla japonica* |
| □□□ Cyprinifmes | □□ Cyprinidae | □□□ | *Zacco platypus* |
| | | □□□ | *Opsariichthys bidens* |
| | | □□ | *Mylopharyngodon piceus* |
| | | □□ | *Ctenopharyngodon idellus* |
| | | □□□ | *Squaliobarbus curriculus* |
| | | □□ | *Ochetobius elongatus* |
| | | □□ | *Elopichthys bambusa* |
| | | □□□ | *Pseudolaubuca sinensis* |
| | | □□□ | *Toxabramis swinhonis* |
| | | □ | *Hemiculter leucisculus* |
| | | □ | *Culter erythropterus* |
| | | □□□□ | *Erythroculter mongolicus* |
| | | □□□ | *Megalobrama amblycephala* |
| | | □□□□□ | *Xenocypris microlepis* |
| | | □□ | *Pseudobrama simoni* |
| | | □□□□ | *Rhodeus sinensis* |
| | | □□□ | *Acheilognathus taenianalis* |
| | | □□□ | *Acheilognathus hypselonotus* |
| | | □□□ | *Sarcocheilichthys nigripinnis* |
| | | □□□ | *Abbottina rivularis* |

| Order | Family | Chinese name | Scientific name |
|---|---|---|---|
| | | □ | *Cyprinus corpio* |
| | | □ | *Carassius auratus* |
| | | □ | *Aristichthys nobilis* |
| | | □ | *Hypophthalmichthys molitrix* |
| | □□ Cobitidae | □□ | *Misgurnus anguillicaudatus* |
| | | □□□□□ | *Pararmisgurnus dabryanus* |
| □□□ Silurformes | □□ Siluridae | □ | *Silurus asotus* |
| | □□ Bagridae | □□□ | *Pelteobagrus fulvidraco* |
| | | □□□ | *Leiocassis longirostis* |
| □□□□Synbranchiformes | □□□□ Synbranchidae | □□ | *Monopterus albus* |
| □□□ Perciformes | □□ Serranidae | □□□ | *Coreosiniperca roulei* |
| | | □ | *Siniperca chuatsi* |
| | | □□ | *Siniperca scherzeri* |
| | □□□ Eleotridae | □□□ | *Odontobutis obscura* |
| | | □□□□ | *Hypseleotris swinhonis* |
| | □□□□ Gobiidae | □□□□□□ | *Ctenogobius giurinus* |
| | □□□ Belontiidae | □□□□ | *Macropodus chinensis* |
| | □□ Channidae | □□ | *Channa argus* |
| | □□□ Mastacembelidae | □□ | *Mastacembelus aculeatus* |


Figure 1:Location of the Project in Anhui Province




| Monitoring Spots of Surface Water | | |
|---|---|---|
| NO. | Section Location | Pile NO. |
| 1 | 100 Meters Downstream of the Junction between Henan and Anhui Provinces | K0+100 |
| 2 | Section of Jieshou City | K1+500 |
| 3 | Section of Shuipu County Taihe | K16+500 |
| 4 | Section of Jiu Town Taihe County | K29 |
| 5 | Section of Taihe County | K38+200 |
| **Monitoring Spots of Ground Water** | | |
| NO. | Monitoring Spots | Pile NO. |
| 1 | Jieshou City 1# | K0+100 |
| 2 | Jieshou City 2# | K1+800 |
| 3 | Taihe Jiu Town | K29 |
| 4 | Taihe County | K38+200 |
| **Monitoring Spots of Dumping Area Soil** | | |
| NO. | Monitoring Spots | Location |
| 1 | Jieshou | 1# Dumping Area |
| 2 | Taihe | 2# Dumping Area |
| 3 | Taihe | 4# Dumping Area |
| **Monitoring Spots of Sediment** | | |
| NO. | Monitoring Spots | Pile NO. |
| 1 | Section of Taihe City | K2+800 |
| 2 | Section of Jiu Town Taihe | K29+500 |
| 3 | Section of Taihe County Town | K38+500 |
| **Monitoring Spots of Noise** | | |
| NO. | Monitoring Spots | Pile NO. |
| 1 | Jieshou City | K2 |
| 2 | Jieshou Xuzhai | K8+200 |
| 3 | Jieshou Shuipu | K16+500 |
| 4 | Taihe Jiu Town | K29 |
| 5 | Taihe County Town | K38+600 |

