Environmental Impact Assessment (Final)

January 2014

PRC: Anhui Intermodal Sustainable Transport Project

Prepared by Anhui Provincial Department of Transport for the Asian Development Bank. This is a final version of the draft originally posted in July 2013 available on http://www.adb.org/projects/45021-002/documents

CURRENCY EQUIVALENTS

(as of 2 December 2013)

Currency unit	–	yuan (CNY)
CNY1.00	=	$0.16415
$1.00	=	CNY6.0919

ABBREVIATIONS

AC	–	Asphalt concrete
ADB	–	Asian Development Bank
APDOT	–	Anhui Province Department of Transport
APEPD	–	Anhui Province Environmental Protection Department
APHAB	–	Anhui Province Highways Administration Bureau
APPSAB	–	Anhui Province Port Shipping Administration Bureau
APPSCIG	–	Anhui Province Ports and Shipping Construction Investment Group
BOD_5	–	5-day biochemical oxygen demand
CNY	–	Chinese Yuan
CO	–	carbon monoxide
COD	–	chemical oxygen demand
DMF	–	Design and monitoring framework
EA	–	Executing Agency
EHS	–	environmental health and safety
EIA	–	environmental impact assessment
EIR	–	Environmental Impact Report
EIRF	–	Environmental Impact Registration Form
EIT	–	environmental impact table
EMC	–	environmental management consultant
EMP	–	environmental management plan
EMS	–	environmental monitoring station
EPB	–	Environmental Protection Bureau
EPD	–	Environmental Protection Department
ESE	–	Environmental supervision engineer
FSR	–	Feasibility study report
FYP	–	Five-Year Plan
GDP	–	gross domestic product
GHG	–	greenhouse gas
GRM	–	grievance redress mechanism
HC	–	hydrocarbon
HGV	–	Heavy goods vehicle
IA	–	implementing Agency
I_{Mn}	–	permanganate index
IPCC	–	International Panel on Climate Change
LDI	–	local design institute
LED	–	Light emitting diode
LPMO	–	Local Project Management Office
MAD		Metres above datum
MEP	–	Ministry of Environmental Protection
MEPB	–	Municipal Environmental Protection Bureau

MG	–	Municipal government
NBES	–	National Protection List of Terrestrial Wild Animal with Beneficial or Important Economic and Scientific Research Value
NH_3-N	–	ammonia nitrogen
NMT	–	non-motorised transport
NO_2	–	nitrogen dioxide
NO_x	–	Nitrogen oxides
O&G	–	oil and grease
O&M	–	operation and maintenance
PAH	–	poly-aromatic hydrocarbon
PAM	–	Project administration manual
PC	–	Pre-stressed Concrete
PCU	–	Passenger car units
PM	–	particulate matter
$PM_{2.5}$	–	particulate matter with diameter of particles ≤2.5 μ
PM_{10}	–	particulate matter with diameter of particles ≤10 μ
PME	–	Powered mechanical equipment
PPMO	–	Provincial Project Management Office
PRC	–	People's Republic of China
PVC	–	polyvinyl chloride
ROW	–	Right of way
RP	–	resettlement plan
RSP	–	respirable suspended particulates
SO_2	–	sulfur dioxide
SPS	–	Safeguard policy statement
SS	–	suspended solids
STI	–	Sustainable Transport Initiative
TDM	–	travel demand management
TN	–	total nitrogen
TP	–	total phosphorus
TPH	–	total petroleum hydrocarbon
TSP	–	total suspended particulates
TTM	–	temporary traffic management
USD	–	United States dollar
VOC	–	volatile organic compound
WHO	–	World Health Organization
XPSAB	–	Xuancheng Port and Shipping Administration Bureau

WEIGHTS AND MEASURES

a	–	annum
^oC	–	degree centigrade
μ	–	micron
cm	–	centimeter
dwt	–	dead weight tonnes
h	–	hour
ha	–	hectare
kg/d	–	kilogram per day
km	–	kilometer

km/h	–	kilometer per hour
km^2	–	square kilometer
m	–	meter
m^2	–	square meter
m^3	–	cubic meter
m/s	–	meter per second
m^3/d	–	cubic meter per day
m^3/s	–	cubic meter per second
mg/l	–	milligram per liter
mg/m^3	–	milligram per cubic meter
mm	–	millimeter
mu	–	Chinese unit of area. 15 mu = 1 ha
pax	–	persons
s	–	second
t	–	metric tonnes
$t/km^2.a$	–	metric tonnes per square kilometer per annum
W		watt
y	–	year

NOTES

In the report, "$" refers to US dollars.

In preparing any country program or strategy, financing any project, or by making any designation of or reference to a particular territory or geographic area in this document, the Asian Development Bank does not intend to make any judgments as to the legal or other status of any territory or area.

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安徽省交通运输厅

12 July 2013

Mr. Sharad Saxena
Senior Transport Specialist
Transport Division
East Asia Department
Tel +63 2 632 4485
Fax +63 2 636 2426

Dear Mr. Saxena:

Subject: PRC 45021: Proposed Anhui Intermodal Sustainable Transport Development Project

The consolidated Environmental Impact Assessment (CEIA) and Environment Management Plan (EMP) for the captioned project were based on six domestic environmental impact assessment reports prepared for the project by the Shanghai Ship and Shipping Research Institute. Five reports have been approved by relevant environmental authorities, the Anhui Environmental Protection Department, the Ma'anshan Environmental Protection Bureau and the Wuhu Environmental Protection Bureau and reviewed by the Anhui Provincial Department of Transport. The report for the Shuiyang Waterway Improvement Project has been reviewed by the Anhui Provincial Department of Transport and the Anhui Environmental Protection Department, and approval of this report by the Anhui Environmental Protection Department is expected before 31 July 2013.

This is to formally advise you that there is no objection to these documents being posted on the ADB website according to ADB disclosure procedures. We will implement all required actions as set out in the CEIA and EMP during project processing and implementation and accept ADB's supervision and inspection of EMP implementation.

We appreciate your support and help for our project processing.

Yours sincerely,

Deputy Director
Anhui Provincial Department of Transport

I. EXECUTIVE SUMMARY

A. Background

1. This consolidated environmental impact assessment (EIA) is for the Anhui Intermodal Sustainable Transport Project, which comprises two subcomponents, (i) the Shuiyang River Waterway Improvement Project (SRWIP) and Xuanzhou Multi-purpose Port Development Project; and (ii) a highway improvement component to improve four sections of roads totalling 122.18 kilometers (km) in Anhui Province, namely (a) the Ma'anshan North Corridor, (b) Yimu Highway Kedian to Mujiatang, (c) the S319 Erba to Wuwei, and (d) the G206 Dongliu to Yaodu Section (**Figure I.1**).

2. This report was prepared based on information provided in the six domestic environmental impact reports (EIR), which have gone through the domestic approval process. Five of the EIRs have been approved and approval of the Shuiyang River Waterway Improvement Project is expected to be received by 31 July 2013. The domestic EIRs were prepared based on information in the domestic feasibility study reports (FSR) and the domestic Soil and Water Conservation (SWC) reports for the project. The SWC reports have all been approved by the Anhui Water Resources Department or the local Water Resources Bureaux.

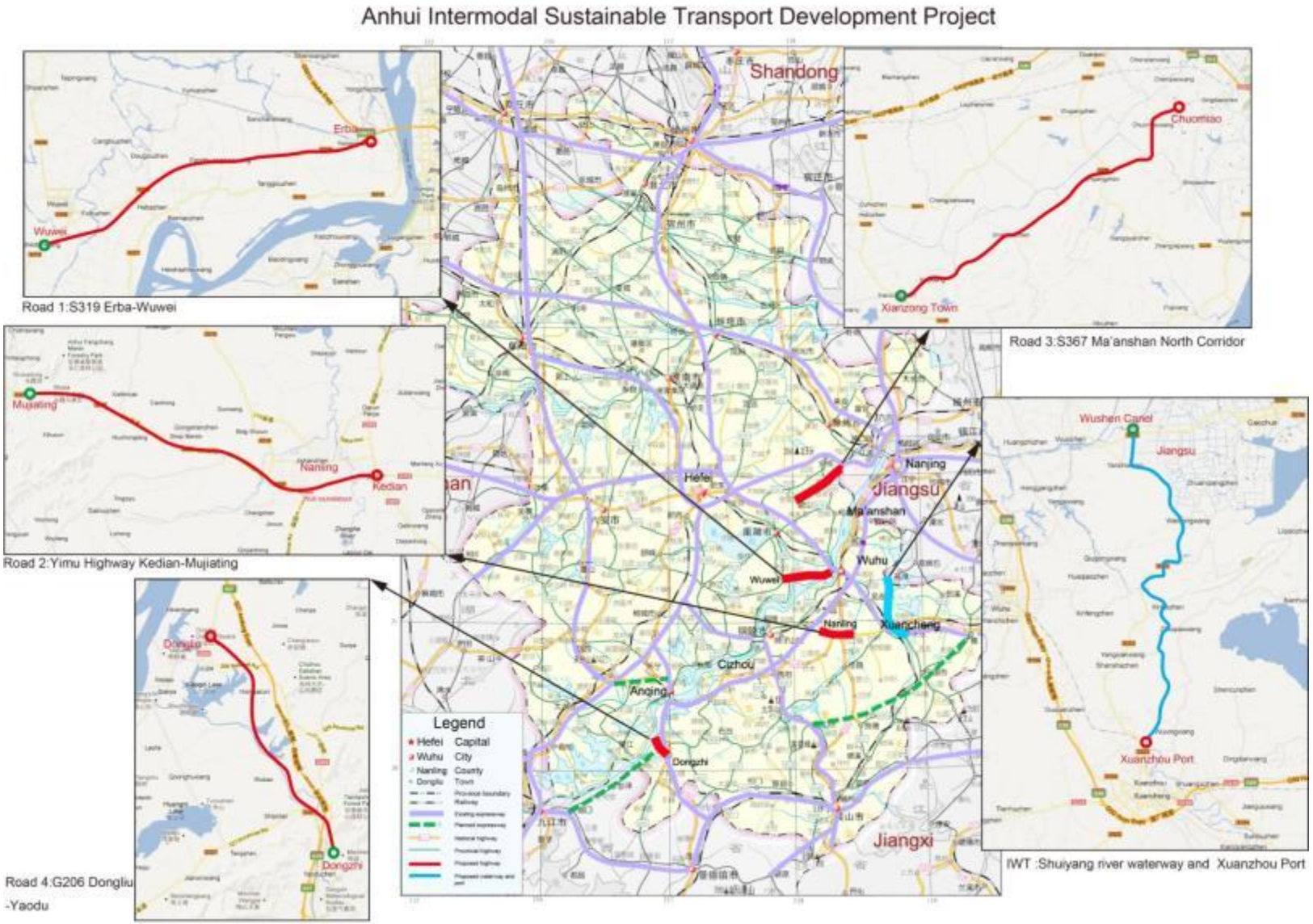
3. Anhui is a land-locked province and one of the poorest provinces in the People's Republic of China (PRC). Although geographically in the east of China, it is considered one of the central provinces. The province is subdivided by the Yangtze River, which has historically separated and isolated the poorer mountains and plains on the southern side of the river from the comparatively more prosperous plains to the north. Compared with the PRC's coastal provinces, Anhui is less accessible and its infrastructure and economy are relatively less well developed.

4. The province has a population of about 63 million, of whom 63% are classed as rural, one of the highest percentages in the country, and substantially higher than the eastern provinces with an average of 45% rural population. The population density at 470 persons per km^2 is higher than the national average of 138 persons per km^2. The GDP per capita at CNY28,792 (USD 4,561) was 75% of the national average in 2012 and ranked the province 26^{th} out of 31 provinces and municipalities in the PRC.

5. There is also substantial poverty and rural-urban disparity. Some 26 out of 61 counties in the province are officially designated as poverty counties. 51 counties have a GDP per capita lower than the provincial average, and only one county reached the national average. Statistics for 2012 indicate that the annual average disposable income for urban dwellers was CNY10,691 and net income of CNY3,556 for rural inhabitants.

6. The provincial capital Hefei is located on the north side of the Yangtze, with a population of 5.7 million in 2010. The second largest city is Wuhu, located on the southern bank on the Yangtze, with a population of 2.3 million and planning to expand rapidly over the coming years.

Figure I.1: Location of the Anhui Highway and Waterway SubProjects



7. The Project aims to improve the quality and capacity of Anhui's transportation network in a sustainable manner. The improvements to the Shuiyang River will allow year-round navigation on the river, except during flood flows, thereby markedly increasing the volume of cargo that can be transported along the river, and supporting development at the new Xuanzhou Port and industrial relocation to Xuancheng City and surrounds. Inland waterways are a more sustainable mode of transport, requiring substantially less carbon emissions per tonnage of cargo, and have fewer impacts on land-take, farming, ecology, and people than new highways.

8. The existing highway network is inadequate and the Provincial 12th Five Year Plan (FYP) includes substantial upgrade of the existing road network. In 2007, only 8.4% of the highway network was Class I or II highway, compared with the national average of 10.6%, and more than 82% of the roads in the Province were Class IV or unclassified. The highway projects will help to improve inter-Province links between Anhui and Jiangsu, as well as improve north-south and east-west links within Anhui to supplement the expressway network, ease congestion on county roads, improve safety for vehicle travellers and non-motorised transport (NMTs), and improve the quality of people's lives in the county towns and villages.

9. This Project is aligned with the *Anhui Wanjiang Demonstration Zone for Industrial Relocation into Cities along the Yangtze River* plan, the State Council's Policy statement on *Accelerating Development of Inland Water Transport on the Yangtze River and Other Waterways* 2011, Anhui's 12th Five Year Plan (12th FYP) (2011-2015) and *Notice on Strengthening Construction and Management of Waterway Transport Infrastructure and Speeding up Waterborne Transport*, the *Xuancheng Port Master Plan* and *Strategic Environmental Assessment*, and the master plans for the affected towns.

10. The Project is also consistent with ADB's Country Partnership Strategy for the PRC in the areas of: (i) inclusive growth–by promoting improved transportation in less developed regions, (ii) environmentally sustainable growth–through the promotion of inland waterways, and (iii) regional co-operation–by promoting improvements in inter-province transportation links. The focus on public transport and multi-modal integration fits well with ADB's Sustainable Transport Initiative.

B. Project Design

11. The expected outcome of the Project is improved waterway navigation to increase the efficient, environmentally sound and safe transportation of bulk cargo via barges from the southern hinterland of Anhui Province towards the Yangtze River and associated river ports and the upgrading of provincial highways to increase transport capacity, improve travel times, reduce accidents and improve safety conditions for drivers and pedestrians.

12. The expected project outputs are (i) waterway component – improved waterway to meet restricted Class IV waterway with Class III water depth standard over about 50 km from Haitangwan upstream to Yanchi Village downstream and the new Xuanzhou river port in Huancheng City with Phase 1 to comprise four berths, 27.2 ha for associated auxiliary uses, and to handle initially some 1.5M t of cargo annually, and (ii) highways component: upgrades along four separate highways, totalling 122.33 km, with 75.46 km of national and provincial roads upgraded from Class II to Class I and 46.87 km of rural roads upgraded from Classes III and IV to Class II.

C. Project Benefits

13. The Shuiyang River Waterway Improvement Project and Xuanzhou Multi-purpose Port will directly benefit the regional economy in and around Xuancheng City, through the opening up of the inland waterway to year round trade, the increase in shipping on the Shuiyang River, the potential to develop industry and manufacturing in Xuancheng, and develop trade and transportation links with the Yangtze River Delta and Shanghai. The scheme will benefit the environment by promoting a low carbon transportation system that would transport bulk cargo for significantly lower carbon emissions per kilometre travelled compared to highways and rail, helping to reduce the contribution of transportation to greenhouse gases, while improving transport capacity. The scheme will indirectly benefit the people and environment in Xuancheng City by encouraging a modal shift of cargo from heavy goods vehicles (HGV) to ships, thereby helping to offset the growth of highway freight on the local and regional road network to the benefit of local travel and people living and working in Xuanzhou.

14. The Highway Schemes will benefit the current and future users of the local and regional road network, through improved journey times, more reliable journeys and safer more comfortable journeys. Traffic flow is predicted to rise by multiples of three to five fold between now and 2029 on these schemes, except for the Yimu Highway where future growth would be depressed by the opening of the TongNanXuan Expressway towards the end of the decade. The high forecasts are largely due to the increase in car traffic from relatively low ownership levels. While the current traffic flows represent a mixture of local and regional traffic, the local traffic component is already important and likely to grow. All the highway schemes are compliant with the local town plans and improved regional transport links will support development of designated development land in local communities.

15. The highways also carry commercial and regional traffic, including a disproportionate volume of HGVs, which affect the quality of the road, create environmental impacts due to noise, air emissions and severance of communities, and increase the risk of accidents. Improvements in the road design will help to mitigate the adverse effects of HGVs.

16. Various aspects of the proposed design will improve the safety conditions for travellers and pedestrians. These include the separation of vehicular traffic, cyclists and pedestrians on the urban expressways for the Yimu Highway and the G206; pedestrian crossings; increase in over-taking capacity from dual single to dual two lane carriageways; and lighting in urban areas.

17. Minor route alignments to bypass towns and villages on the Ma'anshan North Corridor, S319 Xihe Bridge Crossing and the G206 new build will provide relief from noise, air emissions and severance to local communities. The diversion of traffic from the old G206 Dongliu to Yaodu Section to the new alignment may bring about some modest benefits to the noise and air pollution as well as reducing traffic through the Tiantai Mountain Forest Park.

D. Project Impacts and Mitigation Measures

18. This Project was classified as category A for environment by ADB.

1. Shuiyang River Waterway Improvement Project and Xuanzhou Multi-purpose Project

19. The SRWIP and new port will require 429.8 mu (28.7 ha) of permanent land take which is an irreversible impact and a further 1,651 mu (110 ha) of temporary land, mostly for the

temporary spoil disposal sites and construction staging areas. Some 156 households or an estimated population of 478 will be affected by land acquisition, house demolition or both. It will be necessary to demolish villagers' houses, relocate short sections of utilities and other assets, and relocate a ship yard currently occupying the proposed site of the ship lock near Shuiyang Town. Compensation and resettlement will be carried out in line with the PRC and ADB applicable policies and requirements.

20. Various design measures have been taken into consideration to mitigate the potential impacts of the scheme:

a) The proposed scheme provides for sufficient water depth for year round traffic by balancing the volume of dredging required with raising water levels in the summer months with a deflatable barrage. This approach reduces the impacts associated with dredging a longer section of river, without compromising fish migration, long term water quality on the river, or creating newly inundated areas and waterlogging.
b) The river barrage is inflatable, so that it can be filled with water at the start of the dry season to raise water depths upstream, and deflated with the onset of the wet season, allowing the passage of floods downstream and fish migration. This is a more flexible, environmentally friendly design compared with a built barrage.
c) The dredging method proposed using a cutter suction dredger which draws the sediment and water through the dredger and along a pumping main to the final disposal site. This approach minimises turbidity levels in the river, which in turn help to avoid impacting on the drinking water in-takes. As the sediment is pumped to the dredged disposal sites, there is little road traffic during sediment transport.
d) The new port has been located at the Xuancheng Industrial Park where wastewater, solid waste, power and water will be provided through the services to the Park. The location of the port will help to stimulate industrial development at the Park and provide employment.

21. Construction of the scheme is not expected to affect rare, threatened, or protected species, although fauna with Provincial protection status have been recorded as occurring in the area. It was concluded that no critical habitat for these protected species and other fauna existed in the project area of influence. No ancient trees will be affected by the scheme. No known physical cultural resources would be affected by this Project.

22. During construction, the main adverse environmental impacts will be increased turbidity in the river within about 100 m downstream of the dredger, noise from the dredging and other construction activities, the loss of seven ponds which will be infilled with the dredged spoil and converted to farmland, odour and supernatant water drainage from the dredged spoil disposal ponds, the loss of farmland and semi-natural habitats in the vicinity of the Port, dust around earthworks especially at the port site, the safe treatment and disposal of construction wastewater and sewage, and solid waste disposal. Good housekeeping and effective mitigation measures will be implemented to reduce these impacts to acceptable levels. The temporary land take areas will be returned to their former use, vegetated and landscaped, or restored to farmland upon completion of the construction stage.

23. The project is located in an area where Schistosomiasis is endemic. Special measures will be implemented to minimise contact with the disease by the workforce and control the

spread of the disease vectors. Occupational health and safety measures will be implemented to minimise accidents and injury during construction.

24. The main adverse impacts on the river during operation are the elevation of water levels upstream of the rubber barrage during low flows and the associated changes in velocity; noise, wastewater and solid waste discharges from ships; and wastewater and solid waste disposal from the administrative offices at the ship lock. The discharge of waste from ships is controlled by law, and ship inspections and law enforcement will be carried out. The administrative building will be served by the Shuiyang Town sewerage system and domestic solid waste will be disposed of to the sanitary landfill in Shuiyang Town. The scheme is not considered likely to impact adversely on fisheries or the downstream channel of the Qiugong Flood Channel.

25. At Xuanzhou Port the main operational impacts are noise, dust especially during the loading and unloading of bulk materials, wastewater and solid waste. Noise and air quality will be mitigation through the selection of operational plant and operational procedures. Oily wastewater will be pre-treated on site and discharged to the Industrial Zone wastewater collection system together with sewage arising in the port precinct. Stormwater will drain to the river. Solid waste will be segregated on site and disposed of as appropriate for the waste streams.

26. Based on information gathered and assessments performed by the domestic environmental design institute, it is concluded that environmental impacts during the construction and operational stages of the project would be acceptable and in compliance with PRC regulations and standards and ADB's Safeguard Policy Statement (2009) if the prepared EMP is implemented and monitored diligently. The EMP defines mitigation measures and monitoring requirements for the design, construction, and operational stages of the project. Appropriate environmental safeguards for the planned works are provided and form part of a comprehensive set of project management documents.

27. Consideration was given to project alternatives for raising water levels in the river, the location of the port, the downstream connection to the Wushen Canal and the placement of the secondary barrage on the Qiugong River.

28. Three options were considered for the waterway, dredging along the whole channel, combining a rubber barrage at Shuiyang Town with dredging, and combining a rubber barrage downstream with dredging. The preferred option optimised the security of the operation of a barrage with an intermediate volume of dredging.

29. Two options were considered for the connection to the Wushen Canal where the Shuiyang River breaks into two branches. The preferred option follows the main channel which flows through Jiangsu Province. Anhui and Jiangsu Provincial Governments have reached a signed agreement for the latter to implement the necessary works to upgrade the waterway within their jurisdiction to achieve the benefits of the SRWIP upstream. The alternative was to follow a secondary channel through Anhui Province which would not have to rely on Jiangsu Province to complete the works, but would require much greater dredging to obtain the necessary channel dimensions and considerable re-settlement.

30. Two options were considered for the proposed port. The old port is located close to Jingting Mountain Provincial Level Scenic Spot, but the port does not have sufficient land for expansion. An alternative site at Xia Shi Mountain was not suitable as the area was designated

a green area. The preferred port location is in a designated industrial zone which is suitable for port activities.

31. Two options were considered for the secondary barrage on the overflow river. The option close to the juncture of the two rivers is preferred to maintain water levels and avoid additional inundation.

2. Highway Subprojects

32. The total permanent land-take for the four highway schemes is 3,847.88 mu (256.5ha), of which 55% is cultivated land, and the remainder includes woodland and grassland. The loss of this land is an irreversible impact. A further 2,671.79 mu (178 ha) of temporary land take will be required, for spoil and borrow pits and also temporary haul roads. Some 4,270 households and 16,920 people will be impacted by land acquisition, house demolition or both. Compensation and resettlement will fully meet the PRC and ADB applicable policies and requirements.

33. Various design considerations were developed to mitigate the potential adverse impacts on the scheme.

a) Ma'anshan North Corridor is being upgraded from Class III/IV to Class II. Key features are: dual single lane road with provision of a hard shoulder along each carriageway which will improve travel safety for NMTs; provision of low noise surface over 23.43 km; and off-line sections which will remove traffic-related impacts from householders along the old road.
b) Yimu Highway Kedian to Mujiating. This scheme will improve conditions for vehicle travellers and NMTs. The Class I Highway (8.8 km) will be dual two-lane with hard shoulder, improving the road space for vehicular traffic and NMTs. The Urban Trunk Road (13.56 km) will be dual three lane with a separate lane for NMTs, improving safety for NMTs by having a physical barrier from the highway. Both sections will be lit. The design also includes 1.8 km of low noise surface asphalt.
c) S319 Erba to Wuwei. This route will be upgraded to Class I dual two lanes with hard shoulder, but with provision to convert the road to dual three lanes without having to widen the sub-base further. The scheme allows for improvements in pedestrians crossings.
d) G206 Dongliu to Yaodu Section. The proposed scheme offers improved vertical and horizontal alignments suitable for a Class I Highway. The design is for a dual three lane highway with provision for a NMT lane, improving safety for cyclists and pedestrians, and lighting.

34. Construction of the highway subprojects is not expected to affect rare, threatened, or protected species. The Ma'anshan North Corridor and S319 Erba to Wuwei Projects predominantly affect farm land. The Yimu Highway Kedian to Mujingting and G206 Dongliu to Yaodu Subprojects do cross natural habitats including woodland and grassland, where valuable trees may occur. The G206 Dongliu to Yaodu also passes lakes and is close to the Tiantai Mountain Forest Park which support National Grade II protected species of birds including the White fronted goose, Black kite and Black baza and the Chinese pangolin. The Black kite and Black baza are both listed in the International Union for Conservation of Nature (IUCN) red list as of Least Concern (LC). The White fronted goose's main wintering ground in the area is the Qili Lake, which is located more than 7 km from the G206 alignment. The Chinese pangolin's

range of distribution is mostly confined to the mid to high altitudes of the Tiantai Mountain Forest Park and seldom ventures into low lying valleys where the G206 alignment traverses. No known physical cultural resources would be affected by this Project.

35. The main impacts during construction will be noise, dust, deep cuttings on the G206 and the need for slope stabilisation, borrow and spoil sites, reduced water quality during the in-channel works for bridges, the collection and disposal of site drainage, construction wastewater, and sewage, and solid waste disposal. Good housekeeping and effective mitigation measures will be implemented to reduce these impacts to acceptable levels. The temporary land take areas will be returned to their former use, vegetated and landscaped, or restored to farmland upon completion of the construction stage.

36. Community health and safety and occupational health and safety measures will be implemented to safeguard the workforce and the local communities nearby. Measures will include hygiene and secure drinking water source for construction camps, health and safety training for the workforce, and medical checks for staff.

37. The main impacts from start of operations would be traffic noise and air emissions from vehicles. In the year of opening, the traffic levels with and without the scheme are likely to be small to negligible, such that the additional increase in air quality and noise resulting from the project is small. Air quality from motor vehicle emissions has been predicted to be in compliance with applicable standards at existing sensitive receptors along the project roads. For traffic noise, mitigation measures include the installation of double-glazed windows at some 1942 sensitive receptors along the project roads that will experience exceedance of applicable noise standards by 2021, and the provision of low noise asphalt surfacing on sections of the Ma'anshan North Corridor and Yimu Highway.

38. The alternatives were based around route alignments.

a) Ma'anshan North Corridor. Three alternative sub-alignments were considered along the route. In the Chuomiao Section on line widening was preferred to a new build section despite the greater numbers of house demolition, as the on line option had better connections with the existing highway network and required less earthworks. Off-line options were chosen for Sima River and Shiyang Town and Xianzhong Town, where the bypasses reduced impacts on people, made for better alignments, and at Xianzhong Town connected well into the S226 without going into the centre of the town.
b) Yimu Highway Kedian to Mujiating. On line widening was selected and no alternatives were considered.
c) S319 Erba to Wuwei. Most of the route is on line widening. However, two options were considered for the crossing of the Xihe River and entry into Wuwei Country. A new alignment and bridge, 2 km upstream from the existing was preferred, as the new crossing linked into the newly expanding area of Wuwei and avoided the congested town centre.
d) G206 Dongliu to Yaodu Section. The proposed scheme is an alternative alignment to the existing G206. The new alignment bypasses the centre of Dongliu and nearby villages, and avoids the Tiantai Mountain Forest Park, bringing a better alignment for a Class I highway while providing social and ecological benefits.

E. Information Disclosure, Consultation and Participation

39. Information disclosure and public consultation have been undertaken during the preparation of the domestic EIRs for the highways and waterway transport sub-projects. This included: publication of notices and documents on government websites; meetings with key stakeholders including government departments, local authorities, sector-specific institutions and authorities, and local representatives; interviews with local residents; and a questionnaire survey.

40. Two rounds of information disclosure were conducted by the domestic EIA institute during May 2012 to March 2013 on each subproject. Project information was posted on relevant government web-sites in the first round. The second round included questionnaire surveys in addition to posting project information on government web-sites. The purpose of the questionnaire surveys was to obtain the views of local people located in the vicinity of the sub-project areas. Over 480 survey forms were issued with a return rate of 98%. Concerns raised were environmental impacts from construction activities and traffic noise and vehicle emissions during operation of the roads. Respondents supported a range of traffic noise mitigation measures, with low noise road surface being the most popular followed by restriction on the use of horn, noise barriers and property insulation.

41. In addition to information disclosure, two public meetings were conducted by the domestic EIA institute with assistance from the PPTA consultant in April 2013 for the highway subprojects and the waterway project, respectively. These meetings comprised of discussion sessions and interviews with representatives from the affected local communities. The purpose was to present the EIR findings and recommendations and to solicit feedback. The project specific grievance redress mechanism (GRM) was explained during the meetings. Concerns raised include obstruction of rubber barrage to migratory fish, restoration of temporary land take areas, and prevention on the spread of host snails in the waterway dredging areas causing schistosomiasis. Mitigation measures for these were described by the EIA institute during the meetings and included in this report.

F. Grievance Redress Mechanism

42. This report and the EMP describe a grievance redress mechanism (GRM) to document and resolve complaints from affected people. The GRM will be accessible to diverse members of the community, including vulnerable groups such as women and youths. Multiple points of entry and modes of access, including face-to-face meetings, written complaints, telephone conversations, or e-mail, will be available. Opportunities for confidentiality and privacy for complainants will be honored where requested.

G. Key EMP Implementation Responsibilities

43. The Anhui Provincial Department of Transport (APDOT), through the Provincial Project Management Office (PPMO), will be responsible for the overall implementation of and compliance with the EMP, including inspection, monitoring, reporting, and initiating corrective actions or measures. The PPMO will appoint one qualified environment specialist to undertake environmental management activities including (i) managing the environmental activities carried out under the project; (ii) ensuring effective EMP implementation; (iii) recruiting and supervising the Environmental Supervision Engineer (ESE); (iv) preparing periodic EMP implementation progress reports; and (v) coordinating with other municipal agencies and ADB on all relevant

environmental matters. The PPMO also has the final responsibility for implementation of the GRM for handling disputes. The PPMO intends to appoint a single company through competitive tendering as the ESE in order to bring consistency in environmental management performance across the five subprojects during project implementation.

44. Separate Implementing Agencies (IAs) will be appointed for each subproject. Each IA will set up a Local PMO (LPMO) to manage the project and will appoint one environmental specialist with specific responsibilities for implementing the EMP.

45. The IA for the SRWIP and Xuanzhou Multi-Purpose Port will be the Anhui Province Ports and Shipping Construction Investment Group Co. Ltd (APPSCIG). The Construction Management Division will be responsible for the construction of the project and the Operations Unit will manage the port and ship lock operation. The Xuancheng Port and Shipping Administration Bureau (XPSAB) will provide support to APPSCIG for example on land acquisition, resettlement, and co-ordination between the local government agencies and will also manage the non-profit making elements of the project during operation such as maintenance dredging and maintenance of navigation buoys.

46. The IAs for the Highways Subprojects will be Ma'anshan Highways Administration Bureau for the Ma'anshan North Corridor, Nanling County Transport Bureau for the Yimu Highway Kedian to Mujiating Section, Wuwei Country Transport Bureau for the S319 Erba to Wuwei, and Chizhou Highways Administration Bureau for the G206 Dongliu to Yaodu Section. The construction, maintenance and management (including environmental management) will be done at the county level. The county level Transport Bureaux will assist in land acquisition, resettlement, use of local resources, and balancing the interests of various stakeholders during project implementation.

47. Environmental monitoring stations (EMSs) will be appointed through competitive tendering to undertake the environmental monitoring of air quality, noise, and water quality.

H. Risks and Key Assurances

48. The Project has no unusual technical risks and conventional engineering designs with proven reliability and performance will be adopted for all the components.

49. From an environment safeguards point of view, the main risk relates to the failure of the PPMO, IA LPMOs and operation and maintenance (O&M) units to monitor environmental impacts and implement the EMP effectively during construction and operational stages. This risk will be mitigated by (i) providing training in environmental management under the project; (ii) appointing qualified independent environmental supervision engineer, (iii) following appropriate project implementation mitigation and monitoring arrangements, (iv) ADB conducting regular project review missions; and (v) environmental assurances covenanted in the loan and project agreement with ADB.

50. The general environmental assurances are concerned with ensuring that APDOT PPMO, ESE, IA LPMOs, contractors and other organisations implement the appropriate measures such that: the project complies with all legal and other obligations of the PRC and ADB; appropriate environmental management staff resources are committed to the project; the monitoring programmes are prepared and implemented; changes to project designs are reviewed and further EIA undertaken if required; during construction actions are taken to avoid

interruptions to utilities and irrigation canals; and all the parties comply with their reporting requirements under the loan.

51. Specific environmental assurances are provided on the timely and environmentally acceptable relocation of the shipyard and subsequent clean up; on the implementation of environmental health measures appropriate to the level of risk to prevent the spread of schistosomiasis in the project area; that appropriate level of attention is paid to the conservation of the environment, particularly all species of flora and fauna that are afforded protection under national and international legislation and Conventions; and that the APDOT PPMO implements the GRM within 60 days from the loan effectiveness.

I. Overall Conclusion

52. The project will improve the transportation networks in Anhui Province, promote a modal switch from highways to low carbon inland waterways for bulk cargo, improve journey times, comfort and safety on county and regional roads, and facilitate local and regional economic development.

53. The domestic EIRs and this EIA conclude that all identified environmental impacts can be mitigated to acceptable levels if the measures defined in the EMP are carefully implemented and monitored. The Project is feasible from an environmental safeguards point of view.

II. POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK

A. Policy Framework in the PRC

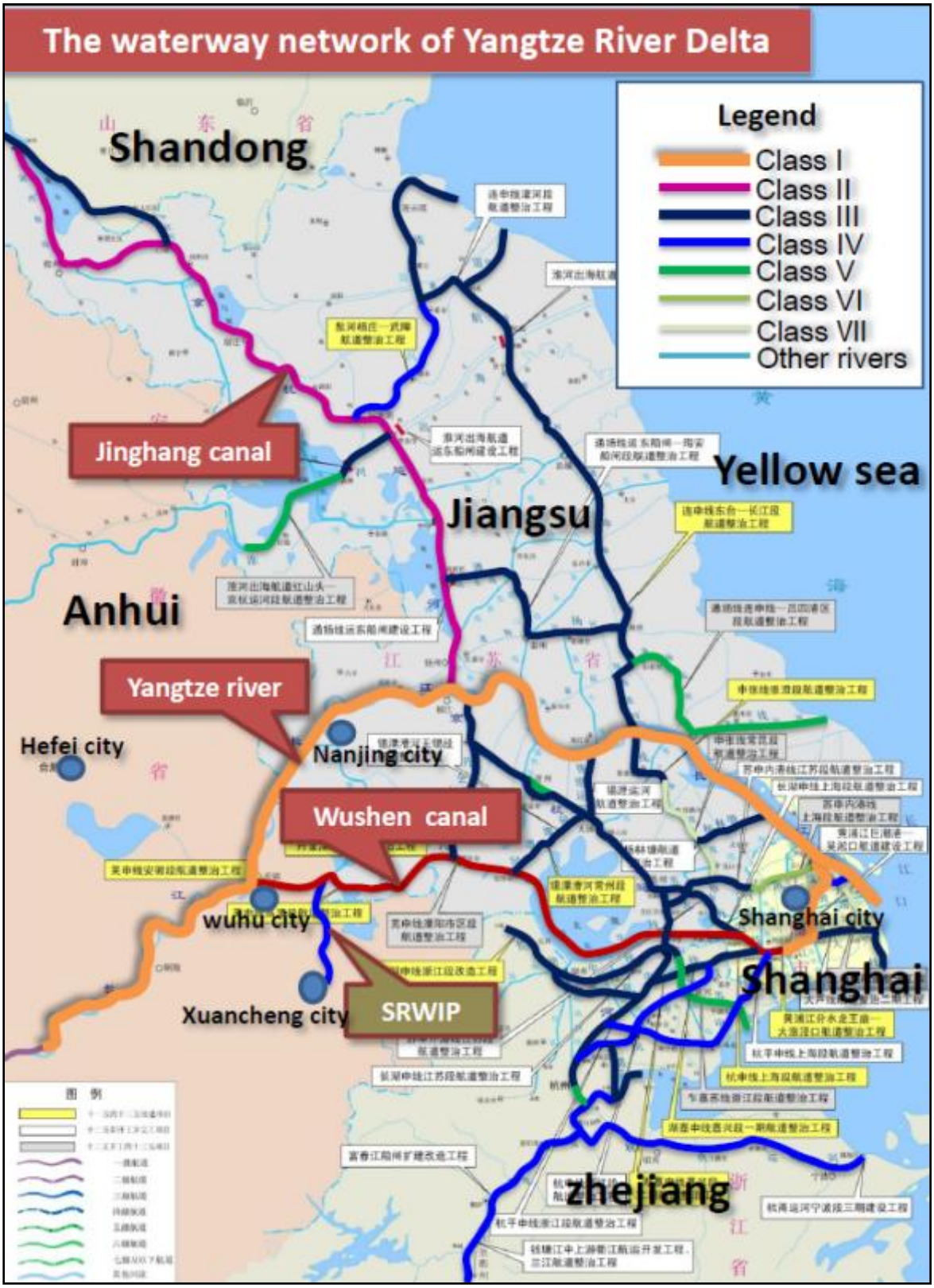
54. The policy framework in the PRC is governed by the five year plan (FYP) process. Important themes coming out of the twelfth FYP (12th FYP) (2011-2015) include inclusive growth, moving towards a more balanced economy, sustainable development and clean energy. There is emphasis on reducing the social, environmental, and economic imbalances resulting from three decades of strong economic growth. This includes re-balancing growth between the eastern coastal provinces and the poorer regions of the central provinces, of which Anhui is one, and the western and north-west provinces. The 12th FYP promotes continued expansion of inter-regional transportation networks, including the upgrade of highways to connect rural county townships and villages via Class 2 roads and above and inland waterways in the Yangtze River Delta.

55. **Plans Relating to the Shuiyang River Waterway Improvement Project (SRWIP).** In January 2010, the Chinese State Council approved the plan *Anhui Wanjiang Demonstration Zone (WDZ) for Industrial Relocation into Cities along the Yangtze River.* This plan is concerned with the re-location of industry from the eastern provinces into a belt along the Yangtze River within Anhui Province. The policy aims to help re-balance the economies of the eastern and central provinces, by taking advantage of the cost competitiveness of Anhui Province. In 2010, the GDP within the WDZ amounted to 70% of the whole of Anhui Province, the population living within the WDZ was about 30.58 million, or some 66% of the total population in the province, and the WDZ covered some 83,000 km of highways, including 1,622 km of expressway, and 4,440 km or 68% of Anhui's total waterways. The WDZ links Anhui Province with the Yangtze River Delta Area, and is the closest province to the eastern provinces for the relocation of industry as shown on **Figure II.1**.

56. The plan covers the period 2009-2015, and may be extended to 2020. The spatial extent of the plan covers one axis, incorporating cities along the river including Anqing, Tongling, Wuhu and Ma'anshan, two cores referring to Hefei and Wuhu, and two wings including Chuzhou and Xuancheng City.

57. To realise the objectives of the development strategy of the WDZ requires a well-developed transport network in Anhui so that raw materials and manufactured products can be moved efficiently from origin to destination. At present the transportation network within this zone is inadequate for rapid industrial and economic development. The waterway transport network has limited navigability during the dry season due to low flows while the highway network is constrained both in quality and capacity.

Figure II.1: Waterway Network of the Yangtze River Delta



58. The *State Council Policy Statement: Accelerating Development of Inland Water Transport in Yangtze River and Other Waterways (2011, No. 2 Official Document)* and the *Anhui Provincial Government: Notice on Strengthening Construction and Management of Waterway Transport Infrastructure and Speeding up Waterborne Transport* promote inland water transport as a key development strategy. These statements provide a framework for short and long term macro plans for waterway transport development and objectives for an integrated, efficient, safe, energy saving, and environmentally friendly inland water transport system.

59. Under the *Anhui Provincial Development Plan for Inland Water Transportation*, the Shuiyang River has been identified as a key waterway for regional intermodal transport and the new port for Xuancheng City has been prioritised for development. Therefore SRWIP is consistent with the plan.

60. The *Administrative Permit CXK (2010) No. 43* of the Yangtze River Commission requires that the Shuiyang River flood control works are determined in accordance with the *River Flood Control Planning Report of the Shuiyang River, Qingyi River and Zhanghe River Basins* and constructed in advance of the SRWIP. Therefore, the construction of the flood management, water conservancy and flood control facilities and the dredging and widening works of the Shuiyang Town reach, flood embankment improvements, and the new flood by-pass channel, are all a pre-condition to the implementation of the SRWIP.

61. The *Xuancheng Port Master Plan* was published by the Xuancheng Port & Shipping Administration Bureau in 2007, and the associated strategic environmental assessment (SEA) for this master plan was conducted by the environmental impact assessment (EIA) team at Hohai University. The master plan has clearly defined the location of seven ports along the whole course of the Shuiyang River, including the proposed new port at the Xuanzhou Industrial Park. According to this master plan, the new port should have six 500 – 1000 tonnes bulk cargo berths for cement export and coal import, and four 500 – 1000 tonnes berths for chemical products, with total yearly throughput of 3.8 million tonnes. The new port was allocated a shoreline 900 m long and a land area of 45 ha, with a hinterland depth of 500 m, bottom land of 1.8 ha, and water area of 3.6 ha. The new port project portfolio is consistent with the master plan.

62. The SEA of the master plan addressed all the significant environmental implications arising from the implementation of the plan, including direct impacts on water quality, air quality, ecosystem, acoustic environment, and indirect impacts induced by secondary development. The shoreline use and location of the port was environmentally justified in the SEA, which went on to suggest that the project EIA to be undertaken for the waterway and the port could make use of the findings of the SEA and should focus on the detailed impacts envisaged in both the construction and operation phases and the prescription of mitigation measures.

63. *Xuancheng City Master Plan*. Xuancheng City has prepared a city master plan, transport plan, port plan, land use plan and Xuancheng New Industrial Development Zone plan. The proposed new port is to be located in the Xuanzhou Industrial Park, serving the industrial park and meeting its requirements for bulk cargo transport as well as cargo transport for Xuancheng City. Furthermore, the well-established public utility infrastructure of the industrial district can be shared by the port, including power, water supply, public sewer, wastewater treatment plant and domestic waste collection.

64. Under the transport plan, Xuancheng City plans to construct a new long bridge over the Shuiyang River about 150m from the proposed new port. This road would provide ready access to the port for road freight, to serve the hinterland on both sides of the Shuiyang River, and increase the connectivity of the port with industries transporting raw materials and manufactured goods.

65. **Master Plans Relating to the Highway Projects.** The 12th Five Year Master Plans for Transportation (2011-2015) have been prepared at the Province, City and County levels. These include the four highway subprojects proposed for this Project, as follows.

66. The *Ma'anshan City Comprehensive Transport Master Plan 2012* sets an objective to upgrade 67.6 km of the Ma'anshan North Corridor from a county road to a Class II highway in the short term and to a Class I highway by 2030, forming an important east-west link to Nanjing and Jiangsu Province, as well as serving the north of Ma'anshan City.

67. The *Wuhu City 12th Five Year Transport Master Plan (2011-2015)* lists the S319 upgrade to Class I over 86.8 km from Wuhu to Anqing, including the section from Erba to Wuwei for this Project, and the upgrade of the Yimu highway to Class I over 66.3 km including 17.7 km along the S320 and 48.6 km of the G318, incorporating the Kedian to Mujiating Section for this Project.

68. The improvements in the Wuhu City plan are cascaded down to the *Nanling County and Wuwei County 12th Five Year Transport Master Plans (2011-2015)*. The *Wuwei County 12th FYP* includes upgrading the S319, Tongjiang Road, and X016 to Class I over 105.78 km to provide an east-west transport corridor along the north side of the Yangtze River, which includes the proposed project to upgrade the S319 between Erba and Wuwei over 36.52 km.

69. The *Dongzhi County 12th Five Year Transport Master Plan (2011–2015)* lists the G206 as a priority north-south scheme for completion during the plan period, comprising the upgrade of 117 km, of which 54 km are to be upgraded to Class I, including the proposed project to build a new link between Dongliu and Yaodu over 16.58 km, and 63 km to Class II.

70. Most of the cities and towns along the proposed highway schemes have prepared their town plans. One exception is Gongshan Town, which lies about 1.4 km from the proposed project to upgrade the Yimu Highway on the Kedian to Mujiating Section over 22.36 km. These issues are discussed further in Chapter V in relation to the impact of the highway improvements on the town plans.

B. Legal Framework in the PRC

71. The relevant requirements of the PRC govern the way in which EIA for the construction of the improved waterway, new ports and highways is carried out. This suite of laws, regulations, guidelines and standards listed below, indicates the comprehensive coverage of PRC's environmental safeguards. These requirements cover pollution prevention and control of air, noise, water and solid waste. The requirements also provide technical guidelines on assessing ambient air quality and noise, water and ecological impacts.

Laws

i. *Environmental Protection Law*, December 26, 1989;
ii. *Noise Pollution Prevention and Control Law*, March 1, 1997;
iii. *Energy Conservation Law,* January 1, 1998;
iv. *Forest Law*, April 1998;
v. *Atmospheric Pollution Prevention and Control Law*, September 1, 2000;
vi. *Water Law*, October 1, 2002;
vii. *Environmental Impact Assessment Law,* September 1, 2003;
viii. *Ports Law*, January 2004;
ix. *Wild Animal Protection Law*, August, 2004;
x. *Solid Waste Environmental Pollution Prevention and Control Law*, April 1, 2005;
xi. *Protection of Cultural Relics Law*, October 2002;
xii. *Urban and Rural Planning Law*, October 2007;
xiii. *Water Pollution Prevention and Control Law*, June 1, 2008;
xiv. *Water and Soil Conservation Law*, March 1, 2011;

Regulations, Provisions and Ordinances

xv. *Administration of Navigable Channels Regulation*, August 1987
xvi. *Circular on Strengthening the Management of Environmental Impact Assessment for Construction Projects Financed by International Financial Organizations,* (MEP Announcement No. [1993] 324);
xvii. *Construction Project Environmental Protection and Management Regulation, (State Department Order No*. 253), November 29, 1998;
xviii. *Environmental Impact Assessment Public Participation Interim Guideline*, (MEP Announcement No. [2006] 28);
xix. *Prevention and Control of Vessel Pollution of the Inland Water Environment*, January 2006;
xx. *Ordinance on Agro-ecological Environmental Protection in Anhui Province,* June 2006;
xxi. *Regulation of Anhui Province on Ports*, June 2006
xxii. *Directory for the Management of Different Categories of Construction Project Environmental Impact Assessment,* (MEP Order No. 2), October 1, 2008*;*
xxiii. *Ordinance on Environmental Protection in Anhui Province*, November 2010;

Technical Guidelines and Specifications

xiv*.* *Technical Guidelines for Environmental Impact Assessment: General Program* (HJ 2.1-2011);
xv. *Guidelines for Environmental Impact Assessment: Atmospheric Environment* (HJ 2.2-2008);
xvi. *Technical Guidelines for Noise Impact Assessment* (HJ 2.4-2009);
xvii. *Technical Guidelines for Environmental Impact Assessment: Surface Water Environment* (HJ/T 2.3-93);
xviii. *Technical Guidelines for Environmental Impact Assessment: Ground Water Environment* (HJ 610-2011);
xxix. *Technical Guideline for Environmental Impact Assessment: Ecological Impact* (HJ 19-2011) [replaces HJ/T 19-1997];
xxx. *Technical Guideline for Construction Project Environmental Risk Assessment* (HJ/T 169-2004);

xxxi. *Technical Guideline on Environmental Monitoring Quality Management* (HJ 630-2011).
xxxii. *Technical Specifications to Determine the Suitable Areas for Environmental Noise of Urban Area,* (GB/T 15190-94);
xxxiii. *Specifications for Road Construction Project Environmental Impact Assessment* (JTG B03-2006);
xxxiv. *Ground Level Traffic Noise Pollution Prevention Technical Policy* (MEP Announcement No. [2010)7];
xxxv. *Residential Building Sound Proof Design Specification* (GB 50118-2010);
xxxvi. *Specifications for Environmental Impact Assessment of Port Engineering* (JTS105-1-2011);

Environmental Standards
xxxvii. *Quality Standard for Ground Water* (GB/T 14848-93);
xxxviii. *Environmental Quality Standard for Soils* (GB 15618-1995);
xxxix. *Ambient Air Quality Standard* (GB 3095-1996);
xl. *Air Pollutant Integrated Emission Standard* (GB 16297-1996).
xli. *Integrated Wastewater Discharge Standard* (GB 8978-1996);
xlii. *Environmental Quality Standards for Surface Water* (GB 3838-2002);
xliii. *Environmental Quality Standard for Noise* (GB 3096-2008);
xliv. *Emission Standard of Environmental Noise for Boundary of Construction Site* (GB 12523-2011);

C. Relevant International Agreements

72. The PRC is a signatory to a number of international agreements relevant to environment protection. Those relevant to the project, along with the date of signing by the PRC, are as follows.

(i) *Convention on Biological Diversity,* 29 December 1993. To develop national strategies for the conservation and sustainable use of biological diversity. None of the project components directly affect designated nature conservation areas or areas with high biodiversity. Highway Subproject IV is located 200m from a Forest Park, which supports protected species.
(ii) *Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat,* 21 December 1975. To stem the progressive encroachment on and loss of wetlands now and in the future, recognising the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value. There are no Ramsar sites in the study area. Highways Subproject IV does impinge on several lakes which support waterfowl.
(iii) *Kyoto Protocol to the United Nations Framework Convention on Climate Change,* 23 February 2005. To further reduce greenhouse gas emissions by enhancing the national programs of developed countries aimed at this goal and by establishing percentage reduction targets for the developed countries. The inland waterway project would decrease GHG emissions in comparison with the movement of the same volume of cargo by vehicle. The highway subprojects would decrease congestion in urban areas.

(iv) *Montreal Protocol on Substances That Deplete the Ozone Layer,* 1 January 1989. To protect the ozone layer by controlling emissions of substances that deplete it;

(v) *United Nations Framework Convention on Climate Change,* 21 March 1994. To achieve stabilization of greenhouse gas concentrations in the atmosphere at a low enough level to prevent dangerous anthropogenic interference with the climate system.

D. Applicable ADB Policies

73. The ADB Safeguard Policy Statement (SPS, 2009) sets out the policy objectives, scope and triggers, and principles for environmental, involuntary resettlement and indigenous people safeguards. The objective of the environmental safeguards is to ensure the environmental soundness and sustainability of projects and to support the integration of environmental considerations into the project decision-making process. A screening process for each proposed project is carried out as early as possible, to determine the extent and type of environmental assessment so that appropriate studies are undertaken commensurate with the significance of potential impacts and risks. Subsequent to the screening process an environmental assessment should be conducted to identify potential direct, indirect, cumulative, and induced impacts and risks to physical, biological, socioeconomic (including impacts on livelihood through environmental media, health and safety, vulnerable groups, and gender issues), and physical cultural resources in the context of the project's area of influence.

74. All projects considered for loans and investments by ADB are subject to classification for the purpose of determining environmental assessment requirements. The determination of the environment category is to be based on the most environmentally sensitive component of the project. The Anhui Inter-modal Transport Project is classified as Category A for environment as it has potential for significant adverse environmental impacts. All category A projects require an EIA to address significant impacts.

75. ADB's SPS 2009 requires a number of considerations that are over and above the domestic EIR requirements. These include, amongst others: (i) project risks and respective mitigation measures and project assurances; (ii) project level Grievance Redress Mechanism (GRM); (iii) definition of the project area of influence; (iv) physical cultural resources damage prevention analysis; (v) climate change mitigation and adaptation; (vi) occupational and community health and safety requirements (including emergency preparedness and response); (vii) economic displacement that is not part of land acquisition; (viii) biodiversity conservation and natural resources management requirements; (ix) provision of extensive sufficient justification if local standards are used; (x) meaningful consultation and participation; and (xi) implementation schedule and (measurable) performance indicators in the EMP.

76. In line with ADB's Public Communications Policy, ADB is committed to working with the borrower/client to ensure that relevant information (whether positive or negative) about social and environmental safeguard issues is made available in a timely manner, in an accessible place, and in a form and language(s) understandable to affected people and to other stakeholders, including the general public, so they can provide meaningful inputs into project design and implementation. For environment category A projects, ADB will post draft EIA reports at least 120 days before Board consideration.

77. The SPS 2009 requires that no project activity will be implemented in areas of critical habitat (which includes legally protected areas that meet the criteria of the Ramsar List of Wetlands of International Importance and the UNESCO world natural heritage sites) unless it can be demonstrated that the project will: (i) not result in any measurable adverse impacts on the critical habitat which could impair its high biodiversity value or the ability to function; and (ii) not lead to a reduction in the population of any recognized endangered or critically endangered species or a loss in area of the habitat concerned such that the persistence of a viable and representative host ecosystem be compromised. This Project does not directly affect any designated sites. One of the highway schemes, the existing G206 Dongliu to Yaodu Section passes through the Provincial Tiantai Mountain Forest Park, which is largely a secondary forest habitat and supports wildlife afforded National level II protection, and near lakes which support waterfowl with National level II protection and Provincial Level II protection. Other species afforded protection under PRC legislation are also known to occur within the wider area. This project provides a new section of the alignment that avoids going through the Tiantai Mountain Forest Park, with a distance of 200 m from the boundary of the park at the nearest point.

78. This Project is aligned with the key thrusts of ADB's assistance to the PRC under the *PRC Country Partnership Strategy (CPS)*[1] *2011–2015* in the areas of: (i) inclusive growth by promoting improved transportation in less developed regions, (ii) environmentally sustainable growth, through the promotion of inland waterways, and (iii) regional co-operation and integration by promoting improvements in inter-province transportation links.

79. The proposed Project is in line with ADB's *Sustainable Transport Initiative* (STI)[2] which aims to mainstream sustainability considerations in transport. In particular this Project is aligned with the ADB's aims to focus on rehabilitation of the road network and inland waterways and ports, in particular, the following four themes:

(i) Urban transport – the proposed highway schemes improve links between and through county towns, taking into account the implications of existing town plans on future land use and traffic generation.
(ii) Addressing climate change – the proposed inland waterway improvement scheme and port is a low carbon transportation initiative, which facilitates the movement of bulk cargo, both raw materials for industry and manufactured products, for lower emissions compared with alternative means of transport. Climate change adaptation has been considered for all the subprojects.
(iii) Cross border transport and logistics – the highway and inland waterway subprojects all promote cross province network connectivity. The inland waterway improvement scheme seeks to improve links with the Yangtze Delta Area and eastern coastal provinces, via the Wushen Canal which is currently under construction. The highway schemes improve links between Anhui and Jiangsu Provinces. The upgrading of the highways offer improved journey times for non-tolled roads, promoting more inclusive use by local communities who may be less able to afford expressway tolls.

[1] ADB. 2012. PRC Country Partnership Strategy 2011-2015, Manila.
[2] The STI, approved by ADB management on 20 July 2010, set a new direction for ADB's transport sector efforts to promote more environmentally and socially sustainable transport solutions in DMCs in line with ADB's *Strategy 2020*.

(iv) Road safety and social sustainability – upgrading the highway schemes should lead to improved safety conditions for vehicle and non-motorised travel (NMT) (pedestrians and cyclists).

E. Policies and Approaches to Climate Change

80. Most of the global warming observed over the past 50 years was likely induced by the increase in concentrations of greenhouse gases (GHGs), such as carbon dioxide (CO_2), methane (CH_4), and nitrogen dioxide (NO_2), due to human activities. In the context of global warming, climate in the PRC has experienced noticeable changes over the past 100 years as well[3].

81. According to data compiled by the International Energy Agency, total emissions from fossil fuel combustion in the PRC exceeded those from the United States (US) in 2007 for the first time and thus, the PRC became the world's largest GHG emitter. The PRC's GHG emission trajectory since 1980 has gone through three distinct phases—(i) moderate growth (slightly higher than the US) between 1980 and 1997, (ii) levelling off between 1998 and 2002 even though economic growth continued substantially unabated, and then (iii) a rapid and substantially unprecedented burst of growth (with annual increases ranging from 11.2% to 11.9%) since 2002. The latest data show that the PRC's carbon dioxide (CO_2) emissions increased in 2009 by an additional 9.1%, bringing its share of global emissions to 24.2%.

82. The picture in terms of per capita emissions provides a somewhat different perspective. The US is by far the world's largest per capita CO_2 producer (18.4 tonnes per capita in 2008, 4.2 times the global average in 2008), although the rate has declined by 24% since 1971. Per capita emissions in the PRC, on the other hand, increased by 430% over the 1971–2006 period (from 1 tonnes per capita in 1971 to 4.9 tonnes per capita in 2008). Per capita emissions also increased in Brazil and India but at much lower rates, largely due to differences in energy mix and economic structure.[4]

83. There has been increasing awareness of the adverse effects of PRC's unprecedented industrialization—which contributes to the country's ranking as the world's biggest emitter of greenhouse gases responsible for climate change—on temperature increase, extreme weather events, biodiversity, livelihoods, and economic development. It is predicted that the trend of climate warming in the PRC will further intensify in the future with (i) air temperature increases between 1.3–2.1ºC by 2020 and 2.3–3.3ºC by 2050 as compared with that in 2000, (ii) projected nationwide precipitation increase of 2–3% by 2020 and 5–7% by 2050, (iii) more frequent occurrence of extreme weather/climate events, (iv) sea level rise along the coasts, and (v) glacial retreat at an accelerated rate.

84. In response to the risks posed by climate change, the State Council established the National Leading Group on Climate Change (NLGCC) in June 2007, led by Premier Wen Jiabao and with 27 member agencies. The role of the NLGCC is to: (i) devise national climate change strategies, directions, and measures, (ii) unify national actions on climate change, (iii) research international cooperation and negotiation processes, and (iv) coordinate solutions on key issues in responding to climate change. In January 2008, the Ministry of Environmental Protection

[3] National Development and Reform Commission of the PRC, 2007. *China's National Climate Change Programme*.
[4] Zhang, Q. & Crooks, R. 2012. *Towards an Environmentally Sustainable Future: Country Environmental Analysis of the People's Republic of China*. ADB.

(MEP) announced revised criteria for “ecologically sound” provinces, cities, and counties that balance environmental protection objectives with economic growth goals.

85. The PRC formulated a national Agenda 21 entitled China’s Agenda 21 - White Paper on China's Population, Environment and Development in the 21st Century, soon after the United Nations Conference on Environment and Development in 1992, and adopted the following policies and measures taking into account its specific national circumstances, making positive contribution to the mitigation of climate change:

(i) Restructuring the economy, promoting technology advancement and improving energy efficiency.
(ii) Optimizing energy mix by developing low-carbon and renewable energy.
(iii) Launching national wide tree-planting and afforestation campaign and enhancing ecology restoration and protection.
(iv) Effectively controlling the growth rate of population through family planning.
(v) Strengthening laws and regulations, and policies and measures relevant to addressing climate change.
(vi) Further improving institutions and mechanisms.
(vii) Attaching great importance to climate change research and capacity building.
(viii) Strengthening education, training and public awareness on climate change.
(ix) Imposing regulations on the automobile industry, requiring an annual vehicle test, and drafting a vehicle inspection and maintenance program.
(x) Set emission and fuel efficiency targets and tighter deadlines for manufacturers to meet the increasingly stringent EURO standards.
(xi) Offer tax incentives for manufacturers of more environment-friendly cars.

86. In line with the national policies responding to climate change in general, the PRC has a comprehensive program for the control and reduction of vehicle emissions (Box 1). The current plan includes the following main focus areas connected with vehicle emissions:

- Improvement and stricter enforcement of national emission standards for new vehicles;
- Improvement of conventional fuels to make them cleaner with less GHG emissions;
- Use of alternative or cleaner fuels;
- Improved maintenance and inspection of vehicles; and
- Encouragement for the scrapping of older high emission vehicles.

Box 1: National Activities and Initiatives to Reduce Vehicle Emissions

Unleaded fuel: Measures have been taken to phase out the distribution of leaded fuels. Since 1 January 2000, there has been no further production, and since 1 July 2000 there has been no sale of leaded fuels in the PRC. Trucks and heavy vehicles in the PRC mostly have diesel engines, which do not require any lead additives.

Sulfur content: Sulfur content is regulated through the petroleum refining production standards (content and quality based). The limit of sulfur content is defined in the Standards of Unleaded petrol (gasoline) for motor vehicles (GB17930-1999) and Hazardous Materials Control Standard for Motor Vehicle Gasoline (GAWK-1-1999) is less than 0.08% (m/m). The Government has targeted sulfur in fuels as part of the broader SO_2 control efforts. In 2003 the Government drafted a new regulation for diesel fuel sulfur content (GB-T19147-2003), which states that in urban areas diesel fuel cannot have more than 0.05% sulfur content by weight/mass. The regulation is still in draft form and has not yet been made into law.

Fuel Economy: The Government is preparing to impose fuel economy standards on new cars that will be significantly more stringent than those in United States and will be the first of their kind in the PRC. The intention is to force auto makers to introduce the latest hybrid engines and other technologies to PRC auto makers. In early 2004, the Government required that new private vehicles sold in major cities must meet air pollution standards nearly as strict as those in Western Europe and the US. New standards require that from 2005 all new cars, vans and sport utility vehicles should get two more miles per gallon of fuel from pre 2005. This figure will increase to five miles per gallon in 2008.

Alternative or Cleaner Fuels: To reduce vehicle emissions, the PRC Government has established a National Clean Automobile Work Team led by the Ministry of Science and Technology, which is committed to speeding up the development and use of clean-fuel vehicles. A pilot program for the use of cleaner fuel has been implemented in 12 cities including Beijing, Tianjin, Shanghai, Chongqing and Chengdu. The PRC's four leading vehicle makers, the First Automotive Corp, the Dongfeng Motor Corporation, the Shanghai Automotive Industry Corporation and the Tianjin Automotive Industry Corporation, have been designated production centers for compressed natural gas (CNG) powered vehicles. In October 2003, the number of CNG-powered vehicles reached 190,000 and 560 natural gas stations had been built in 16 major cities.

Electric and Hybrid: In addition to CNG, the Government is also encouraging research and development of electric and hybrid-powered vehicles. Of note is the rapid growth of the electric powered 2-wheeled cycles in large and smaller urban centers throughout PRC (reversing the trend toward petrol-powered motorcycles, which has and is causing considerable pollution problems in other countries, e.g. Vietnam and Indonesia).

Strengthening of Regular Emission testing of existing cars: This includes improved testing equipment, enforcement of testing, more testing stations, improved monitoring of tests and their emission levels, and general publicity to ensure all vehicles are tested in accordance with the regulation every two years. This is the responsibility of the Provincial Governments.

Encourage use of clean energy and alternative fuels for public transport vehicles and taxis: To encourage urban public transport vehicles (including taxis) to use clean energy or alternative fuels. Provincial and local government should encourage greater use of public transport vehicles (including taxis) and to promote "green bus" planning with use of energy-efficient low-emission or clean energy vehicles. All buses and taxis are to be included in emissions testing programs to reduce emissions into the urban environment.

Elimination of older and high emission vehicles: Encourage the elimination of high emission vehicles through car trade-in programs.

87. **ADB's Approaches to Climate Change.** In line with Strategy 2020, ADB is integrating climate change into its planning and investment to ensure continued economic growth and a sustainable future for all in Asia and the Pacific. Five strategic priorities have been identified to respond to climate change: (i) strengthening policies, governance and capacities, (ii) expanding the use of clean and renewable energy, (iii) encouraging sustainable urban development and transport, (iv) promoting climate-resilient development, and (v) managing land use and forests for carbon sequestration.

88. The current CPS between ADB and the PRC aims to reduce energy intensity and coal dependency in the PRC, focusing on six areas: (i) energy efficiency and conservation; (ii) alternative energy, e.g., solar, wind, biomass, and hydropower; (iii) clean coal technologies; (iv) urban environment improvement; (v) methane capture from coal mines; and (vi) regional cooperation in energy use.

89. In the context of the transport sector, discussions most often pertain to its contribution to the overall emissions of GHGs and how investments in the sector could contribute to an overall mitigation strategy. However, it must be simultaneously recognized that the transport infrastructure is directly vulnerable to the impacts of climate change. Some of the risks may include reduced road safety and security, increased need for road maintenance due to landslides, and costly rehabilitation works as drainage is insufficient for peak rainfall events.

90. ADB has developed guidelines and strategies on integrating climate change into transport projects including (i) the Guidelines for Climate Proofing Investment in the Transport Sector: Road Infrastructure Projects provides a step-by-step methodological approach to assist project teams to incorporate climate change adaptation measures into transport sector investment projects; (ii) the Sector Briefing on Climate Change Impacts and Adaptation in Transport (Roads) provides a quick overview of the potential impacts on climate change on transportation and possible adaptation options, and (iii) the Urban Transport Strategy to Combat Climate Change in the People's Republic of China focuses on developing a more sustainable urban transport system in the PRC, taking into account the quality of user services, has been published to support greener and more sustainable transport in ADB projects. These, and other relevant documents, are taken into account throughout the project design process.

F. Institutional Framework for Environmental Management in the PRC

91. The administrative framework for EIA in the PRC consists of national, provincial and local (city) environmental protection authorities. The national authority is the Ministry of Environmental Protection (MEP), who advises on laws, regulations and technical guidelines on EIA and pollution prevention and control. At the province level, Environmental Protection Departments (EPDs) are mandated with control and regulation of EIA and pollution prevention and control. They are also often delegated the authority by the MEP to approve EIA reports for construction projects in the provinces, except those of national interest and those that cross provincial boundaries that would need MEP approval. The local or city-level EPBs enforce environmental laws and conduct environmental monitoring within city limits. Local Environmental Protection Bureaux (EPBs) could be delegated the authority to approve environmental impact assessments by the provincial EPDs.

92. Domestic project environmental impact reports (EIRs)[5] have been prepared by the Shanghai Ship and Shipping Research Institute (SSSRI) for each of the six subprojects under consideration, in accordance with the provisions of the PRC's *Environmental Impact Assessment Law* of 2003 and the *Directory for the Management of Different Categories of Construction Project Environmental Impact Assessment,* (MEP Order No. 2), October 1, 2008.

93. In Anhui Province, responsibility for approving the EIRs lies with the level of organisation which commissioned the project. The approvals for the EIRs are summarised in Table II.1 below. Five of the six EIRs have been approved. Approval of the EIR for the SRWIP is expected to be received by the end of July 2013.

Table II.1: Status of the Domestic Environmental Impact Report Approvals

Project Name	Prepared by	Publication Date	Approval Date	Approval Authority
Shuiyang River Waterway Improvement Project (SRWIP)	SSSRI	June 2013	Submitted to Anhui Province EPD. Regulatory review completed. Approval expected by 31 July 2013	Anhui Province EPD
Xuanzhou Multipurpose Wharf Port	SSSRI	April 2013	8 July 2013	Anhui Province EPD
Highway Subproject I – S367 Ma'anshan North Corridor	SSSRI	March 2013	23 April 2013	Ma'anshan Municipal EPB
Highway Subproject II – Yimu Highway, Kedian to Mujiating	SSSRI	April 2013	14 June 2013	Wuhu Municipal EPB
Highway Subproject III – S319 Erba-Wuwei Section	SSSRI	April 2013	14 June 2013	Wuhu Municipal EPB
Highway Subproject IV – G206 Donliu to Yaodu Section in Dongzhi County	SSSRI	October 2012	25 October 2012	Anhui Province EPD

Note: EPD = Environmental Protection Department, EPB = Environmental Protection Bureau.

94. The Soil and Water Conservation (SWC) Reports have been approved as shown in Table II.2. The findings of the draft SWC reports were taken into account in the preparation of the domestic EIRs.

[5] The *Directory for the Management of Different Categories of Construction Project Environmental Impact Assessment* classifies environmental impact assessments for construction projects into three categories with different reporting requirements, based on the 'significance' of potential environmental impact due to the project and the environmental sensitivity of the project site as described in this Directory. An Environmental Impact Report (EIR) is required for construction projects with potential significant environmental impacts. An Environmental Impact Table (EIT) is required for construction projects with less significant environmental impacts. An Environmental Impact Registration Form (EIRF) is required for construction projects with the least significant environmental impacts.

Table II.2: Status of the Soil and Water Conservation Reports

Project Name	Prepared by	Approval Date	Approval Authority
Shuiyang River Waterway Improvement Project	Anhui Provincial Water Conservancy and Hydropower Survey and Design Institute	June 2013	Anhui Province WRD
Xuanzhou Multipurpose Wharf Port	Anhui Jinyuan Water Conservancy and Hydropower Consulting Co. Ltd.	April 2013	Anhui Province WRD
Highway Subproject I – S367 Ma'anshan North Corridor	Anhui Yingce Consulting Services Co. Ltd	February 2013	Ma'anshan Municipal WRB
Highway Subproject II – Yimu Highway, Kedian to Mujiating	Anhui Jianghe Hydrological and Hydraulic Engineering Design Institute	May 2013	Wuhu Municipal WRB
Highway Subproject III – S319 Erba-Wuwei Section	Anhui Jianghe Hydrological and Hydraulic Engineering Design Institute	May 2013	Wuhu Municipal WRB
Highway Subproject IV – G206 Donliu to Yaodu Section in Dongzhi County	Anhui Jinyuan Water Conservancy and Hydropower Consulting Co. Ltd.	August 2012	Anhui Province WRD

Note: WRD = Water Resources Department, WRB = Water Resources Bureau.

95. **Environmental Standards.** In the PRC EIA requirements, ambient conditions of air, noise and water quality in the project area determine the appropriate category for point source or impacting emissions and effluent standards for the construction and operational phases of built infrastructure. However, the World Bank Group (WBG) Environmental Health and Safety (EHS) guidelines[6] and Ports, Harbours and Terminal Guidelines[7] (see below) are based on best practice construction and operational procedures. Both the PRC standards and EHS guidelines will be used in the assessments.

96. **Air Quality.** The PRC ranks air quality into three classes according to its *Ambient Air Quality Standard* (GB 3095-1996), with Class I having the best air quality and Class III the worst air quality. The ambient air quality in the assessment area of this project has been assigned to meet GB 3095-1996 Class II standards. A new standard was issued in 2012 (GB 3095-2012), which will become effective on January 1, 2016, replacing GB 3095-1996. The WBG adopted the World Health Organization (WHO) standards[8] for its EHS standards for air quality.

97. The WHO set up air quality guideline (AQG) standards for various air quality parameters for the protection of public health. Yet recognising that progressive actions are needed to achieve these standards and the financial and technological limitations of some countries, cities or localities especially in developing countries, the WHO also established interim targets as intermediate milestones towards achieving the AQG.

98. **Table II.3** compares the PRC's GB 3095-1996 Class II standards with the GB 3095-2012 standards and the WBG's EHS standards.

[6] World Bank Group. 2007. Environmental, health and safety guidelines - General EHS guidelines. Washington D.C.
[7] World Bank Group. 2007 Environmental, Health, and Safety Guidelines for Ports, Harbors, and Terminals. Washington D.C.
[8] World Health Organization. 2005. WHO air quality guidelines global update 2005. Report on a Working Group meeting, Bonn, Germany, 18-20 October 2005.

Table II.3: Comparison of the PRC's GB 3095-1996, GB 3095-2012, and World Bank Group EHS Ambient Air Quality Standards

Air Quality Parameter	Averaging Period	GB 3095-1996 Class II (mg/m^3)	GB 3095-2012 Class II (mg/m^3)	World Bank Group EHS[9] (mg/m^3)	
				Interim Targets	AQG
SO_2	1-year	0.06	0.06	n/a	n/a
	24-hour	0.15	0.15	0.050-0.125	0.020
	1-hour	0.50	0.50	n/a	n/a
PM_{10}	1-year	0.10	0.10	0.030-0.070	0.020
	24-hour	0.15	0.15	0.075-0.150	0.050
$PM_{2.5}$	1-year	n/a	n/a	0.015-0.035	0.010
	24-hr	n/a	0.15	0.0375-0.075	0.025
	1-hour	n/a	0.35	n/a	n/a
NO_2	1-year	0.08	0.04	n/a	0.040
	24-hour	0.12	0.08	n/a	n/a
	1-hour	0.24	0.20	n/a	0.200
CO	24-hour	4.0	4.0	n/a	n/a
	1-hour	10.0	10.0	n/a	n/a

99. Longer averaging period such as 1-year as shown in Table II.3 is more applicable to assessing impacts from multiple as well as regional sources; while shorter averaging periods such as 24-hour and 1-hour are more applicable to assessing short term impacts from project related activities, such as from peak hour traffic or daily or peak construction activities.

100. Comparing the PRC's GB 3095-1996 Class II standards with the WBG's EHS standards, Table II.3 shows that the PRC's 24-hour SO_2 standard (0.15 mg/m^3) is higher than the upper limit of WBG's interim standard (0.125 mg/m^3); 1-hour NO_2 standard (0.24 mg/m^3) is higher than the WBG's guideline standard (0.200 mg/m^3); and 24-hour PM_{10} standard (0.15 mg/m^3) is the same as the upper limit of the WBG's interim standard.

101. When GB 3095-2012 replaces GB3095-1996 on January 1, 2016, Class II standards of 24-hour SO_2 (0.15 mg/m^3) and $PM_{2.5}$ (0.15 mg/m^3) are higher than the upper limit of the WBG's interim standards (0.125 mg/m^3 and 0.075 mg/m^3 respectively); while 24-hour PM_{10} (0.15 mg/m^3) and 1-hour NO_2 (0.20 mg/m^3) are the same as the upper limit of the WBG's upper limit of interim standard and guideline standard, respectively.

102. **Noise.** According to the *Technical Specifications to Determine the Suitable Areas for Environmental Noise of Urban Area* (GB/T 15190-94), the area within 200 m on both sides of road or road junction should comply with the corresponding provisions in *Environmental Quality Standard for Noise* (GB 3096-2008). GB 3096-2008 categorizes five functional areas based on their tolerance to noise pollution: from Category 0 to Category 4. Category 0 is for areas with convalescent facilities that are the least tolerant to noisy environments and therefore have the most stringent day and night time noise standards. Category 1 is for areas predominated by residential areas, hospitals and clinics, educational institutions and research centres. Category 2 is for areas with mixed residential and commercial functions. Category 3 is for areas with industrial production and storage and logistics functions. Category 4 is for regions adjacent to traffic noise sources such as major roads and highways, and is subdivided into 4a and 4b with the former applicable to road and marine traffic noise and the latter applicable to rail noise. Standards for various functional area categories are compared with the WBG's EHS guidelines

[9] World Bank Group 2007, ibid.

as listed in Table II.4. This shows that the WBG has lower noise limits for residential, commercial and industrial mixed areas but higher noise limits for industrial areas and night time noise near trunk roads.

Table II.4: Environmental quality standards for noise (Unit: Equivalent Sound Level, LAeq dB)

Noise Functional Area Category	Applicable Area	GB 3096-2008 Standards		World Bank Group EHS[10]	
		Day	Night	Day	Night
0	Areas needing extreme quiet, such as convalescence areas	50	40	55	45
1	Area mainly for residence, cultural and educational institutions	55	45		
2	Residential, commercial and industrial mixed area	60	50		
3	Industrial area	65	55	70	70
4a	Area on both sides of urban road traffic trunk line	70	55		

Note: Functional Area 4 is divided into 4a for trunk roads and 4b for railway lines.

103. **Surface Water Quality.** For water quality assessment, the determining standard is PRC's *Environmental Quality Standards for Surface Water* (GB 3838-2002). It defines five water quality categories for different environmental functions. Category I is the best, suitable for headwaters and National Nature Reserves. Category II is suitable for drinking water sources in Class I protection areas, habitats for rare aquatic organisms, breeding grounds for fish and crustaceans and feeding grounds for juvenile fish. Category III is suitable for drinking water sources in Class II protection areas, wintering grounds for fish and crustaceans, migration routes, water bodies for aquaculture and capture fishery, and swimming activities. Category IV is suitable for general industrial use and non-contact recreational activities. Category V is the worst which is only suitable for agricultural and scenic water uses. This standard is set out in **Table II.5**. The WBG has guidelines on effluent quality standards but not ambient water quality, and recognizes the use of local ambient water quality criteria for EHS purpose.

Table II.5: Some Environmental Quality Standards for Different Classes of Surface Water (Unit: mg/l)

GB 3838-2002	Dissolved Oxygen (DO)	Permanganate Index (I_{Mn})	Biochemical Oxygen Demand (BOD_5)	Chemical Oxygen Demand (COD)	Ammoniacal Nitrogen (NH_3-N)
Category I	90% saturation or ≥7.5	≤2	≤3	≤15	≤0.15
Category II	≥6	≤4	≤3	≤15	≤0.5
Category III	≥5	≤6	≤4	≤20	≤1.0
Category IV	≥3	≤10	≤6	≤30	≤1.5
Category V	≥2	≤15	≤10	≤40	≤2.0

104. There are no specific PRC standards on water quality during dredging. The water quality in the drinking water in-take works on the Shuiyang River must comply with the suspended sediment standard of ≤ 25 mg/l, which has been taken from the standard for use of surface waters in irrigation (GB5084-2005).

105. Discharge of wastewater from construction sites and supernatant water from dredged sediment disposal sites is regulated under PRC's *Integrated Wastewater Discharge Standard* (GB 8978-1996). Class I standards apply to discharges into Category III water bodies under GB

[10] World Bank Group 2007, ibid.

3838-2002. Class II standards apply to discharges into Categories IV and V water bodies. Class III standards apply to discharges into municipal sewers going to municipal WWTPs with secondary treatment. Table II.6 shows these standards.

Table II.6: Wastewater discharge standards for construction sites and dredged sediment disposal sites according to GB 8978-1996

Parameter		Class I (for discharging into Category III water body)	Class II (for discharging into Categories IV and V water body)	Class III (for discharging into municipal sewer)
pH		6 ~ 9	6 ~ 9	6 ~ 9
SS	mg/L	70	150	400
BOD_5	mg/L	20	30	300
COD	mg/L	100	150	500
TPH	mg/L	5	10	20
Volatile phenol	mg/L	0.5	0.5	2.0
NH_3-N	mg/L	15	25	---
PO_4^{2-} (as P)	mg/L	0.5	1.0	---
LAS (= anionic surfactant)	mg/L	5.0	10	20

106. **Soil and river sediment quality.** Soil quality in the PRC is divided into three classes according to the *Environmental Quality Standard for Soils* (GB 15618-1995). Class 1 represents the best and Class 3 the worst. The PRC does not have quality standards for sediments in waterways such as rivers, lakes, reservoirs and the sea. It is common practice in the PRC to use either GB 15618-1995 to assess sediment quality since most sediment would be disposed on land and most likely for future agricultural or planting uses, or the *Control Standards for Pollutants in Sludges from Agricultural Use* (GB 4284-84) for assessing sediment quality. The rationale for using the latter being that the physical nature of river sediment is similar to sludge. The EIRs for this project used GB 4284-84 to assess sediment quality. Table II.7 presents both GB 15618-1995 (soil) and GB 4284-84 (sludge for agricultural use) standards. The WBG does not have EHS standards for soil and sediment quality.

Table II.7: Comparison of environmental quality standards for soil and control standards for pollutants in sludge for agricultural use

Parameter		Maximum Allowable Concentration (mg/kg dry weight)						
		GB 15618-1995 (Soil)					GB 4284-84 (Sludge for Agricultural Use)	
		Class 1	Class 2			Class 3		
	Soil pH	Back ground	<6.5	6.5~7.5	>7.5	>6.5	<6.5	≥6.5
Cadmium (Cd)		0.20	0.30	0.30	0.60	1.0	5	20
Mercury (Hg)		0.15	0.30	0.50	1.0	1.5	5	15
Arsenic (As)	Paddy	15	30	25	20	30	75	75
	Dry land	15	40	30	25	40		
Copper (Cu)	Farm land	35	50	100	100	400	250	500
	Orchard	---	150	200	200	400		
Lead (Pb)		35	250	300	350	500	300	1000
Chromium (Cr)	Paddy	90	250	300	350	400	600	1000
	Dry land	90	150	200	250	300		
Zinc (Zn)		100	200	250	300	500	500	1000
Nickel (Ni)		40	40	50	60	200	100	200
Boron (B, soluable)		---	---	---	---	---	150	150
DDT		0.05	0.50			1.0	---	---
666 (Lindane)		0.05	0.50			1.0	---	---
Mineral oil		---	---	---	---	---	3000	3000
Benzo(a)pyrene		---	---	---	---	---	3	3

107. **Greenhouse Gas (GHG) Emissions.** The PRC does not have evaluation standards for GHG emissions. The WBG's EHS guidelines list recommendations for GHG reduction at industrial facilities but no evaluation standard. ADB sets a GHG emission threshold of 100,000 t carbon dioxide equivalent (CO_2e) per year.[11] Projects that exceed this threshold should estimate the net (after mitigation) GHG direct emissions and (ii) the indirect emissions from off site production used by the project. Road projects need to assess whether they would exceed this threshold. Table II.8 shows the maximum passenger car unit (pcu) per road length to trigger the threshold.

Table II.8: Maximum Number of Passenger Car Units per km to trigger 100,000 CO_{2e} per year

Road Length (km)	Passenger Car Units (pcu)
20	57,000
30	38,000
40	28,000
50	23,000
60	19,000
70	16,000
80	14,000
90	13,000
100	11,000

108. **Occupational Health and Safety.** The PRC does not have laws and regulations on occupational health and safety *per se*, but addresses workers' health and safety under the *Labor Law* (January 1, 1995) requiring employers to provide workers with a healthy and safe working environment, safety equipment and training. WBG's EHS guidelines on occupational health and safety on construction sites are presented in Table II.9. Although not specifically listed in Table II.9, occupational health and safety training for construction workers on following the guidelines and on the use of personal protection equipment (PPE) is an important component in the guidelines to address all the issues.

Table II.9: The World Bank Group's Occupational Health & Safety Guidelines for Construction Sites

Issue	Guidelines
Over exertion causing injury	● Train workers in lifting and materials handling techniques ● Plan wok site layout to minimize manual transfer of heavy loads ● Select tools and design work stations that reduce force requirements and holding times ● Implement administrative controls such as job rotations and rest or stretch breaks
Slips and falls due to poor housekeeping	● Implement good housekeeping practices ● Clean up excessive waste debris and liquid spills regularly ● Locate electrical cords and ropes in common areas and marked corridors ● Use slip retardant footwear
Work in heights	● Use temporary fall prevention devices such as rails or other barriers ● Use personal fall arrest systems such as full body harness ● Use control zones and safety monitoring systems to warn workers of their proximity to fall hazard zones
Struck by objects	● Use designated and restricted waste drop or chute for safe movement of wastes from upper to lower levels ● Conduct sawing, cutting, grinding, sanding, chipping or chiselling with proper guards and anchoring as applicable

[11] Asian Development Bank. 2012. Environmental safeguards: A good practice sourcebook – draft working document.

Issue	Guidelines
	● Maintain clear traffic ways to avoid driving of heavy equipment over loose scrap ● Use temporary fall protection measures in scaffolds and outer edges of elevated work surfaces ● Evacuate work areas during blasting operations, and use blast mats to deflect debris ● Wear appropriate personal protection equipment (PPE)
Moving machinery	● Plan and segregate the location of vehicle traffic, machine operation, and walking areas ● Control vehicle traffic routes and speed ● Use high visibility vests for workers in heavy equipment operating areas ● Outfit moving equipment with audible back-up alarms ● Use inspected and well-maintained lifting devices that are appropriate for the load
Dust	● Implement dust suppression techniques ● Use PPE such as dust masks where dust levels are excessive
Confined spaces and excavations	● Control site-specific factors which may contribute to excavation slope stability ● Provide safe means of access and egress from excavations ● Avoid operating combustion equipment for prolonged periods inside excavation areas
Other site hazards	● Use specially trained personnel to identify and remove waste materials from tanks, vessels, processing equipment or contaminated land ● Use specially trained personnel to identify and selectively remove potentially hazardous materials in building elements prior to demolition ● Use waste-specific PPE based on occupational health and safety assessment results

109. **Community Health and Safety.** The WBG provides EHS guidelines on community health and safety for the protection of residents in communities near construction sites (Table II.10).

Table II.10: The World Bank Group's Environmental and Safety Guidelines for Community Health and Safety

Issues	Guidelines
Protection of communities from physical, chemical or other hazards	● Restrict access to the site through institutional and administrative controls ● Remove hazardous conditions on construction sites that cannot be controlled effectively with site access restrictions
Prevention of vector-borne diseases	● Prevent larval and adult propagation through sanitary improvements and elimination of breeding habitats close to human settlement ● Eliminate unstable impound water ● Consider the application of residual pesticide if needed ● Implement integrated vector control programs ● Educate area residents on risks, prevention, and available treatment ● Monitor communities during high-risk seasons to detect and treat cases
Traffic safety	● Adopt best transport safety practices across all aspects of project operations ● Minimize pedestrian interaction with construction vehicles ● Collaborate with local communities and responsible authorities to improve signage, visibility and overall safety of roads ● Collaborate with local communities on education about traffic and pedestrian safety ● Collaborate with emergency responders to ensure that appropriate first aid is provided in the event of accidents ● Use locally sourced materials whenever possible to minimize transport distances ● Locate construction staging areas and worker camps close to project sites and arrange worker bus transport to minimize external traffic ● Employ traffic control measures such as road signs and flag persons to warn of dangerous conditions.

110. **Evaluation Standards for the Project.** The following PRC evaluation standards were adopted for this Project in the domestic EIR in accordance with the national requirements (Table II.11).

Table II.11: PRC Evaluation Standards Adopted for this Project

Environmental Parameter	PRC Evaluation Standard	Remark
Ambient air quality	*Ambient Air Quality Standard* (GB 3095-1996) and its revision Class II standard	Daily average: TSP: 0.30 mg/m^3 PM_{10}: 0.15 mg/m^3 NO_2: 0.08 mg/m^3 SO_2: 0.15 mg/m^3 CO: 4.0 mg/m^3 Hourly average: NO_2: 0.24 mg/m^3 (0.20 mg/m^3 after January 1, 2016) CO: 10.0 mg/m^3
Construction air pollutant emission	*Air Pollutant Integrated Emission Standard* (GB 16297-1996)	Maximum allowable emission concentration: Particulate matter (PM): 120 mg/m^3 Fumes from asphalt plant: 40 mg/m^3 during production and 75 mg/m^3 during mixing Limits for fugitive emission: PM: ≤1.0 mg/m^3 at construction site boundary Fumes from asphalt plant: no obvious emission at asphalt production plant
Odour	*Emission Standard of Odorous Pollutants* (GB14554-93)	Ammonia: 1.5 mg/m^3 H_2S: 0.06 mg/m^3 Trimethylamine: 0.08 mg/m^3 Odour concentration (dimensionless): 20
Environmental noise	*Environmental Quality Standard for Noise* (GB 3096-2008): • Function Area Category 4a for areas within 35 m from the road redline or the façade of the first row of houses more than three storeys high. • Functional Area Category 2 for areas between 35 m to 200 m from the road redline	Functional Area 2: Day time: 60 dB(A) Night time: 50 dB(A) Functional Area 3: Day time: 65 dB(A) Night time: 55 dB(A) Functional Area 4a: Day time: 70 dB(A) Night time: 55 dB(A)
Construction noise	*Emission Standard of Environmental Noise for Boundary of Construction Site* (GB 12523-2011)	Noise level at construction site boundary Day time: 70 dB(A) Night time: 55 dB(A)
Surface water quality	*Environmental Quality Standards for Surface Water* (GB 3838-2002): • Category II standards for Zhanghe River, • Category III standard for Shuiyang River, Xihe River, Sima River, Yaodu River • Category IV standard for Guishan River * SS taken from the *Standards for Irrigation Water Quality* (GB5084-2005)	Category III water body pH: 6-9 CODmn: ≤6 mg/l BOD5: ≤80 mg/l SS: ≤25 mg/l* NH_3-N: ≤1.0 mg/l Oil pollutant: ≤0.05 mg/l TN: ≤1.0 mg/l TP: ≤0.2 mg/l (see also **Table II.5**)
Groundwater quality	*Environmental Quality Standard for Groundwater* (GB/T14848-93)	Category III groundwater body pH: 6.5-8.5 Permanganate Index: ≤ 3 mg/l NH_3-N: ≤0.2 mg/l Cyanide: 450 mg/l

<table>
<tr><th>Environmental Parameter</th><th>PRC Evaluation Standard</th><th>Remark</th></tr>
<tr><td></td><td></td><td>Coliform: ≤3
Chloride: ≤250 mg/l
Pb: ≤0.05 mg/l
Sulphate: ≤250 mg/l
Cr^{6+} : ≤0.05 mg/l
Total hardness: ≤450 mg/l
Hg: ≤0.001mg/l
As: ≤0.05 mg/l
Total dissolved solids: 1000mg/l</td></tr>
<tr><td>Wastewater discharge including the discharge of supernatant water from dredging sediment disposal sites</td><td>Integrated Wastewater Discharge Standard (GB 8978-1996)

Category I standard is used for the discharge of wastewater from the Shuiyang River Waterway Management and Service Station and for the Highway Subprojects to surface waters. No discharge to the Zhanghe River is permitted.