Figure 2-1:Location of the Project and Monitoring Spots

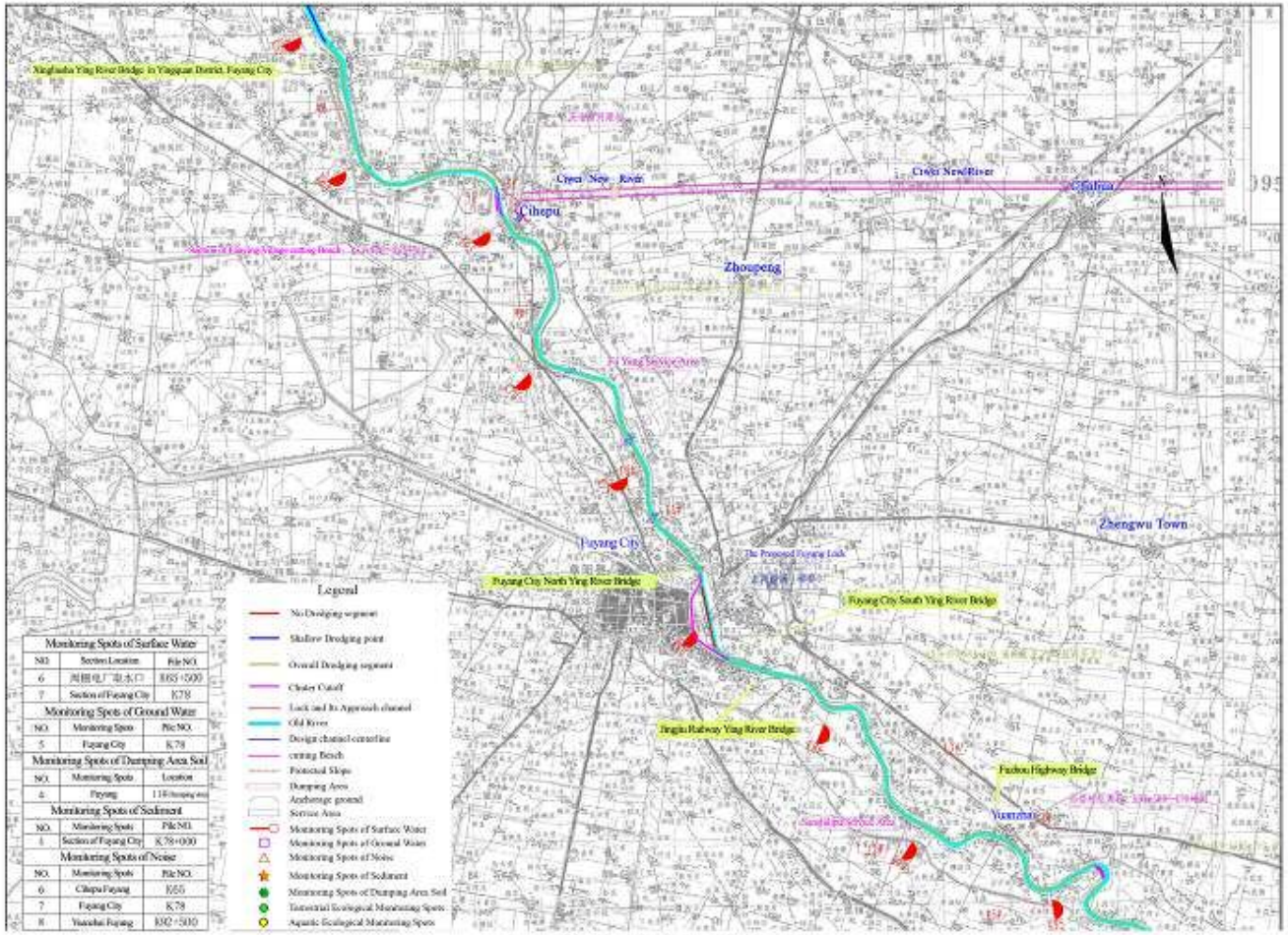