Wastewater Quality Standard for Discharge to Municipal Sewers CJ343-2010

Category III standard is used for the discharge of sewage from the Xuanzhou multi-purpose Port into the municipal sewerage system.</td><td><u>Discharge into Category I water body</u>
pH: 6-9
COD: ≤100 mg/l
BOD_5: ≤20 mg/l
SS: ≤70 mg/l
Oil Pollutant: 5 mg/l
NH_3-N: ≤15 mg/l

<u>Category III standard for discharge to sewer</u>:
pH: 6-9
COD: ≤500 mg/l
BOD_5: ≤300 mg/l
SS: ≤400 mg/l
Oil Pollutant: 20 mg/l
NH_3-N: ≤45 mg/l (CJ343-2010)</td></tr>
<tr><td>Dredged sediment applied to agricultural land</td><td>Control Standards for Pollutants in Sludges for Agricultural Use (GB3552-84)</td><td><table><tr><th>Parameter</th><th>pH <6.5</th><th>pH > 6.5</th></tr><tr><td>As</td><td>75</td><td>75</td></tr><tr><td>Hg</td><td>5</td><td>15</td></tr><tr><td>Pb</td><td>300</td><td>1000</td></tr><tr><td>Cu</td><td>250</td><td>500</td></tr><tr><td>Zn</td><td>500</td><td>1000</td></tr><tr><td>Cr</td><td>600</td><td>1000</td></tr><tr><td>Ni</td><td>100</td><td>200</td></tr></table></td></tr>
<tr><td>Soils</td><td>Environmental Quality Standards for Soils (GB15618-1995)
Grade II soil in dumping areas</td><td><u>Grade II Soils</u>
pH: 6.5 – 7.5
As: 25 mg/kg
Hg: 0.5 mg/kg
Pb: 300 mg/kg
Cu: 100 mg/kg
Zn: 250 mg/kg
Cr: 300 mg/kg
Cd: 0.6 mg/kg</td></tr>
<tr><td>Pollution from Ships</td><td>Emission Standards for Pollutants from Ships (GB3552.83)</td><td><u>Oil wastewater from ships</u>
Oil pollutant: ≤15 mg/l
BOD5: ≤50 mg/l
SS: ≤150 mg/l
Coliform: ≤250 individuals / l
<u>Food and other waste</u>
Disposal into waters is prohibited</td></tr>
</table>

Source: Draft EIRs.

111. **Assessment Areas.** The project area of influence, or assessment areas, for air, noise, surface water and ecological impacts are defined by the technical guidelines for EIA in the PRC, based on the environmental sensitivity of the project areas and the nature of the project and its components. The domestic EIR followed these guidelines in defining the assessment areas. The assessment areas also include those areas defined by ADB's SPS (2009) as the project's area of influence consisting of: (i) the primary project sites and related facilities, (ii) sites of associated facilities, and (iii) sites and communities that could potentially be affected by cumulative and/or induced impacts from this project. The assessment areas for various environmental aspects of the project areas are shown in Table II.12, with the physical cultural resource, occupational health and safety, and community health and safety assessment areas added for this EIA.

Table II.12: Assessment Areas

Environmental Aspect	Assessment Area
Air quality	Up to 200m on either side of the road centreline
Noise	Up to 200m on either side of the road centre line
Surface water quality	I. Up to 200m on either side of the road centreline. II. River crossings: 100 m upstream to 1000 m downstream of the bridge crossing.
Ground water quality	Ground water aquifer
Ecology	Up to 300m either side of the road centre line
Physical cultural resource	Construction footprint
Occupational health & safety	Construction footprint
Community health & safety	Up to 200m either side of the red line which demarcates the edge of the highway project

Source: Domestic EIRs.

112. **Assessment Period.** The duration of impacts assessed in this report covers the construction and operational phases of the Project. The construction phase for the subcomponents varies between one and three years (see Table II.13). The assessment period for the operation of SRWIP and Xuanzhou Port is 35 years and 6 years respectively. The assessment period for the operation of the highway subprojects is 15 years from the year of opening.

Table II.13: Assessment period for the SRWIP and Highway Subprojects

Subproject	Construction Period	Year of Opening	Operation Period based on Design Year
Shuiyang River Waterway Improvement - SRWIP	36 months	2015	2050
Xuanzhou Port	24 months	2014	2020
Ma'anshan North Corridor	18 months	June 2015	2029
Yimu Highway – Kedian to Mujiating	28 months	October 2015	2029
S319 – Erba to Wuwei	24 months	December 2015	2029
206 – Dongliu to Yaodu	36 months	December 2015	2029

III. DESCRIPTION OF THE PROJECT

A. Project Rationale

113. **Background.** Anhui is a land-locked province and one of the poorest provinces in the People's Republic of China (PRC). Although geographically in the east of the PRC, it is considered as one of the central provinces. The province is subdivided by the Yangtze River, which has historically separated and isolated the poorer mountains and plains on the southern side of the river from the comparatively more prosperous northern part of the province. Compared with the PRC's coastal provinces, Anhui is less accessible and its infrastructure and economy are relatively less well developed.

114. The province has a population of about 63 million, of whom 63% are classed as rural, one of the highest percentages in the country, and substantially higher than the eastern provinces with an average of 45% rural population. The population density at 470 persons per km^2 is higher than the national average of 138 persons per km^2. The GDP per capita at CNY28,792 (USD 4,561) was 75% of the national average in 2012 and ranked the province 26th out of 31 provinces and municipalities in the PRC.

115. There is also substantial poverty and rural-urban disparity. Some 26 out of 61 counties in the province are officially designated as poverty counties. 51 counties have a GDP per capita lower than the provincial average, and only 1 county reached the national average. Statistics for 2012 indicate that the annual average per capita disposable income for urban dwellers was CNY10,691 and net income of CNY3,556 for rural inhabitants.

116. The provincial capital Hefei is located on the north side of the Yangtze, with a total population of 7,457,027 in 2010, of whom 3,352,076 live in the metro area. The second largest city is Wuhu, located on the southern bank of the Yangtze, with a population of 3,842,100 of whom 2,400,000 lived in the metro area in 2011. Both cities are expanding, and require improved highways to facilitate the movement of goods and people between them and other provincial towns.

117. The existing highway network is inadequate and the Provincial 12th FYP includes substantial upgrade of the existing road network. In 2007, only 8.4% of the highway network was Class I or II highway, compared with the national average of 10.6%, and more than 82% of the roads in the Province were Class IV or unclassified. The highway projects will help to improve inter-Province links between Anhui and Jiangsu, as well as improving north-south and east-west links within Anhui to supplement the expressway network, ease congestion on county roads, improve safety for vehicle travellers and NMTs, and improve the quality of people's lives in the county towns and villages.

118. **Inland Waterway Improvements.** The Shuiyang River is a tributary on the south bank of the Yangtze. Typical of many rivers in the area, discharge is seasonally variable, with high flows during the months of summer monsoon. The river is embanked along much of its length to avoid flooding in the surrounding low lying paddy fields and fish ponds. The river flow was regulated following the construction of Tonggong Dam in 1958, which resulted in lower dry season flows, significantly reduced suspended sediment levels, and the cessation of navigation above Haitangwan. The Shuiyang River connects Xuancheng City and surrounds to the

Yangtze River, the Wushen Canal, and the downstream Yangtze River Delta and Shanghai, an enormously important economic area, which generates as much as 20% of the PRC's GDP.

119. At present, the Shuiyang River is carefully navigable by single vessels up to 1000 dead weight tonnage (dwt) during the annual wet season typically for four months from May to August, provided that there is at least 2.0m draught for sufficient duration to allow vessels to travel up to Haitangwan and back to Yanchi. Smaller vessels can ply the river over a longer period but navigation all but ceases during the dry season. Safe navigation is dependent on local knowledge of the river. The Shuiyang River is currently a Class V and VI navigable river. The proposed project would improve the Shuiyang River to restricted Class IV[12] throughout the year (a combination of Class III but Class IV determined by the tight curvature on the meander bends), although much of the river will be Class III. This would allow 1000dwt vessels to navigate the river up to the new port at Xuanzhou all year around, except during high flows defined by the 1:20 year flow when all navigation has to stop for safety reasons, thereby significantly increasing movement of cargo, both the movement of raw materials up the river to the Xuanzhou Industrial Park to support manufacture, and the movement of raw materials and manufactured goods from Xuancheng City to the towns along the Yangtze and the Yangtze River Delta.

120. **Existing Port in Xuancheng City.** The existing unloading facility is located at Haitanwang near the foot of Jingting Mountain, 5 km from Xuancheng City. It has long served as an important hub for transporting coal, grain and mineral resources for Xuanzhou District and Ningguo City, although much of the current use is river extracted minerals only with a processing plant on the site. With a total length about 1000 m and the water area more than 7000 m^2, the shoreline is relatively suitable for mooring 300 tonne vessels all year. It has a land area of 3000 m^2 and a storage yard of 21,000 m^2. With five river bank moorings in total, the site has maintained an annual handling volume around 100 thousand tonnes since 1986 and has kept growing in recent years with a record of 1.1 million tonnes in 2011.

121. The old facility only offloads and separates sand and gravel from licensed river dredging (Plates III.1 and 2). This activity will continue here after the new port is operational and the new port is not being specifically designed for this sand and gravel construction materials market. The existing port is contracted out to private operators. There is no space for expansion due to the embanked railway and highway that run to the back of the site and the designation of Jingting Mountain as a Scenic Spot. Navigation during the peak of the dry season December to February currently has to cease.

[12] See Table III.3 for road classifications in the PRC.

Plate III.1: Existing port with sand and gravel handling facilities

Plate III.2: Existing port on the Shuiyang River

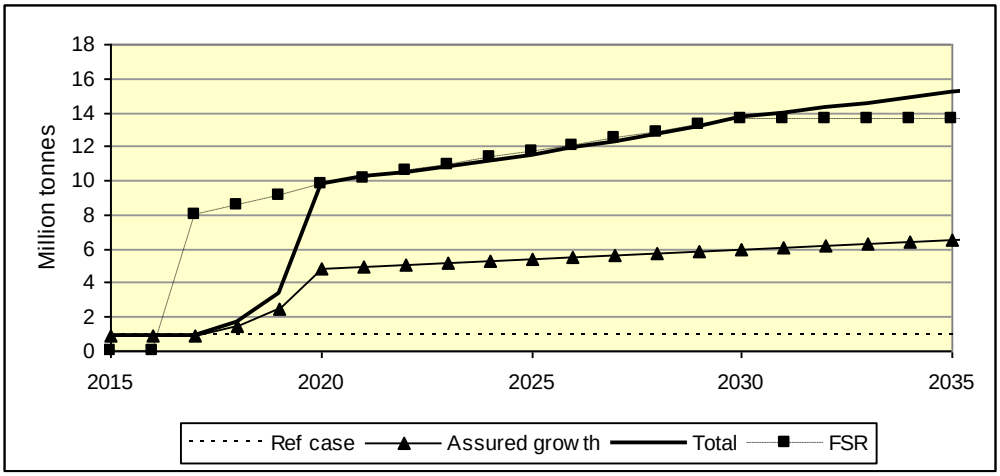
122. **New Xuanzhou Port.** The need for a new port is identified in the Xuancheng Master Plan and is to be located in the Xuanzhou Industrial Park for maximum effect. The new port would handle bulk and general cargo, both imports of raw materials to serve construction industry, chemical industry and the Sierte Fertilizer Company, and exports including chemicals, fertilizers, and other manufactured goods. The feasibility study report (FSR) forecasts annual cargo reaching 1.5M tonnes by 2020 and 2.5M tonnes by 2030 as shown in Table III.1 below for Xuanzhou Port, and total cargo of c15M tonnes by 2030 for the area. The PPTA has re-forecast likely cargo as shown in Figure III.1, which allows for a ramp up of cargo from the current low levels. The proposed Xuanzhou Port will have a nominal annual capacity of 1.5M tonnes per year by 2020 and 2.5M tonnes by 2030. Consequently, these forecasts assume that Phases 1 and 2 of the new facility are built, and handles c15% of the cargo forecast for the area, the remainder being handled at private ports in the vicinity.

Table III.1: Handling Capacity Forecast for the Port (10,000 tonnes)

Cargo	2020			2030		
	Import	Export	Total	Import	Export	Total
Coal	10	0	10	20	0	20
Non-metal minerals	25	0	25	30	0	30
Fertiliser	0	15	15	0	20	20
Construction materials	20	0	20	30	0	30
Solid chemical materials and products	20	10	30	20	10	30
Steel and other metals	30	0	30	30	0	30
Others	5	15	20	20	70	10
Sum	110	40	150	150	100	250

Source: FSR.

Figure III.1: Cargo Flow Projections



Source: FSR and PPTA economic studies.

123. The site is currently occupied by farmers, with several houses and a large pond formed from an old river channel on the landward side of the site (Plate III.3). Artisanal fishing is practised in the river (Plate III.4), but the locals commented that there were few fish.

Plate III.3: View of the Proposed Xuanzhou Port Location Taken from the Shuiyang River Flood Embankment

Plate III.4: View of the Shuiyang River at the Proposed Port Location

124. **Highway Network.** The need to improve the highway network is recognised in the current 12th FYPs for the Province, which identifies some 122,184 km of roads for improvement between 2011 and 2015. This project includes four highway improvement subprojects totalling some 122.18 km, three of them road upgrade schemes and one new build project. Upgrade totals 81.96 km (67%) while new build totals 42.22 km (33%). A summary of these subprojects is provided **in Table III.2 below**.

Table III.2: Summary of the Highway Subprojects

No.	Name	Current Class	Proposed Class	Type of Scheme	Length (km)
I	S367 Ma'anshan City North Channel	III/IV	II	Upgrade / New build	29.0 / 19.874 Totalling 46.874
II	Yimu Highway Kedian-Mujiating Section in Nanling County	II	I	Upgrade	22.36
III	S319 Erba-Wuwei Section in Wuwei County	II	I	Upgrade / New build	30.6/5.77 Totalling 36.37
IV	G206 Dongliu-Yaodu Section in Dongzhi County	II	I	New build	16.58

Source: Domestic EIRs.

125. The PRC classifies roads into four classes under the Construction Commission's *Temporary Provision for Urban Planning Fixed Standards* shown in Table III.3.

Table III.3: Road Classification in the PRC

Road Class	Design Speed (km/hr)	Total Road Width (m)	Motorized Traffic	Non-motorized Traffic	Divider between Motorized Traffic and Non-motorized Traffic
I	60~80	40~70	≥4 lanes, each 3.75m wide	≥6~7m	compulsory
II	40~60	30~60	≥4 lanes, each 3.5m wide	≥5m	required
III	30~40	20~30	≥2 lanes, each 3.5m wide	≥5m	optional
IV	<30	16~30	≥2 lanes, each 3.5m wide	optional	optional

126. **Road Safety.** Nationally, the number of reported road fatalities has fallen in recent years, despite the enormous growth in traffic, from 107,000 deaths in 2004 to 65,000 in 2010. The total number of accidents has also fallen over the same period, from 520,000 to 220,000. The number of fatalities per accident has risen from 0.2 to 0.3. Reported road deaths in 2010 were 4.9 per 100,000 of population and 8.3 per 10,000 vehicles, while accident rates in the same year were 17 per

100,000 population and 28 per 10,000 vehicles. Nonetheless, reported accidents are potentially under-reported, in comparison with international data.

127. In Anhui Province, the limited available data indicate that the number of accidents has fallen in recent years (see Table III.4).

Table III.4: Anhui Province Accident Data

Item	2006	2007	2008	2009	2010
Road accidents	14,151	13,273	8,413	8,191	7,714
Deaths			2,424		2,080
Injuries			7,242		9,364
Accidents/10,000 veh	446	382	212	180	163
Deaths/10,000 veh			61		44
Accidents/100,000 pop	21	20	12	12	11
Deaths/100,000 pop			3.6		3.0
100m t-km					5,005
100m pax-km					1,010
Est 100 million veh-km	440	650	890	1,060	1,100
Accidents per 100m veh-km	32	20	9.5	7.7	7.0
Fatalities per 100m veh-km			2.7		1.9

Sources: National statistics, PPTA 7119-PRC[13] and the Consultant's Calculations.

128. IRAP[14] reported on accident risks for a selection of highways in Anhui Province covering some 374.1 km. They identified a range of accident risks, which are summarised in Table III.5 below.

Table III.5: Summary of Potential Accident Risks

Item	Class	Description of Risk	
Head on collisions	Class I and IIa	Lowest risk. Class I road has a central barrier or island. Classes I and IIa are dual two lane, which reduces overtaking demand.	
	Class II and III	Relatively high risk. No central barrier, single lane, and overtaking demand	
Running off the road	All classes	There is a similar level of risk across all classes of road, despite higher design standards for Class I, due to positioning of trees, street lamps, and other street furniture within 5m of the side of the road.	
Accidents at intersections	Class I and II	Similar level of risk	
	Class III	Potentially lower level risk given low traffic and large spacing between intersections[a]	
Accident Risks[b]		Vehicle Travellers	27%
		Motorcyclists	35%
		Cyclists	19%
		Pedestrians	19%

Source: [a] Based on observations from a single Class III in Anhui Province in iRAP, [b] Analysis of Official Traffic Accident Report of China 2010.

129. A disproportionate number of accidents affect cyclists and pedestrians, amounting to 38% for national statistics, which could be reduced through improved safety design for NMTs, particularly in villages and towns where there are greater numbers of NMTS and poor separation from vehicles.

[13] PPTA 7119 PRC. Anhui Road Network Development Project, 2008.
[14] International Road Assessment Programme, Building China RAP, a study commissioned by ADB.

130. Upgrading roads has the potential to reduce the number of accidents, by increasing lane and over-taking capacity, removing obstacles near the edge of the highway, improving intersections, separating vehicles and NMTs, and improving pedestrian crossings.

B. Project Benefits, Impact, Outcome and Output

131. **Project Benefits.** The Project will provide improved transport links for freight and people, with increased modal share for inland waterways and improved highway linkages between Anhui and Jiangsu Provinces, and within Anhui Province.

132. **Impact, Outcome and Output.** The expected impact of the project is increased economic growth in Anhui. The SRWIP would provide increased economic growth in the Xuancheng City area, by increasing the capacity of navigation on the Shuiyang River to all year round movements of bulk cargo, comprising raw materials for the newly expanding industry around Xuancheng and the export of minerals and manufactured products from Xuancheng to the Yangtze River Delta, eastern Provinces, and trans-shipment for international trade. The impact of the four highway projects would be to improve journey times and ambience, with relatively little environmental impact given that most of the works (67%) are improvements to existing highways.

133. The expected outcome of the project is the provision of more efficient transportation links for both inland waterways and highways. The improved inland waterway provides increased bulk freight transport capacity in a more environmentally sustainable way compared to the movement of similar volumes of goods by road or rail, in terms of fuel use and greenhouse gas emissions; land-take and the associated direct and indirect impacts on ecology, soils, agricultural land, noise, air quality, and people; and reduced traffic accidents. The four highway subprojects would relieve congestion, improve journey times, reduce transportation costs, and reduce accidents.

134. The project outputs comprise two components:

(i) The Shuiyang River Waterway Improvement Works (SRWIP), Xuanzhou Multi-Purpose Wharf, and associated developments, consisting of: (a) channel improvements throughout the 43.9 km including dredging, widening, meander re-shaping and selective bank revetment, with a greater dredging impact over the downstream 11 km to deepen shallow shoals and strengthen flood embankments; (b) placement of two low water rubber barrages, one on the main channel with an associated ship lock and the smaller second dam on the Qiugong River; (c) a new road bridge over the Shuiyang River at Xiaohekou to improve navigation clearance; and (iv) the construction of a new river wharf at Xuangzhou.

(ii) Four highway improvement subprojects consisting of: (a) upgrading and new build sections of the S367 Ma'anshan North Corridor (46.874 km); (b) upgrading the Kedian-Mujiating section of the Yimu Highway (22.36 km); (c) upgrading and new build section of the Erjun Road on the S319 (36.37 km); and (d) the construction of a new alignment for the Dongliu-Yaodu section of the G206 in Dongzhi County (16.58 km).

C. Highway Improvement Subprojects

1. Subproject I – the Ma'anshan North Corridor

135. This county road is located on the north bank of the Yangtze River between the towns of Xiangzong to the west and Chuomiao to the east (see Figure III.2). At the western end, the route connects with the S226, which in turn leads to the G5011 Hufi Expressway between Hefei to the north and Wuhu City on the south bank via the Wuhu Yangtze Bridge. To the east, the county road stops at the Provincial border, a few kilometres from national road G312, an expressway between Hefei in Anhui and Nanjing in Jiangsu. Improvements to the Ma'anshan North Corridor would provide additional capacity for east-west movements between the two main national expressways radiating from Hefei, improve links for provincial traffic between Anhui and Jiangsu, and local traffic to the north of Ma'anshan Town.

Figure III.2: Ma'anshan North Corridor

136. Information on the design of the existing road is presented in Table III.6 and some illustrations are shown in Plates III.5 to 8 below. The road width varies along its length, between 14m and 6.5m, with poor road geometry. The running surface is cement concrete in poor condition with broken cement concrete slabs and cracked asphalt concrete. There are proposals to upgrade the navigation of the Sima River from Class VI to IV. The need to widen the highway and upgrade the navigation class of the Sima River means that the current bridge over the Sima River needs to be replaced to meet both the highway and navigation standards.

Table III.6: Specifications of Existing County Highways X032 and X0004

Class	No. of Lanes	Pavement	Design Speed (km/h)	Road Width (m)	Flood Return Period
Plain & Hilly Area III/IV	Dual 1	Concrete (Bitumen K6+932.8 - K7+377.113)	40/20	6.5 – 14	1:50 years

Source: FSR.

Plate III.5: Ma'anshan: Typical village scene

Plate III.6: Ma'anshan: Sima River Crossing

Plate III.7: Ma'anshan: Shanhou Village

Plate III.8: Ma'anshan: Eastern end near border with Jiangsu Province

137. Existing and future traffic data are presented in Tables III.7 and 8 below. The current traffic levels are about 3,300 pcu/day, including a proportionately high percentage of HGVs, probably reflecting its position linking the G5011 and G312 expressways. The high percentage of HGVs may also explain the poor pavement conditions. Cars only account for about a quarter of the traffic in Shiyang Town and about half the traffic in Shanhou and Xianzong Towns.

Table III.7: Existing Traffic Volume (per day, surveyed on August 15, 2012)

Survey Point	Light Truck	Medium Truck	Heavy Truck	Trailer	Container	Car	Bus	Total	
								Actual	pcu
X032 Shiyang Town	179	241	991	91	39	535	117	2,193	3,151
X004 Shanhou Town	351	352	353	79	54	1,330	276	2,795	3,346
X004 Xianzong Town	348	400	345	82	53	1376	300	2,904	3,514

Source: FSR.

Table III.8: Traffic Forecast

Road Section	Design Year	Daytime Volume (per hour)				Night-time Volume (per hour)			
		Small	Mid-sized	Heavy	Total	Small	Mid-sized	Heavy	Total
Start – Chuma Expressway	2015	58	11	50	119	14	3	12	29
	2021	89	16	74	179	22	4	18	44
	2029	149	21	103	273	37	5	26	68
Chuma Expressway - S206	2015	61	12	55	128	15	3	14	32
	2021	97	18	80	195	24	4	20	48
	2029	163	23	113	299	41	6	28	75
S206 - S226	2015	101	19	39	159	25	5	10	40
	2021	152	27	58	237	38	7	14	59
	2029	235	33	85	353	59	8	21	88

Source: FSR.

138. The future traffic growth is predicted to increase three-fold from the current baseline of about 3,300 pcu/day to 9,630 pcu/day in the design year 2029.

139. The main engineering indicators are summarised in Table III.9 and quantities are provided in Table III.10.

Table III.9: Subproject I - Major Engineering Indicators

Item	Indicator
Road class	Plain and Hilly Class II
Road length	46.874 km
Design speed	60 km/h
Pavement type	Bitumen
Road width (red line)	12m
Carriageway width	2 * 3.75
Stopping Sight Distance	75m
Maximum longitudinal gradient	6%
Minimum grade length	150m
Design load for bridges	Highway II
Flood return period	1:100 years

Source: FSR and Domestic EIR.

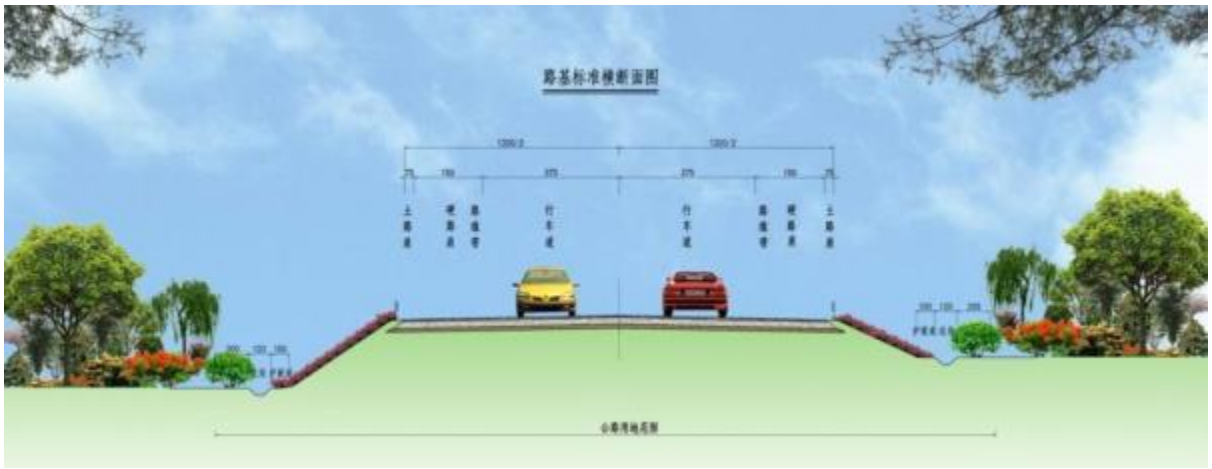
Table III.10: Upgrading Construction Quantity

No.	Items		Unit	Quantity
1	Length	New Build	km	19.874
2		Existing Upgrading	km	29.0
3	**New Permanent Land Acquisition**		Ha	75.4
4	Subgrade	Cut	10^3m^3	149.6
5		Fill	10^3m^3	952.9
6		Slope Protection	10^3m^3	24.83
7	**Pavement**		10^3m^3	451.75
8	Bridges	Large Bridge	m/No.	1087.4 / 2
9		Medium-sized Bridge	m/No.	146.2 / 4
10		Small Bridges	m/No.	118.8 / 5
11		Culvert	No.	176
12	Intersection	At grade crossings	No.	97
13	Demolition	Buildings	10^3m^2	115.6
14		Power Transmission / Telecom	Line m	320
	Total Cost		Million yuan	455

Source: FSR and Domestic EIR.

140. The proposed cross section for the road is illustrated in Figure III.3 below. The upgraded road would comprise dual single lane carriageways each 3.75 m wide, with a 1.5 m hard shoulder, and 0.75 m earth berm on either side of the carriageway. The highway corridor would be 12 m wide in total.

Figure III.3: Typical Cross Section of the Proposed Scheme



141. The pavement would comprise 4 cm of AC-13 asphalt concrete, 6cm of AC-20 asphalt concrete, 32–36 cm of cement treated with gravel, and 20 cm of stabilised soil base course.

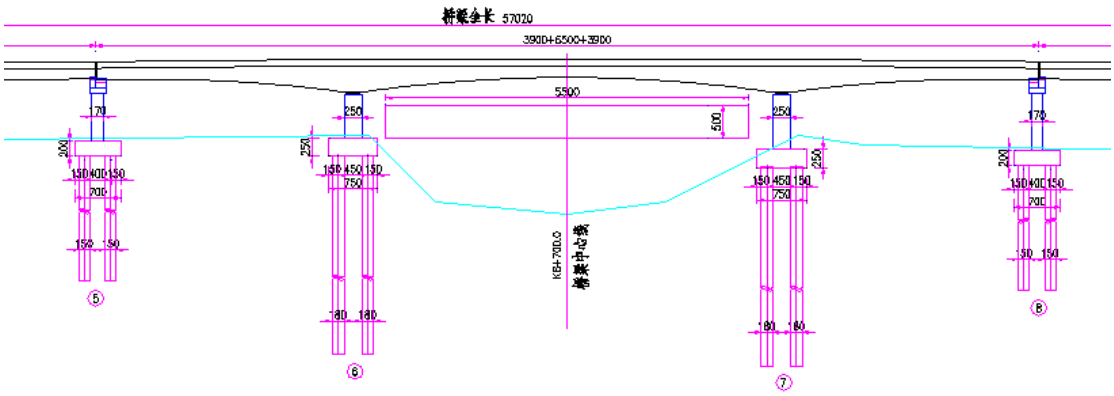
142. The scheme will affect eleven bridges, five of which will be rebuilt and the remainder upgraded (see Table III.11). A new bridge will be built over the Sima River, to allow for the wider carriageway and the upgrading of the river for navigation purposes. A cross-section of the proposed bridge is provided in Figure III.4 below. This will be designed as a pre-stressed concrete continuous beam bridge, 570 m long, with 16 sets of piers, a central span 65 m wide over the river, and 5 m clearance above the full channel level to meet Class IV navigation standard.

Table III.11: Summary of Bridges

No.	Bridge Name	Chainage at Bridge Centre	Length (m)	Span	Structure		Note
					Upper	Foundation	
1	Zhaoyanba Medium Bridge	K5+970	26	1-20	Pre-stressed Plate	Piles	Rebuild
2	Zhangrenli Medium Bridge	K6+683	44.4	3-13	Pre-stressed Plate	Piles	Rebuild
3	Sima River Large Bridge	K8+700	570.2	5-30+39+65+39+9-30	Pre-stressed Box Beam	Piles	Rebuild
4	Kongfushan Medium Bridge	K10+723	31.4	1-25	Pre-stressed Box Beam	Piles	Upgrade
5	Jiangtaishan Large Bridge	K15+205	517.2	17-30	Pre-stressed Box Beam	Piles	Upgrade
6	Gangli Small Bridge	K17+966	18.4	1-13	Pre-stressed Plate	Piles	Rebuild
7	Xiongzhuang Small Bridge	K20+605	34	3-10	Pre-stressed Plate	Piles	Upgrade
8	Shizhuang Small Bridge	K22+216	18.4	1-13	Pre-stressed Plate	Piles	Rebuild
9	Jiangzhuang Small Bridge	K27+780	14	1-10	Pre-stressed Plate	Piles	Upgrade
10	Dongfeng River Small Bridge	K30+380	34	3-10	Pre-stressed Plate	Piles	Upgrade
11	Shengxiaozhuang Small Bridge	K42+586	44.4	3-13	Pre-stressed Plate	Piles	Upgrade

Source: Domestic EIR.

Figure III.4: Cross Section of the Central Part of the Proposed Sima Bridge



Cross section of Simahe Bridge

143. **NMT.** NMT may use the hard shoulder. However, they may be in conflict with vehicles, which also tend to use the hard shoulder if they need to stop or use it as a second lane during congested periods.

144. **Speed Control.** The design speed is 60 km/hour. There will be speed signs and possibly road markings before intersection or residential areas to warn drivers of speed limits and traffic safety.

145. **Lighting.** It is not proposed to light the scheme, which is not standard for a Class II highway. However, it is possible that the relevant urban authority may decide to install lighting at a future date, for example in the urban sections.

146. **Land-take.** The scheme will require a total land-take of 191.02 ha, of which 32.35 ha would be the existing highway, 75.41 ha would be permanent acquisition and 83.26 ha temporary acquisition that would be returned to its previous use after construction (see Table III.12). New permanent land-take amounts to 75.41 ha of farmland, woodland and other land uses.

Table III.12: Breakdown of Land Acquisition (ha)

Land Use	Arable Land	Woodland	Surface Water	Other Land	Existing RoW	Subtotal
Permanent Land Acquired	26.91	15.08	0	33.42	(32.35)	75.41
Temporary Land Acquired	45.92	21.84	0.03	15.47	0	83.26
Total	72.83	36.92	0.03	48.89	(32.35)	158.67

Source: Domestic EIR.

Notes: (1) "Other land" covers a range of uses such as field paths, alkaline lands, swamp lands, sandy lands, bare lands and other unused lands, according to PRC National Standard GB21010-2007 *Current Land Use Classification*.
(2) RoW – Right of Way, refers to the land used by the existing highway. RoW is not counted under land acquisition
(3) Temporary land acquired includes the land used for construction camps (sites), access roads, concrete batching plants, borrow pits, and so on.

147. **Haul roads.** This scheme requires an estimated 53 km of temporary access roads, reflecting the need for access to the off-line sections, especially the new Sima River bridge crossing.

148. **Earthworks.** Summaries of the earthworks balance and the need for borrow pits and disposal sites are presented in Tables III.13 and 14. The borrow sites are mostly located within 500 m of the proposed road with the exception of one site located 1.43 km away. The proposed borrow sites are mostly areas of dryland farming. The borrow pits will be infilled using spoil from construction.

Table III.13: Earthworks Balance

No.	Chainage	Excavation (10^3m^3)					Fill (10^3m^3)			
		Backfill	Reused for Access Roads	Topsoil Reused for Green Belt	Disposal	Subtotal	Borrow Pits	Backfill of Excavation	Reuse of Excavation	Subtotal
1	AK0+000 – AK1+000	0.7	1.2	1.3	3.0	6.2	43.3	0.7		4.4.0
2	AK1+000 – AK6+536	3.2		4.0	7.1	14.3	82.2	3.2		85.4
3	AK6+536 – AK7+500	1.1		1.1	22.0	24.2	31.0	1.1		32.1
4	AK7+500 – AK17+200	57.8	0.1	9.8	40.9	108.6	319.0	57.8		376.8
5	AK17+200 – AK41+100	4.0	4.0	28.5	8.5	45.0	334.7	4.0		338.7
6	AK41+100 – AK46+874	2.4	8.3	5.8	12.6	29.1	251.7	2.4		254.1
7	Bridge Construction				2.0	2.0				0.00
8	Access Roads	1.3		3.0	0.00	4.3		1.3	13.6	14.9
	Total	**70.5**	**13.6**	**53.5**	**96.1**	**233.7**	**1061.9**	**70.5**	**13.6**	**1146.0**

Source: Domestic EIR.

Table III.14: Summary of Borrow Pits and Spoil Disposal Sites

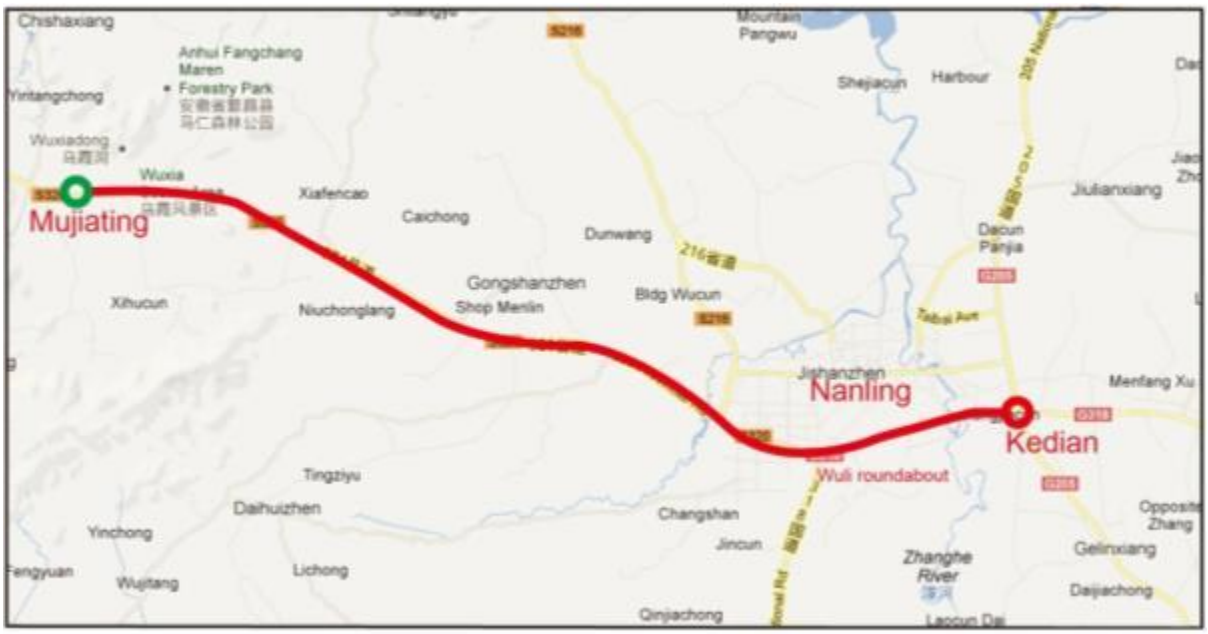
No.	Location	Borrow Quantity (10^3m^3)	Spoil (10^3m^3)	Land Acquisition (ha)	Depth (m)	Land Type	Note
1	AK1+800 Right Side 250m from Alignment	202.6	16.8	8.9	3	Mainly dry lands, with some paddy rice fields	Spoil disposed of in borrow pits
2	AK11+900 Left Side 30m from Alignment	169.6	10.0	8.19	3	Mainly dry lands, with some paddy rice fields	Spoil disposed of in borrow pits
3	AK24+600 Left Side 260m from Alignment	182.4	14.3	11.56	3	Mainly dry lands, with some paddy rice fields	Spoil disposed of in borrow pits
4	AK27+550 Left Side 450m from Alignment	110.2	9.1	6.03	3	Mainly dry lands, with some paddy rice fields	Spoil disposed of in borrow pits
5	AK37+000 Right Side 100m from Alignment	94.1	7.2	6.14	3	Mainly dry lands, with some paddy rice fields	Spoil disposed of in borrow pits
6	AK43+900 Left Side 1430m from Alignment	162.3	18.4	9.48	3	Mainly dry lands, with some woodlands	Spoil disposed of in borrow pits
7	AK46+000 Left Side 260m from Alignment	140.8	20.3	7.82	3	Mainly dry lands, with some woodlands	Spoil disposed of in borrow pits
	Total	**1,062**	**96.1**	**58.15**			

Source: Domestic EIR.

2. Subproject II – Yimu Highway, Kedian to Mujiating

149. This section of the Yimu highway forms part of an east west link between Kedian and Mujiating, two medium-sized towns in Nanling County on the south bank of the Yangtze River and south of Wuhu City (see Figure III.5). The route passes through several villages and towns, including Jieshan Town, Nanling County, Tongling, and Gongshan Town.

Figure III.5: Yimu Highway, Kedian to Mujiating



150. This section of Yimu highway is currently Class II. It has been upgraded in the past, resulting in three sets of design standards along this section.

(i) Standardised Cross Section over 32.03 km and on either side of the Wuli roundabout section. The standardised cross section is 15m wide, with dual single lane carriageway 4.5 m each, and a 1.5 m hard shoulder and 1.5 m wider berm along each carriageway.

(ii) Wuli Roundabout Section between K16+600 and K17+760 comprises a 31.5 m wide cross section, with dual two lane carriageways 975 m each and a 2 m wide separator, and a 4 m wide lane for NMTs along each carriageway.

(iii) End section between K33+125 and K34+205 is 25 m wide, with a dual two-lane carriageway 750 m +750 m, with a 2.5 m separator, and 2.5 m wide lane for NMT.

151. The highway is mostly in good condition, with some pavement defects. There are several junctions, one of which is grade separated, and ten bridges comprising one large bridge over the Zhanghe, two medium sized bridges, and seven small bridges. Zhanghe Bridge was built in 1998 and requires maintenance to address the longitudinal cracks on the concrete slabs, exposure of the steel reinforcement on the piers, and scour around the bridge piers. Sections of the existing road are lit.

Plate III.9: Yimu Highway

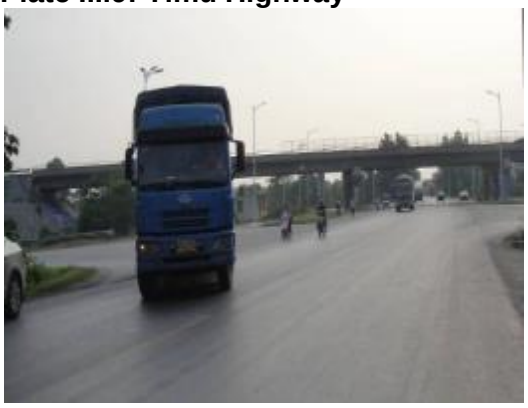


Plate III.10: Yimu Highway

Plate III.11: Yimu Highway: Bowen Middle School Sensitive Receptor

Plate III.12: Yimu highway: woodland section

152. The existing road carries heavy traffic of around 11,000 pcu/day, which is close to the limit for this class of highway (see Table III.15). Freight traffic forms a relatively high proportion of the total traffic. Some sections have a commuter traffic flow pattern, and will become congested unless capacity is increased.

Table III.15: Existing Traffic Volume (per day, surveyed in 2011)

Road Section	S320 (west part of the highway)		G318 (east part of the highway)	
Traffic Volume	11,076 pcu		12,564 pcu	
Traffic Composition	58.6% (Freight)	41.4% (Passenger)	59.62% (Freight)	40.38% (Passenger)

Source: FSR.

153. Future traffic growth assumes that cars will account for an increasing proportion of the traffic reaching about 60% by 2015 and 70% by the design year 2029 (Table III.16 below). By the design year traffic flows are forecast to reach 13,691 pcu/day, an increase of about 25% on baseline traffic flows.

154. Future traffic growth on the Jimu Highway may be depressed following the opening of the Tongnanxuan Expressway, planned for end 2015 according to the APDOT,[15] which has been taken into account in forecasting traffic figures.

[15] The PPTA economic assessment assumes opening in 2020.

Table III.16: Traffic Forecast

Road Section	Design Year	Daytime Volume (per hour)				Night-time Volume (per hour)			
		Small	Mid-sized	Heavy	Total	Small	Mid-sized	Heavy	Total
G205 Intersection to Wuli Roundabout K11+900 - K15+520	2015	221	18	112	351	55	4	28	87
	2021	175	13	74	262	44	3	19	66
	2029	242	11	89	342	61	3	22	86
Wuli Roundabout to S216 Intersection K15+520 - K18+912	2015	319	25	161	505	80	6	40	126
	2021	440	32	186	658	110	8	46	164
	2029	577	26	211	814	144	7	53	204
S216 Intersection to X070 Intersection K18+912 - K21+736	2015	212	17	107	336	53	4	27	84
	2021	269	20	114	403	67	5	28	100
	2029	303	14	111	428	76	3	28	107
X070 Intersection to Mujiating (End) K21+736 - K34+260	2015	180	14	91	285	45	4	23	72
	2021	257	19	109	385	64	5	27	96
	2029	268	12	98	378	67	3	25	95

Source: Domestic EIR.

155. Summaries of the main engineering indicators and quantities are presented in Tables III.17 and 18 below.

Table III.17: Major Engineering Indicators

No.	Items	Unit	Indicators	
			Highway	Urban Road
1	Class		Plain & Hilly Class I	Urban Trunk Road
2	Pavement		Bitumen	
3	Design Speed	km/h	80	60
4	Roadbed Width	M	24.5	46
5	Carriageway Width	M	4*3.75	2*3.75+3.5
6	Max. Longitudinal Gradient	%	3	
7	Min. Grade Length	M	191.6	
8	Design Loads for Bridges		Highway – II	
9	Flood Return Period		1:100 to 1:300 years	

Source: Domestic EIR.

Table III.18: Upgrading Construction Quantities

No.	Items		Unit	Quantity	
				Class I Highway	Urban Trunk Road
1	Chainages			K25+460 – K34+260	K11+900 – K25+460
2	Length		km	8.8	13.56
3	New Permanent Land Acquisition		ha	87.94	
4	Subgrade	Cut	10^3m^3	756.738	
5		Fill	10^3m^3	1106.636	
6	Pavement		10^3m^3	629.5	
7	Bridges	Large Bridge	m/No.	148 / 1	
8		Small & Medium-sized Bridges	m/No.	300.5 / 9	
9		Culvert	No.	65	
10	Intersection	At grade crossings	No.	28	
11	Demolition	Buildings	m^2	15,642	
12		Telegraph Poles	No.	615	
13	Service Area		No.	2	
14	Cost		million yuan	872.4	

Source: Domestic EIR.

156. Typical cross sections are shown in Figures III.6 and 7 below.

Figure III.6: Typical Cross Section for the Class I Highway

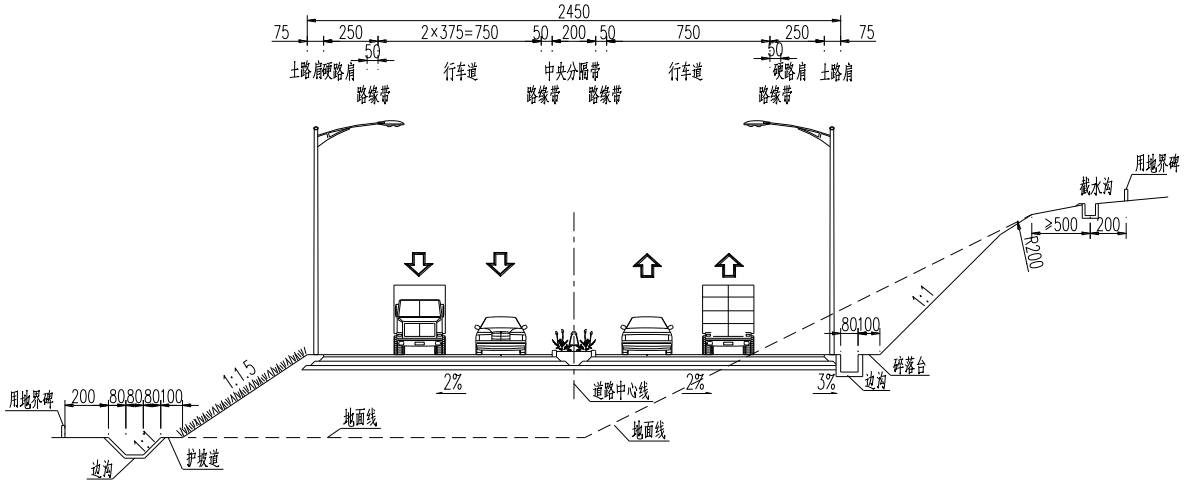
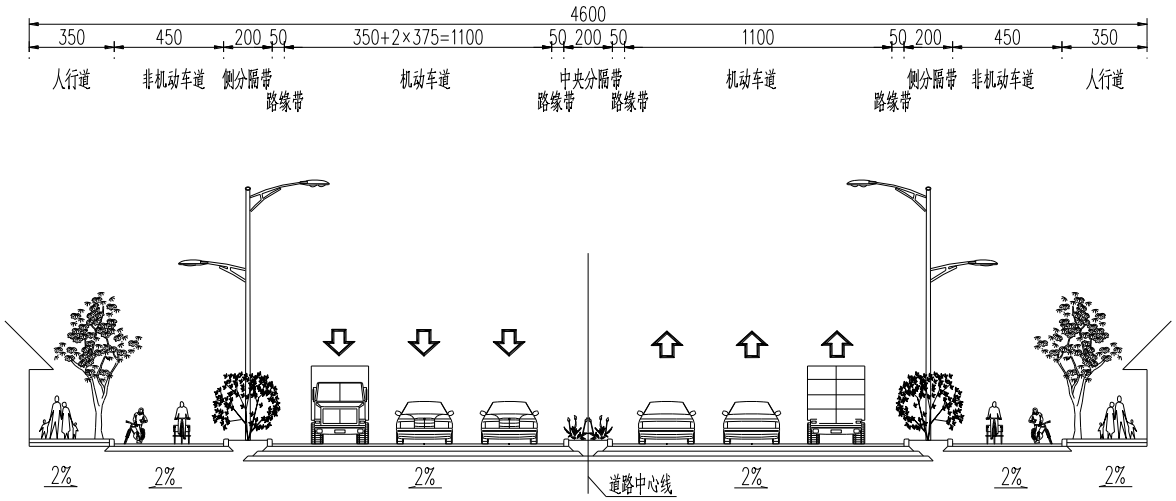


Figure III.7: Typical Cross Section for the City Trunk Road



157. **NMTs.** On the highway section, there is no provision for pedestrian walkways, although pedestrians may use the hard shoulder. For the City Trunk Road, segregated provision will be made for NMTs. Pedestrian crossings will be provided by at grade zebra crossings at a minimum spacing of 500 m, totalling 31 pedestrian crossings.

158. **Vehicle turning movements.** Along the highway section, vehicle 'U' turning places will be provided approximately every 4 km.

159. **Lighting.** It is proposed to light the whole length of the upgraded route. Along the highway section, lighting will comprise columns 12 m high, with a single luminaire containing 2 x 110 W LED bulbs. Along the City Trunk Road, lighting will comprise 12 m high columns with an 8 m high mounted luminaire containing a 110 W LED bulb over the NMU lane and a 12 m high luminaire containing two 180 W LED bulbs over the carriageway. The lighting will be provided at 30–50 m spacing.

160. The highway pavement composition is described in **Table III.19** below.

Table III.19: Highway Pavement Composition for Highway Subproject II

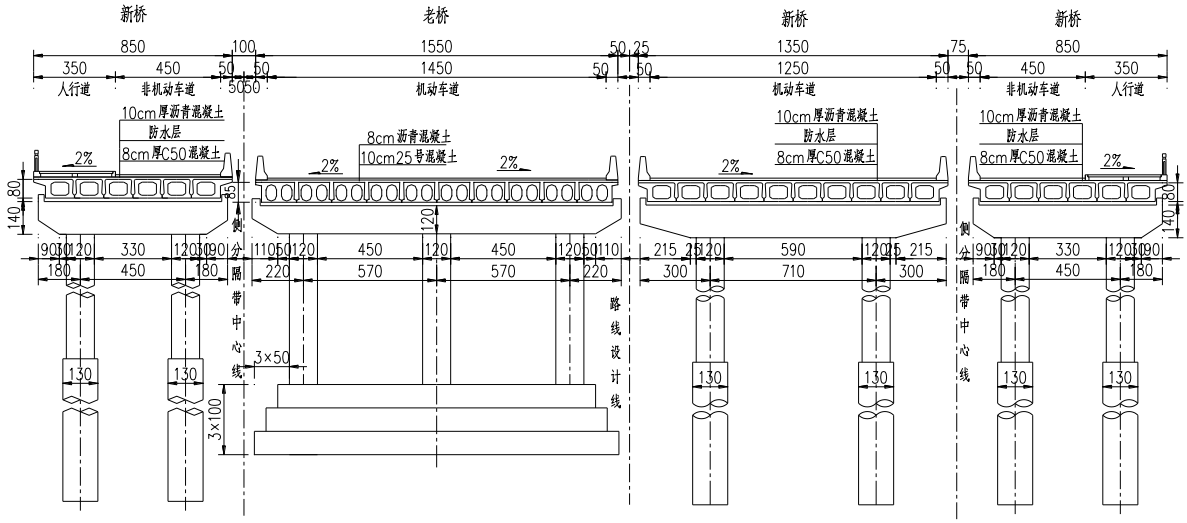
Old Pavement	New Subgrade
- 4 cm of AC-13 modified asphalt concrete - 5 cm of AC-16 modified asphalt concrete - 8 cm of AC-20 asphalt concrete - 15-20 cm of cement treated gravel	- 4 cm of AC-13 modified asphalt concrete - 5 cm of AC-16 modified asphalt concrete - 8 cm of AC-25 asphalt concrete - 20 cm of cement treated gravel - 20 cm of aggregated gravel

161. Table III.20 summarises the details for bridges below. Minor repairs are required to the existing Zhanghe Bridge. Widening will be provided by constructing three new bridges, one to carry traffic and two narrower bridges to carry non-motorised traffic. A cross section of the proposed arrangement is illustrated in Figure III.8.

Table III.20: Overview of Bridges

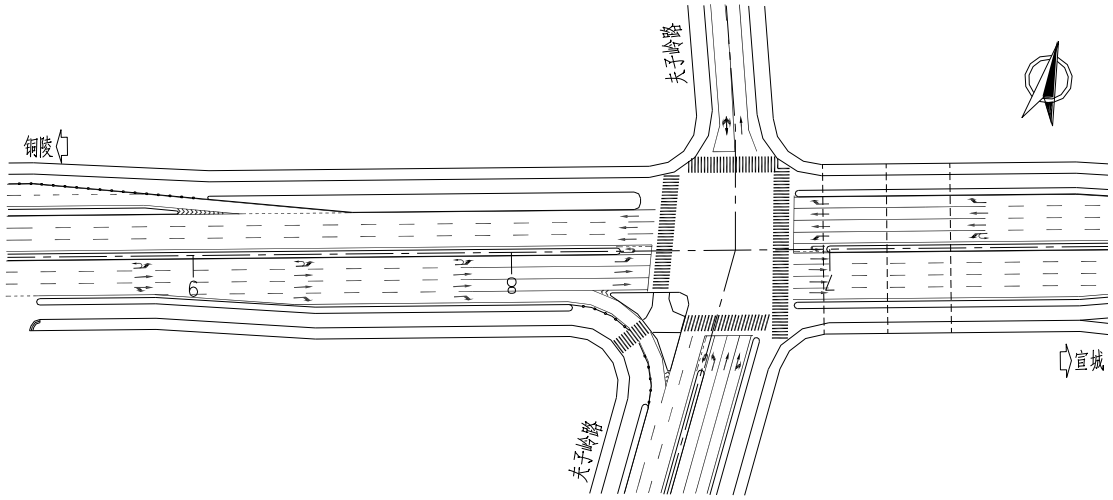
No.	Bridge Name	Mileage of Bridge Center	River Name	River Width (m)	Span	Length (m)	Note
1	Zhanghe Large Bridge	K13+426	Zhanghe	50	9-16	148	Widen Existing Bridge
2	Hongjiaba No.1 Small Bridge	K19+169	Houganghe	3	2-13	33.5	Rebuild
3	Hongjiaba No.2 Small Bridge	K19+340	Houganghe	3	2-13	33.5	Rebuild
4	Guishandalao Medium Bridge	K31+900	Guishanhe	10	3-16	55.5	Rebuild

Figure III.8: Cross Section of the Proposed Zhanghe Bridge



162. **Junctions.** There will be 28 at grade intersections, 23 of them traffic light controlled junctions. The largest junction is Wuli Junction, which will be at grade, traffic light controlled junction, with separated turning lanes.

Figure III.9: Plan form of Wuli Junction with Fuziling Road



163. There will also be a separate exit and entrance for the bus station about 400 m east of Wuli Junction.

164. **Land-take.** Estimates of temporary and permanent land-take are presented in Tables III.21 and 22 below. A total of 87.94 ha of permanent land-take is required, of which 74% is uncultivated land and 26% cultivated land. A further 62.33 ha of temporary land-take is required during construction, mostly for the borrow pits and spoil disposal sites. Almost 60% of the temporary land take is from grassland and the remaining from unused land, with very little impact on farmland.

Table III.21: Permanent Land Acquisition

Administration Division	Section Length (km)	Land Acquired (ha)		
		Cultivated Land	Uncultivated Land	Subtotal
Jishan Township	9.8	8.86	38.39	47.25
Gongshan Township	12.56	13.97	26.72	40.69
Total	22.36	22.83	65.11	87.94

Table III.22: Temporary Land Acquisition

Temporary Facilities	Land Acquired (ha)			
	Cultivated Land	Grassland	Other Unused Land	Subtotal
Borrow Pits and Spoil Deposit Areas	-	34.33	20.0	54.33
Construction Sites and Camps	-	-	3.5	3.5
Access Roads	1	2	1.5	4.5
Total	1	36.33	25.0	62.33

165. **Temporary construction roads.** An estimated 1.45 km of temporary access roads is required.

166. **Earthworks.** Summary of the balance of cut and fill, borrow pits and spoil disposal sites are presented in Tables III.23 and 24 below. The borrow sites are located in shrublands between 1 and 3 km from the road and will be restored as fish ponds, cultivated land or woodland.

Table III.23: Earthwork Balance (10^3m^3)

Engineering Division		Cut	Fill	Borrow Pits	Spoil for Disposal	Notes
Subgrade	Subgrade	615.5	1549.1	1003.8	70.2	Most of excavation reused
	Demolition Debris	1.5	1.5			Debris reused as filling materials
	Subtotal	617.0	1550.6	1003.8	70.2	
Bridges	Cofferdam Filling		1.0			Borrowed from subgrade cut
	Cofferdam Dismantle	1.0				Returned for subgrade fill
	Pier Foundation	5.0	5.0			Excavation reused as backfill
	Subtotal	6.0	6.0			
Access Roads		9.6	9.6			Excavation reused as backfill
Construction Sites and Camps		3.5	3.5			Excavation reused as backfill
Total		636.1	1569.7	1003.8	70.2	

Source: Domestic EIR.

Table III.24: Borrow Pits and Spoil Disposal

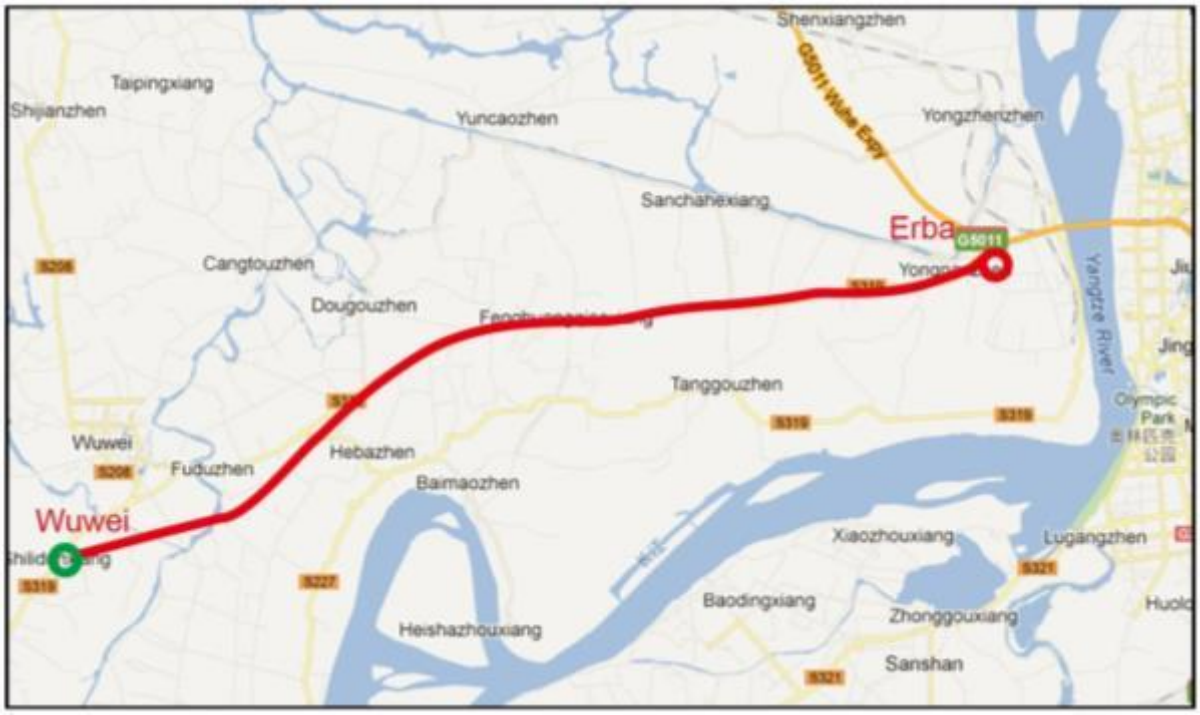
No.	Name	Location	Quantity of Borrow / Spoil (10^3m^3)	Land Acquisition (ha)	Access Roads		Acquired Land Type	Notes
					Length (km)	Land Acquisition (ha)		
1	Gelin Village Borrow Pit	K11+910 Left side, 3000m from alignment	450	12	1.5	0.747	Unused shrubland	After borrowing, partially used as fishpond and part reclaimed as woodland.
2	Wujia Village Borrow Pit	K17+280 Left side, 2000m from alignment	210	9	1.5	0.747	Unused shrubland	Reclaimed as farmland or woodland.
3	Suncun Village Borrow Pit	K18+910 Left side, 1500m from alignment	350	23.33	1.8	0.9	Unused shrubland	Reclaimed as farmland or woodland.
4	Gelin Village Spoil Disposal	K11+910 Left side, 3000m from alignment	40.2	5	1.5	0.747	Unused shrubland	Spoil disposed in the borrow pit and reclaimed.
5	Luojiachong Village Spoil Disposal	K16+570 Left side, 2000m from alignment	15	2.5	1.8	0.9	Unused shrubland	Reclaimed as woodland
6	Gaochong Village Spoil Disposal	K27+285 Right side, 1000m from alignment	15	2.5	1.5	0.747	Unused shrubland	Reclaimed as woodland
	Total		**1010 – 70.2***	**54.33**	**9.6**	**4.788**		

Source: Domestic EIR. Note: The total borrow quantity is about 1.01 million cubic meters and the spoil disposal is 70,200 cubic meters.

3. Subproject III – S319 Erba to Wuwei Section

167. This section of Class II highway connects Wuwei to the west with Erba in the east on the north bank of the Yangtze River. The eastern end joins the G5011 or Wuhe Expressway, a north-south national level road which crosses the Yangtze River on the Wuhu Yangtze Bridge, one of only three existing such bridges in Anhui Province, and connects the provincial capital Hefei with Wuhu the second largest city in Anhui. A map of the route is presented in Figure III.10 and some illustrations of the existing road are presented in Plates III.13 to 16 below.

Figure III.10: S319 Erba to Wuwei Section



168. The S319 crosses flat terrain, with a high standard of alignment and profile that exceed the standards stipulated in the National Specifications for Class II highways. In the rural section, the route mostly comprises a well built, wide road, with 17 m asphalt pavement, dual single lane with hard shoulder. Numerous side roads, mostly unpaved rural roads, join the S319 at regular intervals, many of which are associated with zebra crossings for pedestrians, which are slightly offset from the junctions. There are also rumble strips to control traffic speed and improve safety and a small number of crossings which are controlled by lights. The speed limit is 60 km/h in the rural section.

169. The quality of the road surface deteriorates to the west of the junction with the old S319 near Km 31+000 and through the urban area, where the speed limit is reduced to 40 km/h.

170. There is one large bridge on the existing alignment, Wangfudu Bridge which crosses the Xihe River in the urban area. The bridge was reportedly built around 2003–2004. It provides a dual two lane carriageway, but with insufficient width compared with the national standard for a Class I highway. The remaining structures comprise culverts and small bridges crossing streams and irrigation canals in the rural section.

Plate III.13: S319 in rural section with Poplar avenue

Plate III.14: S319 near start of proposed new build section

Plate III.15: S319 Yongnan Central Primary School Sensitive Receptor

Plate III.16: S319 in Wuwei County urban area

171. Existing traffic data and forecasts are presented in Tables III.25 and 26. At present, the traffic is relatively heavy at both ends of the scheme, with mid-level traffic flows in the middle section. The proposed improvements would help to alleviate congestion in Wuwei, due to the construction of a new bridge over the Xihe River. Traffic flows are estimated to increase almost four fold by the design year with some 22,132 pcu/day.

Table III.25: Existing Traffic Volume (per day, surveyed in 2009)

Light Truck	Mid-Truck	Heavy Truck	Trailer	Tractor	Car	Bus	Total	
							Actual	pcu
593	356	237	2	20	1,098	1,647	3,953	5,929

Table III.26: Traffic Forecast

Design Year	Daytime Volume (per hour)				Night-time Volume (per hour)			
	Small	Mid-sized	Heavy	Total	Small	Mid-sized	Heavy	Total
2016	307	27	82	416	51	5	14	70
2022	491	40	122	653	82	7	20	109
2030	787	58	175	1020	131	10	29	170

172. The main engineering features and quantities are summarised in Tables III.27 and 28 below.

Table III.27: Specifications for Upgrading the Highway

No.	Items	Unit	Indicators
1	Class		Plain & Hilly Class I
2	Pavement		Bitumen
3	Design Speed	Km/h	80
4	Road Width	M	25.5 upgrade / 26.5 new build
5	Carriageway Width	M	2*2-3.75
6	Stopping Sight Distance	M	110
7	Max. Longitudinal Gradient	%	0.43
8	Min. Grade Length	M	260
9	Design Loads of Bridge		Highway - I
10	Flood Return Period		1:100, 1:300 years

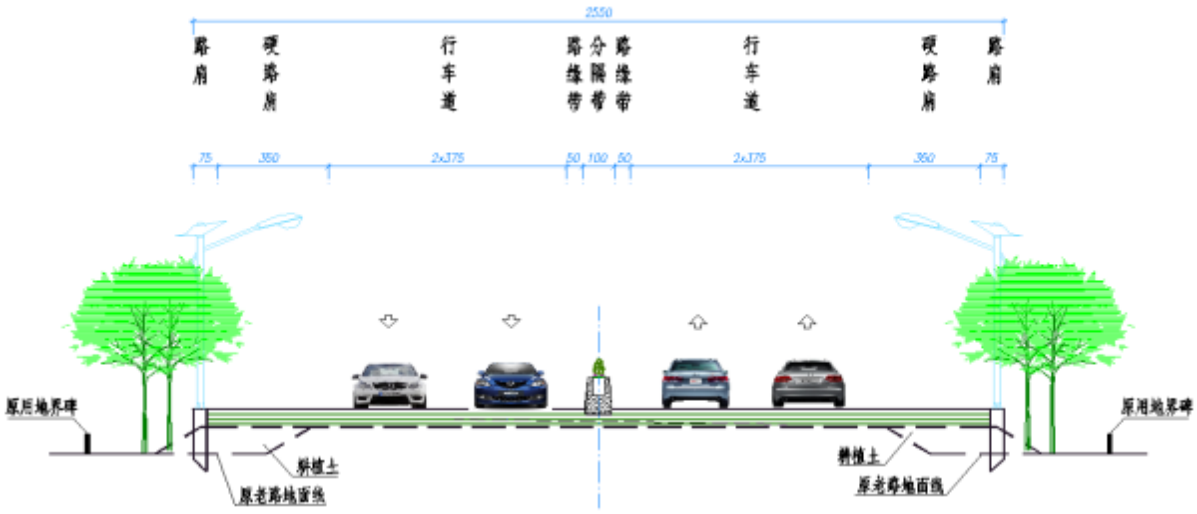
Table III.28: Upgrading Construction Quantity

No.	Items		Unit	Quantity
1	Length	New Build	Km	5.77 (K30+600 – K36+370)
2		Existing Upgrading	Km	30.6 (K0+000 – K30+600)
3	New Permanent Land Acquisition		Ha	22.86
4	Using Existing RoW		Ha	91.92
5	Subgrade	Cut	10^3m^3	94.7
6		Fill	10^3m^3	416.8
7		Slope Protection	10^3m^3	132.0
8	Pavement		10^3m^3	837.73
9	Bridges	Large Bridge	m/No.	866/1
12		Culvert	No.	85
13	Intersection	Separate Intersection	No.	2
14		At Grade Crossing	No.	59
15		Over Bridge	No.	6
16	Demolition	Buildings	m^2	4975
17		Power/Telegraph Pole	No.	753
18	Total Cost		Million yuan	933.66

173. The existing highway between K0+000 and K30+600 will be widened from 17 m to 25.5 m. This is wider than the standard for a Class I road of 24.5 m but maximises the use of the road corridor between the tree lined avenue and would allow for future re-marking of the road for a dual-three lane highway without the need for further land-take or road upgrading.

174. A typical cross section of the highway is presented in Figure III.11 below. The road widening would provide a central reserve with concrete safety barrier, dual-two lane carriageways, a 3.5 m wide pavement for NMTs, and a 0.75 m wide earth berm or retaining structure.

Figure III.11: Typical Cross Section of the Highway



175. The highway pavement structure would comprise 4 cm of AC-13 modified asphalt concrete, 5 cm of AC-16 modified asphalt concrete, 7 cm of AC-20 asphalt concrete, 36 cm of cement treated gravel, and 20 cm of cement treated gravel.

176. Between K30+600 and K36+370 the highway would continue along a new alignment to cross the Xihe River about 2 km upstream of the existing crossing, over a new continuous beam bridge. Specifications for the bridge are summarised in Table III.29.

Table III.29: Bridge Overview

No.	Bridge Name	Chainage at Bridge Centre	Length	Span	Structure		Note
					Upper	Foundation	
1	Xihe Large Bridge	K35+777	866	3*4-30+(33+55+55+33)+30+2*4-30	Variable cross section continuous beam for main bridge and pre-stressed box beam for approach bridge	Floating piles as the foundation of column pier	New build

177. The new crossing will connect with Biyadi Boulevard on the west side of the river, through a newly expanding part of Wuwei County, prior to re-joining the S319 on the outskirts of Wuwei County.

178. The proposed scheme will cross the Tajaing Road and X042 at K18+315 and K27+810 via underpasses. There will be 61 at grade crossings for rural roads.

179. **Lighting.** The design includes lighting along the whole highway.

180. **NMTs.** In the highway section, there will be a 3.5 m lane provision for NMTs. Pedestrian crossings will be provided at zebra crossings and light controlled crossings. The project also includes five new pedestrian bridges at the following locations: K2+874, K6+096, K11+610, K14+425 and K30+940.

181. **Land Acquisition.** A summary of the permanent and temporary land acquisition is presented in **Table III.30** below. Total land take including the existing highway will be 131.18 ha. Altogether 37.58 ha will be acquired, of which almost 65% is permanent acquisition consisting of mostly paddy and dry farmland.

Table III.30: Breakdown of Land Acquisition (ha)

Land Use	Paddy Field	Dry Farmland	Ponds	River Course	Homestead	Other Land	Existing RoW	Subtotal
Permanent Land Acquired	10.43	6.96	4.61	0.14	0.72	8.41	(91.92)	24.31
Temporary Land Acquired	0	12.67	0.6				(1.68)	13.27
Total	10.43	63	5.21	0.14	0.72	8.41	(93.6)	37.58

Note: Existing road way right of way not included in land acquisition total.

182. **Access Roads.** Some 799 m of temporary access roads are required for construction.

183. **Earthworks.** Tables III.31 and 32 summarise the balance of cut and fill and information on borrow pits and disposal sites.

Table III.31: Earthwork Balance (10^3m^3)

No.	Chainage	Cut	Fill	Borrow		Spoil		Notes
				Quantity	Source	Quantity	Disposal	
1	K0+000~K5+000	3.6	19.8	16.8	Borrow pit	0.6	No.1 Disposal	The cut will be partially used.
2	K5+000~K10+000	3.4	24.3	21.5	Borrow pit	0.6	No.1 Disposal	The cut will be partially used.
3	K10+000~K15+000	3.3	26.4	23.8	Borrow pit	0.7	No.1 Disposal	The cut will be partially used.
4	K15+000~K20+000	4.5	24.4	20.7	Borrow pit	0.8	No.1 Disposal	The cut will be partially used.
5	K20+000~K25+000	3.7	22.3	19.4	Borrow pit	0.8	No.1 Disposal	The cut will be partially used.
6	K25+000~K30+000	3.2	21.6	19.2	Borrow pit	0.8	No.1 Disposal	The cut will be partially used.
7	K30+000~K31+600	1.6	7.9	6.6	Borrow pit	0.3	No.1 Disposal	The cut will be partially used.
8	K31+600~K35+000	51.8	184.5	145.9	Borrow pit	13.2	No. 2 Disposal	The cut will be partially used.
9	K35+000~K36+370	12.9	80.2	70.6	Borrow pit	3.3	No. 2 Disposal	The cut will be partially used.
10	Bridge Construction	4.8	3.0	0		1.8	No. 3 and No. 4 Disposal	The cut will be partially used.
11	Access Roads	0.3	0.8	0.5	Borrow pit	0		The cut will be totally used.
12	Construction Sites/Camps	1.6	1.6					Cut and fill are balanced.
	Total	94.7	416.8	345.0		22.9		

Source: Domestic EIR.

Table III.32: Borrow Pits and Spoil Disposal

No.	Location	Borrow Quantity (10^3m^3)	Spoil Disposal (10^3m^3)	Land Acquisition (ha)	Fill / Cut Depth (m)	Land Type	Note
1	Spoil deposit, K12+400 Left side		5.0	0.15	4	Fish Pond	Reclaimed as farmland
2	Spoil deposit, K31+100 Right side		15	0.4	4	Fish Pond	Reclaimed as farmland
3	Spoil deposit, east end of Xihe Bridge, foot of river bank.		2.0	0.03	4	Fish Pond	Reclaimed as farmland
4	Spoil deposit, west end of Xihe Bridge, foot of river bank.		1.0	0.02	4	Fish Pond	Reclaimed as farmland
5	Borrow pit, Shilidun Township, 5km south of Wuwei County Seat	345.0		6.0	5 - 7	Dry farmland and shrublands	Reclaimed as farmland
	Total	345.0	23.0	6.6			

Source: Domestic EIR.

4. Subproject IV – G206 Dongliu to Yaodu Section

184. The G206 is a national level highway located on the south bank of the Yangtze River between Dadukou and Guangang Town. The road runs parallel to the G35 Juguang expressway, which was opened in 2008. The Section of the G206 between Dongliu and Yaodu connects the residential and industrial development area of the Dongliu Economic Zone with the main county town Yaodu in Dongzhi County. The G206 crosses sections of flat terrain characterised by good alignment and profile conditions and hilly countryside with poor geometry and sight lines. The pavement width varies between 7 and 9 m.

Figure III.12: G206 Dongliu to Yaodu

185. The proposed scheme is to build a new dual three lane highway, leaving the existing road to collect local traffic. This would result in three roads providing north-south movements in the vicinity of Dongliu and Yaodu, the expressway which is tolled, the new G206, and the old G206 which would become a country road.

186. Since opening in 2008, the new expressway has diverted some 20–50% of the traffic from the G206. While the G206 remains busy, with some 5,700 pcu/day and carries a high proportion of HGVs (Plates III.17 and 18), there has been no clear evidence of traffic growth since 2008.

187. The Dongzhi County Master Plan, which covers Dongliu and Yaodu, sets out proposals for substantial industrial growth and residential development in Yaodu and Dongliu. This makes the resumption of pre-expressway traffic growth rates fairly likely. The forecast traffic for the design year 2029 is 28,693 pcu/day, a five fold increase on current levels.

Plate III.17: Existing G206

Plate III.18: Existing G206

188. Forecast traffic is provided in Table III.33 for hourly day-time and night-time.

Table III.33: Traffic Forecast

Design Year	Daytime Volume (per hour)				Night-time Volume (per hour)			
	Small	Mid-sized	Heavy	Total	Small	Mid-sized	Heavy	Total
2015	168	36	108	312	42	9	27	78
2021	345	61	149	555	86	15	37	138
2029	543	99	247	889	136	25	62	223

189. Summaries of the main engineering features and construction quantities are provided in **Tables III.34** and **35** below.

Table III.34: Project Specifications

No.	Items	Unit	Indicators
1	Class		Plain & Hilly Class I
2	Pavement		Bitumen
3	Design Speed	Km/h	80
4	Road Width (Red Line)	m	34
5	Carriageway Width	m	2*3-3.75
6	Stopping Sight Distance	m	110
7	Max. Longitudinal Gradient	%	1.5
8	Min. Grade Length	m	200
9	Design Loads of Bridge		Highway – I
10	Flood Return Period		1:100 years

Source: Domestic EIR.

Table III.35: Construction Quantity

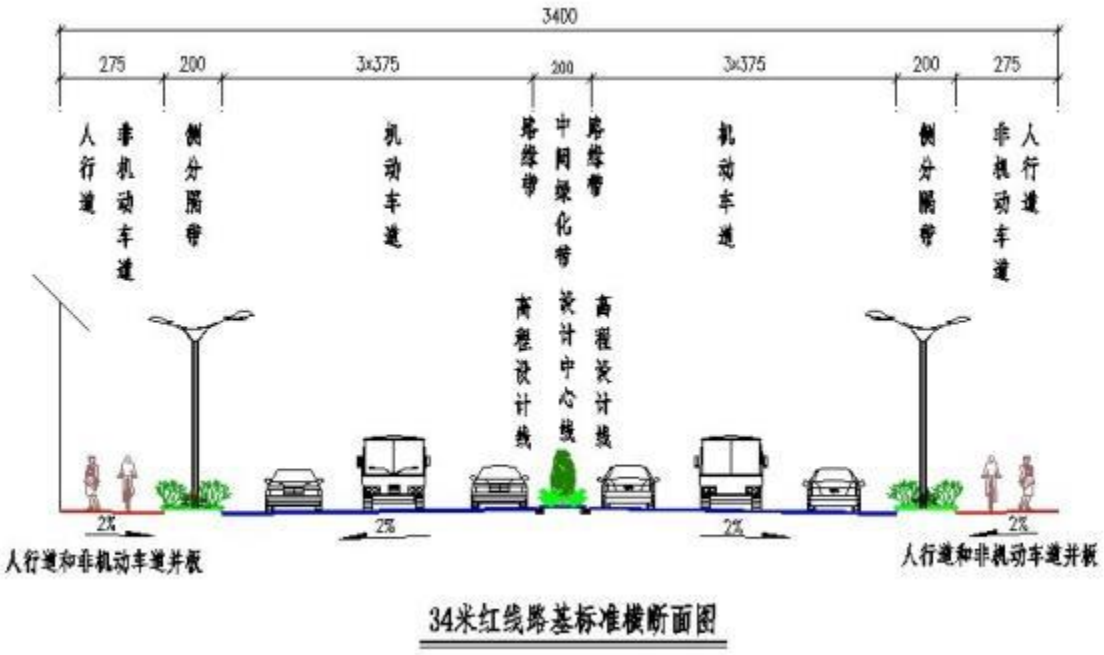
No.	Items		Unit	Quantity
1	Newly Built Length		km	16.58
2	Permanent Land Acquisition		ha	68.06
3	Temporary Land Acquisition		ha	14.35
4	Subgrade	Cut	10^3m^3	1585.93
5		Fill	10^3m^3	2056.63
6		Slope Protection	10^3m^3	28.96
7	Pavement		10^3m^3	373.05
8	Bridges	Large Bridge	m/No.	247.83/2
9		Medium Bridge	m/No.	149.04/2
10		Culvert	No.	49
11	At Grade Crossing		No.	12
12	House Demolition		m^2	4100
13	Total Cost		Million yuan	774

Source: Domestic EIR.

190. The proposed alignment starts at K1275+100 on the G206 (or K0+000 for the new build section) near Xiayang Village. The alignment would pass around the eastern tip of Zhanglong Reservoir, through Zhanggang Village, and follow the eastern flank of the Yaodu River flood embankment past Xiaohuangni and Quanshui Lakes, pass under the Tongling-Jiujiang Railway, cross the Anqing-Jingdezhen Expressway and reconnect with the old G206 at K1293+200 (or K16+580 on the new section).

191. A typical cross section of the proposed scheme is shown in Figure III.13 below. The highway corridor would be 34 m wide, comprising a central reserve with kerbs and planted with shrubs to form a hedge, dual three lane carriageways, a 2 m strip with lighting and a separate lane 2.75 m wide lane for NTMs.

Figure III.13: Typical Cross Section of the Highway



192. The Project includes the construction of four new bridges, two medium and two large (see **Table III.36**). There will be 12 traffic light controlled intersections.

Table III.36: Bridge Overview

No.	Bridge Name	Mileage at Bridge Center	Length	Span	Structure	
					Upper	Foundation
1	Xiaohuangni Lake Large Bridge	K7+787	105.08	5-20	Prestressed reinforced concrete T beam	Column pier with piles
2	Medium Bridge	K10+950	64.04	3-20	Prestressed reinforced concrete T beam	Column pier with piles
3	Anjing Expressway Separate Intersection Large Bridge	K15+678.731	142.75	4-30	Prestressed combination box beam	Column pier with piles
4	Medium Bridge over a branch of Yaodu River	K16+260	85	4-20	Prestressed reinforced concrete T beam	Column pier with piles

193. Sections of the highway will be aligned alongside the Yaodu River flood embankments on the western side to minimise impacts on Xiaohunagni Lake, Quanshui Lake and Tonghu Lake to the east. The distance between the centreline of the proposed highway and the lakes varies between 20 and 160 m.

194. The new alignment crosses several hilly sections, requiring a number of moderate to deep cuttings over some 2.15 km. The maximum cutting is 15 m at K7+350. The Soil and Water Conservation plan sets out agreed mitigation measures for slope protection.

195. Soft ground remediation may be required along the highway, for example along the section between the Yaodu River and the lakes. Various options will be considered during detailed design, for example, piling, earth re-inforcement, and the replacement of soft soils.

196. The proposed highway pavement would comprise 4 cm of AC-13 asphalt concrete, 6 cm of AC-20 asphalt concrete, 8 cm of AC-25 asphalt concrete, 36 cm of cement treated gravel, and 20 cm of aggregated gravel.

197. **NMTs.** The scheme provides for a separated lane for NMTs along its entire length.

198. **Lighting.** The proposed scheme is to be lit along its whole length, with 12 m lighting columns in the planted strip separating vehicular traffic and NMTs at 35 m distance.

199. **Land take.** Temporary and permanent land-take required for the Project are summarised in Table III.37 below. Some 88.121 ha will be acquired in total, of which 78% permanently. Most of the permanent land-take is from cultivated land, followed by water, and woodland.

Table III.37: Land Acquisition (ha)

Land Use	Cultivated Land	Woodland	Ponds	Other Land	Subtotal
Permanent Land Acquired	33.89	12.35	21.14	1.49	68.87
Temporary Land Acquired	1.2	1.75	2.0	14.30	19.25
Total	35.09	14.1	23.14	15.79	88.12

200. **Access Roads.** An estimated 16.6 km of access roads and eight access bridges totalling 200m will be required during construction.

201. **Earthworks.** A summary of the balance of cut and fill and information about borrow pits and spoil disposal is presented in Tables III.38 and 39 below. No borrow pits are required for this scheme, but four spoil disposal sites will be required.

Table III.38: Earthwork Balance (10^3m^3)

No.	Chainage	Cut	Fill	Borrow		Reused as Backfill		Disposal	Note
				Quantity	Source	Quantity	Moved to		
1	K0+000~K 6+000	719.8	555.1					164.7	The cut will be partially reused and the rest will be dumped at No. 1 disposal site.
2	K6+000~K 12+000	514.2	713.6	201.6	No.3 section			2.2	The cut will be mostly reused and the rest will be dumped at No. 2 disposal site.
3	K12+000~ K16+580	822.7	317.2			201.6	No.2 section	303.9	The cut will be partially reused and the rest will be dumped at No. 2 and No. 3 disposal sites.
4	Construction Sites/Camps	6.9	6.9						The spoil will be totally reused.
5	Access Roads	18.8	18.8						The spoil will be totally reused.
	Total	2082.4	1611.6	201.6		201.6		470.8	

Source: Domestic EIRs.

Table III.39: Spoil Disposal

No.	Chainage	Spoil (10^3m^3)	Land Acquisition (ha)	Stack Height (m)	Access Road (m)	Land Type	Note
1	K4+000 Left side	164.7	3.0	5.5	100	Gully, grassland	To be reclaimed as farmlands or woodlands
2	K14+000 Left side	164.0	4.4	4.1	300	Gully, grassland	To be reclaimed as farmlands or woodlands
3	K16+500 Left side	142.0	2.0	7		Fish Pond	To be reclaimed as farmlands
	Total	470.7					

Note: The earthwork of this project has been well balanced so that no borrow pit was proposed.
Source: Domestic EIRs.

5. Issues related to Construction and Operation of the Highway Subprojects

202. **Construction-related Issues for the Highway Subprojects.** Tables III.40 and III.41 summarise construction-related issues and activities.

Table III.40: Summary of Highway Construction-Related Issues

Construction Issues	Resources
Materials	- Stone from local quarries - Sand and gravel won from nearby borrow pits and from earthworks - Cement from local cement plants - Steel purchased locally - Asphalt from plants in Wuhu and Anqing Petrochemical Plant - Timber purchased locally
Water supply	- Obtain drinking water and construction water from local piped water supply in nearby towns and villages
Power supply	- Where possible, connect to the local grid - Elsewhere use portable diesel generators
Construction traffic	- Haulage by road
Soil and water conservation	- Sowing grass - Cement rubble arch lining with grass - Hexagonal pre-cast hollow block formation
Construction camps	- Where possible, construction companies will arrange to hire accommodation for workforce in nearby towns. - Specially constructed camps may be required in rural sections
Wastewater disposal - sewage	- Temporary toilets at construction camps and sites - Sullage from septic tanks removed to Municipal wastewater plant - In rural areas solids dug out and applied to farmland
Wastewater disposal – oily wastewater	- Pass wastewater through settlement tanks and oil separators and re-use
Wastewater disposal – construction water	- Discharge wastewater to settlement ponds, prior to discharge to drains

Table III.41: Typical Construction Activities

Scheme Components	Key Activities
Land clearance	- Vegetation and crop clearance by villages and farmers - Removal of potentially polluting sources - Removal and reuse of asphalt and sub-base of existing highways
Highways	- Earthworks including slope removal, cuttings and embankments - Stockpiling of topsoil, spoil, and aggregate for concrete - Laying and rolling of sub-base - Asphalt mixing and laying of asphalt - Road marking - Signage and lighting - Special ground stabilisation works on soft ground such as piling - Slope stability works, soil and water conservation - Landscaping
Bridges	- Piling of foundations - Concrete mixing - Pre-casting at nearby works yard and lift into position - Piers - Superstructure
Haul roads	- Temporary haulage roads required to access new sections of alignment, borrow pits and waste disposal sites. Mostly bulldozed earth construction.

203. **Activities Following Scheme Opening.** The main activities following scheme opening are routine highway maintenance and emergency response.

204. Routine highway maintenance activities may include: periodic replacement of dead plants and pruning and removal of vegetation; checking and clearance of culverts and open drains; inspections of structures and associated repairs; repairs to safety barriers; and maintenance of the running surface including re-surfacing.

205. In the event of traffic accidents, the activities would include inspection of the accident by police; attendance to injured persons; removal of debris and site clean-up. Accidents involving HGVs will require clean up of spilled loads including solid cargo, chemicals and hydrocarbons.

D. Shuiyang River Waterway Improvement Project (SRWIP) and Xuanzhou Multipurpose Wharf Project

1. Shuiyang River Waterway Improvement Project

206. **River Improvement Works.** The proposed project is to improve navigation on the Shuiyang River from Class V and VI to restricted Class IV over some 43.9 km from Haitangwan upstream to Yanchi Village downstream. The PRC classifies navigation channels into 7 classes under GB 50139-2004: *Navigable Classification for Inland Rivers*. Upgrade from Class V to Class IV would allow the passage of 500t vessels instead of limited to 300t vessels. The future Class IV Shuiyang River could also accommodate 1,000 t vessels provided that their drafts are ≤2.0 m.

207. The works involve dredging, widening, re-profiling and selectively revetting parts of the channel to expand and deepen the river channel, and installation of two inflatable dams to raise/retain water levels on the main stream, one adjacent to a new ship lock. The design standards for the SRWIP are summarised in Table III.42 below and the main features of the project are shown in Figures III.14 and 15.

Table III.42: Design Standards for the SRWIP

Item	Design Standards
Construction Standard	Class IV restricted waterway with Class III water depth
Designed Ship Form	500t barge: 42.0*9.2*1.8m
Compatible Ship Form	1000t barge:67.5*10.8*2.0m
Navigation Channel	
Distance	43.9 km
Minimum water depth (Class III)	3.2m
River bed width for two-way lanes (Class III)	45.0m
Best meander radius (Class IV restricted)	320.0m
Max Navigation Water Level	14.01-10.84
Min Navigation Water Level	5.3m before the dam 2.02-1.82m after the dam
Major Construction Volumes	
Dredging	273 10^4m^3
Embankment coffer dams	26.9 km
Coffer dams	82.0 10^4m^3
Navigation marks	29
Temporary land occupation	1660 mu
Permanent land occupation	93.2 mu
House demolition	2000 m^2
River Barrage on Main Stream	
Design standard	Class IV
Width of barrage on main stream	100m
Width of barrage on Qiugong River	40m
Height of dam when fully inflated	4.5m
Normal water level	5.3m
Ship Lock	
Design class	III
Effective length	180m
Effective width	23m
Water depth across lock sill	4m
Capacity	1851 10^4 tonnes
Permanent land acquisition	20.2 mu
Xiaohekou Bridge	
Construction standard	Clearance height>=7m; Clearance width>=60m
Length	Bridge 487m
Width	11.5m
Number of lanes	2
Permanent land acquisition	15.2 mu

Source: Domestic EIR.