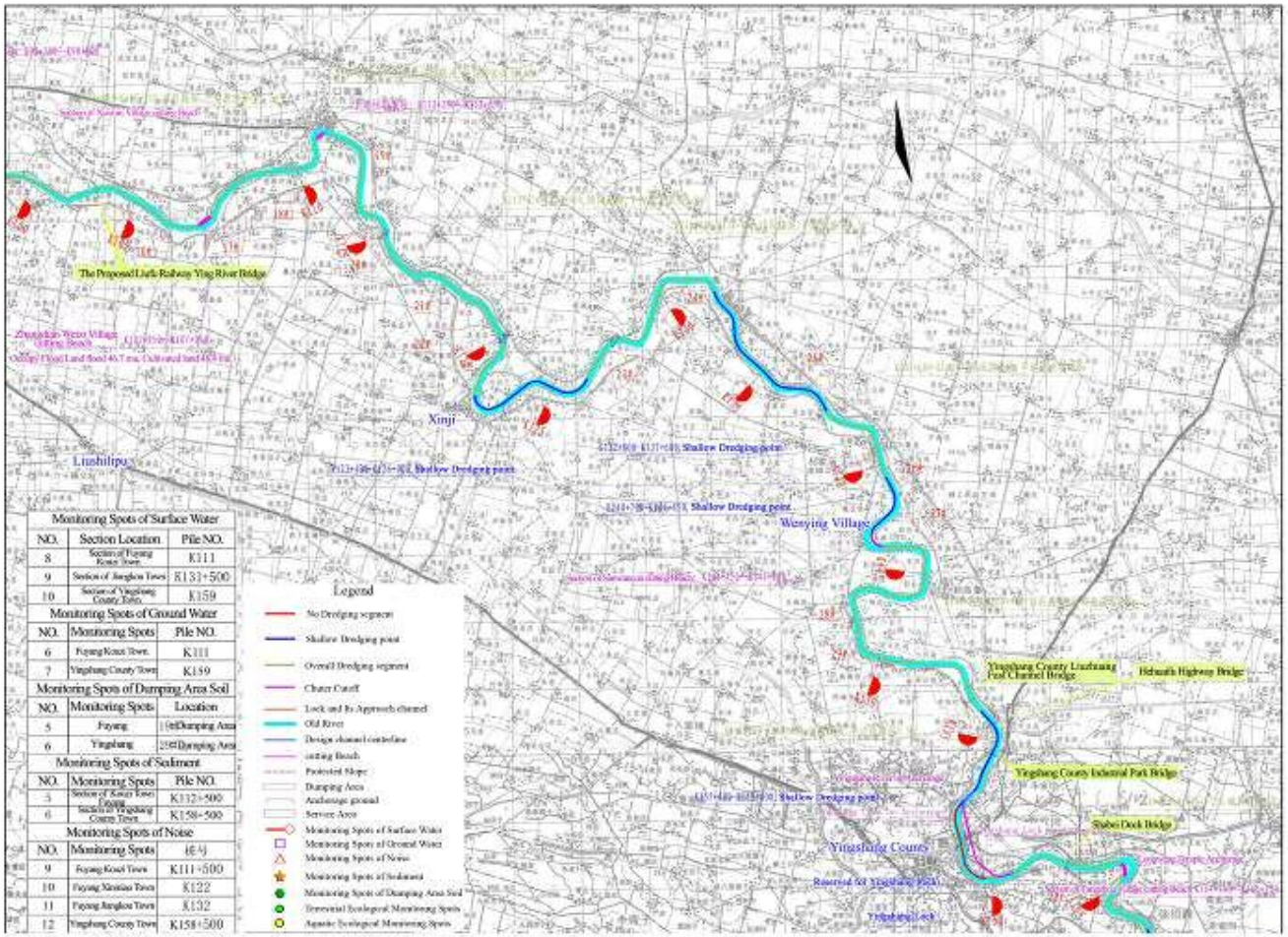
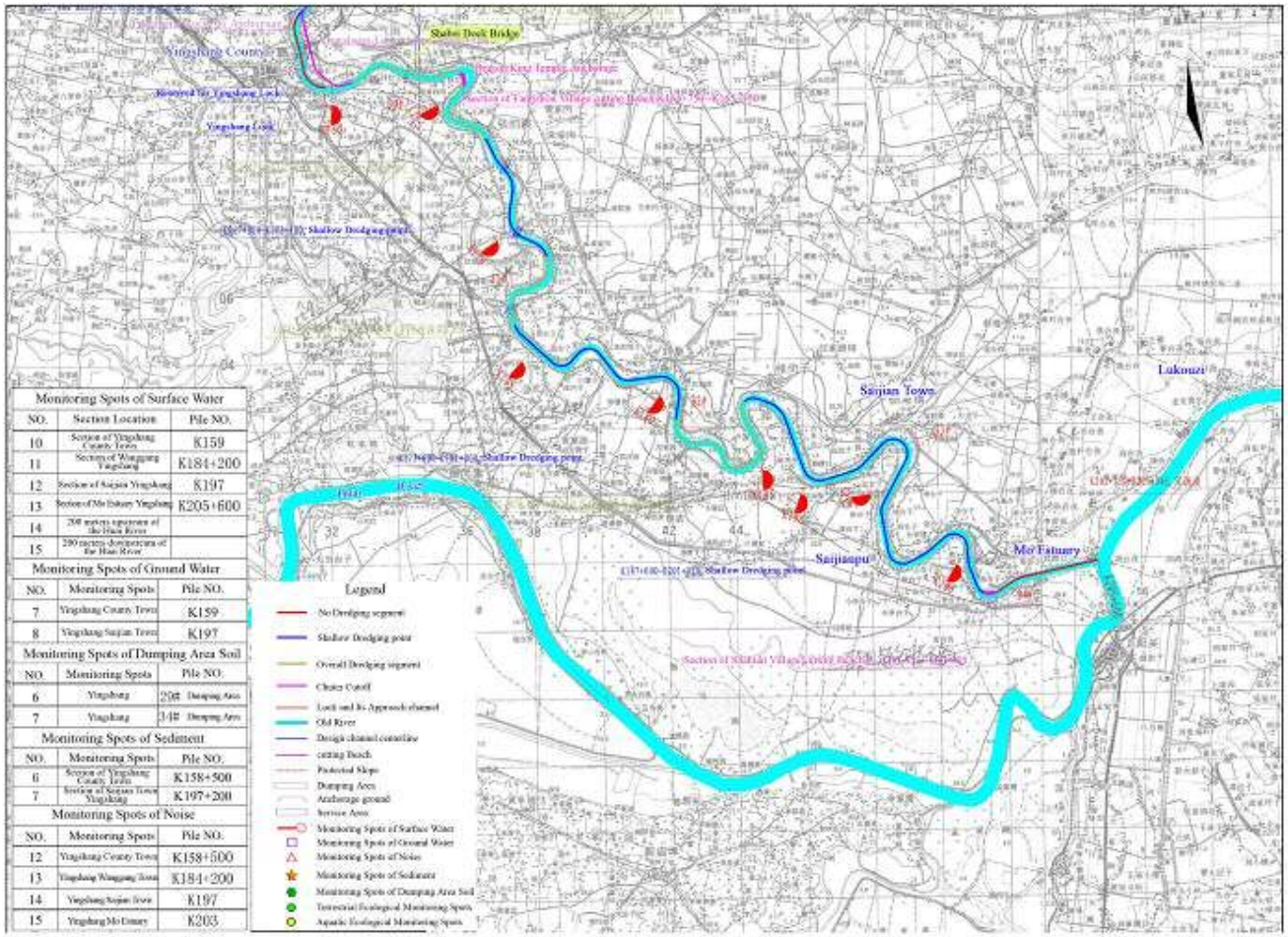