Figure III.14: Components of the Shuiyang River Waterway Improvement Project

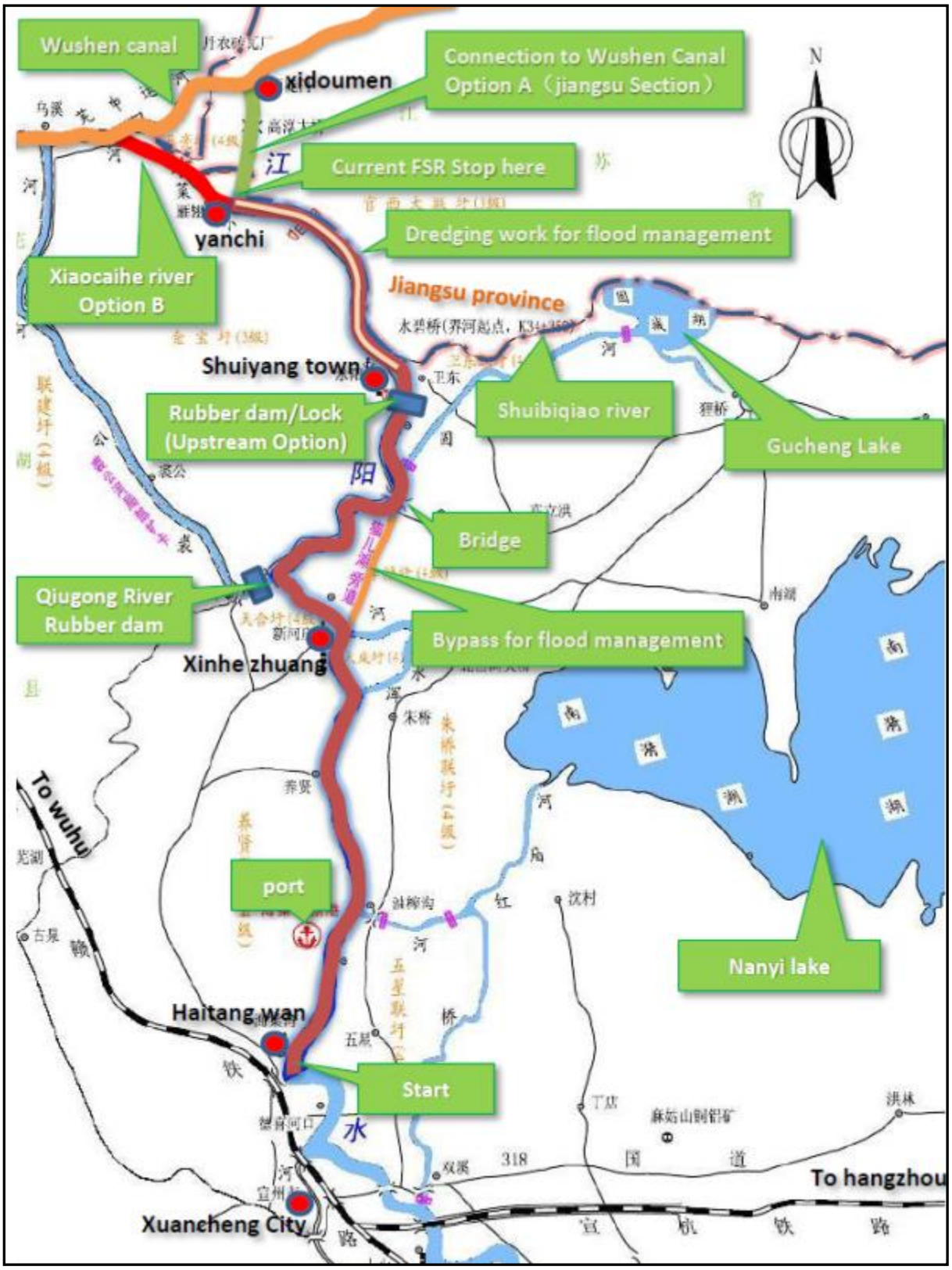


Figure III.15: Schematic Layout of the Proposed Scheme and Other Projects

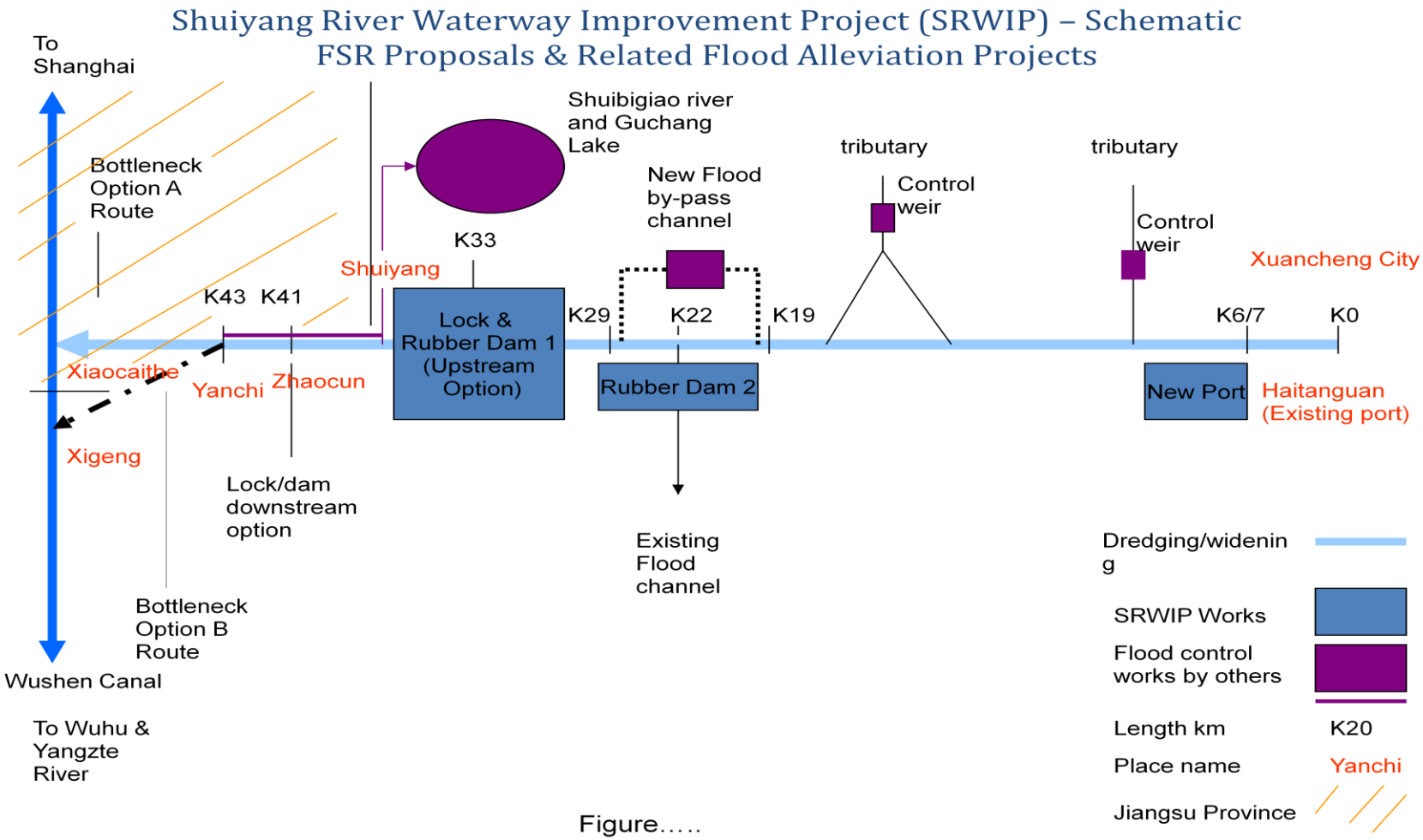
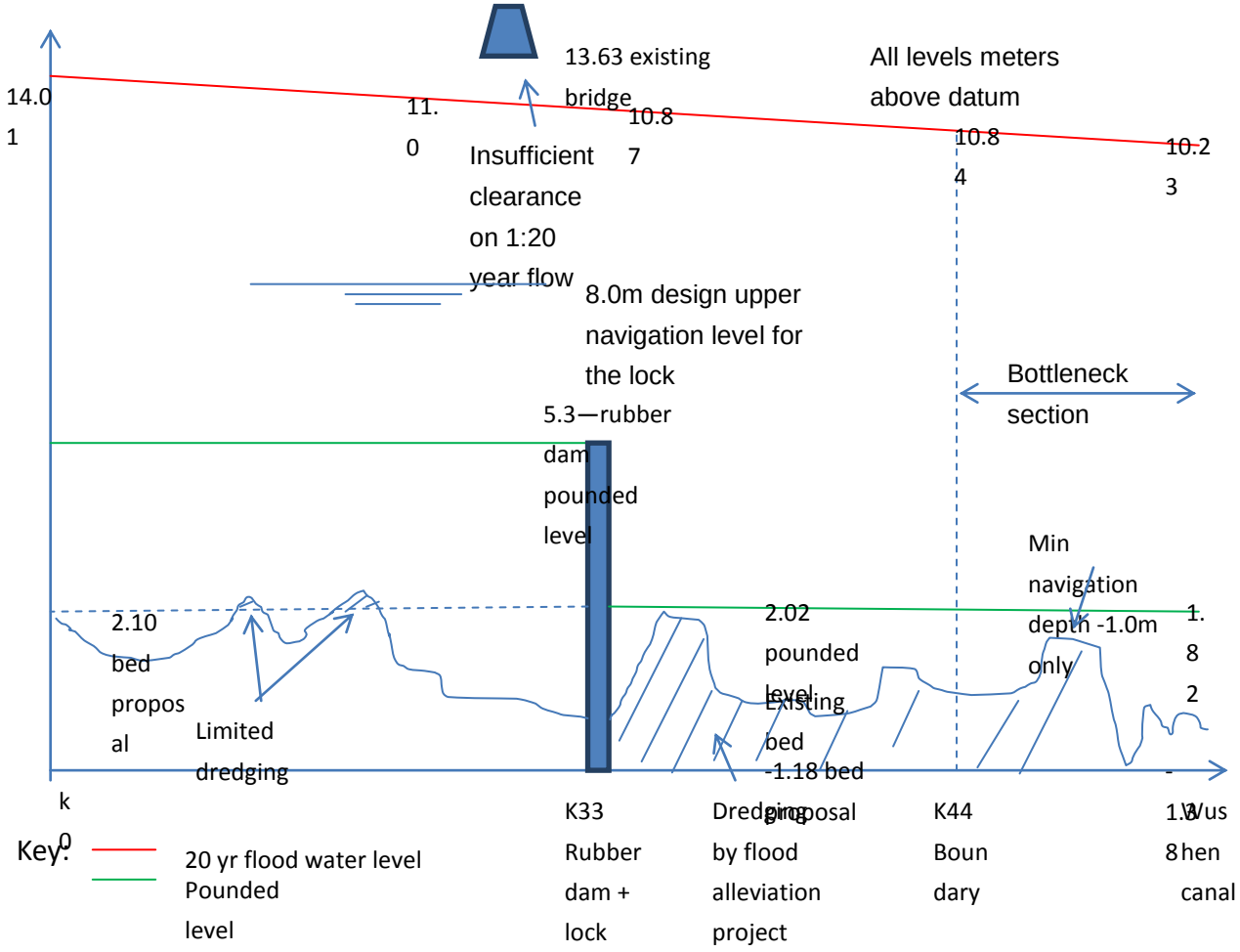


Figure.....

208. A low water rubber barrage and ship lock will be constructed approximately 0.5 km upstream of Shuiyang Town, in order to raise low water levels upstream during low river flows and provide passage for ships. Some localised dredging and reshaping of meander bends will also be required upstream of the rubber barrage in order to comply with the restricted Class IV design standard. Between Shuiyang Town and Yanchi Village downstream, compliance with the design standard would be achieved through more substantial dredging and reshaping of the river channel. A schematic version of the longitudinal section of SRWIP is shown in Figure III.16, depicting the relationship between the dam location, dredging to the required bed levels, and the 1:20 year flood level at which point navigation will close for river velocity safety reasons. The Xiaohekou Bridge needs to be demolished and rebuilt in order to have sufficient clearance during a 1:20 flood event.

Figure III.16: Schematic Layout of the Longitudinal Cross Section of the SRWIP



209. **Dredging Requirements.** Dredging is mostly required downstream of Shuiyang Town over approximately 11 km, but includes shallows upstream of Shuiyang Town too. Dredging will be undertaken using a cutter-suction dredger, pumping the dredged material by pipeline between 1 and 2 km to the proposed spoil disposalsites. A grab dredger may also be used for works in specific areas such as at the port site and the material placed on barges for transport

to the spoil disposalsites. The total volume of spoil to be dredged is estimated at about 2.5 million cubic metres.

210. Channel improvement works including dredging, widening and re-profiling will only be undertaken during the drier months between about October and May during the construction period between 2014 and 2016. No such work will be carried out during the wetter months of June to September for safety reasons.

211. The latest FSR shows bank protection along some 26.9 km of bank protection works on the left and right hand flood banks.

212. The dredged spoil will be disposed at seven locations (see Table III.43) comprising "unused" ponds belonging to villages or collectives, which may support some informal fishing. The ponds will be infilled with the dredged material and converted to farmland. Two examples are illustrated in Plate III.19 which is located within the river floodplain and bunds and Plate III.20 which is located near the downstream connection of the flood alleviation channel and the Shuiyang River.

Table III.43: Summary of Dredged Sludge Disposal Sites

No.	Location			Temporary area (ha)	Capacity (10^4m^3)
	Chainage	Bank of River[16]	Location		
1	K16-K17	Right	Tiancheng	16.87	46
2	K23-K24	Left	Wucun	5.2	16
3	K28-K29	Right	Dongsheng	20.8	38
4	K32-K33	Right	Fenggu	11.07	30
5	K35-K36	Left	Shuiyang Town	21.87	50
6	K40-K41	Left	Zhaojia village	12.2	44
7	K40-K41	Left	Yanchi	16.07	56
Total				**104**	**280**

Source: Domestic EIR.

[16] The left and right hand banks of the river assume one is facing downstream.

Plate III.19: View upstream of the Shuiyang River, new Flood Alleviation Channel and proposed dredged spoil dump site (pond in middle distance)

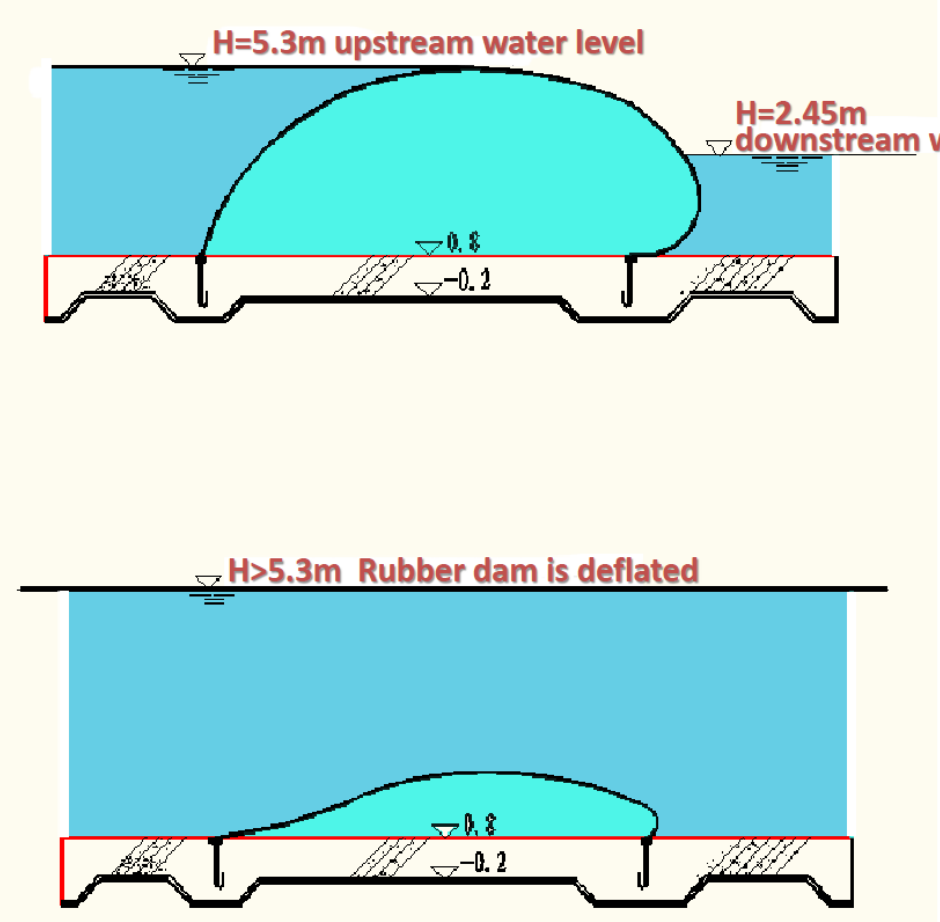
Plate III.20: Proposed dredged dumping site in pond within Shuiyang River flood bunds

213. **Rubber Barrage and Ship Lock on the Main Channel.** The rubber barrage would be made of a high-intensity synthetic fibre bearing frame and synthetic rubber, consisting of a multi-span five bag construction approximately 40m per bag length. The anchor would be fixed on the foundation slab to form the shape of a sealed bag, which is filled by pumping water to form a retaining dam.

214. This design is low cost, has a short construction period, good durability, and good seismic performance. The design has been widely used in the PRC, Japan and the USA. Based on previous performance in the PRC, this type of structure is expected to have a design life of 15 to 20 years.

215. The rubber barrage would act as a river water level retaining structure during low and normal river flows. It would be inflated by pumping river water into the barrage bag towards the end of the wet season, to raise water levels up to 5.3 m upstream of the barrage. During high river flows and floods, the rubber bag would be partly to fully deflated to allow navigable river depths upstream and the passage of flood waters downstream (see Figure III.17).

Figure III.17: Illustration of the Operation of the Rubber Barrage



216. The raised water levels would be contained within the existing embanked channel, and would be no higher than typical wet season flows. The water level in a 1:20 year flow is about 10.87m at the site of the rubber barrage. Consequently, there will be no new flooding within the channel up to that return period.

217. The ship navigation lock will be located on the left hand bank alongside the rubber barrage to allow the passage of ships without affecting the raised water levels in the main channel. The lock would be designed to comply with the 1000 dwt vessel Class III standard.

218. The effective size of the ship chamber is sufficient to allow a maximum of four 1000 dwt vessels in a single lockage or 4,000 tonnes. The average time taken by a single lockage is approximately 35 minutes excluding waiting time and the annual one-way capacity of the lock based on the design code requirements and 4x1000 dwt vessels at each lockage is 19,000,000 tonnes per year. The most optimistic cargo forecast over 20 years of operation suggests up to 10 million tonnes per year which means the lock will not be used at full capacity all the time.

219. Single lifting gates with superstructure will be installed at either end of the lock with filling and emptying being arranged by culverts and hydraulically operated sluices. The rubber barrage(s) and ship lock integrated operating regime proposed is as follows:

(i) Under minimum low river flow operation with the barrageinflated, the upstream minimum and normal water level at the dam site is 5.3 metres above datum (mad) and the maximum working head between upstream and downstream water levels across the barrage is planned to be 2.85 mad. When the upstream water level is at 5.3 mad, vessels are navigated through the ship lock and the lock gates need to be opened and closed.

(ii) Eight metres is the designed upper navigable level for use of the ship lock. When the upstream water level is between 5.3 mad and 8 mad, the upstream river water levels and the downstream river water levels will each converge towards 8 mad as river flow increases. The downstream water levels start to dictate the upstream water levels across the rubber barrage, so there may be a need partly to deflate and optimise the rubber bag top level to discharge increasing river flows across the barrage. No vessels will be allowed to cross over the low water rubber barrage during this interim phase of operation so while upstream and downstream water levels are the same or similar, the lock gates shall be opened at both ends of the lock for vessels to pass through with no need for gate operation.

(iii) When the upstream water level is in excess of 8 mad, the rubber barrage will be fully deflated and vessels will be allowed to pass over the deflated bag and be navigated via navigation markers through the main waterway, by passing the lock, saving 35 minutes plus waiting time for each lockage.

(iv) When the upstream water level exceeds the maximum navigable water level at the site 10.87 mad (predicted to be the statistical 1:20 year flood level at the site), navigation will be closed.

220. The operating criteria are summarised in Table III.44 below.

Table III.44: Operating Criteria of the Ship Lock

Upstream water level (m)	Downstream water level (m)	Lock Use
5.3	2.45	Yes
8.0	<8.0 and 8.0	Yes, but with gates open
8.0 to 10.87	8.0 to 10.87	No, navigation over the deflated dam
>10.87	> 10.87	Navigation closed at 1:20 year flood level

221. **Rubber Barrage on the Qiugong River.** A smaller rubber barrage will be installed on the Qiugong River flood channel near its confluence with the main Shuiyang River at K22. The barrage would operate in the same way as the main barrage, and be operated in tandem to maintain the desired water depths in the main channel up to the new port by preventing the higher navigable water levels on the Shuiyang from being lost down the flood channel.

222. **Navigation Marks.** Some 17 navigation marks will be installed along the Shuiyang River, comprising 1 to mark the confluence of the Shuiyang and Wushen Canal, two bridge opening markers, two lateral markers, four boundary markers and eight signposts.

223. There will be waiting areas for temporary anchorage up and downstream of the ship lock.

224. **New bridge and other works.** The existing bridge near Xiaohekou does not provide sufficient headroom for a Class IV restricted navigation river and will have to be demolished and replaced with a new one. The new bridge would be a pre-stressed, three-span structure, with opening widths of 50 m x 80 m x 50 m and on piled foundations.

225. Other works will include the relocation of infrastructure and ground attachments identified in Table III.45.

Table III.45: Affected Infrastructure and Ground Attachments

No.	Item	Proprietor	Unit	Qty.	Remarks
1	350 kV high-tension line	Power supply company	m	1200	
2	10,000 kV power line	Power supply company	m	1200	
3	Drainage pumping station	Village collective	/	1	2 units
4	Sluice gate	Village collective	/	1	
5	380 kV low-tension line	Power supply company	m	1000	
6	Fruit trees	Individual villagers	/	206	
7	Transformer	Power supply company	/	1	
8	Pumped wells	Individual villagers	/	8	
9	Masonry wells	Individual villagers	/	107	
10	Manual wells	Individual villagers	/	34	
11	Scattered trees	Individual villagers	/	501	

2. Xuanzhou Multipurpose Port Project

226. **Xuanzhou Multipurpose River Port.** The proposed port would be located on the left hand bank of the Shuiyang River, in the northeast of the North Zone of the new Xuanzhou Industrial Park and 150m from the proposed new ring road Shuiyang River Bridge. The port will be built in two phases but only Phase 1 is included within the project. Phase 2 might be required within the 20 year time horizon but would depend on actual cargo growth. It should be noted that only some 15% of the forecast cargo will actually use the new port; the remainder is forecast to use the existing minerals facility and be developed by various river side industrial operations that currently use road transportation methods (eg cement and coal). Any new river wharves required for this riverside cargo are also not included in this project. Phase 1 involves the construction of four 1,000-tonnes berths covering a total area of 10,142 m^2 and associated auxiliary areas to provide offices, warehousing and logistics covering a total 27.2 ha. Phase 2, which is not included in the SRWIP, envisages the expansion of the port with further six 1,000-tonnes berths over an additional 7,353 m^2 together with a reserve area of 34 ha for expansion of the auxiliary areas but note the comments above. Tables III.46 to 48 provide further details of the subcomponents of the Project.

Table III.46: Details of the Xuanzhou Multipurpose Port

Category	Subcomponent		Description
Main Works	Hydraulic Structure	Front Platform	The platform is 295m long and 20m wide, with 4 berths.
		Trestle Stand	Three trestle stands 12m wide will be built. The abutment sits on the flood dike. There is a 3m wide bench set on the dike slope.
	Land Area		Construction of general cargo yard, bulk cargo yard, general cargo warehouse, warehouse for public storage and processing, office building, living service quarter, machinery maintenance workshop, power distribution room, spare parts room, garage for moving machines, rest rooms for workers, gate house, toilets, roads, and green belts.
Auxiliary Works	Water Supply & Wastewater Discharge, Firefighting, Heating & Ventilation, Communication & Control, Power Supply, Lighting, etc.		The port water supply relies on the public water distribution system. The runoff and wastewater will be collected separately and discharged into public stormwater drains and sewerage system.
Support Works	Channel Improvement		The port will serve shipping on the Shuiyang River over 43.9 km, and down to the Wushen Canal and Yangtze River.
	Anchorage Ground		No anchorage ground has been set for the port in the near future. Ships will moor upstream or downstream.
	Roads		The planned Huancheng North Road and Shishan Road will provide the main access to the port, but these roads are not included in the project.
Greening	Plantation		Greening the land area of 7 ha.

Table III.47: Main Production and Auxiliary Buildings

No.	Name	Unit	Quantity	Structure Summary
1	Office building (including miniature exhibition)	m^2	1000	PC framework
2	General cargo warehouse	m^2	3300	PC frame bent structure and steel roof
3	Warehouse for public storage and processing (including sorting, distribution, packing, labelling, etc.)	m^2	10,190	PC frame bent structure and steel roof
4	Living service quarter	m^2	1000	PC framework
5	Machinery maintenance workshop	m^2	400	PC frame bent structure and steel roof
6	Power distribution room	m^2	400	Brick-concrete structure
7	Spare parts storage room	m^2	200	Brick-concrete structure
8	Garage for mobile machinery	m^2	320	Brick-concrete structure
9	Rest room for workers	m^2	180	Brick-concrete structure
10	Gate house	m^2	120	Brick-concrete structure
11	Toilets	m^2	90	Brick-concrete structure

Table III.48: Construction Quantity

No.	Items	Unit	Quantity
1	Class of berth	tonnes	1000
2	Berths	No.	4
3	Berth length	m	295
4	Shoreline occupation	m	310
5	Land acquisition	ha	26.87
6	Earthwork cut	10^3m^3	395.0
7	Earthwork fill	10^3m^3	753.0
8	Area of stock yards	10^3m^2	22.0
9	Green area	ha	7.0
10	Production and auxiliary buildings	10^3m^2	17.0
11	Quota of staff	person	92
12	Total Cost	Million yuan	206.923

227. The river-side port will be built out over the river with a platform at the same height as the flood bank protection works and supported on piled piers over the river. The port has been designed to operate to a minimum level of 5.3 mad (the height of the rubber dam at Shuiyang Town) and a maximum water level of 13.08 mad.

228. The land between the flood protection bund and the landward boundary of the port will be partially infilled, using spoil taken from nearby borrow areas. Summaries of the earthworks required and borrow areas are provided in Tables III.49 and 50.

Table III.49: Earthworks Balance (10^3m^3)

No.	Engineering Division	Cut	Fill	Fill from Borrow Pit	Cut Reused as Backfill	Disposal	Note
1	Stock Yards and Land Facilities	386.0	743.0	589.0	154.0	232.0	The surplus spoil will be dumped at the spoil disposal site
2	Berths and Trestle Stands	8.2	4.5		4.5	3.7	The surplus spoil will be dumped at the spoil disposal site
3	Roads	0.7	5.3	5.3		0.7	All the cut spoil will be dumped at the spoil disposal site.
	Total	394.9	752.8	594.3	158.5	236.4	

Table III.50: Borrow Pits and Spoil Disposal

No.	Location	Borrow Quantity (10^3m^3)	Deposed Spoil (10^3m^3)	Land Acquisition (ha)	Cut / Fill Depth (m)	Land Type	Note
1	The public borrow pit lies about 2 km to the west of the new port	595		10.13	5.9	Unused Hillock	To be reclaimed as farmland or woodland after construction
2	The spoil disposal site is located to the southwest of the port		237	6.51	3.3	Fish Pond	To be reclaimed as farmland after construction

229. The site is currently accessible by a rural road, which would need to be upgraded to provide construction access. Access to the port will be via the road into the industrial park. A new short link is required to the back of the port to connect with Qiling Road. The planned ring roads, North Ring Road and Shishan Road, will be built by local government and do not form part of the SRWIP.

230. **Operation.** Following opening of the SRWIP the volume of ships on the river would be expected to increase. Potential sources of pollution are: the discharge of solid waste and wastewater, accidental spillages for example oil spillages following collisions, wastewaters or cargo, noise from the ships horns, and air emissions from the engines.

231. Xuanzhou multi-purpose port will operate all year around with a complement of about 92 staff. The main types of cargo and estimated volumes are presented in Table III.1 and the equipment needed to operate the port is listed in Table III.51 below.

Table III.51: Main Specifications and Numbers of Loading and Unloading Machines

No.	Names & Model	Unit	Numbers	Specification
1	GQ20-18 Fixed Crane	set	2	Lifting 20 tonnes, working radius 7.5 - 18 m
2	GQ10-18 Fixed Crane	set	2	Lifting 10 tonnes, working radius 7.5 - 18 m
3	Hopper	set	2	Open mouth 4.5m×4.5m
4	Power driven wheel crane	set	1	Max. lifting 20 tonnes
5	20t Bridge Crane	set	1	Max. lifting 20 tonnes , gauge 22.5 m
6	Forklift	set	4	Lifting 2 tonnes
7	Loader	set	2	Loading capacity of 5 tonnes with volume of 2.5 m^3
8	Dump Truck	set	3	Loading capacity of 30 tonnes
9	Tractor Flat Car	set	3	Traction of 20 kN, loading capacity of 55 tonnes
10	Weighbridge	set	1	Capacity of 100 tonnes, dimension of 18×3.6 m

Source: Domestic EIR.

232. The main types of waste generated from the site would be: office and domestic solid waste, packaging relating to cargo, grey water and sewage, stormwater drainage, oil wastewater from the maintenance workshops. The proposed port would be served by utilities (power, water supply, sewerage, and solid waste collections) for the planned Xuanzhou Industrial Park. Oily wastewater from the repair shops would be passed through an oil separator and recycled. Oil rags would be transferred to a qualified and specialised agency for appropriate disposal as hazardous waste. There will be no final disposal facilities for such waste at the port.

233. The navigation lock control building will be staffed by some 15 technical and managerial staff. Wastes generated from the site would comprise: office and domestic solid waste and sewage. The site will be provided with power, water supply and sewerage via connection with utilities in Shuiyang Town.

234. **Programme.** The SRWIP is programmed to take three years to construct, with the port construction taking two years. Although the downstream Jiangsu section is presently Class VI, it is in fact able to operate under Class V conditions and its limitation is on vessel tonnage rather than on vessel traffic volume. An agreement has been signed between Anhui Province and

Jiangsu Province to ensure that complimentary upgrades are made by Jiangsu Prvonce on their section of the waterway.

3. Associated Facility and Other Projects

235. **Associated Facility.** One associated facility has been identified for the SRWIP, comprising the removal of the ship yard at Shuiyang Town, which is located in the vicinity of the proposed rubber dam and ship lock (see Plates III.21 and III.22). Funds will be provided to the owner of the ship yard to relocate, but the owner will be responsible for obtaining the necessary permits, including an EIR, and relocating the shipyard to a new location. The new site is downstream in the Xiaocaihe River area. Following the removal of the shipyard and prior to commencement of construction for the SRWIP ship lock, a site investigation programme will be undertaken to assess the extent of contaminated soils, particularly hydrocarbons, heavy metals and asbestos, followed by appropriate site remediation if needed.

Plate III.21: Shipbuilding yard near Shuiyang Town	**Plate III.22: Location of proposed ship lock**
	

236. **Other Projects.** The following projects are on-going and will improve the operational efficiency of SRWIP, but are not part of the SRWIP (see Figure III.15) and are not deemed as associated facilities.

(i) Wushen Canal. This is an inter-province and inter-basin inland navigation canal some 306.7 km long, which connects the Yangtze River in the west with Taihu Lake and the South Jiangsu Waterway Network near Shanghai in the east. The Canal is currently under construction, and when completed will significantly reduce the navigable travel time between Anhui Province and Shanghai by avoiding the Yangtze River. Construction is currently delayed due to problems associated with Tai Lake, but completion is due in 2015. The Wushen Canal will be a Class III navigable waterway.

(ii) Local Works on the Shuiyang River. Flood alleviation works on the Shuiyang River are being undertaken by the Water Resources Bureau. The SRWIP FSR assumes these works will be available and will be carried out separately and at no cost to the SRWIP project. These works are due for completion during 2014. The main works are as follows.

(a) River widening and straightening at Shuiyang Town. The Shuiyang Water Resources Bureau is currently widening the river on the right hand bank

(see the earthworks in Plates III.21 and 22). This work has involved demolition of property and the re-alignment of the flood bank.

(b) Flood Alleviation Channel. A new flood alleviation channel is under construction between Xinhezhuang and Xiaohekou.

237. **Xuancheng City Road Transport Masterplan.** Under this masterplan, Xuancheng City plans to construct a new long bridge over the Shuiyang River about 150 m from the proposed new port. This road would provide ready access to the port for road freight, to serve the hinterland on both sides of the Shuiyang River, and increase the connectivity of the port with industries transporting raw materials and manufactured goods.

4. Construction-related issues for the SRWIP and New Port

238. **Tables III.52** and **III.53** summarise construction-related issues and activities.

Table III.52: Summary of Waterway Construction-Related Issues

Construction Issues	Resources
Materials	- Cement, wood, steel, diesel, petrol, etc to be purchased from Wuhu County Xuancheng City and Gaochun County Town - Building stone has to be brought to site as there are no suitable quarries in the area - Sand and gravel can be dredged from the river
Water supply	- Obtain drinking water and construction water from local piped water supply in nearby towns and villages - Construction water can be taken from the Shuiyang River
Power supply	- Where possible, connect to the local grid - Elsewhere use portable diesel generators
Construction traffic	- Haulage by river and by road
Soil and water conservation	- Greening proposals at the port
Construction camps	- Where possible, construction companies will arrange to hire accommodation for workforce in nearby towns.
Wastewater disposal - sewage	- Temporary toilets at construction camps and sites - Sullage from septic tanks removed to be spread on agricultural land and excess to be disposed of to the Municipal wastewater plant
Wastewater disposal – oily wastewater	- Pass wastewater through settlement tanks and oil separators and re-use
Wastewater disposal – construction water	- Discharge wastewater to settlement ponds, prior to discharge to drains

Table III.53: Typical Construction Activities

Scheme Components	Key Activities
Dredging	- Construction of temporary coffer dams and drainage in sludge dump sites - Cutter suction dredger to start downstream and work upstream and pump slurry to sludge dump sites - Trial runs to start, to assess impact of operations on water quality (suspended solids) - Lay pipeline and secure with anchor every c200-300m - Pump soft watery sludges over longer distances and dump hard / rocky sludges at closest dump sites - Grab dredger to dump slurry on barges
Bank Protection Works	- Ecological concrete: trim the slopes, compact, place capping, prepare grid moulds, pour concrete, sow with grass plugs

Scheme Components	Key Activities
	- Geotextile bag and concrete: Level slopes, lay geotextile bags, pour concrete - RipRap blanket: Dump rip rap in dry season during low flows from barges from upstream to downstream or from land using dump trucks. Use stone blocks 25-50kg which are too large to be washed away during medium to high flows.
Bridge Works	- Approach roads - Pile foundations: Install temporary sheet piling in river / floodplain, excavation, install steel reinforcement cages, and concrete pour. Cap foundations with reinforced concrete. Complete during dry season. - Piers: Cast in situ. - Superstructure: Pre-cast box girders at construction site, hoisted and installed, pour wet joints and middle cross beams, and construct top deck.
Rubber Dam	- Install cofferdam across part of the channel and create diversion channel. - Excavations: excavate foundation pit for the rubber dam. - Concrete and masonry works. - Manufacture rubber dam bags at factories, transport to site and install. - Complete the works during one dry season.
Ship Lock	- Foundation pit de-watering o Deep well dewatering: install wells at 20-30m spacing, 36 wells at 15m depth, install system of pervious pipes and drains around the wells, discharge groundwater to the river. o Split wall construction dewatering: install a row of deep wells along outside of the wall, depth and number as above, with 18 upstream and 18 downstream of wall. - Earthworks: Excavate foundation pit and approach channel, place earth in dump trucks, use dredger for wet slurry. Use earth for backfilling. - Foundation Treatment Works: Construct foundations, lock chamber and guide wall with in situ cast bored piles 20m long. - Concrete Construction of Works. - Fabrication and installation of metal structures: made in factories and brought to site.
New Port	- River wharf: o Bored piles with reinforced concrete o Cast superstructure on site and lift into place o River slope protection works - Land parts: o Clear the site, dredge ponds, infill with earth, level and compact. o Lay utilities, prepare ground surface for working areas, roads and foundations for buildings. o Erect buildings.

E. Climate Change Adaptation Considerations

239. Climate change modelling was undertaken for the SRWIP project areas under ADB Project Number TA 7608, *Climate Resilience in Shuiyang River Infrastructure Improvement*. The climate of the area is tropical summer monsoon, with a pronounced wet season between May and September, and a dry season in the winter. There are marked spatial variations in

temperature and rainfall due to topography. There are also strong inter-annual variations in rainfall.

240. The studies projected a general increase in mean annual temperature of 1.5ºC by 2050 and 3.8ºC by 2100 and an increase in rainfall across the area of 1 to 3% by 2050 and 3 to 7% by 2100. Rainfall increases would be greater in the wet season, especially June, with lower increases and possibly decreases in rainfall during the dry season.

241. Studies of the annual maximum daily rainfall for a 1:20 year event indicated that high intensity rainfall may become more common, with the return period decreasing to 11 to 12 years by 2050, and 6 to 7 years by 2010. The effect of climate change on extreme precipitation decreased with increasing duration, and no obvious climate change impact was found for the annual maximum precipitation distribution for a duration greater than three days.

242. River flows are strongly seasonal in response to rainfall, with a marked flood season during the summer monsoon and low flows during the dry season. Further analysis would be required to convert the predicted changes in rainfall to return periods for flow levels in the Shuiyang River and what this means for the 1 in 20 year navigation closure ceiling and top hard concrete design levels for the lock, the two dams and the new port. The changes in rainfall and temperature patterns predicted point to the increased risk of high flows in the river, reduced number of days of navigation due to high flows, and more extreme winter low flows both in terms of lower water levels and longer duration. Low season flows may be further exacerbated by increased water demand in the lowlands for other purposes such as irrigation, industry, and drinking. The climate change modelling also indicated that wind speed is likely to increase during the flood season (May to August) to between 1 and 3% by 2050 and 2 to 8% by 2100, although this is unlikely to affect navigation, but may have implications for high bridges. The climate change models do not include fog, but the increase in temperature may result in less fog, which is beneficial for navigation.

243. The SRWIP proposes to improve the dry season low flows by placing two inflatable dams across the main river and a tributary. This approach has been adopted elsewhere in PRC and other countries. The current design is considered sufficient to provide the necessary draft under changing climate conditions, and will be increasingly required to adapt to more extreme dry season flows in the future.

244. The main adaptation to marginally higher flood water levels, more frequent flood flows and possibly more frequent or different dry periods would be to take account of marginally higher flood water levels in the detailed design of SRWIP and the rubber dam operating regimes. This would probably not be precise allowances but approximate allowances with very little impact on cost.

245. The main risks of the climate changes described above on the proposed highway schemes are:

(i) Peak rainfall events, frequency, and magnitude (for designing bridges, culverts and road drainage)
(ii) Changes to the onset of the rainy season (for road maintenance and construction scheduling)
(iii) Changes in temperature including both gradual increase and increase in extreme temperature (likely to impact road pavements)

(iv) Changes in precipitation (will impact road foundations)

246. Detailed design of the bridge structures, culverts, highway drainage, road subgrade, pavement, and slope protection will examine adaptation measures to counter the above potential climate change risks.

IV. DESCRIPTION OF THE ENVIRONMENT

A. General

247. The description of the pre-project baseline environment (biophysical and socioeconomic) establishes (i) the environmental setting within which the project will be implemented, and (ii) the environmental values which will change (either negatively or positively) as a result of the project. The scope of the baseline environmental surveys was determined by the kinds of components proposed, presence of environmental receptors and potential impacts.

B. Physical Setting

248. **Geography and Geology.** Anhui Province is situated in east central China, separated from the coast by the Provinces of Jiangsu and Zhejiang. The topography of the province is variable. The Huang Mountains lie in the south and south east of the Province and the Dabie Mountains lie to the south west, separated by the Yangtze River which flows diagonally from the south west to the north east across the southern third of the Province. Much of the land along the Yangtze River is flat and low lying, backed by low lying, south-west to north-east trending hills on both sides of the river. The proposed subprojects are all located on the low lying plains and hill country along the Yangtze River.

249. The Shuiyang River Basin is located south of the Yangtze River. The Shuiyang rises in the Huang Mountains and flows northwards toward the Yangtze. Between Xuancheng and Xinhezhuang village, the river flows through rolling hill country. The terrain changes markedly downstream of Xinhezhuang, where the Shuiyang River meanders across the flat, low-lying plains of the Yangtze River Basin characterised by extensive areas of paddy and fishponds fed by irrigation canals (see Plate IV.1). The bed slope of the river in this area is very low at 0.004 to 0.006%.

Plate IV.1: Shuiyang River looking downstream	**Plate IV.2: Low lying polders and irrigation canals surrounding the lower Shuiyang River**
	

250. The mountains of the Shuiyang River Basin are composed of Cretaceous, Silurian and Jurassic sandstones, shales and mudstones. These are overlain by Quaternary alluvium of gravels, sands and clays in the floodplains.

251. Soil types in the region include the zonal yellow brown and brown-red soils, and non-zonal paddy soils, rendzina, terra rossa, purple soils, marshy soils, grey meadow soils, and skeletal soils. On arable lands, the main soil types are paddy soil, followed by wet soils, brown-red soils and yellow-brown soils.

252. According to the *China Ground Motion Parameters Zoning Map of 2001*, the seismic intensity in the study area is Grade VI. The PRC classifies seismic intensity into 12 classes under the *China Seismic Intensity Table* (GB/T 17742-2008), from Class I to Class XII based on the severity of "shaking" of the earth surface and the extent of potential impact. Class VI is intermediate in severity with most people unable to stand still and furniture falling.

253. The Highway Subprojects are located on low lying, rolling plains on both sides of the Yangtze River, where there is no significant risk of geomorphological hazards.

254. **Climate.** Anhui lies in the subtropical humid monsoon climate zone, with a mild climate and four distinct seasons, with a warm wet summer, dry and mild winter, and transitional periods. Table IV.1 presents general climate characteristics for the project locations in Anhui.

Table IV.1: Anhui's Climate Statistics

Parameter	Xuancheng City	Ma'anshan City	S319	G206
Annual average temperature	15.6^{o} C	15.8ºC	16.0ºC	16.2ºC
Extreme lowest temperature	-14.0^{o} C	-13.2ºC	-15.7ºC	-10
Extreme highest temperature	11^{o} C	40.0ºC	41.3ºC	41ºC
Annual average frost free days	240 days	259	240	250
Annual average sunshine hours	2100 hrs	2126 hrs	2090	2000 hrs
Predominant wind during the year	N winter / autumn E spring / summer	NE winter S summer E spring/autumn	NE autumn/winter E spring/summer	NE autumn/winter SE spring/summer
Mean annual wind speed	2.2 m/s	2.2 m/s	2.3 m/s	2.5 m/s
Annual average precipitation	1380 mm	1067 mm	1180 mm	1580mm
Annual evaporation capacity	1450mm	1488 mm	1420 mm	1400mm
Average annual relative humidity	78%	78%	79%	80%

Source: Websites for Anhui.

255. **Hydrology.** The Shuiyang River drainage basin covers an area of 10,305 km^2. The river rises in the mountains to the south from three tributaries, the Xijin River, Zhongjin River and the Dongjin River, which converge to form the main trunk of the Shuiyang. The main river flows through the towns of Xuancheng, Haitangwan, Xinhezhuang, Shuiyang Town, Yanchi Town, Xigeng and Huangchi and joins the Qingge River at Qingshui.

256. The navigation section of the river lies between Haitangwan and Xigeng. Upstream of Haitangwan the river has the characteristics of a mountain river, with steep slopes and rapid response to rainfall. Between Haitangwan and Xinhezhuang the river is in a transitional stage, and downstream of Xinhezhuang the water network is typified by polder areas, low lying land surrounded by dykes for flood control, raising fish or paddy rice (see Plate IV.2).

257. The Shuiyang River is regulated by the Tonggong Dam upstream of Xuancheng City, which has resulted in modified hydrology, including less pronounced responses to heavy rainfall, possibly lower winter flows and a reduction in suspended sediment and bedload downstream. Flood protection works have been built along both banks of the river in the navigable section. The discharge in the river is seasonally variable, with high flows during the summer monsoon between May and August, and low flows through the winter months. Due to the steep topography and short slopes in the mountainous areas, the response time to heavy rainfall is rapid and peak flow discharge is high. The flood peak generally lasts for three to seven days. The maximum peak flow measured at Xinhezhuang was 1,896 m^3/s with a water level of 11.61 (metres above Yellow Sea datum) mad in 1986. By comparison, the mean annual discharge as measured at Xuancheng is 80.96 m^3/s. The mean annual runoff is 25.53 million m^3, with maximum and minimum values of 50.0 and 9.8 million m^3.

258. During the summer monsoon, high water levels on the Yangtze River result in waters in the tributaries backing up and leading to reverse flows, with the Shuiyang River flowing to Nanyi Lake. This is a natural process, which is an important phenomenon in attenuating flooding on the Yangtze River.

259. The main flood risk in the study area comes from heavy rainfall. Water levels in the surrounding low lying polder landscape are controlled by a series of canals and drains, with sluice gates to the Shuiyang River.

260. Other important rivers in the Highways Subprojects study area are as follows:

(i) Sima River. This river rises in the hills to the north of the Yangtze and joins the Chuhe River, before flowing into the Yangtze River. It is about 60m wide where it is bridged by Highways Subproject I – the Ma'anshan North Corridor Subproject.

(ii) Zhanghe River. This river originates in Nanling Country, and joins the Yangtze west of Digang Town. The catchment area is 1,359 km^2 and is about 45 m wide where it is crossed by the Yimu Highway for Subproject II.

(iii) Xihe River. The Xihe River originates in Lujiang County and flows into the Yuxi River, a tributary of the Yangtze. The river has a catchment area of 2,224 km^2 and is 40 m wide where it is bridged by the S319 for Subproject III.

(iv) Yaodu River. The Yaodu River rises in the Qimen Mountains and flows to the Yangtze River, draining a catchment area of 8,964 km^2. The river is about 40 m wide in the study area for Subproject IV G206.

261. **Groundwater.** In the middle to lower Shuiyang River valley, groundwater is found in the Quaternary alluvium on the floodplain. Perched aquifers are widely found in the layers of fine-grained sediments throughout the area separated by clayey deposits. Recharge is mostly by rainfall although during the wet season, but there is cross flow from the river into the groundwater. There is also widespread connectivity between the phreatic and surface water resources due to the dense network of polders, irrigation canals and drains. In the dry season, groundwater levels fall and the shallow near-surface perched aquifers are depleted. These characteristics are likely to be found elsewhere in the Yangtze floodplain.

C. Natural Resources, Ecology and Biodiversity

1. Shuiyang River Waterway Improvement Project

262. **Habitats and Flora of the Shuiyang River Valley**. The ecology and biodiversity of the Shuiyang River were assessed based on literature research, discussions with local people and limited field work undertaken in December 2012. Lists of flora and fauna found or believed to be present in the main habitats in the Shuiyang River corridor are presented in Tables IV.2 and IV.3.

263. The low lying lands either side of the Shuiyang River are highly disturbed habitats and mostly given over to paddy and fishponds. The main natural habitats are grasslands, shrublands, and aquatic vegetation associated with ponds and waterlogged areas.