Figure 2-2:Location of the Project and Monitoring Spots




| Monitoring Spots of Surface Water | | |
|---|---|---|
| NO. | Section Location | Pile NO. |
| 8 | Section of Fuyang Kouzi Town | K111 |
| 9 | Section of Jinglou Town | K131+500 |
| 10 | Section of Yingshang County Town | K159 |
| **Monitoring Spots of Ground Water** | | |
| NO. | Monitoring Spots | Pile NO. |
| 6 | Fuyang Kouzi Town | K111 |
| 7 | Yingshang County Town | K159 |
| **Monitoring Spots of Dumping Area Soil** | | |
| NO. | Monitoring Spots | Location |
| 5 | Fuyang | 1#Dumping Area |
| 6 | Yingshang | 2#Dumping Area |
| **Monitoring Spots of Sediment** | | |
| NO. | Monitoring Spots | Pile NO. |
| 5 | Section of Kouzi Town (Middle) | K112+500 |
| 6 | Section of Yingshang County Town | K158+500 |
| **Monitoring Spots of Noise** | | |
| NO. | Monitoring Spots | (EA) |
| 9 | Fuyang Kouzi Town | K111+500 |
| 10 | Fuyang Xinxiao Town | K122 |
| 11 | Fuyang Jinglou Town | K132 |
| 12 | Yingshang County Town | K158+500 |