264. The grasslands and shrubs are located on the river banks, under and alongside the tree plantations, and on fallow land. Common herbaceous plants include Asiatic dayflower *Commelina communis*, wild zoysia *Zoysia* spp, Siberian cocklebur *Xanthium sibiricum*, Green foxtail *Setaria viridis*, Japanese bloodgrass *Imperata cylindrica*, Goosegrass *Galium aparine*, Rough corn bedstraw *Galium tricorne*, Canadian fleabane *Conyza Canadensis*, Common madder *Rubia cordifolia*, and Artemisia sp. *Artemisia lavandulaefolia*. A common shrub on the river banks is Paper mulberry *Broussonetia papyrifera*.

265. The Shuiyang River and semi-natural ponds support a range of emergents (Common reed *Phragmites australis*, Bulrush *Typha orientalis*, Manchurian wild rice *Zizania caduciflora*, and Water shamrock *Marsilea quadrifolia*), floating leaved-macrophytes (such as Water chestnut *Trapa incisa*), floating plants (Mosquito fern *Azolla imbricata*), submerged plants (Potamogentonaceae, Hydrocharitaeae, Halorgaidaceae and Ceratophllaceae), and ferns, grasses, etc.

266. **Fauna along the Shuiyang River Corridor.** The main faunal groups found in the study area are amphibians and reptiles, birds, and small mammals (see Table IV.3). The amphibians (7 species) and reptiles (9 species) are mainly found in association with water, ditches, and wetlands. Some 42 species of bird were identified, of which 21 species were passiformes, 6 were ciconiiformes, and smaller numbers of other families. The species represent oriental species (18), palaearctic (12) and widespread (12) realm, indicating that Anhui Province is located in a transitional zone for avifauna. Birds were distributed widely, including in villages, on farmland, forests, along the river shore, and around ponds. Some 13 species of mammals have been recorded in the study area based on literature searches and observations of fur, faeces, and other traces, which are listed in Table IV.3.

267. **Agricultural Ecology.** The people living along the Shuiyang River downstream of Shuiyang Town are mostly engaged in aquaculture in the extensive network of ponds on the valley floor for crabs and fish (see Plate IV.2). The main cash crops grown in the area are rice, wheat, cotton, corn, broad beans, sesame, soybean, fruit and a variety of vegetables such as eggplant, tomato, squash, raddish, and lettuce. Artificial forest ecosystems comprise Simon's poplar *Populus simonii* planted around villages and roads while weeping willow *Salix sp*. is planted near water.

268. **Aquatic Ecology.** Water sampling was undertaken at six locations along the Shuiyang River in December 2012 and analysed for phytoplankton and zooplankton. Benthos were sampled from the bottom sediments at the same locations. Phytoplankton were found at all the monitoring stations, with 50 species identified, dominated by diatoms (21 species) and green algae (17 species). Some 55 species of zooplankton were identified, mostly comprising protozoa (20 species), rotifer (19 species), and cladocera (9 species). Some 39 species of benthos were found, dominated by molluscs (18 species), annelids (6 species), and arthropods (4 species). Molluscs accounted for 98 to 100% of the benthos in terms of biomass.

269. An assessment of fish species was based on literature searches, discussions with the local Fisheries Department, and local people during public consultations. Some 34 species of fish have been reported to occur in the river, mostly cypriniformes (25 species), followed by siluriformes (4 species). The main fish are Black carp *Mylopharyngodon piceus*, Grass carp *Ctenopharyngodon idellus*, Silver carp *Hypophthalmichthys molitrix*, Big head carp *Aristichthys nobilis*, Common carp *Cyprinus carpio*, goldfish *Carassius auratus* and loach *Misgurnus anguillicaudatus*.

270. The EIR notes that three species of silver fish, Tahu icefish *Neosalanx taihuensis*, *Hemisalanx prognathus* and *Reganisalanx brachyrostralis* were common in the Shuiyang River, but that the population collapsed during the late 1980s and 1990s. No reasons were provided, but this may have been due to over-fishing or potentially resulting from the impacts of the upstream dam on river flows.

271. Fish spawning typically occurs between February and July. The ecological survey for the Waterway component was carried out in December 2012, outside the spawning season and no sites could be verified during the survey. The local Fisheries Department confirmed that there were no concentrated fish spawning, feeding or wintering areas on the Shuiyang River.

272. No nationally protected species of fish have been recorded to inhabit the Shuiyang River based on the literature searches.

273. **Protected Species.** The Yangtze alligator *Alligator sinensis* is a small alligator, about 5 feet long, which lives in the slower moving, freshwaters of the lower Yangtze basin. The species is classified by the IUCN as critically endangered and in China is classed as a Grade I state protected species. The wild population in Anhui Province is estimated at not more than 120 individuals, with the largest group living around Xuancheng City with 46 individuals. There is an artificial breeding centre at Xiadu forest farm, about 7 km from Xuancheng City, with a reported population of 10,000. According to the domestic EIR, the habitat along the Yangtze in the project area is not appropriate for the Yangtze alligator, due to the extensive human interventions through urbanisation and cultivation.

274. No nationally protected wildlife has been recorded in the study area. Ten species of provincial level protected species do occur, which are listed in Table IV.3. Of these, the Leopard cat is a level I protected species and the remainder are level II protected species.

2. Ecology of the Highway Subproject Corridors

275. **Approach.** A review of the ecology and wildlife along the highway subprojects was based on literature reviews and surveys of a corridor 300m either side of the centreline of the

proposed scheme. Summaries of flora and fauna found along the highway corridors are presented in Tables IV.2 and IV.3.

276. **Highway Subproject I – Ma'anshan North Corridor.** The Ma'anshan North Corridor crosses an intensively cultivated region, with little natural habitat. Some two thirds of the corridor comprises the existing highway and the new build section mostly by-passes the villages across paddy fields. The main crops in the area vary with the season, summer and autumn crops include rice, beans and cotton. Winter and spring crops are mainly wheat, rape and broad beans. A wide range of vegetables are grown in the villages. Economic trees include pomegranate, pear, peach, apricot and persimmon. Other planted trees include Empress tree *Paulownia tomentosa*, False acacia *Robinia pseudoacacia*, Poplar, Chinese fir *Cunninghamia lanceolata*, and Camphor tree *Cinnamomum camphora*. Poplar is particularly widespread along roads, river banks and in villages. Herbaceous species are typical of farmland and wasteland.

277. Given the high level of human disturbance, few wild animals are likely to be found in the highway corridor. Typical species are likely to include amphibians and reptiles such as frog, gecko, lizard, grass snake, and snake; small mammals such as bat, hare, squirrel, hedgehog, vole, and Chinese striped hamster; and birds typically found in association with farmland and trees such as magpie, crow, dove, cuckoo, woodpecker and sparrow.

278. **Highway Subproject II – Yimu Highway, Kedian to Mujiating Section.** The highway corridor comprises an existing road, in a densely populated area with no nearby scenic spots or designated nature reserves. Much of the route crosses urban landscapes and villages, where there is little natural vegetation and few wild animals are likely. In the hill section between K25+460 and K34+260 there are mixed planted broadleaf and conifer woodlands and scrublands.

279. The main land use in the area is paddy. In addition to rice, other crops grown in the area include Asian rice *Oryza sativa*, maize *Zea mays*, cotton *Gossypium* sp, Soybean *Glycine max*, vegetables such as pepper *Capsicum anuum*, tomato *Lycopersicon esculentum* and lettuce *Lactuca sativa*, and herbaceous plants such as wild carrot *Daucus carota*, Chinese motherwort *Leonurus japonicus* and Chinese parsley *Oenanthe javanica*. The woodlands comprise planted mixed broadleaf conifer forests, including Chinese fir, Masson's pine *Pinus massoniana*, Chinese sweetgum *Liquidambar formosana*, Chinese wingnut *Pterocarya stenoptera*, and Dawn Redwood *Metasequoia*. The main trees used in landscaping are the Camphor tree and Dawn redwood. The trees and shrubs found along the highways and around the edges of woodland, and include Brazilian tulipwood *Dalbergia hupeana*, Oriental white oak, Siberian elm *Ulmus pumila*, Chinese sweetgum, and Paper mulberry. There are also grasses and compositae such as Tall fleabane *Erigeron annuus*, Japanese bloodgrass, Motherwort *Leonurus japonicus*, Pokeberry *Radix phytolacca* and Wormwood *Artemisia argyi*.

280. Given the widespread human intervention in the area, large wild animals in the study area are unlikely, but small mammals such as hare, mice, and rat are likely to be common. Amphibians and reptiles in ditches and wetlands are likely to include frog, toad, and newt. The mosaic of habitats such as villages, farmland, water, fallow land, shrubland and forest, is likely to favour a range of birds. Forest birds may include oriole and great tit. Shrubland birds include thrushes and doves. Birds typical of farmland and grasslands include magpie, sparrow and pheasant.

281. **Highway Subproject III – S319 Erba to Wuwei Section.** Most of this section crosses farmland, with a narrow band of Poplar trees planted on either side of the road. The new build section crosses undeveloped and newly developed land in urban areas.

282. The main plants growing in the area are winter-sown wheat, summer-sown crops including rice, cotton, and soybean. Small areas of vegetables are grown in the villages for home consumption. Economic trees include pear, peach, jujube and persimmon. Tree plantations support *Paulownia*, False acacia, poplar, willow *Salix matsudana*, Chinese scholar tree *Styphnolobium japonicum*, mulberry and paper mulberry. Shrubs and grasses are distributed around fields.

283. Given the intensity of farming along the highway corridor, the fauna is expected to be limited to common species of amphibians, reptiles, small mammals and birds.

284. **Highway Subproject IV – G206 Donliu to Yaodu.** The proposed alignment crosses a mixture of farmland, forest, grasslands, and wetlands. The main crops grown are rice, cotton, and vegetables such as pepper and eggplant. The forests are mainly plantations of mixed broadleaf and conifer forest on the hills around Yangmei Mountain between K0+800 to K2+300 and between K15+000 to K16+580 close to the Tiantai Mountain Forest Park. Protection forest comprising Poplar and Dawn redwood has been planted along the Yaodu river bank. Shrubland and grasslands are found on the woodland edges, on the rolling hills around the lakes, and along the Yaodu river banks.

285. The fauna is typical of the habitats in the area. Amphibians and reptiles include a variety of frogs, toads and snakes, some of them Class II level protection. There are potentially a large number of different species of birds present in the area given the range of habitats, including farmland, lakes, wetlands, forests and grasslands. Historic records indicate over 50 species present in the area, with records of 41 species of waterbirds, of which a number overwinter on the lakes. There are few recorded mammals, mostly rodents, weasel and hare.

286. **Protected Areas.** The Tiantai Mountain Forest Park is located in Yaodu Township of Dongzhi County. Covering an area of 260,000mu (approximately 17,333 ha), it extends over the end of Huangshan Mountain, with hilly landform between 200-300 mad elevation, reaching 648m on Sangangjian peak. The natural vegetation zone is subtropical evergreen broadleaf and deciduous mixed forest, but much of the original habitat has been lost due to human intervention, and the existing forest is mostly secondary fir forest. The existing G206 crosses a short distance of the park, but the new alignment has been designed to avoid the park, with a minimum distance of 200m from the park boundary between K15+000 and K16+580.

287. The Shengjin Lake National Nature Reserve is located at least 5 km away from the proposed new alignment of G206, on the border of Dongzhi County and Guichi District of Chizhou City. The Reserve covers 33,340 ha and divided into the core area of 10,150 ha, a buffer zone covering 10,300 ha, and the experimental area of 12,890 ha. According to survey reports by the World Wildlife Fund in 2004 and 2005, the Lake qualifies under the Ramsar Convention for wetlands of international importance on two criteria, the presence of six waterfowl species listed under the Convention and the populations for 21 waterfowl species meeting the standard of Ramsar Convention. Key species are Siberian crane *Grus leucogeranus*, White-head crane *Grus monacha*, and Oriental white stork *Ciconia boyciana* which are National Class I protected, and Tundra swan *Cygnus columbianus*, Eurasian

spoonbill *Platalea leucorodia*, and Greater white-fronted goose *Anser albifrons* which are National Class II protected. A summary of observations by the Administration Bureau of Shengjin Lake National Nature Reserve for the 2012/13 winter season include the following:

- White-head crane *Grus monacha*: The main overwintering grounds are at Shengjin Lake. Observations early in the season identified 46 cranes, ahead of the main population which had not arrived at the time of the survey. White-head cranes move and forage in family units, with the cohort ranging from a few to hundreds of individuals.
- Oriental white stork *Ciconia boyciana*: Only 78 birds were identified and the numbers vary significantly from year to year.
- Siberian crane *Grus leucogeranus*: Only two individuals were observed. The Siberian crane normally overwinters on Boyang Lake, and uses Shengjin Lake as a stopover.
- Eurasian spoonbill *Platalea leucorodia*: The global population ranges from 31,000 to 34,000. Some 599 individuals were recorded, with two major groups with 280 individuals in one and 154 individuals in the other group.
- Tundra swan *Cygnus columbianus*: Some 554 individuals were recorded.

288. The biggest family of birds is anseriformes (waterfowl), which account for 83.9% of birds. The species with the largest population is Bean goose *Anser fabalis,* and to a lesser extent, Swan goose *Anser cygnoides*, Greylag *Anser anser*, and Lesser whitefronted goose *Anser erythropus*.

289. The Shengjin Lake National Nature Reserve is a very important wetland in the Yangtze River catchment area, providing overwintering grounds for more than 100,000 waterfowls comprising about 60 species. The number of overwintering birds varies from year to year, depending on the water levels. During the year of higher water level, food shortage impels the birds to other places for forage.

290. **Protected Species.** A number of protected species may be found in the G206 highway corridor. The nearby lakes support a variety of waterfowl, including the White fronted goose *Anser albifrons*, which is National Protection Level II, and the Swan goose *Anser cygnoides,* Spot billed duck *Anas poecilorhyncha*, Bean goose *Anser fabalis*, Falcated duck *Anas falcata*, Common teal *Anas crecca*, Mallard *Anas platyrhynchos*, and Smew *Mergellus albellus*, which are Province Protection Level II. However, the main habitat for waterfowl is Qili Lake to the south west of the scheme. The Tiantai Mountain Forest Park supports the following National Level II conservation species, the Chinese pangolin *Manis pentadactyla*, a ground burrowing animal, and two birds of prey Black baza *Aviceda leuphotes* and Black kite *Milvus migrans*.

291. Of the above four species that are under National level II protection, the IUCN listed the Chinese pangolin as Endangered (EN), the Swan goose as Vulnerable (VU), and the White fronted goose, the Black baza and the Black kite as Least Concern (LC) (see Table IV.3). Of the 17 bird species listed in the provincial protection list, all were listed as LC on the IUCN red list except the Swan goose *Anser cygnoides*, which was listed as Vulnerable (VU).

292. The woodlands and farmland along the Highway Subprojects also support a number of birds afforded Province Protection Level I such as the Indian cuckoo *Cuculus micropterus*, Grey capped pygmy woodpecker *Dendrocopos major*, Barn swallow *Hirundo rustica* and the Azure winged magpie *Cyanopica cyanus* and Province Protection Level II species such as the Common pheasant *Phasanus colchicus* and the Melodious laughing thrush *Garrulax canorus*.

293. Two species of reptiles that are on the provincial protection list were listed on the IUCN red list as EN (the Chinese coin turtle *Chinemys reevesii*) and VU (the Soft shell turtle *Trionyx sinensis*). These species showed a relatively wide distribution, having been recorded in all the road subproject areas. Other fauna receiving provincial protection include the Mongolian toad *Bufo raddei*, Asiatic toad *B. Gargarizans*, the Dark spotted frog *Rana nigromaculata* and the Chinese rat snake *Zaocys dhumnades*.

294. None of the species of flora identified in the study areas is afforded protection under the Chinese system. However, IUCN identifies Dawn redwood *Metasequoia glyptostroboides* as endangered*. M. glyptostroboides* is the only living species of the genus. It is commonly planted in Jiangxi and Anhui provinces and is a popular ornamental tree in villages, and does not occur naturally in the project area of influence.

Table IV.2: Typical Species of Flora Found in the Project Areas

Scientific Name	English Name	Chinese Name	Waterway	Road Subprojects				Protection Status	
			SWRIP	I	II	III	IV	IUCN	China
Trees and Shrubs									
Cunninghamia lanceolata	Chinese fir	为杉木	✓	✓	✓	✓	✓	LC	
Pinus massoniana	Masson's pine	马尾松	✓	✓	✓	✓	✓	LC	
Liquidambar formosana	Chinese sweet gum	枫香	✓	✓	✓	✓	✓	NA	
Pterocarya stenoptera	Chinese wingnut	枫杨		✓	✓	✓	✓	NA	
Taxodium ascendens	Pond cypress	常见种有池杉	✓	✓	✓	✓	✓	NA	
Metasequoia glyptostroboides	Dawn redwood	水杉	✓	✓	✓	✓	✓	**EN**	
Cryptomeria fortunei	China cedar	柳杉	✓	✓	✓	✓	✓	NA	
Quercus aliena	Oriental white oak	槲栎	✓		✓		✓	NA	
Vitex negundo	Five-leaved chaste tree	黄荆	✓		✓		✓	NA	
Lindera glauca	Greyblue spicebush	山胡椒			✓		✓	NA	
Paulownia tomentosa	Empress tree	泡桐	✓	✓			✓	NA	
Robinia pseudoacacia	Black locust	刺槐	✓	✓	✓	✓	✓	LC	
Populus simonii	Simon's poplar	杨树	✓	✓		✓	✓	NA	
Cinnamomum camphora	Camphor tree	樟树		✓			✓	NA	
Platycladus orientalis	Golden pygmy	侧柏		✓			✓	NT	
Ailanthus altissima	Tree of heaven	臭椿		✓			✓	NA	
Acer buergerianum	Trident maple	三角枫		✓			✓	NA	
Quercus acutissima	Sawtooth Oak	麻栎		✓			✓	NA	
Phytolacca acinosa	Indian poke	商陆			✓		✓	NA	
Ulmus pumila	Siberian elm	白榆			✓		✓	NA	
Platycarya strobilacea	Walnut family (no common name)	化香树			✓		✓	NA	
Rhododendron simsii	Formosa azalea	杜鹃花			✓		✓	NA	
Euscaphis japonica	Korean sweetheart tree	野鸦椿			✓		✓	NA	

Scientific Name	English Name	Chinese Name	Waterway	Road Subprojects				Protection Status	
			SWRIP	I	II	III	IV	IUCN	China
Sabina chinensis	Chinese juniper	圆柏	✓	✓	✓	✓		NA	
Broussonetia papyrifera	Paper mulberry	构树	✓			✓	✓	NA	
Styphnolobium japonicum	Chinese scholar tree	槐树		✓	✓	✓		NA	
Salix sp.	Weeping willow		✓					-	
Crops									
Oryza sativa	Asian rice	稻	✓	✓	✓	✓	✓	NA	
Gossypium spp	Cotton	棉花	✓	✓	✓	✓	✓	NA	
Zea mays	Maize	玉米	✓	✓	✓	✓	✓	NA	
Glycine max	Soybean	大豆	✓	✓	✓	✓	✓	NA	
Sesamum indicum	Sesame	芝麻指数	✓				✓	NA	
Nicotiana tabacum	Tobacco	烟草			✓		✓	NA	
Capsicum annuum	Chilli	辣椒	✓		✓		✓	NA	
Solanum melongena	Eggplant	茄	✓		✓		✓	NA	
Lycopersicon esculentum	Tomato	番茄	✓		✓		✓	NA	
Cucurbita moschata	Winter squash	南瓜	✓	✓	✓	✓	✓	NA	
Lactuca sativa	Lettuce	莴笋	✓		✓		✓	NA	
Daucus carota	Wild carrot	野胡萝卜	✓		✓		✓	DD	
Herbaceous Plants									
Leonurus japonicus	Chinese motherwort	益母草	✓	✓	✓	✓	✓	NA	
Plantago asiatica	Branched plantain	车前		✓	✓	✓	✓	NA	
Solanum nigrum	Black nightshade	龙葵	✓				✓	NA	
Artemisia argyi	Wormwood	艾		✓	✓			NA	
Artemisia lavandulaefolia	Artemisia	野艾蒿	✓		✓		✓	NK	
Polygonum aviculare	Knotweed	萹蓄	✓		✓		✓	NA	
Veronica didyma	Grey field speedwell	婆婆纳			✓		✓	NA	
Torilis scabra	Rough hedge parsley	窃衣	✓		✓		✓	NA	
Commelina communis	Asiatic dayflower	鸭跖草	✓		✓		✓	NA	
Chenopodium glaucum	Oak-leaved goosefoot	灰绿藜			✓		✓	NA	
Oenanthe javanica	Chinese parsley	水芹	✓		✓		✓	LC	
Verbena officinalis	Common verbena	马鞭草	✓		✓		✓	NA	
Xanthium sibiricum	Siberian cocklebur	苍耳	✓		✓		✓	NA	
Euphorbia supina	Prostrate surge	斑地锦	✓	✓	✓	✓	✓	NA	
Setaria viridis	Green foxtail	狗尾草	✓	✓	✓	✓	✓		
Menispermum dauricum	Moonseed	蝙蝠葛		✓	✓	✓	✓	NA	
Polygonum perfoliatum	Asiatic tearthumb	杠板归	✓		✓		✓	NA	
Rubia cordifolia	Common madder	茜草	✓		✓		✓	NA	
Salvia plebeia	Small flowered sage	荔枝草	✓		✓		✓	NA	
Zoysia japonica	Wild zoysia	结缕草	✓	✓	✓	✓	✓	NA	
Galium aparine	Goosegrass		✓					NA	
Galium tricorne	Rough corn bedstraw	麦仁珠	✓					NA	
Imperata cylindrica	Japanese	白茅	✓	✓	✓	✓	✓	NA	

Scientific Name	English Name	Chinese Name	Waterway	Road Subprojects				Protection Status	
			SWRIP	I	II	III	IV	IUCN	China
	bloodgrass								
Conyza Canadensis	Canadian fleabane	小飞蓬	✓				✓	NA	
Achyranthes bidentata	Agrimony	牛膝	✓					NA	
Ponds and Waterlogged areas									
Marsilea quadrifolia	Water shamrock	苹	✓	✓	✓	✓	✓	LC	
Azolla imbricata	Mosquito ferm	满江红	✓					LC	
Rumex acetosa	Garden sorrel	酸模	✓					NA	
Polygonum hydropiper	Water pepper	水蓼	✓				✓	LC	
Alternanthera philoxeroides	Alligator weed	水花生	✓					NA	
Ranunculus chinensis	Poisonous buttercup herb	茴茴蒜	✓					NA	
Trapa incisa	Water chestnut	小果菱	✓					LC	
Myriophyllum spicatum	Spiked watermilfoil	穗状狐尾藻	✓					LC	
Myriophyllum verticillatum	Whorled watermilfoil	狐尾藻	✓					NA	
Veronica anagallis	Water speedwell	仙桃草	✓					LC	
Ceratophyllum demersum	Cedar moss	金鱼藻沉没	✓					LC	
Oenanthe sinensis	Water dropwort	中华水芹	✓					NA	
Nymphoides peltatum	Floating heart	荇菜	✓					NA	
Potamogeton distinctus	Bog pondweed	眼子菜	✓					LC	
Potamogeton malaianus	Bamboo leaved pondweed	竹叶眼子菜	✓					LC	
Potamogeton pectinatus	Fennel pondweed	蓖齿眼子菜	✓					LC	
Potamogeton crispus	Curly leaved pondweed	菹草	✓					LC	
Hydrilla verticillata	Indian stargrass	黑藻	✓					LC	
Hydrocharis dubia	Frogbit	水鳖	✓					LC	
Vallisneria natans	Tape grass	苦草	✓					LC	
Leersia japonica	Japanese cut grass	假稻	✓					NA	
Phragmites australis	Common reed	芦苇	✓	✓	✓	✓	✓	LC	
Zizania latifolia	Wild rice	茭白	✓	✓	✓	✓		NA	
Juncellus serotinus	Dongguan grass	水莎草	✓	✓	✓	✓		NA	
Scirpus yagara	Yagara bulrush	荆三棱	✓					NA	
Eleocharis plantagineiformis	Wild water chestnut	野荸荠	✓					NA	
Eleocharis yokoscensis	Water chestnut	牛毛毡	✓					NA	
Alismataceae	Water plantain	泽泻科	✓						
Najas minor	Slender naiad	小茨藻	✓					LC	
Typha orientalis	Bulrush	香蒲	✓					LC	
Hippochaete ramosissimum	Reed		✓	✓	✓	✓	✓	N/K	
Malachium aquaticum	Water chickweed	玛拉基书水车	✓					NA	

Scientific Name	English Name	Chinese Name	Waterway	Road Subprojects				Protection Status	
			SWRIP	I	II	III	IV	IUCN	China
IUCN = International Union for Conservation of Nature; N/K = Not Known in IUCN database; N/A = not assessed for IUCN classification; DD = data deficient: LC = least concern; NT = near threatened; VU = vulnerable; EN = endangered; CR = critically endangered (see http://www.iucnredlist.org).									

Table IV.3: Typical Species of Fauna Potentially Found in the Project Areas[17]

Scientific Name	English Name	Chinese Name	SRWIP and Port	Road Subprojects				Protection Status	
				I	II	III	IV	IUCN	China
Mammals									
Erinaceus amurensis	Amur hedgehog	北方刺猬	✓	✓	✓	✓	✓	LC	
Erinaceus europaeus	Hedgehog	刺猬	✓	✓		✓		LC	
Crocidura suaveolens	Lesser white-toothed shrew	小麝鼩	✓				✓	LC	
Mogera insularis	Insular mole	华南缺齿鼹					✓	LC	
Rhinolophus affinis	Intermediate horseshoe bat	中菊头蝠	✓				✓	LC	
Rhinolophus cornutus	Little Japanese horseshoe bat	角菊头蝠	✓				✓	LC	
Hipposideros armiger	Great roundleaf bat	大蹄蝠	✓				✓	LC	
Hipposideros pratti	Pratt's roundleaf bat	普氏蹄蝠	✓				✓	LC	
Pipistrellus minus	Lesser horseshoe bat	小伏翼	✓	✓	✓	✓	✓	LC	
Nyctalus velutinus	Chinese noctule bat	中华山蝠		✓				LC	
Vespertilio superans	Asian parti-coloured bat	东方蝙蝠		✓				LC	
Miniopterus schreibersil	Schreiber's long fingered bat	折翼蝠		✓	✓	✓	✓	NT	
Manis pentadactyla	Chinese Pangolin	穿山甲					✓	**EN**	National II
Lepus europaeus	European hare	欧兔		✓				LC	
Lepus sinensis	Chinese hare	华南兔	✓				✓	LC	
Lepus capensis	Brown hare (Cape hare)	草兔	✓	✓	✓	✓	✓	LC	
Callosciurus erythraeus	Pallas' squirrel	赤腹松鼠					✓	LC	
Tamiops swinhoei	Swinhoei's striped squirrel	隐纹花松鼠	✓				✓	LC	
Sciurus vulgaris	Red squirrel	欧亚红松鼠		✓				LC	
Sciurotamias davidianus	Père David's rock squirrel	岩松鼠					✓	LC	
Eothenomys melanogaster	Père David's vole	黑腹绒鼠	✓				✓	LC	
Microtus fortis	Reed vole	东方田鼠	✓				✓	LC	
Micromys minutus	Harvest mouse	巢鼠	✓	✓	✓	✓	✓	LC	
Mus musculus	House mouse	小家鼠	✓	✓	✓	✓	✓	LC	
Apodemus agrarius	Striped field mouse	黑线姬鼠	✓	✓	✓	✓	✓	LC	
Apodemus draco	South China field mouse	中华姬鼠	✓	✓	✓	✓	✓	LC	
Rattus tanezumi	Tanezumi rat (Asian house rat)	黄胸鼠	✓	✓	✓	✓	✓	LC	
Rattus norvegicus	Brown rat	褐家鼠	✓	✓	✓	✓	✓	LC	
Niviventer confucianus	Chinese white bellied rat	社鼠		✓	✓	✓	✓	LC	
Niviventer fulvescens	Chestnut white bellied rat	针毛鼠			✓		✓	LC	

[17] The list of fauna is based on field observations and literature searches. Consequently, not all the species listed were identified in the field.

Scientific Name	English Name	Chinese Name	SRWIP and Port	Road Subprojects				Protection Status	
				I	II	III	IV	IUCN	China
Rattus nitidus	Himalayan field rat	大足鼠					✓	LC	
Berylmys bowersi	Bower's white-toothed rat	青毛硕鼠					✓	LC	
Leopoldamys edwardsi	Edward's long-tailed giant rat	白腹巨鼠					✓	LC	
Martes flavigula	Yellow throated martin	青鼬			✓		✓	LC	
Mustela kathiah	Yellow bellied weasel	黄腹鼬					✓	LC	
Mustela sibirica	Himalayan weasel	黄鼬	✓	✓	✓	✓		LC	
Meles meles	Badger	狗獾	✓				✓	LC	Province II
Herpestes urva	Crab eating mongoose	食蟹獴					✓	LC	
Prionailurus bengalensis	Leopard cat	豹猫	✓				✓	LC	Province I
Sus scrofa	Wild boar	野猪					✓	LC	
Cricetulus barabensis	Chinese striped hamster	黑线仓鼠	✓	✓				LC	
Tscherskia triton	Greater long-tailed hamster	大仓鼠	✓					LC	
Microtinae	Family lemmings and muskrat	林旅鼠属						-	
Amphibians									
Cynops orientalis	Chinese fire belly newt	东方蝾螈			✓		✓	LC	
Bufo bufo	Common toad	大蟾蜍	✓	✓	✓	✓	✓	LC	
Bufo raddei	Mongolian toad	花背蟾蜍	✓	✓	✓	✓		LC	Province II
Bufo gargarizans	Asiatic toad	中华蟾蜍	✓					LC	Province II
Hyla arborea	European tree frog	无斑雨蛙			✓		✓	LC	
Rana nigromaculata	Dark spotted frog	黑斑蛙	✓	✓	✓		✓	NT	Province II
Rana plancyi	Beijing gold striped pond frog	金线蛙	✓		✓		✓	LC	Province II
Rana limnocharis	Rice frog	泽蛙	✓	✓	✓	✓	✓	LC	
Rana japonica	Japanese rice frog	日本林蛙		✓	✓	✓	✓	LC	
Rana latouchii	Brown wood frog	阔褶娃	✓	✓	✓	✓	✓	LC	
Rana tormotus	Concave eared torrent frog	凹耳蛙		✓				NK	
Rana catesbeiana	American bullfrog	牛蛙		✓				LC	
Kaloula borealis	Northern sticky frog	北方狭口蛙		✓	✓	✓		LC	
Microhyla heymonsi	Arcuate spotted pygmy frog	小弧斑姬蛙	✓				✓	LC	
Microhyla ornata	Ornate rice frog	饰纹姬蛙	✓	✓	✓	✓	✓	LC	
Hyla chinensis	Common Chinese tree frog	中国雨蛙		✓				LC	
Reptiles									
Chinemys reevesii	Chinese coin turtle	乌龟	✓	✓	✓	✓	✓	**EN**	Province II
Trionyx sinensis	Soft shell turtle	鳖	✓	✓	✓	✓	✓	**VU**	Province II
Eumeces elegans	Five-striped blue tailed skink	蓝尾石龙子	✓				✓	NA	

Scientific Name	English Name	Chinese Name	SRWIP and Port	Road Subprojects				Protection Status	
				I	II	III	IV	IUCN	China
Eumeces chinensis	Chinese skink	中国石龙子	✓		✓		✓	NA	
Sphenomorphus indicus	Indian forest skink	铜蜓蜥	✓				✓	NA	
Takydromus septentrionalis	Northern grass lizard	北草蜥		✓	✓	✓		NA	
Takydromus wolteri	Mountain grass lizard	白条草蜥	✓	✓	✓	✓	✓	NA	
Dinodon rufozonatum	Red banded snake	赤链蛇	✓	✓	✓	✓	✓	NA	
Sinonatrix annularis	Ringed water snake	赤链华游蛇					✓	NA	
Elaphe carinata	King rat snake	王锦蛇		✓			✓	NA	
Elaphe dione	Dione rat snake	白条锦蛇		✓	✓	✓		NA	
Elaphe rufodorsata	Red backed rat snake	乌梢蛇	✓	✓	✓	✓	✓	LC	
Elaphe taeniura	Beauty rat snake	黑眉锦蛇	✓					NA	Province II
Zaocys dhumnades	Chinese rat snake	乌梢蛇	✓	✓			✓	NA	Province II
Agkistrodon halys	Siberian pit viper	中介蝮	✓	✓				NA	
Bungarus multicinctus	Many-banded krait	银环蛇					✓	LC	
Gloydius halys	Pallas pit viper	蝮蛇					✓	NA	
Eremias brenchleyi	Lizard	山地麻蜥		✓				NA	
Gekko japonicas	Schlegel's Japanese gecko	多疣壁虎		✓	✓	✓		LC	
Gekko swinhonis	Gecko house lizard	无蹼壁虎		✓	✓	✓		**VU**	
Birds									
Tachybaptus ruficollis	Little grebe	小□□	✓	✓	✓	✓	✓	LC	
Ardeola bacchus	Chinese pond heron	池鹭	✓	✓	✓	✓	✓	LC	
Bubulcus ibis	Cattle egret	牛背鹭	✓	✓	✓	✓	✓	LC	
Egretta alba	Great egret	大白鹭		✓	✓	✓		N/A	
Egretta garzetta	Little egret	小白鹭	✓	✓	✓	✓	✓	LC	
Ixobrychus sinensis	Yellow bittern	黄斑苇鳽		✓	✓	✓		LC	
Ixobrychus cinnamomcus	Cinnamon bittern	栗苇鳽	✓	✓	✓	✓		LC	
Ixobrychus flavicollis	Black bittern	黑苇鳽	✓					LC	
Nyticorzaz nyticorax	Black-crowned night heron	夜鹭	✓	✓	✓	✓		LC	
Hydrophasianus chirurgus	Pheasant-tailed jacana	水雉	✓	✓	✓	✓		LC	
Anas poecilorhyncha	Spot billed duck	斑嘴鸭					✓	LC	Province II
Aviceda leuphotes	Black baza	黑冠鹃隼					✓	LC	National II
Milvus migrans	Black kite	鸢					✓	LC	National II
Phasanus colchicus	Common pheasant	环颈雉	✓	✓	✓	✓	✓	N/A	Province II
Gallinula chloropus	Common moorhen	黑水鸡	✓	✓	✓	✓	✓	LC	
Amaurornis akool	Brown crake	红脚苦恶鸟	✓	✓	✓	✓		LC	
Amaurornis phoenicurus	White-breasted waterhen	白胸苦恶鸟		✓	✓	✓		LC	
Vanellus cinereus	Grey headed	灰头麦鸡		✓	✓	✓	✓	LC	

Scientific Name	English Name	Chinese Name	SRWIP and Port	Road Subprojects				Protection Status	
				I	II	III	IV	IUCN	China
	lapwing								
Vanellus vanellus	Northern lapwing	凤头麦鸡		✓	✓	✓		LC	
Charadrius dubius	Little Ringed Plover	金眶鸻		✓	✓	✓		LC	
Charadrius alexandrinus	Kentish Plover	环颈鸻	✓					LC	
Tringa ochropus	Green Sandpiper	白腰草鹬	✓					LC	
Tringa nebularia	Common Greenshank	青脚鹬	✓					LC	
Chlidonias hybrida	Whiskered tern	须浮鸥	✓					LC	
Sterna albifrons	Little tern	白额燕鸥	✓					LC	
Columba livia	Rock pigeon	原鸽	✓	✓	✓	✓		LC	
Streptopelia orientalis	Rufous turtle dove	山斑鸠	✓	✓	✓	✓	✓	LC	
Streptopelia chinensis	Spotted dove	珠颈斑鸠	✓	✓	✓	✓	✓	LC	
Cuculus canorus	Common cuckoo	大杜鹃	✓	✓	✓	✓		LC	
Cuculus micropterus	Indian cuckoo	四声杜鹃		✓	✓	✓	✓	LC	Province I
Cuculus poliocephalus	Lesser cuckoo	小杜鹃		✓				LC	
Halcyon pileata	Black-capped kingfisher	蓝翡翠	✓					LC	
Dendrocopos major	Great spotted woodpecker	大拟啄木鸟	✓	✓	✓	✓	✓	LC	Province I
Alauda arvensis	Eurasian skylark	云雀		✓	✓	✓		LC	
Picus canus	Grey faced woodpecker	灰头绿啄木鸟					✓	LC	Province I
Hirundo rustica	Barn swallow	家燕	✓	✓	✓	✓	✓	LC	Province I
Hirundo daurica	Red rumped swallow	金腰燕					✓	LC	Province I
Motacilla alba	White wagtail	白鹡鸰	✓	✓	✓	✓	✓	LC	
Spizixos sermitorques	Yellow wagtail	领雀嘴鹎	✓	✓	✓	✓		LC	
Spizixos semitorques	Collared finchbill	领雀嘴鹎	✓					LC	
Pericrocotus cantonensis	Swinhoe's minivet	小灰山椒鸟					✓	LC	
Pycnonotus sinensis	Light vented bulbul	白头鹎	✓	✓	✓	✓	✓	LC	
Lanius schach	Long-tailed shrike	大红背伯劳	✓	✓	✓	✓		LC	Province II
Lanius cristatus	Red-tailed shrike	红尾伯劳		✓	✓	✓		LC	
Oriolus chinensis	Black naped oriole	黑枕黄鹂	✓					LC	
Dicrurus macrocercus	Black drongo	黑卷尾	✓	✓	✓	✓	✓	LC	
Dicrurus leucophaeus	Ashy drongo	灰卷尾	✓	✓	✓	✓		LC	
Sturnus cineraceus	Ashy starling	灰椋鸟	✓	✓	✓	✓	✓	LC	
Sturnus sericeus	Silky starling	丝光椋鸟	✓	✓	✓	✓	✓	LC	
Acridotheres cristatellus	Crested Myna	八哥	✓	✓	✓	✓	✓	LC	
Pica pica	Eurasian magpie	喜鹊	✓	✓	✓	✓	✓	LC	
Cyanopica cyanus	Azure winged magpie	灰喜鹊	✓	✓	✓	✓	✓	LC	Province I
Urocissa erythrorhyncha	Red-billed blue magpie	红嘴蓝鹊					✓	LC	Province I
Turdus merula	Eurasian	乌鶇	✓	✓	✓	✓		LC	

Scientific Name	English Name	Chinese Name	SRWIP and Port	Road Subprojects				Protection Status	
				I	II	III	IV	IUCN	China
	blackbird								
Phylloscopus borealis	Arctic warbler	极北柳莺	✓					LC	
Garrulax perspicillatus	Laughing thrush	黑脸噪鹛	✓				✓	LC	
Garrulax canorus	Melodious laughing thrush	画眉		✓	✓		✓	LC	Province II
Cettia diphone	Japanese bush-warbler	日本树莺		✓	✓	✓		LC	
Cettia fortipes	Brown flanked bush warbler	强脚树莺					✓	LC	
Cistic Cisticola juncidis	Zitting cisticola	棕扇尾莺		✓	✓	✓		LC	
Parus major	Great tit	大山雀	✓	✓	✓	✓	✓	LC	
Aegithalos caudatus	Long-tailed tit	银喉山雀	✓	✓	✓	✓		LC	
Aegithalos concinnus	Red-headed tit	红头山雀		✓	✓	✓		LC	
Passer domesticus	House sparrow	家麻雀	✓	✓	✓	✓	✓	LC	
Passer montanus	Eurasian tree sparrow	麻雀		✓	✓	✓		LC	
Lonchura striata	White rumped munia	白腰文鸟					✓	LC	
Eophona migratoria	Yellow-billed grosbeak	黑尾蜡嘴雀	✓	✓	✓	✓	✓	LC	
Eophona personata	Japanese grosbeak	黑头蜡嘴雀		✓	✓	✓	✓	LC	
Emberiza pusilla	Little bunting	小鹀		✓	✓	✓		LC	
Emberiza cioides	Meadow bunting	三道眉草鹀		✓	✓	✓		LC	
Emberiza rustica	Rustic bunting	田鹀		✓	✓	✓		LC	
Anser fabalis	Bean goose	豆雁					✓	LC	Province II
Anser cygnoides	Swan goose	鸿雁					✓	**VU**	Province II
Anser albifrons	White fronted goose	白额雁					✓	LC	National II
Anas falcata	Falcated duck	罗纹鸭					✓	NT	Province II
Anas crecca	Common teal	绿翅鸭					✓	LC	Province II
Anas platyrhynchos	Mallard	绿头鸭					✓	LC	Province II
Mergellus albellus	Smew	斑头秋沙鸭					✓	LC	Province II
Ardea purpurea	Purple heron	草鹭					✓	LC	
Ardea cinerea	Grey heron	苍鹭		✓	✓	✓	✓	LC	
Oriolus chinesis	Black naped oriole	黑枕黄鹂		✓				LC	
Corvus cornix	Hooded crow	冠小嘴乌鸦		✓				LC	
Garrulus glandarius	Eurasian jay	松鸦		✓				LC	
Strigiformes	Owls	鸮形目		✓				-	
Fish									
Zacco platypus	Freshwater minnow	宽鳍鱲	✓					NA	
Opsariichthys bidens	Chinese hook snout carp	马口鱼	✓					LC	
Acrossocheilus fasciatus	Type of ray-finned fish	光唇鱼	✓					NA	
Carassius auratus	Goldfish	黑鲫	✓					LC	
Mylopharyngodon piceus	Black carp	青鱼	✓					DD	
Ctenopharyngodon idellus	Grass carp	草鱼	✓					NA	

Scientific Name	English Name	Chinese Name	SRWIP and Port	Road Subprojects				Protection Status	
				I	II	III	IV	IUCN	China
Hypophthalmichthys molitrix	Silver carp	鲢鱼	✓					DD	
Aristichthys nobilis	Big head carp	鳙鱼	✓					NA	
Parabramis pekinensis	White amur bream	鳊	✓					NA	
Pseudorasbora parva	Topmouth gudgeon	麦穗鱼	✓					LC	
Abbottina rivularis	Chinese falso gudgeon	棒花鱼	✓					NA	
Squalidus argentatus	No common name		✓					DD	
Pseudogobio vaillanti	No common name	似鮈	✓					LC	
Gnathopogon spp.	No common name	颌须鮈	✓					NK	
Saurogobio dabryi	Chinese lizard gudgeon	蛇鮈	✓					NA	
Hemiculter leucisculus	Sharpbelly		✓					LC	
Phoxinus lagowskii	Lagowshii's minnow	拉氏鱥	✓					NA	
Squaliobarbus curriculus	Barbel chub	赤眼鳟	✓					DD	
Rhodeus sericeus	Bittering	黑龙江鳑鲏	✓					LC	
Acheilongnathu gracilis	No common name	无须鱊	✓					NA	
Acheilongnathu chankaensis	No common name	兴凯鱊	✓					NA	
Misgurnus anguillicaudatus	Pond loach	泥鳅	✓					LC	
Cobitis sinensis	Siberian spiny loach	中华花鳅	✓					LC	
Cobitis rarus	No common name		✓					NA	
Parabotia fasciata	No common name	花斑副沙鳅	✓					LA	
Vanmanenia stenosoma	No common name	原缨口鳅	✓					NA	
Silurus asotus	Amur catfish	鲇	✓					LC	
Pelteobagrus fulvidraco	Yellow catfish	黄颡鱼	✓					NA	
Pseudobagrus truncates	Cuttail bullhead	切尾拟鲿	✓					NA	
Liobagrus styani	No common name	司氏	✓					NA	
Rhinogobius spp	Goby		✓						
Odontobutis obscures	No common name		✓					NA	
Mastacembelus aculeatus	Lesser spiny eel		✓					NA	
Siniperca chuatsi	Mandarin fish	鳜	✓					DD	
Monopterus alba	Asian swamp eel	黄鳝	✓					NA	
IUCN = International Union for Conservation of Nature; NK = Not Known in IUCN database; NA = not assessed for IUCN classification; DD = data deficient: LC = least concern; NT = near threatened; VU = vulnerable; EN = endangered; CR = critically endangered (see http://www.iucnredlist.org).									

Source: Domestic EIRs.

D. Socioeconomic Conditions

295. **Administrative Jurisdictions.** The proposed projects are located across six cities and counties in Anhui Province as indicated in Table IV.4. Hefei is the capital of Anhui Province and is located on the north side of the Yangtze River. It had a population of about 5.7million in 2010, an increase of almost 28% on the 2000 Census.

296. The second largest city in Anhui Province is Wuhu, with a population of about 2.3 million. Wuhu City lies on the southern shore of the Yangtze River. Wuhu governs Wuhu, Fanchang, Nanling and Wuwei Counties and four jurisdictions of Jinghu, Gejang, Jiujfiang and Sanqu.

297. Ma'anshan City is located on the south bank of the Yangtze in east Anhui and close to Jiangsu Province and is the nearest port in Anhui to the Yangtze River Delta. The population of the city in 2012 was about 2.3 million. Ma'anshan City administers Huashan District, Bowang District, Dangtu County, Hexian County and Hanshan County.

298. Chizhou City is located in southwest Anhui Province on the south bank of the Yangtze River. It is an important riverside port and historical city, with a population of 1.4 million in 2012. The City administers Guichi District, Dongzhi County, Shitai County, Qingyang County and Jiuhua Mountain Scenic Spot.

299. Xuancheng City is located in southeast Anhui. The City has jurisdiction over five counties, one city and one district, with a total population of about 2.74 million. The Shuiyang River flows northwards, providing access to the Yangtze River. The highway network includes the Xuancheng Hangzhou Expressway. There are also north-south Anhui-Jiangxi Railway and the east-west Xuancheng-Hanzhou Railway.

Table IV.4: Towns (Sub-district) in the Project Areas

Subproject	City/County in Project Area	Towns (Sub-district)
SRWIP and Xuanzhou Port	Xuancheng	Jingting Mt. Sub-district, Yangxian Township, Zhuqiao Township, Wuxing Township, Xinhe Town, Shuiyang Town, and Yanchi Town
Ma'anshan North Corridor (S367)	Hanshan	Shiyang Town and Shanhou Town
	He	Zhaoguan Town and Xianzong Town
Kedian – Mujiating (S320/G318)	Nanling	Jishan Town and Gongshan Town
S319 Erba – Wuwei	Wuwei	Erba Town, Tanggou Town, Tugou Town, Fudu Town, and Wucheng Town
G206 Dongliu – Yaodu	Dongzhi	Dongliu Town and Yaodu Town

300. **Population.** The population of Anhui Province was about 59.5 million in 2010, of whom about 43% are classed as urban and 57% as rural, based on their registration. With a land area of 139,400 km^2, the population density in the province averages about 440 individuals / km^2. Population data for the study areas are presented in Table IV.5. The highest proportion of urbanisation is in Xuangzhou with 42.3% of the population registered as urban. The Highway Subprojects are located in areas with much lower levels of urban residents, varying between 18.87% in Hanshan (Subproject I Ma'anshan North Corridor) to 12.59% in Wuwei County (Subproject III S319). In Anhui province, the ratio of males to females in 2011 was 107.8:100, which is slightly higher than the national average of 105.2:100 in 2010.

301. **Economy and GDP.** In 2010, the per capita gross domestic product (GDP) for Anhui Province was CNY20,888, which is almost half the national average of CNY37,977. The average per capita GDP for the project areas was CNY17,767, varying between 12,888 in Dongzhi County and 20,779 in Wuwei County (Table IV.6). Output from manufacturing provided the highest proportion of GDP at 50.72% for the study areas, which is above the national average of 46.8%, followed by the tertiary sector with 31.17% compared to a national average of 43%. The comparatively high output from the primary sector, as indicated by 18.08% GDP, reflects the importance of agriculture and extractive industries in the study area.

Table IV.5: Demographics of the Cities and Counties in the Project Area (2010)

Administration Division	Total number of households (10^4)	Total population (10^4)	Average population per household	By gender (10^4)		By status of household registration (10^4)		
				Males	Females	Urban	Rural	% Urban
Xuanzhou	30.05	86.59	2.88	44.56	42.03	36.6	50	42.3%
Wuwei	44.85	142.44	3.18	74.36	68.08	17.93	124.51	12.59%
Dongzhi	18.33	54.50	2.97	27.86	26.64	7.22	47.28	13.24%
Nanling	18.59	55.44	2.98	28.60	26.85	8.33	47.12	15.02%
Hanshan	15.10	44.47	2.95	23.20	21.28	8.39	36.08	18.87%
He	20.35	66.55	3.27	34.91	31.64	9.48	57.07	14.24%
Anhui	**1825.70**	**5950**	**3.09**	**3024.4**	**2925.5**	**2559.1**	**3391**	**43.01%**
Project area	**147.27**	**450**	**3.06**	**233.49**	**216.52**	**87.95**	**362.06**	**19.54%**

Source: Anhui Statistical Yearbook 2011.

Table IV.6: GDP and Industrial Composition

Administration Division	GDP (10^2million yuan)		Proportion of industries (%)			Per Capita GDP
	Total	Growth rate	Primary industries	Secondary industries	Tertiary industries	
Xuanzhou	147.5	13.30	23.0	40.0	37.0	17,164
Wuwei	526.0	15.00	16.80	47.20	36.00	20,779
Dongzhi	70.2	16.10	25.10	41.70	33.20	12,888
Nanling	101.4	18.1	18.9	57.5	23.6	18,308
Hanshan	80.4	15.70	20.10	49.00	30.90	14,509
He	92.0	15.70	19.70	51.60	28.70	16,900
Anhui	**12,263.4**	**14.50**	**14.10**	**52.10**	**33.80**	**20,888**
Project area	**1,140.2**	**15.32**	**18.08**	**50.72**	**31.17**	**17,767**
China	**39,798**		**10.2**	**46.8**	**43.0**	**37,977**

Source: Anhui Statistical Yearbook 2011.

302. **Employment.** Typical incomes for urban and rural workers are indicated in Table IV.7. Urban salaried workers are earning between four and nine times the income of rural people in the same area.

Table IV.7: Income disparity between urban and rural residents

Administrative Region	Average income of urban employees (RMB/Year)	Average income of rural peasants (RMB/Year)	Ratio of urban to rural income
Wuhu City	32,154	6,738	4.8
Chizhou City	31,275	5,827	5.4
Ma'anshan City	46,439	5,285	8.8
Wuwei County	33,545	6,193	5.4
Nanling County	35,186	7,861	4.5
Dongzhi County	30,860	5,838	5.3
Hexian County	30,484	8,235	3.7
Hanshan County	37,875	8,319	4.6

Source: National EIR.

303. **Socio-economic indicators.** A detailed account of the socio-economic indicators for communities affected by the subproject, based on interviews with affected persons conducted by the PPTA, are presented in the Resettlement Plans and summarised in Table IV.8. The affected persons (AP) are all Han Chinese, with no ethnic minorities. The age structure typically shows that a fifth of the population are children, some two-thirds are of working age, and 10-20% are over 60. The proportion of people over 60 is notably higher along Highway Subproject IV, which may reflect the urbanisation of younger people, leaving proportionally older people in rural areas. Between 40% and 50% of the APs have received junior high level education, but only around 10% have had higher education. Illiteracy rates, where identified, are about 5%. These figures are similar to the county statistics for education (Table IV.X). Housing construction is fairly similar across the study areas. The average size of houses is notably higher among APs along Highway Subproject II, who also have less cultivation land per head. Crop production and the income per mu of cultivated land are similar across the study areas. Based on the household goods enjoyed by APs, the population in the study area enjoys a medium level standard of living, with access to a range of electronic goods and transportation. Average net income is relatively similar across most of the study areas, with the exception of Highway Subproject IV which may in part be accounted for by the relatively higher proportion of elderly people. The main source of income is from wages and off-farm employment. Average expenditure varies from 3,347 Yuan to 5,360 Yuan, which is comparatively low compared to rural people in Cities and Counties (Table IV.8 above).

304. **Gender Issues.** The socio-economic surveys undertaken by the PPTA found significant differences between males and females. No widows, divorced or abandoned women were found in the surveys. The level of education was higher for men than women by several percentage points across all levels of education. The contribution of men's income to the total household varied between two thirds and three quarters. Women's employment opportunities were largely restricted to farming, and are expected to take the greater share of caring for relatives and household. The proportion of women working outside the home is much lower than men. For example, in the SRWIP study area 27.4% of women worked away from home compared to 58% of men. In Yimu it was noted that older women tended to take care of families and younger women tended to work outside the home.

Table IV.8: Socio-economic Indicators in the Project Areas

Indicators	Waterway	Road Subprojects			
	SRWIP	I	II	III	IV
Population					
Affected Households	157	1538	519	1552	693
Est. Population	486	6497		6146	2448
Sampled AH	40	308	135	451	144
Affected Persons	154	1294	438	1533	401
Proportion of Women	47.4%			51%	47.4%
Sampling Rate	25.5%	20%	26.01%	29.03%	16.29%
Ethnic group	Han	Han	Han	Han	Han
Age Structure					
0-17 yrs	(0-17) 22%	23. 75	(0-16) 20.32%	(0-16) 19.69%	22.5%
18-35	(18-40) 41%	20.47	(17-40) 42.47%	(17-60) 66.93%	(18-40) 39.6%
36-60	(41-60) 23%	40.32	(40- 60) 28.54%		(41-60) 24.5%
+60	14%	15.46	(+60) 8.68%	(+60) 13.38%	21.7%
Total					
Education Status					
Pre School or Illiterate	14.94%	8.27%	22.37%		11.2%
Primary School	20.78%	35.36%		25.2%	28.9%
Junior High School	49.35%	48.07%	43.38%	44.6%	37.9%
Senior High School	10.39%		25.11%	20.2%	13.0%
Higher education	4.55%	8.29%	9.13%	10.1%	9.0%
Housing					
Construction materials	Masonry concrete structures	Masonry concrete and timber	Masonry concrete and earth timber	Masonry timber structure	Masonry tile structure
Average size / HH	131.9 m2	136.42 m2	198.52m2	165.03 m2	129 m2
Average size / capita	34.26 m2	36.58 m2	71.31m2	48.93 m2	36.86 m2
Land Resources					
Average cultivated area/HH	4.98 mu	3.82 mu	2.01 mu	4.29 mu	4.7 mu
Average cultivated area / capita	1.29 mu	1.21 mu	0.78 mu	1.26 mu	1.34 mu
Main crops	Paddy rice, cotton and corn	Paddy rice, rape and cotton	Paddy rice, wheat, some vegetations, commercial forests and fruit	Paddy rice, cotton and vegetables	Paddy rice, cotton and corn
Average net annual income	1,000 Yuan/mu	1,000 Yuan/mu	950 Yuan/mu		1,300 Yuan/mu
No. Household Goods / HH					
TV set	2.2	2.49	1.42	1.11	1.5
Refrigerator	0.45	0.73	0.84		1
Fans	2.6	2.97			3
Air Conditioning	0.37	0.76			
Fixed or mobile telephone	2.4	2.14	2.85	2.45	2
Bicycles		1.86	2.34	0.86	N/A
Motorcycles	0.8	1.38			N/A
Tractor		0.38	0.08	0.03	N/A
Overall standard of living		Medium	Medium	Medium	Medium
HH Income and Expenditure					
Average Net	8,320 Yuan	9,350 Yuan	9,847 Yuan	9,770 Yuan	6,214 Yuan

Indicators	Waterway	Road Subprojects			
	SRWIP	I	II	III	IV
Income/HH					
- Agriculture		18.44%	7.71%	19.89%	
- Stockbreeding		14.76%	1.56%	12.94%	
- Wages and Employment	91.8%	63.00%	89.13%	62.30%	91%
- Other non-agricultural	3.8%	2.53%		2.29%	
- Property	4.4%	1.28%	1.6%	1.30%	4.5%
Gross Expenditure/HH	4,130 Yuan	4,936 Yuan	3,704 Yuan	5,360 Yuan	3,347 Yuan
- Food		29.54%			
- Clothes		9.57%			
- Domestic equipment		12.42%			
- Medical care		8.65%			
- Traffic / comms		8.27%			
- Education, culture, amusement		11.19%			
- Other		15.34%			

Source: PPTA Resettlement Report.

Table IV.9: Educational Levels of Population Aged 6 or Above

Cities in Project Area	Junior college or above (%)	Senior high/ secondary technical school (%)	Junior high school (%)	Primary school (%)	Illiteracy rate (%)
Wuhu	13.28	15.30	33.17	26.85	5.87
Chizhou	6.66	11.25	33.54	32.98	8.53
Ma'anshan	11.12	14.94	37.63	26.00	5.24
Xuancheng	5.52	10.74	36.56	31.40	9.46
Anhui	6.73	10.84	38.60	27.76	8.10

Source: Sixth National Census in 2010.

Table IV.10: Health Care Conditions of Project Areas

Item	Anhui	Wuhu	Chizhou	Ma'anshan	Xuancheng
Total number of medical institutions	7383	462	237	301	379
Number of medical institutions per 10,000 people	1.2	2.0	1.5	2.3	1.4
Total number of sickbeds	186116	10,753	4199	4310	7954
Number of sickbeds per 10,000 people	31.3	46.9	26.2	33.4	28.6
Total number of medical workers	247493	14,993	6,121	8,304	10,694
Number of medical workers per 10,000 people	42	65	38	64	38
Total number of medical technicians	206,403	12,490	5,278	6,917	9,049
Number of medical technicians per 10,000 people	35	54	33	54	33

Table IV.11: Length of Highways by type and inland waterways in the Project Areas (by Class) (2010)

Cities	Total length of inland waterways (km)	Total length of highways (km)	Graded highways (km)						Ungraded highways (km)
			Total	Expressway	Class I	Class II	Class III	Class IV	
Wuhu	N/A	4809	4400	113	69	413	729	3076	409
Chizhou	N/A	6828	6087	215	44	669	274	4885	741
Ma'anshan	N/A	2223	2181	41	/	173	153	1812	43
Xuancheng	N/A	11956	11766	102	21	887	930	9826	190
Anhui	6,507	149,382	142,340	2,929	499	10,504	15,306	113,106	7,042

Source: Anhui Statistical Yearbook 2011. N/A = data not available at city and county level.

305. **Health and Health Care.** The provision of health resources is variable across the study areas, with greater facilities per head of population in Wuhu and Ma'anshan reflecting the concentration of facilities in the larger cities (see Table IV.10).

306. The disease schistosomiasis is endemic in the lower Yangtze basin given the extensive presence of the host snail and human settlement, and is known to occur in several counties and towns in the study area. Severe incidence of the disease has been reported for Xinhezhuang Village near the Shuiyang River, and in Nanling County and Xiayang Village in Dongliu Town which are near the Highway Subprojects Yimu Highway Kedian to Mujiating Section and the G206 Dongliu to Yaodu Section respectively. The disease is caused by water-borne flat worms called schistosomes, which penetrate the skin and enter the human body. The disease is often associated with poverty, as it is linked to the lack of water and sanitation in the home, and is also common among farmers working on irrigation and hydro-electric power schemes.

307. **Transportation.** Anhui Province has about 6,507 km of inland waterways and some 149,382 km of highways. There are three existing bridges crossing the Yangtze River in the province with more under construction and planned. The Yangtze and its tributaries provide transportation routes downstream to Shanghai and the coast, and upstream to Wuhan and beyond. Expressways account for about 2% of all highways in Anhui, while Class IV roads account for almost 80%, indicating the importance of upgrading the highway network (Table IV.11). Hefei is connected to Shanghai and Wuhan by rail.

308. It has not been possible to obtain statistics on traffic accidents or information on blackspots for the study areas, over and above the provincial data presented in Table III.4. However, traffic accidents and safety have been raised during the public consultations as a concern of villagers (see Chapter VII). Observations of the quality of roads and street furniture together with the behaviour of drivers on the road point to a high risk of avoidable accidents (see Table IV.12).

Table IV.I2: Observed accident risks on the Highway Subprojects

Item	Current Class	Description of Risk
Ma'anshan North Corridor 	III/IV	- Narrow roads, sometimes lacking road markings and sections with poor condition of pavement - Off road obstacles eg telegraph poles, trees (especially in rural areas), stone boundary walls - Lack of pedestrian walkways in rural sections - Lack of physical separation between vehicles and pedestrians
S320 Yimu Highway 	II	- Tree lined route presenting off road obstacles - No central reserve or barrier - Marked as dual single lane with lane for non motorised users - No physical separation for pedestrians - Vehicles parking partly in running lane and partly in lane for non-motorised users
S319 	II	- Tree lined route presenting off road obstacles - No central reserve or barrier - Marked as single lane with lane for non-motorised users, but used as dual two lane for vehicles - No physical separation between traffic and non-motorised vehicles - Large number of side roads, many earth rural roads, with poor sight lines due to trees, and potentially slow moving farm vehicles - At grade pedestrian crossings, often offset from junctions
G206 	II	- Dual single lane carriageway with no central reserve or barrier - Large proportion of HGVs - Poor accommodation for pedestrians - No physical separation between traffic and non motorised users - Risk of off road collision with street furniture and trees within 5m

309. **Physical Cultural Resources.** Literature review and public consultations did not reveal the presence of physical cultural resources as defined in SPS 2009 within the project assessment area.

310. **Tourist Locations and Scenic Spots.** There are no scenic spots or tourist sites within 3 km of the Ma'anshan North Corridor and the S319 Erba-Wuwei Highway. The ungraded Wuxia

Scenic Spot is located within 3 km of the Yimu Highway Subproject and the Provincial Level Lishan Landscape and Scenic Spot in Dongzhi County is located about 1 km from the proposed G206 Dongliu-Yaodi Highway. The Jingting Mountain Scenic Spot in Xuancheng City is located near Haitangwan and the existing port on the Shuiyang River some kilometres away from the proposed Xuanzhou Port.

E. Environmental Quality

311. **Surface Water Quality.** The PRC's *Environmental Quality Standard for Surface Water* (GB 3838-2002) defines five water quality categories for different environmental functions (see **Table II.5**). The water bodies within the assessment area are Categories II, III and IV (see **Tables IV.13** and **IV.14**). The results indicate general compliance with the relevant water body class. Two exceptions are the concentrations of total nitrogen on the Shuiyang River and the petroleum hydrocarbon standard for the Zhang River at Location 2.

312. The water quality monitoring was undertaken during the dry season and as such is not representative of water quality at other times of the year. In particular, suspended total solids are likely to be much higher in the wet season.

313. **Characterisation of the muds to be dredged from the Shuiyang River.** Two samples of the bottom muds to be dredged from the Shuiyang River were analysed for heavy metals. **Table IV.15** shows that the levels of heavy metals are well below the standards and sediments are not contaminated.

314. **Characterisation of the soils at the disposal sites for the dredged sludges.** Two soils samples from two of the proposed spoil disposal sites were analysed for heavy metals and were found not to be contaminated (Table IV.16).

Table IV.13: Baseline Water Quality Monitoring Results for the Shuiyang River (mg/l, except for pH)

Monitoring items	Date of sampling	pH value	SS[1]	Permanganate index	Petroleum Hydrocarbon	Ammonia nitrogen	BOD_5	TN	TP	CODcr
Evaluation standard value for Class III[2]		6~9	≤80	≤6	≤0.05	≤1.0	≤4	≤1.0	0.2	≤20
Wharf front	25-26/12/2012	7.07~7.08	4L	2.2~2.3	0.025~0.026	0.422~0.431	2.0~2.2	**1.68~1.72**	0.13~0.14	
Shuiyang Town water intake	25-26/12/2012	7.18~7.19	4L	2.2~2.5	0.030~0.031	0.202~0.209	1.9~2.1	**1.10~1.12**	0.12~0.13	
Boundary of two provinces	25-26/12/2012	7.23~7.25	4L	2.2~2.5	0.027~0.028	0.329~0.356	2.3~2.6	**1.39~1.43**	0.10~0.11	

[1] Suspended sediment value for Grade II Surface Water Resources (SL63-94).
[2] Class III of the Environmental Quality Standards for Surface Waters (GB3838-2002).
Note: L – Indicates below the limit of detection.
Source: Domestic EIRs.

Table IV.14: Baseline Water Quality Monitoring Results for the Rivers in the Highway Subprojects

River	Location	Concentration Range (unit in mg/l except pH)					Date	Comment
		pH	SS[1]	NH_3-N	COD_{cr}	Petroleum Hydrocarbon		
Class II		6-9	80	0.5	15	0.05		Standards
Class III		6-9	80	1.0	20	0.05		Standards
Class IV		6-9	80	1.5	30	0.5		Standards
Highway Subproject I								
Sima River	Main channel	7.59	11	0.744		0.04L	9 Oct 2012	Class III
		7.48	10	0.753		0.04L	10 Oct 2012	
	2m from right bank	7.47	14	0.602		0.04L	9 Oct 2012	
		7.36	16	0.643		0.04L	10 Oct 2012	
	2m from left bank	7.76	15	0.604		0.04L	9 Oct 2012	
		7.65	16	0.576		0.04L	10 Oct 2012	
Highway Subproject II								
Zhang River	Location 1	7.58	10	0.413	10	0.046	9 Oct 2012	Class II
		7.61	12	0.485	11	0.045	10 Oct 2012	
	Location 2	7.86	12	0.428	13	**0.400**	9 Oct 2012	
		7.82	11	0.437	14	**0.420**	10 Oct 2012	
Guishan River	Location 1	7.88	11	0.577	11	0.46	9 Oct 2012	Class IV
		7.67	13	0.523	12	0.41	10 Oct 2012	
Highway Subproject III								
West River	Location 1	7.74	20	0.465		<0.01	9 Oct 2012	Class III
		7.72	21	0.459		<0.01	10 Oct 2012	
Highway Subproject IV								
Xiaohuangni Lake River	Location 1	7.37	42	0.525		0.04	6 June 2012	Class III
		7.46	49	0.490		0.02	7 June 2012	
		7.69	33	0.483		0.03	8 June 2012	
Tributary of Yaodu River	Location 1	7.55	25	0.111		0.01	6 June 2012	Class III
		7.73	16	0.098		0.02	7 June 2012	
		7.6	19	0.137		0.01	8 June 2012	

[1] The standard for suspended sediments is taken from the use of surface waters in irrigation.
Source: Domestic EIRs.

Table IV.15: Characterisation of the bottom muds in the Shuiyang River (sampled 20 December 2012)

Site	pH	As	Hg	Pb	Cu	Zn	Cr	Ni	Cd
GB4284-84	pH＜6.5	75	5	300	250	500	600	100	**5**
Liyutan	**6.12**	5.23	0.098	31.5	27.5	68.9	14.3	29.9	0.105
Guanjiadu	**6.17**	6.08	0.085	35.4	33.9	75.4	18.1	37.2	0.234

Table IV.16: Characterisation of the soils at the proposed dredged sediment disposal sites (sampled on 2 May 2013)

Site	pH	As	Hg	Pb	Cu	Zn	Cr	Cd
GB15618－1995 Grade 2	6.5-7.5	25	0.5	300	100	250	300	0.6
No. 1 Dumping Area	**6.83**	5.31	0.005	22.0	19.5	45.0	21.1	0.05
N0. 7 Dumping Area	6.57	11.3	0.009	27.8	25.7	55.3	18.7	0.07

315. **Air Quality.** The PRC ranks air quality into three classes according to its *Ambient Air Quality Standard* (GB 3095-1996), with Class I being the best air quality and Class III the worst air quality. Typically, ambient air quality baseline monitoring for EIA in the PRC consists of measuring the daily average concentration levels of total suspended particulates (TSP) and/or PM_{10} (also known as respirable suspended particulates, RSP), sulphur dioxide (SO_2) and nitrogen dioxide (NO_2) on seven consecutive days. Carbon monoxide (CO) is often included in transport projects.

316. The Domestic EIRs presented ambient air quality monitoring data for SO_2, NO_2 and TSP collected at one sensitive receptor per scheme. The data are summarised in Table IV.17 below and compared with the GB 3095-1996 Class II ambient air quality standard. Monitoring results show that SO2, NO_2, PM_{10}, and TSP all complied with GB 3095-1996 Class II ambient air quality standard at these locations on the days of baseline monitoring. Comparison with the World Bank Group's EHS standard showed that the daily average baseline ambient PM_{10} levels at all locations on the days of monitoring were higher than the EHS interim targets. The World Bank Group does not have daily average standards for CO and NO_2 (see Table II.3).

Table IV.17: Baseline Air Quality Monitoring Results

Project	Location	Daily Average Concentration Range (mg/m^3)				
		CO	SO_2	NO_2	PM_{10}	TSP
Xuanzhou Port	1		0.024 – 0.03	0.01 – 0.012		0.11 – 0.15
SRWIP	1		0.019 – 0.027	0.049 – 0.067	0.06 – 0.08	
Highway I				0.012 – 0.022		0.031 – 0.048
Highway II	1			0.019 – 0.033		0.105 – 0.134
Highway III	1			0.025 – 0.034		0.135 – 0.145
Highway IV	1			0.021 – 0.045		0.09 – 0.23
GB 3095-1996 Class II standard		4.0	0.15	0.08	0.15	0.30
World Bank Group EHS standard		n/a		n/a	Interim: 0.075-0.15 Guideline: 0.05	

Source: Domestic EIRs.

317. **Noise.** Noise standards in the PRC are prescribed in *Environmental Quality Standard for Noise* (GB 3096-2008). GB 3096-2008 categorizes five functional areas based on their tolerance to noise pollution: from Category 0 to Category 4 (see Table II.4). The noise assessment area for the Highway Subprojects fall into functional areas Category 4a (areas within 35 m from the road red line) and Category 2 (areas between 35 m to 200 m from the road red line).

318. Baseline noise monitoring data were collected over two days at selected existing noise sensitive receptors along the SRWIP and Highway Subprojects on the following days:

(i) SRWIP: 25 and 26 December 2012
(ii) Xuanzhou Port: 25 and 26 December 2012
(iii) Highway Subproject I: 10 and 11 September 2012
(iv) Highway Subproject II: 29 and 30 September 2012
(v) Highway Subproject III: 28 and 29 September 2012
(vi) Highway Subproject IV: 6 and 7 June 2012

319. The noise baseline monitoring results are presented in Tables IV.18 to IV.21. The following observations were made:

(i) The results for Ma'anshan North Corridor, Highway Subproject II Yima Highway, and Highway Subproject III S319 Erba-Wuwei are all within the standard for day and night time noise levels.

(ii) There are exceedances of the night-time noise standards in Weizhuang and Zhanggang villages which are attributed to traffic levels on the existing G206 Dongliu to Yaodu Highway.

Table IV.18: Baseline Noise Monitoring Results at Sensitive Receptors along the Shuiyang River and at Xuanzhou Port, Unit: dB(A)

Name of sensitive sites	25 December 2012		26 December 2012		Class for noise assessment
	Daytime	Night-time	Daytime	Night-time	
Waterway					
Miaobu	48.2	40.9	48.5	41.1	2
Youzagou	49.1	41.8	48.4	42.9	2
Wanghe village	47.4	41.3	46.7	41.8	2
Xinhezhuag	49.0	41.5	48.6	42.1	2
Baojiadian	47.1	41.2	46.8	40.9	2
Loujia village	47.6	40.7	48.1	41.4	2
Shuiyang town	50.1	43.6	49.9	43.3	2
Liangpengxia	48.0	42.4	48.3	41.5	2
Xuanzhou Port					
Zhangcun Group, Shishan Village	47.8	40.8	47.2	41.5	2
Sanjiali Group, Shishan Village	48.4	41.9	48.7	42.8	2

Source: Domestic EIR.

Table IV.19: Baseline Noise Monitoring Results at Sensitive Receptors along Highway Subproject I – Ma'anshan North Corridor

No.	Name of sensitive points	10/9/2012		11/9/2012		Class for noise assessment
		Daytime	Night-time	Daytime	Night-time	
1	Dachen	50.9	39.7	49.3	39.4	2
2	Chuomiaoji	50.8	42.6	40.6	38.5	2
3	Ruiqiao	48.3	40.1	38.8	39	2
4	Shashigang	49.3	44.9	46.5	40.2	2
5	Dajing	48.0	40.0	48.2	38.7	2
6	Huanghe	48	42.9	43.8	37.4	2
7	Xiongzhuang	50.1	41.3	48.6	37.3	2
8	Zhenzhuang	46.7	40.3	45.6	39.3	2
9	Taodian Primary school	46.8	37.9	45.5	38.1	2
10	Taodian	52.2	46	52.6	46.4	2
11	Huangcun	49.1	38.9	48.1	39.4	2
12	Hanqiao	49.0	40.0	49.1	39.8	2
13	Chenzhanglu	50.6	42.1	50.3	38.7	2
14	Zhongheji	48.0	40.2	48.8	39.9	2
15	Gaozu primary school	49.9	38.9	49.2	40	2
16	Panxiaocun	51.1	38.7	50.6	40.1	2
17	Baozhuang	48.7	37.8	50.5	38.6	2
18	Baozhuang Primary school	48.6	41.3	49.0	37.4	2
19	Dajiangzhuang	51.3	41.8	48.4	38.7	2
20	Miaoqiangcun	46.5	37.9	48.1	39.9	2

Source: Domestic EIR.

Table IV.20: Baseline Noise Monitoring Results at Sensitive Receptors along Highway Subproject II – Yimu Highway

No.	Name of sensitive points	29/9/2012		30/9/2012		Class for noise assessment
		Daytime	Night-time	Daytime	Night-time	
1	Kediancun	58.3	44.3	59.6	43.4	2
2	Shangtanghu	56.7	44.1	55.2	43.3	2
3	Dagangcun	55.1	42.8	54.9	43.4	2
4	Big Pinwheel kindergarten	57.8	43.5	58.2	42.5	2
5	Yafutang	55.9	42.7	56.7	43.8	2
7	Shuguangcun	56.4	43.9	57.6	43.6	2
8	Gongyicun	59.3	44.4	58.6	43.4	2
9	Huilongdun	58.6	42.7	57.4	43.6	2
10	Gongshancun	57.8	42.3	57.4	43.5	2
11	Gaolingcun	58.0	43.4	57.0	42.7	2
12	Gaolingcun	57.8	43.8	58.8	43.5	2
13	Guolong	56.6	43.7	57.6	43.1	2
14	Haizijia	57.7	43.4	56.9	42.5	2

15	Tiantouwu	56.5	42.6	56.7	43.6	2
16	Wuxiasi	56.7	42.7	57.8	43.5	2
17	Shuicuncun	57.4	42.4	57.7	42.3	2

Source: Domestic EIR.

Table IV.21: Baseline Noise Monitoring Results at Sensitive Receptors along Highway Subproject III – S319 Erba-Wuwei

No.	Name of sensitive points	28/9/2012		29/9/2012		Class for noise assessment
		Daytime	Night-time	Daytime	Night-time	
1	Datancun	52.6	40.9	56.9	41.3	2
2	Health center in economic development zone in Wuwei County	51.2	41.0	56.6	42.0	2
3	Yongnan Central primary school	49.2	42.5	56.5	41.7	2
4	Zhangwangcun	46.2	41.4	58.6	41.9	2
5	Chenzhuang	53.6	41.8	58.2	42.4	2
6	Xiaozhao	53.6	47.5	48.5	41.8	2
7	Gaoyuqian	49.8	40.8	48.5	46.5	2
8	Wuwei Banqiao primary school	53.0	40.8	49.3	42.1	2
9	Xiaoshangjia	52.1	51.1	51.2	42.3	2
10	Lingjiawan	53.4	44.1	48.5	44.5	2
11	Huangcun	57.0	43.8	57.5	41.3	2
12	Jiajiazhuang	52.9	45.8	51.3	42.9	2
13	Linghou	52.8	40.5	54.3	41.4	2
14	Wanxu	52.9	46.4	55.3	42.2	2
15	Xiaotanjia	49.6	47.1	58.6	41.9	2
16	Xiaodaijia	54.6	46.0	47.3	40.3	2
17	Hualong	55.2	48.4	48.3	41.1	2
18	Wuyicun	49.2	47.6	45.3	46.9	2
19	Shazhuangcun	55.9	45.0	48.7	42.1	2
20	Zhangyu	55.7	48.8	51.6	41.4	2
21	Yangmaozui	56.3	44.8	49.5	40.5	2
22	Zhangnicun	54.4	47.6	55.4	41.9	2
23	Lijiatan	55.1	47.8	48.0	42.3	2
24	Nianxi	55.5	46.1	46.8	42.7	2
25	Xinjian	56.8	44.9	57.4	41.2	2
26	Hexi	53.0	44.8	52.4	42.9	2
27	Xingeng	52.6	43.4	47.0	41.6	2
28	Fengxu	46.7	42.2	48.2	41.4	2
29	Yugeng	48.4	44.8	46.6	44.7	2
30	Changba primary school	47.8	42.1	48.0	43.5	2
31	Makou	49.0	42.7	45.9	39.3	2

Source: Domestic EIR.

Table IV.22: Baseline Noise Monitoring Results at Sensitive Receptors along Highway Subproject IV – G206 Dongliu to Yaodu

No.	Name of sensitive points	6/6/2012		7/6/2012		Class for noise assessment
		Daytime	Night-time	Daytime	Night-time	
1	Weizhuang	68.5	**59.6**	64.3	**58.7**	**4a**
2	Yangjia	46.4	40.2	45.2	41.4	2
3	Zhanggang	67.8	**59.1**	68.6	**58.4**	**4a**
4	Liucun	51.6	43.6	48.2	42.9	2
5	Dormitory of Tree Farm	55.4	51	58.3	49.8	2

Source: Domestic EIR.

320. **Solid Waste Management.** There are solid waste facilities in towns, but none in rural areas.

F. Greenhouse Gas Emissions and Climate Change

321. In 2009, a Climate Change Working Leading Group was established within the Anhui Development and Reform Commission to coordinate climate change adaptation and mitigation activities within the province. The province also established the Climate Center of Anhui Province, which publishes the Climate Change Assessment Report of Anhui Province twice yearly. The Climate Center participated in preparing the Climate Assessment Report in the region of East China published June 2011, and led the preparation of Anhui's first Climate Change Program of Anhui Province, approved in 2009 by the Anhui Province Government. This program describes provincial objectives for addressing climate change and greenhouse gas (GHG) emissions.

322. The Anhui Provincial Weather Center[18] estimated that total carbon dioxide (CO_2) emissions in 2007 were 263.825 million t, dominated by the burning of fossil fuel (76%) (Table IV.20). They predicted, using the Integrated Policy Assessment Model of China: IPAC, that CO_2 emissions in Anhui Province would increase to 338.04 million t in 2015 and 413.58 million t in 2020, but could be reduced to 303.25 million t in 2015 and 335.35 million t with strict policy regulation and enforcement (to reduce energy consumption and pollutant emissions).

Table IV.23: Estimate of Carbon Dioxide Emission in Anhui Province in 2007 (million t)

Emission Source	CO_2 (million t)	Percentage
Burning of fossil fuel	200.710	76.1%
Industrial production (mainly cement clinker, iron and steel production)	46.430	17.6%
Methane from agriculture (527,000 t)	11.067	4.2%
Methane from landfills and wastewater treatment (268,000 t)	5.618	2.1%
Total CO_2 emission	263.825	100%
Carbon sink by forest	(1.197)	
Net CO_2 emission	262.628	

Source: Liu and Jiang, Anhui Provincial Weather Center. 2009.

[18] Liu H, K. J. Jiang. 2009. Analysis of Anhui Province climate change situation and greenhous gas emission prediction. Anhui Provincial Weather Center. In: China Energy Source, 2009, volume 9.

V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

A. Positive Impacts and Environmental Benefits

323. **Beneficiaries.** The project components are spread out across the Yangtze River corridor in Anhui Province, providing project benefits at the regional and local economic scale, to individual beneficiaries living in the wider catchment area and alongside the proposed interventions.

324. The SRWIP will strengthen the connection between Xuancheng City and the Yangtze River Delta and promote the development of the city through trade. The main direct beneficiaries of the SRWIP are the operators of the Xuanzhou Port, the industries in the port area who import materials and export manufactured products; the workforce at the port and in the industries; the operators and crew on the ships. A small number of local households may obtain employment during construction or operation, and in the longer term development of the Xuanzhou Industrial area may offer employment opportunities for local communities.

325. The Highway Subprojects will benefit the current and future users of the local and regional road network, through improved journey times, more reliable journeys and safer more comfortable journeys. Traffic flow is predicted to rise by a multiple of three to five fold between now and 2029 on these schemes, except for the Yimu Highway where future growth may be depressed by the opening of the TongNanXuan Expressway in about 2020. The high forecasts are largely due to the increase in car traffic from relatively low ownership levels.

326. Various aspects of design will improve the safety conditions for travellers and pedestrians. These include the separation of vehicular traffic and cyclists and pedestrians; improved provision for pedestrian crossings; increase in over-taking capacity from dual single to dual two lane carriageways; and lighting in urban areas.

327. Minor route alignments to bypass towns and villages on the Ma'anshan North Corridor, the S319 Erba to Wuwei section re-alignment for the new Wihe Bridge Crossing and the G206 new build will provide relief from noise, air emissions and severance to local communities. The new G206 alignment would also remove traffic passing through the Tiantai Mountain Forest Park.

328. A summary of beneficiaries living, working and travelling in the project areas is presented in Table V.1.

Table V.1: Summary of project beneficiaries

Beneficiaries	Population
Direct beneficiaries	4,500,100
Indirect beneficiaries	26,289,900
Urban beneficiaries	879,500
Urban poor	44,500
Rural poor	481,200
Women	2,116,800

329. **Climate Change.** Transportation is a significant contributor to greenhouse gases (GHG) and the main GHG is CO_2 from the combustion of hydrocarbon in the internal combustion engine. Transportation improvements are required for social and economic development, but ways should be considered of improving transportation while controlling or reducing GHG

emissions. Some actions can be taken at the project level, such as switching transport modes and improving mass transit and public sector transport. Other approaches lie outside the scope of individual projects, such as fuel switching and engine design.

330. The promotion of inland waterways transport introduces an alternative to rail and highway transport for cargo, which provides benefits in terms of lower emissions of greenhouse gases (GHGs) per kilometre or tonnage of cargo transported. The magnitude of the benefits will depend on a variety of factors, for example, fuel consumption gains depend on ship speed and can be offset by energy consumptive inter-modal facilities. A comparison of the estimated GHG emissions for the proposed SRWIP and Xuanzhou Port with the movement of the same amount of cargo by truck is presented later in this chapter in Section D.5. The results indicate potential benefits in terms of GHG emissions in g/tonne-km for the inland waterway project, with potentially greater savings for CO_2, compared to NO_x and PM_{10}, and for break bulk cargo compared to bulk cargo. Waterway transport is most suitable for bulk transport of non-perishable goods, such as mineral ores, which are planned for Xuanzhou Port.

331. The Highway Subprojects will improve the quality of road journeys for travellers. As part of this there is potential gain for reduced fuel consumption, and hence GHGs, due to the reduction of congestion and associated stop-start traffic and more efficient driving. As these are highway improvement schemes, the No Project scenario would still result in increasing volumes of GHG emissions with traffic growth. Some additional traffic growth has been allowed for, as the Highway Subprojects will serve growing urban areas. A comparison of the Do Nothing and the Do Something options show that the proposed schemes contribute a small reduction of GHG emissions in the order of 5 to 10% (see Section D.5). In the assessment year 2029, none of the Highway Subprojects exceeded the ADB significance threshold of 100,000 CO_{2eq} tonnes, with the values ranging from 43,594 tonnes in 2029 for the G206 Dongliu to Yaodu Section to 86,537 tonnes for the S319 Erba to Wuwei.

B. Impacts Associated with Project Location, Planning and Design

1. Land-take

332. **SRWIP and Port.** Estimates of total and permanent land-take are presented in Table V.2 below. Total permanent land-take for the SRWIP is relatively modest at 1.79ha, as most of the works are located within the existing flood bunds, except where modifications to the meander bends require land-take. Temporary land-take is mostly associated with the disposal sites for dredged spoil comprising unused ponds owned by villages or collectives, which when dried out will be converted to farmland.

333. **Mitigation measures.** The need for land-take is mitigated through design of the project footprint, by selecting sludge disposal sites with little natural or economic value, and restoring sludge disposal sites.

334. **Highway Subprojects.** The Highway Subprojects I, II and III are designed partly along the existing alignment, which reduces the amount of new permanent land-take required for the highway improvements and lowers the impact on agricultural land and natural habitats (see Table V.2). Highway Subproject IV is a new road, which affects arable land and natural habitats (secondary forest and grasslands) in approximately equal measure. Only a small amount of temporary land is required from farmland, comprising some 0.9 ha for Highway Subproject II and 2.2 ha for Subproject III, which are both on-line schemes. For the other schemes the

temporary land take is for “unused” land and is mostly required for borrow areas and spoil disposal.

335. **Mitigation measures.** The need for land-take is mitigated through on-line widening and the restoration of temporary land-take to productive uses. Land-take is reduced by fine-tuning the vertical and horizontal alignments to balance cut and fill. Impacts on natural ecosystems and people are reduced further by avoiding farmland where possible, selecting sites of low ecological value for borrow pits and spoil disposal as well as temporary facilities such as construction camps, mixing and prefabrication yards.

Table V.2: Summary of permanent and temporary land-take by current land use (ha)

Project		Land-take	Arable	Woodland	Grassland	Water	Old Road	Other	Housing	Total
SRWIP		Permanent	1.24	0.0				0..37	0.18	1.79
		Temporary				104				104.0
Xuanzhou Port		Permanent	13.4	0.2		4.9			8.3	26.87
		Temporary	5.55	5.23		5.86				16.64
Road Subprojects	I	Permanent	26.91	15.08			(32.69)	33.42		75.41
		Temporary	45.92	21.84	0.0	0.03	0.0	15.41	0.0	83.26
	II	Permanent	22.83	6.57	16.34		(52.34)	42.2		87.94
		Temporary	1.0		36.33			25.0		62.33
	III	Permanent	17.39			4.75	(91.91)	8.41		24.31
		Temporary	1267			0.6	(1.68)			13.27
	IV	Permanent	33.89	12.35		21.14		1.49		68.87
		Temporary	1.5	16.95	1.0			14.30		19.25

Note: “Other” is an official classification in the Chinese land use classification system. “Total” does not include the old/existing road area.
Source: Domestic EIRs (based on the Soil and Water Conservation Plans) and PPTA Resettlement Plans.

2. Town Planning

336. **All Subprojects.** The proposed SRWIP and highway alignments have all been incorporated into the current town and county plans, with the exception of Gongshan Town, whose plans are in preparation (see Table V.3). The proposed highway upgrades are in compliance with the plans, and the potential traffic generated from the undeveloped areas within the plans has been taken into consideration in forecasting traffic growth.

Table V.3: Overview of compliance with the city/township plans

Subproject	Town Planning
SRWIP and Port	• **Xuancheng City**. The city masterplan designates provision for the Xuancheng New Industrial Development Zone plan, including the proposed new port to be developed in two phases. The transport plans also include a new long bridge over the Shuiyang River about 150m downstream of the port.
Highway Subproject I	• **Shiyang Town**. The proposed alignment follows the northern boundary of Shiyang Town. The adjoining land use is reserved development land and green space and the alignment is away from the town centre and planned residential and commercial development areas. The alignment effectively provides a by-pass to Shiyang Town.
Highway Subproject II	• **Nanling County**. Between K11+900 and K25+460, the alignment follows Gongjin Avenue, the main route through the urban area. • **Gongshan Town**. The proposed alignment lies 1.4 km from Gongshan Town and is therefore unlikely to affect the planning process for the town.
Highway Subproject III	• **Wuwei County**. The section K28+860 to K36+520 passes through the urban area of Wuwei County. The new build section from K30+630 to K35+510 passes through land variously designated for education, scientific research, administrative office areas, warehousing, industry and public green space.
Highway	• **Dongliu Town**. The proposed alignment starts at the NE border of the Dongliu

Subproject	Town Planning
Subproject IV	Economic Development Zone. Between K3+500 and K4+100 the alignment passes through reserved development land to the east of Dongliu Town. The alignment connects the Dongliu Economic Development Zone with Dongliu Town. • **Dongzhi Town**. The final section of the route between K16+300 and K16+580 arrives at the northern edge of the town plan crossing riverside protection forest and connecting into the old G206.

3. Occupational Health and Safety

337. **SRWIP and Xuanzhou Multi-purpose Port.** The disease schistosomiasis is endemic in the region and a hotspot is located in Xinhezhang village, at the upstream end of the flood alleviation channel currently under construction. The potential risks are that (a) the workforce on the SRWIP come into contact with the schistosomes and become infected themselves, and (b) the disease is spread to other nearby villages during the dredging operations.

338. **Mitigation measures.** The main mitigation measure is to break contact between people and the host snails and schistosomes in the water. The ecology of the disease is well known, there are specialist medical facilities in the area, and the disease is treatable. The following mitigation is proposed.

(i) During detailed design and pre-construction phases, the IA LPMOs and PPMO will liaise with the local authorities to verify locations where the disease is prevalent and the proximity of those locations to the proposed construction works, especially the dredging.

(ii) Specific procedures will be developed with the local health institutions prior to construction to minimise the risk of the construction labour force becoming infected and spreading the disease. In particular, environmental health education about the disease will be the key.

(iii) Controls are required during dredging in the potentially infected reaches:
  (a) Workforce to avoid direct contact with the water and aquatic vegetation.
  (b) Dredging to keep to the main river channel and avoid shallows with emergent vegetation.
  (c) The dredged material to be pumped to the disposal site(s), comprising ponds which will be infilled with the dredged material.
  (d) The sediment will be covered with lime and allowed to dry out. This process will kill the host snail and the schistosomes.
  (e) The land can be reclaimed for agriculture.
  (f) The workforce will be provided with medical check-ups and receive medication in the event of infection.

339. **Highway Subprojects.** Although schistosomiasis is endemic in the lower Yangtze River, the risk of contracting the disease during the construction of roads is low given the lack of contact by the workforce with infected waters.

340. **Mitigation measures.** The main mitigation measures are as follows:

(i) Environmental health education for the workforce

(ii) Provision of medical examinations for the workforce and medicating in the event of infection

4. Community Health and Safety

341. **SRWIP and Xuanzhou Multi-purpose Port.** Prior to construction, affected households in the proposed construction areas will be relocated and the construction sites need to be made secure.

342. **Highway Subprojects.** The upgrading of the highways will help to reduce the risk of traffic accidents through various design features which are summarised in Table V.4 below.