**Figure 2-3:Location of the Project and Monitoring Spots**




| Monitoring Spots of Surface Water | | |
|---|---|---|
| NO. | Section Location | Pile NO. |
| 10 | Section of Yingshang County Town | K159 |
| 11 | Section of Wangjiang Yingshang | K184+200 |
| 12 | Section of Saijiao Yingshang | K197 |
| 13 | Section of Mo Estuary Yingshang | K205+600 |
| 14 | 200 meters upstream of the Huai River | |
| 15 | 200 meters downstream of the Huai River | |
| **Monitoring Spots of Ground Water** | | |
| NO. | Monitoring Spots | Pile NO. |
| 7 | Yingshang County Town | K159 |
| 8 | Yingshang Saijiao Town | K197 |
| **Monitoring Spots of Dumping Area Soil** | | |
| NO. | Monitoring Spots | Pile NO. |
| 6 | Yingshang | 20# Dumping Area |
| 7 | Yingshang | 34# Dumping Area |
| **Monitoring Spots of Sediment** | | |
| NO. | Monitoring Spots | Pile NO. |
| 6 | Section of Yingshang County Town | K158+500 |
| 7 | Section of Saijiao Town Yingshang | K197+200 |
| **Monitoring Spots of Noise** | | |
| NO. | Monitoring Spots | Pile NO. |
| 12 | Yingshang County Town | K158+500 |
| 13 | Yingshang Wangjiang Town | K184+200 |
| 14 | Yingshang Saijiao Town | K197 |
| 15 | Yingshang Mo Estuary | K203 |

**Figure 2-4:Location of the Project and Monitoring Spots**

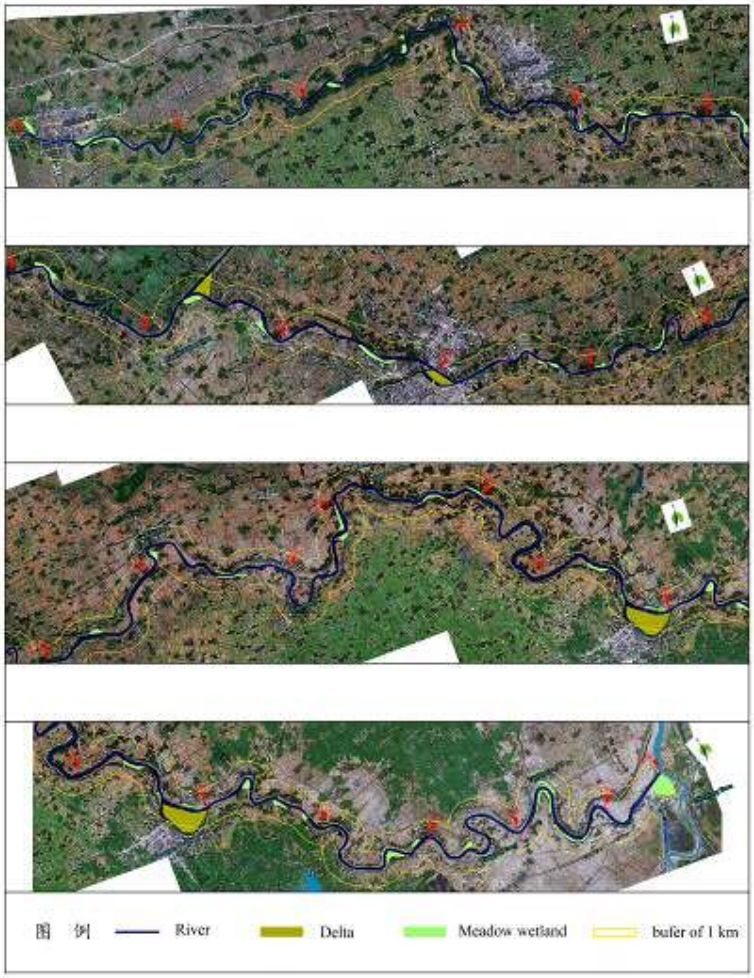



Figure 3:Remote Sensing Image of Shaying River and the Distribution of Natural Wetland