Table V.4: Design features to improve community safety

Scheme	Grade	Increased over-taking capacity	Central safety reserve	Improved Hard shoulder	Separated NMT / pedestrians	New lighting	Improved junctions
I	I	✓		✓			
II	I	✓	✓		✓	✓	✓
III	I	✓	✓			✓	
IV	II	✓	✓		✓	✓	

343. **Mitigation Measures.** Further consideration will be given during detailed design, to measures to improve the safety:

(i) Ma'anshan North Corridor. The possibility of separating pedestrians and vehicles in villages and urban areas by converting the hard shoulder to pedestrian pavements. Consideration should be given to lighting the highway in towns and villages, although this is an issue for the town authorities.

(ii) Yimu Highway. The provision of pedestrian crossings, in particular crossing Wuli Intersection, such as traffic controlled lights for pedestrians only (no vehicle turning), subways or overpasses.

(iii) S319. Further consideration will be given to pedestrian safety along the highway and pedestrian crossings.

(iv) G306. The FSR shows provision for NMT along both carriageways for the length of the scheme. As the route goes through rural countryside, there will be little demand from NMTs at present. Further consideration will be given to safeguarding the provision for NMT for implementation at a later stage. The need for the provision of pedestrian crossings will be considered. Consideration will also be given to the need for lighting.

5. Sustainability and Climate Change Issues

344. **Climate Change.** Consideration should be given to the resilience of the designs to climate change and the need for climate adaptation. Areas for consideration include:

(i) Consider potential impacts from extreme weather events due to climate change in designing road subgrade, pavement, road-side slopes, drainage system, bridges and culverts.

(ii) The design of highway drainage and bridges to take account of extreme storm events due to climate change on the design return periods for stormwater levels in order to maintain flood conveyance of the numerous ditches, canals, and rivers.

345. **Sustainability.** Consideration shall be given to sustainability issues such as:

(i) Minimisation of the use of resources:
(ii) Further consideration will be given during detailed design on recycling of asphalt and sub-grade.
(iii) Where roads are being widened, the re-use and recycling of old pavement materials for pavement and subgrade will be maximized
(iv) Minimisation of waste generation: balance cut and fill,
(v) Adoption of the waste hierarchy in determining waste disposal: reduce, recycle, re-use, incinerate and landfill
(vi) Energy efficiency: reduce energy demand, design energy efficiency, and switch to green energy.
(vii) The need for lighting in rural areas will be reviewed, to determine the value of accident saving benefits versus the capex and opex cost of the lighting and the night-time pollution from lighting and potential impact on flora and fauna.

346. **Reduce nuisance from construction sites through planning.** Construction-related nuisances can be reduced through planning the construction schedule and site layout.

(i) Programme certain activities during less sensitive times of the year.
(ii) Site noisy and dust generating activities away from sensitive receptors.
(iii) Use the site topography, layout, and construction programme to shield construction and operation noise generation from sensitive receptors.

6. Associated Facilities

347. **SRWIP and Xuanzhou Port.** One Associated Facility has been identified, namely a ship building and repair yard is currently located in the proposed area of the ship lock in Shuiyang Town. The following tasks will be required.

(i) The ship building and repair yard owner will need to relocate, and take responsibility for the permits and licencing, including the preparation of an Environmental Impact Report and all other necessary works.
(ii) A soil characterisation study will be undertaken to determine the area and degree of soil contamination at the ship yard site, including the preparation and approval of a site remedial plan which has to be completed to the satisfaction of the APPSCIP, APEPD and Water Bureau prior to the start of construction of the rubber dam and ship lock. The following MEP guidelines will be followed:
    (a) Guidelines for Risk Assessment of Contaminated Sites (consultation document)
    (b) Guidelines for Soil Remediation of Contaminated Sites (consultation document)
    (c) Temporary Method for Environmental Management of Soil on Contaminated Sites (consultation document)
    (d) Technical Guidelines for Environmental Monitoring of Sites (consultation document)

7. Environmental Management and Institutional Strengthening Arrangements

348. A number of environmental management measures will be implemented during the pre-construction phase to ensure the project's environmental management readiness. These measures are discussed in more detail in Chapter IX and the EMP.

C. Impacts and Mitigation Measures during the Construction Stage

1. Air Quality

349. **SRWIP and Xuanzhou Multipurpose Port.** The main sources of air quality pollutants during construction are:

(i) dust from construction activities,
(ii) odour from the disposal of the dredged sludges,
(iii) emissions from construction vehicles and plant,
(iv) concrete mixing, and
(v) emissions from asphalt paving.

350. Construction of the waterway improvements may generate dust during the river bank reconstruction works and wind action at the spoil sites as the dredged materials dry out. There will be extensive earthworks at Xuanzhou Port to raise the ground levels behind the flood defences by bringing in earth from a nearby quarry. Impacts associated with emissions from plant, concrete mixing and asphalt paving are discussed in more detailed below under Highways.

351. Odour may arise at the dredged sediment disposal sites for the SRWIP due to ammonia and hydrogen sulphide released from the drying muds. The odour would decrease spatially with distance from the disposal sites, and with time as the disposal sites dry out. The main mitigation measure is to locate the disposal sites at least 100m from the nearest houses. The dredging would be undertaken in the winter dry season, and the lower temperatures would help to reduce the area affected by bad odours. Based on EIR predictions from similar projects, the odour impact area should be confined to within 20 m from the disposal site, and the nearest households to the disposal sites would be beyond 100m. Once infilled, the disposal sites will be immediately vegetated to prevent soil erosion.

352. Dredging will be carried out using a cutter suction dredger. Once loosen under water, the dredged sediment will be sucked into a floating pipeline and pumped to the disposal site. Exposure of dredged sediment to the air during dredging and transport is unlikely and the release of odour during dredging and dredged sediment transport would also be unlikely.

353. The above air quality impacts would be temporary and largely confined within 100m of the construction site. Most impact is likely to be at the port, as the earthworks will continue for some time, although the local communities would have been relocated in advance of works. These impacts will be mitigated by implementing construction site good practice. With mitigation measures in place, potential air quality impacts during the construction stage would be acceptable.

354. **Highway Subprojects.** The main sources of air quality pollutants during construction are:

(i) dust from earthworks,
(ii) emissions from asphalt paving,
(iii) concrete batching plants, and
(iv) emissions from construction vehicles and plant.

355. On the highway schemes, dust may be generated during top soil stripping and stockpiling, earthworks for embankments and cuttings, the storage of aggregate and concrete batching, and haulage traffic on unpaved roads.

356. The EIR noted that research from the Beijing-Tianjin-Tanghan Highway construction project on the effectiveness of dust suppression by watering found that dust levels can be reduced by 70%. Dust nuisance decreases with distance from the construction site. These impacts will be mitigated by implementing construction site good practice.

357. **Emissions from Asphalt Paving.** Asphalt paving will produce fumes containing small quantities of toxic and hazardous chemicals such as volatile organic compounds (VOC) and poly-aromatic hydrocarbons (PAH). Asphalt fumes generated during road paving would be considerably less than fumes generated during mixing, and reduce to zero as the asphalt cools and solidifies. The impact from asphalt fumes during road paving is therefore of short duration. No mitigation is required.

358. **Emissions from Concrete Batching Plants.** Total Suspended Particulate (TSP) levels from similar construction projects have been found to be approximately 9 mg/m^3, 1.65 mg/m^3 and 0.3 mg/m^3 at distances of 50 m, 100 m and 150 m downwind of concrete batching activities. Compliance with the *Ambient Air Quality Standard* (GB 3095-1996) standard would be achieved at 150 m downwind.

359. The following mitigation measures to suppress dust on construction sites and avoid the spread of dirt on the public roads will be adopted.

(i) During earthworks, the soil horizons will be stripped and stored separately. The earth stockpiles will be no greater than a maximum height of 2m and the side slopes at the natural angle of repose. Where possible the stockpiles will be protected from wind and rain, including the use of windbreaks, covers, and seeding.

(ii) Unpaved areas, backfill areas and haul roads will be watered at least twice a day and more frequently (up to once every two hours) during hot and windy weather.

(iii) All haulage vehicles are to be sheeted to prevent dust and dirt falling off the vehicle. Bulk materials, including cement, sand and lime, transported by road will be compacted and the packing height will not exceed the protective guard on the vehicle. Bulk cement and other fine grained materials will be delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape. Construction vehicles will not be over-loaded.

(iv) Yards for stockpiling aggregate and pre-cast yards will be located at least 300m downwind of nearby houses and villages. The sites will be enclosed and the height of the hoarding will be at least the height of the stockpiles within the enclosure. Dust suppression measures will be taken within the site, for example covering stockpiles with tarpaulin.

(v) Asphalt plants and concrete batching plants will be located at least 300m downwind of nearby houses and villages. The sites will be enclosed and dust suppression measures will be undertaken, for example, by enclosing stockpiles of fine grained material and aggregate mixing activities. The workforce will be provided with personal protective equipment (PPE) such as face masks.

(vi) Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment.

(vii) Minimize the storage time of construction and demolition wastes on site by regularly removing them off site.

(viii) Install wheel washing equipment or conduct wheel washing manually at each exit of the works area to prevent trucks from carrying muddy or dusty substances onto public roads.

(ix) Immediately clean up all muddy or dusty materials on public roads outside the exits of the works areas.
(x) The main haul and access roads will be sealed to prevent raising dust. Unsealed dirt roads will be watered as described in (ii) above to suppress dust.
(xi) Sensibly plan the transport routes and time to avoid busy traffic and heavily populated areas when transporting fine-grained materials.
(xii) Immediately plant vegetation in all temporary land-take areas upon completion of construction to prevent dust and soil erosion.

360. **Air Emissions from Construction Vehicles and Plant.** Construction vehicles and a range of mobile and stationery plant on site will emit exhaust emissions such as carbon monoxide, carbon dioxide, and nitrogen oxides. The volumes are small in relation to the volume of road traffic on highways and unlikely to have a significant effect on the local air quality. The following mitigation measures will be followed to control emissions from vehicles and construction equipment.

(i) Procurement of new vehicles and plant will take into account machinery with lower emissions.
(ii) All vehicles and plant will be maintained in good order and in compliance with the manufacturer's instructions.
(iii) The movement of construction traffic around the site will be minimised.
(iv) Impose and signpost maximum speed limits of 10 kph on unsurfaced haul routes and work areas and 15kph on surfaced haul routes and work areas.
(v) Regularly sweep hard surfacing.
(vi) On-road vehicles are to comply with set emissions standards.
(vii) The burning of wastes on site will be prohibited.
(viii) Vehicles and plant will be switched off when not in use.

361. Road construction is a linear activity. When a road section is constructed and paved, the construction activities move on and away from nearby sensitive receptors. Potential sensitive receptors will therefore be exposed to short term impacts. Exceptions are locations such as bridges, where construction takes several months, and for temporary facilities such as concrete batching, which may be in place for the duration of the construction programme. With the above mitigation measures in place, potential air quality impacts during the construction stage would be acceptable.

2. Construction Noise

362. **SRWIP and Xuanzhou Multipurpose Port.** The main sources of construction noise are:

(i) The noise of the dredger, pumping, and the disposal of sediment at the disposal sites. The dredger would normally operate during day-light hours, but may work 24hrs a day on occasions;
(ii) Earthworks to alter the channel alignment and remove the acute bends on the river and construction of new sections of flood banks;
(iii) Construction of the ship lock and river barrage, including installation of coffer dams to divert the river and construct the frame for the barrage, sheet piling and excavation of the chambers for the ship lock; and
(iv) Construction activities at Xuanzhou Port including piling at the wharf site and extensive earthworks to raise the land behind the wharf.

363. According to the national EIR, typical noise levels during dredging would be 85-100 dB(A), for bridge construction 80-95 dB(A), and for the disposal of dredge material 70-85 dB(A).

The EIR predicted that construction noise based on noise attenuation would potentially impact a distance of up to 60m from the noise source during day time and up to 300m during night time (due to lower noise limit). Construction noise is most likely to affect residents living close to the construction sites, and during night-time when ambient noise levels are lower. As the dredging activity will move along the river, sensitive sites will only be affected for a short duration. At Xuanzhou Port, the nearest houses from the port site will be demolished, although the houses on the opposite side of the river about 170m distant may experience construction noise during the night time. Noise monitoring will be undertaken during construction at various sites to determine compliance and the need for further mitigation.

364. **Highway Schemes.** Construction noise may arise from land clearance, earthworks especially rolling and compacting the earth, blasting if needed in rocky sections, piling both for bridge piers and soft ground remediation, and bridge superstructure. At present, the need for blasting has not been verified and will be considered further during detailed design.

365. The following mitigation measures are needed to reduce construction noise to acceptable levels:

(i) Use quiet equipment (choose the model with the lowest sound power level) and construction methods. Ensure regular maintenance of machinery. Where possible modify the equipment to reduce noise and vibration. Adopt “Switch Off” campaigns to reduce on time for equipment and vehicles.
(ii) Use temporary hoardings or noise barriers to shield noise sources. Use the site layout, configuration and local topography to shield noisy activities from nearby sensitive receptors.
(iii) Avoid construction at night, especially between 2200 and 0600 hours. Where this is not possible, notify local communities well in advance, take measures to use quieter equipment, and to screen the construction site.
(iv) Liaise with all the schools along the highway corridors and reduce noisy construction activities or shield off noise sources using temporary hoardings or noise barriers when day time construction works are within 150 m of these schools, particularly during sensitive periods, such as examinations.
(v) Prepare a Traffic Control and Operation Plan.
(vi) Locate concrete batching plant and pre-casting yards at least 300m from sensitive receptors.
(vii) If possible, for the Xuanzhou Port, transport construction materials by boat to reduce the impact from road haulage.
(viii) Liaise with local communities about the construction programme and warn them in advance of particularly noisy activities. Provide a hotline for public complaints and address in line with the timescales and procedures set out in the agreed project grievance redress mechanism.

366. The World Bank Group’s EHS guideline also provides the following guidance to mitigate noise and vibration impacts caused by the operation of pile drivers, earth moving and excavation equipment, concrete mixers, cranes and the transportation of equipment, materials and people during construction and decommissioning activities:

(i) Planning activities in consultation with local communities so that activities with the greatest potential to generate noise and vibration are planned during periods of the day that will result in least disturbance.
(ii) Using noise control devices, such as temporary noise barriers and deflectors for

impact and blasting activities, and exhaust muffling devices for combustion engines.

(iii) Avoiding or minimizing project transportation through community areas.

3. Surface Water Quality

367. **SRWIP and Xuanzhou Multipurpose Port.** The main impacts on water quality during the construction of the SRWIP will be from dredging and the drinking water supply in-take works; drainage from the dredged materials deposited at dump sites; leakages and accidents relating to the pumping line between the dredger and the disposal site; uncontrolled discharges of wastewater from the construction camps; in channel works for structures; and the disposal of construction water and drainage water.

368. Dredging results in elevated suspended solid (SS) levels in the water column. The domestic EIR quotes monitoring results from dredging work in the Dongjiang River which found SS concentrations of 90 mg/l at 50m from the dredger in the downstream direction, 4.13 mg/l at 1 km downstream and 0.55 mg/l at 2 km downstream. The type of dredging and hydrological conditions was reported to be similar to this Project. With baseline dry season SS concentrations reported to be below the limit of detection of 4 mg/l, the effect of the dredger on water quality may extend for about 1 km downstream. Leakages or accidental spillages along the pumping line could result in water with a high SS discharging into the Shuiyang River. The impact of dredging on water quality will be temporary, ceasing soon after the cessation of the dredging, and unlikely to be significant.

369. Dredging could potentially adversely affect water quality in the vicinity of the 12 drinking water intake works along the river. Chemical testing of the Shuiyang River sediment did not show heavy metal contamination. Potential pollution during dredging is therefore increased turbidity with elevated SS levels when the bottom sediment is disturbed. The PRC's *Drinking Water Source Water Quality Standard* (CJ 3020-93) does not have control standard on turbidity or suspended solids for Grade 2 drinking water source. The water quality around the in-take works however is protected under Anhui Province environmental protection regulations on urban drinking water sources based on distance separation, as indicated in Table V.5.

Table V.5: Levels of protection for drinking water in-takes

Grade	Upstream	Downstream	Land area
1	500m	200m	Within 200m
2	3000m from the boundary of the Grade 1 Zone		Within 200m
3	5000m from the boundary of the Grade 2 Zone		Within 200m

Source: National EIR.

370. The dredged material will contain a high volume of sediment and water. The dump sites selected are all ponds. The water levels in the ponds will need to be pumped away into the local drainage system or to the river, to provide volume for the dredged slurry to be pumped into the ponds. Drainage from the ponds will need to be controlled to avoid the discharge of turbid water into the surrounding drainage system. The drainage water is likely to contain high levels of TSS, which will settle out in the drainage ditches and may cause localised blockages and flooding. Some of the water may return to the Shuiyang River via a network of drains to the drainage sluice gates, but would not adversely affect the river quality.

371. In channel works, such as the construction of new bridges and the new port structures, can result in a number of impacts: disturbance to the river bed, elevated suspended sediments

in the water column due to piling, accidental spillages of sludges and lubricants from piling, oils and fuel, inappropriate disposal of spoil, etc. The EIRs state that the effect of increased turbidity decreases within about 100m from the construction site. The impact area during in channel works would therefore be confined to within 100m of the construction activities.

372. **Mitigation Measures.** The following mitigation measures will be implemented.

(i) Prior to the start of dredging, the contractor must liaise with the relevant Water Resource Bureau, Environmental Protection Bureau, and local township / town, to inform them of the proposals to protect the drinking water supply in-takes. The contractor must continue to keep the authorities informed of progress during the dredging works, so that they can supervise temporary works to protect their drinking water in-take.

(ii) Temporary water in-takes on the Shuiyang River shall be mounted on floating, mobile pontoons and connected into the main water conveyance pipeline. Taking into account the distance separation requirements described in Table V.5, the pontoon will be moved to maintain a distance separation of at least 600 m from the dredger when the dredger is upstream of the water intake, and at least 300 m from the dredger when the dredger is downstream of the intake.

(iii) During dredging, the disposal sites and drains need to be inspected regularly, to ensure that localised deposition in the drainage network does not pose a risk of localised flooding affecting farmland, houses and other assets. The discharge of supernatant water from these sites will comply with the standards in Integrated Wastewater Discharge Standard (GB 8978-1996). If necessary, flocculants such as polyacryl amide will be added to facilitate sedimentation of suspended solids.

(iv) Leakages from the pumping lines can be prevented by correct assembly and testing prior to use. In the event of a leak, the dredging should be stopped until the leak is repaired.

373. **Highway Subprojects.** The construction of the highway subprojects may impact on water quality during the construction of bridges, works near rivers, and accidental spillages and discharges to the drainage system.

374. The fours schemes include many bridges. Two proposed bridges for the Highway Subprojects lie close to water in-take works:

(i) Highway Subproject II – Yimu Highway, Kedian to Mujiating Section. The proposed bridge over the Zhanghe River lies 3 km upstream of a water intake works (capacity 10,000 t/d).

(ii) Highway Subproject III – S319 Erba to Wuwei Section. The proposed bridge over the Xihe River lies 1.2 km upstream of a water intake works. Although this is currently not in use the river is still a reserved water source for the urban area of Wuwei County.

375. Construction sites and construction camps may lead to the pollution of surface waters, for example through the discharge of washing water, sewage, stormwater runoff, production water, and spillages. Good management of the construction sites will reduce the risk of pollution incidents during demolition and construction of in channel structures. The wastewater discharged from camps must comply with Grade I of the GB8978-1996 (see Chapter II).

376. **Mitigation measures.** Good construction site practice will be implemented to reduce the impact of construction on surface water resources.

(i) Depending on the location of the construction camps and size of workforce, the sanitation provision may comprise septic tanks which would be emptied periodically and the waste taken to the nearby Municipal wastewater treatment works, or dug out and spread on agricultural land. Disposal of wastewaters direct to surface waters is prohibited.
(ii) In channel works shall be programmed for the dry season. In general, works will be isolated by coffer dams, to allow construction in the dry and minimise pollution of the watercourse. Spoil arising from piling must be stored temporarily away from water courses and removed on completion of the works.
(iii) Construction waste materials from the demolition of bridges must not be thrown away, but sorted, where possible re-used or recycled for example in landscaping, and the remaining wastes disposed of at a licensed site which would not cause further environmental impacts such as loss of flood conveyance.
(iv) Construction camps, storage yards, prefabrication plants, borrow and spoil areas and other facilities will not be permitted within 200m of the Zhanghe River and within 100m of the Xihe River in order to protect the water resources for drinking water supply.
(v) Sedimentation tanks or other suitable facilities will be installed on-site to treat process water (e.g. concrete batching for bridge construction), oily wastewater from construction machinery and washdown areas, and muddy runoff with high concentrations of suspended solids.
(vi) Temporary site drainage with settlement ponds should be provided along the highway during construction to entrap sediment prior to discharge to the local drainage network.
(vii) During demobilisation, construction sites must be cleared and wastes disposed of in an acceptable way.

4. Groundwater Quality

377. **SRWIP and Xuanzhou Multi-purpose Port.** The main activities likely to impact on groundwater levels and quality are the construction of the ship lock and piling for bridges or as part of remediation works on soft ground.

378. The construction of the ship lock upstream of Shuiyang Town will require de-watering to build the foundations in the dry, resulting in a decrease in the water table in the immediate vicinity of the construction site. This impact is temporary, localised and unlikely to result in significant environmental impacts, such as loss of groundwater supply to wells or wetlands, given the low environmental sensitivity of the site which is currently used as a ship yard. The potential for contamination will depend on whether the site is contaminated due to the ship building and repair activities.

379. Construction of the framework for both the rubber barrages will require the temporary diversion of the river, the installation of sheet piling around the construction site, and de-watering to construct the foundations for the frame in the dry. In river piling works will also be required for the new bridge, Xuanzhou Port, and the medium and large bridges for the Highway Subprojects. Piling can open up pathways for contamination to drain to groundwater, particularly where the groundwater is confined by overlaying impermeable strata. In general, the rivers in

the study area have good quality water, there is little history of industrial pollution in the wider catchment, and the bottom sediments are not contaminated.

380. **Highway Subprojects.** The construction of the highways may impact on groundwater levels during piling for bridges or soft ground treatment. The impacts would be short term and reversible. No specific mitigation is required.

5. Solid Waste

381. **SRWIP and Xuanzhou Multi-purpose Port.** The dredging of the Shuiyang River will generate some 2,457,200 m^3 of sediments that will be disposed of at seven ponds along the river valley. The river bed sediments are not contaminated with heavy metals whch are below the standards for re-use of sludges in agriculture (GB4284-84) and not very different from the soils at the disposal sites. As the ponds are infilled and dry out, the sites will be reclaimed for farmland, without significantly affecting the soils, crops and human health. The temporary storage sites could also be returned to agriculture after construction. This is a sustainable use of the sediment resource.

382. At Xuanzhou Port, the solid wastes arising out of construction will include: inert materials from house demolition, sludges from dredging the land-ward side pond, spoil and sediment from piling, construction litter and domestic litter from the temporary offices. Where possible inert spoil should be re-used on site as part of the land raising or in landscaping, with minimal waste going off site for disposal. Domestic litter is estimated to amount to 0.1 t/d or 36.5 t for the duration of the construction period. This will be collected and disposed of at a licensed Municipal solid waste treatment site.

383. **Highway Subprojects.** On the bridges and highways, solid waste generated during construction will include construction and demolition (C&D) waste dominated by excavated spoil and refuse generated by construction workers on construction sites. If not properly disposed, such wastes will create community health and sanitation problems.

384. Where possible, the existing pavement on the highways to be upgraded should be recycled for use as paving materials for the new road surface and C&D waste will therefore be minimized. Where possible there should be a balance of cut and fill to reduce the need for borrow pits and spoil disposal sites.

385. To minimize adverse impacts from the refuse generated by the workers and C&D waste, refuse will be stored in closed containers and regularly transported off-site for disposal at landfills. C&D wastes will be cleared and removed regularly.

386. Proposed mitigation measures for handling solid wastes are as follows:

(i) Solid wastes must be transported by sheeted vehicles to avoid spillages on the road.
(ii) Excess construction materials and wastes should be reused and recycled where possible.
(iii) Domestic solid waste from construction offices and camps should be collected and transported to the local Municipal engineered landfill.
(iv) Burning solid waste is prohibited on construction sites.

6. Soil Erosion and Slope Stability

387. **SRWIP and Xuanzhou Multipurpose Port.** Accelerated soil erosion during construction is a risk due to the removal of vegetation and exposure of bare ground on construction sites, during the re-modelling of the meanders on the Shuiyang River, the borrow pits and spoil disposal sites, and the extensive area of land raising at Xuanzhou Port.

388. **Mitigation Measures.** Specific mitigation measures for the dredging works are identified below and general mitigation measures for construction sites are covered in the following section on Highways.

(i) In-channel works will be programmed for the dry season.
(ii) Scour protection will be provided on the newly created river banks on the meander bends. A variety of patterns of revetment with vegetation will be considered during detailed design.
(iii) The borrow site for the Xuanzhou Port land raising is a hillock which is being quarried to provide inert material for land raising in the Industrial Park. The final land form will be flat and at the same elevation as the surrounding road network.
(iv) Prior to construction the top soil should be carefully removed and stockpiled separately to subsoils. The top soil should be reused in landscaping works.
(v) Temporary drainage will be installed during construction.
(vi) Temporary construction sites will be restored to their former land use, or as directed by the Supervisor and in consultation with the local villagers. Compacted soils need to be ploughed and sown with green manure such as alfalfa, prior to restoring them to farmland or forest.

389. **Highway Subprojects.** Vegetation clearance, earthworks (cuttings and embankments) and the creation of borrow sites and spoil disposal sites may potentially create foci for soil erosion. Most of the highways cross relatively low lying terrain, but Subproject IV G206 Dongliu to Yaodu crosses more undulating countryside, requiring some deep cutting and high embankments.

390. **Mitigation Measures.** Measures to prevent soil erosion on the Highway Subprojects will be based on a mix of geotechnical solutions and planting schemes. These will include the following:

(i) Vegetation clearance should be minimised.
(ii) Cutting and embankment slopes need to be provided with suitable drainage including side ditches, drainage ditches, water interception ditches, torrent ditches, etc.
(iii) Slopes will be designed to be stable, typically with 1:2 slope. Long slopes will incorporate a berm to break up the length of slope. Shallow slope protection works will include a mixture of planting and concrete block work. On long slopes, geotechnical measures such as soil pinning will be designed as required.
(iv) Earthworks should be vegetated as soon as feasibly possible.
(v) Excavate drainage ditches alongside the highway with grit traps, to be cleared periodically during maintenance.
(vi) Construction materials such as aggregate and cement must be protected from rainfall and runoff to prevent erosion.
(vii) During bridge works, sediment excavated for the piers is to be piled within the permanent land-take under the bridge and covered with straw matting for protection. Sand bags are to be used for footings.

(viii) During site preparation good construction practices methods must be followed to preserve top soil which is to be used in the restoration of the site. All temporary construction sites must be decontaminated and restored to their previous land use, or as otherwise agreed with the villages.
(ix) Soil stockpiles stored for a long time, may be sown with grass seed Trifolium ripens to prevent soil erosion.

7. Flora and Fauna

391. **SRWIP and Xuanzhou Multi-purpose Port.** The improvements to the SRWIP and Xuanzhou Port will result in the loss of semi-natural habitats where the river and flood banks are to be re-formed to improve the curvature of the meanders for navigation. There will also be loss of benthos and disturbance to mobile organisms such as fish during dredging and in channel construction works for the barrages and new bridge as well as loss of semi-natural habitats at the spoil disposal sites, ship lock, and the port site.

392. The permanent and temporary land take is mostly unused ponds for sludge disposal, agricultural land, and scrub and grassland on the river banks and floodplain (see Table V.2). The areas of land-take are very small for the types of habitat, which are common in the area. The loss of flora is not considered to be significant. Construction activities will disturb animals. These may include individuals of some species which are afforded provincial level protection. Most species present such as birds, amphibians, reptiles and small mammals are mobile and would avoid the construction sites. Overall the risk of impacting on protected species of fauna is considered to be low.

393. Dredging will remove the benthos in the central part of the channel, smother benthos and aquatic plants alongside due to sedimentation of the turbid waters, decrease productivity of the plankton in the water column, and disturb fish and other organisms due to the turbid waters, noise and vibration. These effects would be temporary, with water quality returning to baseline conditions within a short period of time and recovery of the aquatic ecosystem over one or two years. No protected species of fish or aquatic flora have been identified in the river and ponds.

394. **Mitigation measures.** The following mitigation measures will be implemented.
(i) A trained ecologist will visit the construction sites prior to start of works to check that there are no protected species present. If protected species are present, the ecologist will make arrangements to translocate the species to a donor site.
(ii) The cutter suction dredger method is known to limit turbidity to within about 100m of the dredger.
(iii) Dredging will be limited to the dry season for safety reasons, and avoid the fish migration season
(iv) The river banks will be grassed to provide slope protection and a forest belt planted on the top of the flood banks on the Shuiyang River to create a green corridor.

8. Highway Subprojects

395. **Highway Subproject I.** Most of the impact on flora results from road widening and the loss of the belt of poplar trees 4m deep planted on either side of the existing highway, and to a lesser extent the loss of woodland and shrubs where the alignment lies near villages. In addition to poplar, other species lost include Empress tree, Locust tree, Camphor tree and shrubs. This habitat type is common in the Province and does not include any protected species. Poplar in

particular is fast growing, and new trees can be replanted along the new highway. The temporary land-take mostly affects agricultural land.

396. **Highway Subproject II.** The new alignment will result in the loss of some 16.34 ha of grassland, 6.57ha of forest, and 42.2 ha of "other" land such as grasslands, scrub, and bare ground. This will require the clearance of trees such as Masson's pine, Chinese fir, Cedar, Camphor tree, Chinese sweetgum, Paper mulberry, Magnolia, Chestnut, etc., as well as shrubs, herbs and grasses. These species are common and the impact on habitat loss is small. Temporary land-take for example for the Zhanghe River Bridge will result in the loss of scrubland and grasses.

397. **Highway Subproject III.** The permanent land-take along much of this scheme is relatively modest and it is intended to widen within the avenue of Poplar trees lining the route, and cropland. These habitat types are common and no rare or endangered species are affected. Poplar trees are widely planted and are frequently used as tree breaks as they grow quickly. Temporary construction land-take is mostly agricultural.

398. **Highway Subproject IV.** The new alignment will cut across mixed broadleaf forest between K0+800 and K2+300 and in the hill country near the Tiantai Mountain Provincial Forest Park between K15+000 and K16+580. This will result in the loss of various species such as Chinese fir, Masson's pine, and Chinese Sweetgum. The alignment also crosses grasslands and the upper shores of nearby lakes. All the species identified during surveys are locally common.

399. All four Highway Subprojects are located in populated agricultural areas, where wildlife is limited. The schemes would reduce habitat for wild animals, and create disturbance during construction from noise and vibration, lighting for night-time work, construction traffic and general activities. Amphibians mainly inhabit ditches, pools and wetlands. They are susceptible to changes in water levels and water quality from local changes in drainage, stormwater runoff, and accidental spillages. Reptiles may occupy a range of habitats, including shrublands, stone crevices, woodland and farmland. Breeding is usually in late spring and summer. Adverse impacts include loss of habitat, disturbance, and pollution of watercourses. A large variety of birds are found in the study area, including resident, migratory and passerine birds. There may be impacts on bird species all year around, although disturbance during nesting (spring) is particularly sensitive. Small mammals are widely distributed in the study area. Adverse impacts may include vegetation clearance and earthworks leading to loss of habitat, particularly on underground and semi-underground species. Birds and small mammals can avoid disturbance by moving away to new habitats. The construction of bridges crossings would result in the temporary loss of aquatic vegetation, benthos and plankton in the vicinity of the works, while vibration and noise would disturb fish and other aquatic animals. Upon completion of bridge construction, these aquatic plant and animal communities would re-colonize. Impact on the community level is not expected.

400. The construction of Highway Subproject IV potentially impacts on protected species, due to the new alignment through secondary woodland and near the lakes:

(i) The birds of prey Black kite *Milvus migrans* and Black Baza *Aviceda leuphotes* (both afforded National level II protection) are found in forests and woodland including the Tiantai Mountain Forest Reserve. This area is already a transport corridor, with the existing G206, the Anjing Highway, Tongjiu railway and S327 all located in the area, so the EIR considers that the new alignment for the G206 will not significantly affect these species.

(ii) Two waterbirds are among the protected species that have been recorded in the assessment area: the White fronted goose Anser albifrons (National level II protection, but Least Concern on the IUCN red list) and the Swan goose Anser cygnoides (Provincial level II protection, but Vulnerable on the IUCN red list). Both are winter migrants found in wetlands and overwinter on the lakes around the Yangtze River from November to around April, including the small lakes alongside the proposed highway and the Little Qili Lake about 5 km from the project. However, the main habitat for waders and waterfowl is Shengin Lake, some which is designated at the National Level. Cao et al. (2008)19 estimated the populations of selected waterbird species in the East Asia Region and the eastern PRC including the Yangtze River and Huai River basins, and indicated that the populations of A. albifrons would be approximately 130,000 in East Asia and 33,000 in eastern PRC, while the populations of A. cygnoides would be approximately 78,000 in both East Asia and eastern PRC. Although no bird count was reported for these two species in the EIR, their wintering grounds, on Little Qili Lake, 5 km from the road alignment and only makes up a small area among all wetland wintering grounds in the Yangtze and Huai River basins. Construction of the highway is not expected to impact significantly on this species.

(iii) The Chinese pangolin *Manis pentadatyla* (National conservation level II, but Endangered on the IUCN red list) is a solitary, nocturnal, burrowing animal, which reportedly live in caves that are half way up the Tiantai Mountain or above within the Forest Park and are rarely found in the valleys near the highway alignment and nearby villages. The proposed alignment is 200m from the Tiantai Mountain Forest Park and there are also two existing roads between the proposed alignment and the Tiantai Mountain Forest Park: the G206 old alignment and the Anjing Expressway. It is unlikely that the Chinese pangolin would venture from the mountain ranges into the project area.

(iv) On this basis, it is concluded that the project area does not support 'critical habitat' for waterbirds or other fauna.

401. The proposed alignment of Highway Subproject IV does not directly impact on the Tiantai Mountain Forest Park, as it is located a minimum of 200m from the boundary of the park in the section K15+000 to K16+580. Without effective controls there could be indirect impacts during construction due to the workforce illegally entering the Park to hunt or collect non-timber forest products.

402. **Mitigation measures.** The main mitigation measures are:

(i) The working area for construction will be delineated and vegetation removal outside this area will not be permitted.

(ii) Prior to the start of construction, billboards will be erected on construction sites to inform people of the legal requirements to protect wildlife, prohibit poaching, and provide a hot-line for informants.

(iii) The workforce is to be provided with environmental training prior to entering the site and during the construction programme on the importance of habitats and wildlife, and the legislation governing their protection. Construction workers shall be prohibited from fishing, hunting and discharging wastes into the environment.

[19] Cao L., M. Barter and G. Lei. 2008. New Anatidae population estimates for eastern China: Implications for current flyway estimates. Biological Conservation, 141 (2008): 2301-2309.

(iv) Foresters from the local forest protection station will be recruited to survey the vegetation and mark out trees suitable for translocation as part of the landscaping works.
(v) The lighting of fires will be prohibited in the construction areas. Environmental education to the workforce must include fire prevention. Construction fires must be reported to the relevant unit for approval.
(vi) Temporary construction lighting shall be shielded to prevent light spill outside the construction site.
(vii) Crossings will be provided through culverts and under bridges for animals.

403. Additional mitigation measures during construction of the G206 Dongliu to Yaodu Section are as follows:

(i) Bird surveys shall be undertaken during construction of the section between K6+000 and K15+000 along the lakesides.
(ii) The programme for the construction of Sections K0+000 to K2+300 and K15+000 to K16+580 on the G206 Dongliu-Yaodu Section must be shortened as far as possible to reduce the impact on wildlife and to avoid peak hours of animal activity.
(iii) Noisy activities such as blasting (if required) and piling will be avoided during the peak bird nesting season between May and June, and blasting will be prohibited in the morning and at night.
(iv) Construction workers shall be prohibited from entering the Tiantai Mountain Forest Reserve.
(v) Special fire protection measures will be taken along K15+000 and K16+580 on Highway Subproject IV near the Tiantai Mountain Forest Reserve.

9. Agriculture

404. **SRWIP and Xuanzhou Multipurpose Port.** There is little land-take for this scheme as much of the works lie within the Shuiyang River flood banks. The disposal of dredged sludges in ponds, which are not used, will permit reclamation of the ponds for agriculture and slightly increase area under agricultural production. The land-take at Xuanzhou Port is part of a larger change in land use to create an industrial park.

405. **Highway Subprojects.** The amount of land-take from agricultural land for the highway schemes is relatively small, and represents less than 1% of available arable land in the affected communities (Table V.6). Consequently the highway schemes will not significantly impact on agricultural production at the local or regional level.

Table V.6: Loss of arable land and crop production for the highway subprojects

Topic	Impact			
Permanent land-take	**Scheme**	**Land-take (ha)**	**Land-take %**	**% total farmland**
	I	26.91	35.7	0.0018 to 0.37
	II	22.83	25.96	0.05
	III	17.39	15.2	<1
	IV	33.89	49.79	0.6
Agricultural production	**Scheme**	**Loss of crops (tonnes/yr)**		**Value ('000/yr)**
	I	152.28		RMB 310.7
	II	93.3		RMB 190.0
	III	70.49		N/A
	IV	254.15		RMB 813.3

N/A = Not available.
Source: PPTA Resettlement Plan.

406. As the proposed highway schemes all cross agricultural land, there is potential that construction activities may lead to damage to infrastructure such as canals and ditches, accidental severance of irrigation ditches, soil erosion from adjoining fields, deposition and blockages in channels from construction site runoff, and windblown dust and cement on crops. Windblown lime can affect the pH of soils and water.

407. **Mitigation measures.**

(i) The earth from the areas of permanent land-take shall be stripped and the different soil horizons stockpiled separately to preserve the top soil, which will then be re-used after construction for site restoration or on agricultural land.
(ii) Existing field roads shall be used as access roads where possible.
(iii) Temporary works sites must be cleared up and revegetated as soon as possible after the end of construction.

10. Land Acquisition and Resettlement

408. **SRWIP and Xuanzhou Multipurpose Port.** Details on land acquisition and involuntary resettlement for this project are described in the five Resettlement Plans for the Project and are summarised in **Tables V.7** to **V.11**. In total, the schemes will require some 3955.04 mu (263.7 ha) of permanent land take and 4064.89 mu (271 ha) of temporary land take. The total number of houses to be demolished is 923, with almost two thirds, 616 associated with Highway Subproject I Ma'anshan Northern Corridor. The total affected population is estimated at 17,509, with the highest numbers of affected persons (AP) for Highway Subproject I (with 6,497 APs) followed by Highway Subproject II (with 6,146 APs).

Table V.7: Summary of Resettlement Impacts for the SRWIP

District			**Xuanzhou District**				
Township			**Yangxian Xiang**	**Liqiao Town**	**Shuiyang Town**	**Zhuqiao Xiang**	**Total**
Pile No.			K0-K2	K29+500-K30+500	K32+500-K33+500	K16-K17	/
Villages			1	2	4	1	8
Village groups			4	2	1	1	8
Permanent Land (mu)	Collective land	Subtotal	403	10	16.8	0	429.8
		Where: cultivated land	201	8.8	9.8	0	219.6
		Non-cultivated land	202	1.2	7	0	210.2

District			Xuanzhou District				
Township			**Yangxian Xiang**	**Liqiao Town**	**Shuiyang Town**	**Zhuqiao Xiang**	**Total**
Temporary land occupation (mu)	By spoil grounds		0	478	770	253	1501
	By borrow areas		0	0	0	0	0
HD	Demolished rural residential houses (m^2)		17310	434	500	0	18244
	Demolished rural non-residential properties (m^2)		200	0	0	0	200
	Total (m^2)		17510	434	500	0	18444
Directly affected population	LA only	HHs	0	7	7	0	14
		Population	0	25	26	0	51
	HD only	HHs	16	3	1	0	20
		Population	34	11	3	0	48
	Both LA and HD	HHs	119	1	2	0	122
		Population	369	4	6	0	379
	Subtotal	HHs	135	11	10	0	156
		Population	403	40	35	0	478
	Demolition of non-residential properties	HHs	1	0	0	0	1
		Population	8	0	0	0	8
	Total HH		**136**	**11**	**10**	**0**	**157**
HD: Household demolition; LA Land acquisition; HH Households							

Source: PPTA Resettlement Plan.

Table V.8: Summary of Resettlement Impacts for Highway Subproject I - Ma'anshan Northern Corridor

County			**Hexian**		**Hanshan**		**Total**
Town			**Shiyang**	**Shanhou**	**Zhaoguan**	**Xianzong**	
Pile No.			AK0+000-AK20+180	AK20+180-AK34+770	AK34+770-AK46+000	AK46+000-AK46+873.6	/
Villages			7	4	4	1	16
Village groups			44	33	19	2	98
Permanent LA (mu)		Total	542.84	330.48	231.35	26.45	1131.12
		Where: cultivated land	517.86	280.9	204.86	22.65	1026.27
		Non-cultivated land	24.98	49.58	26.49	3.8	104.85
Temporary land occupation (mu)		Total	497.4	348.7	398.1	4.7	1248.9
		Where: general purposes	124.1	84.7	46.5	4.7	260
		By borrow areas and spoil grounds	373.3	264	351.6	0	988.9
HD		Total (m^2)	28600	47340	35373.1	4520	115833.1
		Demolished rural residential houses (m^2)	28600	47340	34040	4520	114500
		Demolished rural non-residential properties (m^2)	0	0	1333.1	0	1333.1
Directly affected population	LA	HHs	493	234	186	22	935
		Population	1953	1005	811	89	3858
	Demolition of residential houses	HHs	167	283	135	22	607
		Population	659	1307	587	107	2660
	Demolition of non-residential properties	HHs	0	0	5	0	5
		Population	0	0	9	0	9
	Both LA and HD	HHs	4	2	2	1	9
		Population	13	8	6	3	30
	Total	HHs	656	515	324	43	1538
		Population	2599	2304	1401	193	6497
HD: Household demolition; LA Land acquisition; HH Households							

Source: PPTA Resettlement Plan.

Table V.9: Summary of Resettlement Impacts for Highway Subproject II – Yima Highway

County			**Nanling County**		**Total**
Town			**Jishan**	**Gongshan**	
Pile No.			K11+900 - K20+800	Left of K20+800- K34+260	
Villages			5	5	10
Village groups			13	27	40
Permanent LA (mu)	Collective land	Subtotal	300.3	849.6	1149.9
		Where: cultivated land	75.2	241.4	316.6
		Non-cultivated land	225.1	608.2	833.3
	State-owned land		169.2	0	169.2
	Total		469.5	849.6	1319.1
Temporary land occupation (mu)	Ordinary		26.3	18.7	45
	By borrow areas and spoil grounds		502.5	387.5	890
HD	Demolished rural residential houses (m^2)		1715.8	10095.8	11811.6
	Demolished rural non-residential properties (m^2)		1877	1127	3004
	Total (m^2)		3592.8	11222.8	14815.6
Directly affected population	LA only	HHs	137	300	437
		Population	472	1176	1648
	HD only	HHs	10	39	49
		Population	38	171	209
	Both LA and HD	HHs	1	7	8
		Population	3	23	26
	Subtotal	HHs	148	346	494
		Population	513	1370	1883
	Demolition of non- residential properties	HHs	13	12	25
		Population	22	27	49
	Total	HHs	161	358	519
		Population	535	1397	1932
HD: Household demolition; LA Land acquisition; HH Households					

Source: PPTA Resettlement Plan.

Table V.10: Summary of Resettlement Impacts Highway Subproject III – S319 Erba-Wuwei

Subcomponent				**Road works**					**Total**
County				**Wuwei**					
Town				**Dougou**	**Fudu**	**Erba**	**Tanggou**	**Shijian**	
Pile No.				**k19+500-k26+000**	**k26+000-k34+600**	**k0+000-k4+000**	**k4+000-k17+100**		
Number of villages				3	3	2	7	1	16
Number of village groups				16	21	37	39	0	113
Permanent LA (mu)	Collective land		Subtotal	19.57	246.81	13.90	73.73	0	354.01
			Where: cultivated land	17.83	207.27	13.90	52.38	0	291.38
			Non-cultivated land	1.74	39.54	0.00	21.35	0	62.63
	State-owned land			10.70	0.00	0.00	0.00	0	10.70
	Total			30.27	246.81	13.90	73.73	0	364.71
Temporary land occupation (mu)	General purposes			0	48	0	0	0	48
	Borrow areas and spoil grounds			0	0	0	0	151	151
	Total			0	48	0	0	151	199
HD	Demolished rural residential houses (m^2)			0	8333	0	0	0	8333
	Demolished rural non-residential properties (m^2)			0	977	0	0	0	977
	Total (m^2)			0	9310	0	0	0	9310
Directly affected population	LA only		HHs	211	743	110	460	0	1524
			Population	865	2865	417	1853	0	6000
	HD only		HHs	0	60	0	0	0	60
			Population	0	231	0	0	0	231
	Both LA and HD		HHs	0	34	0	0	0	34
			Population	0	130	0	0	0	130
	Subtotal		HHs	211	769	110	460	0	1550
			Population	865	2966	417	1853	0	6101
	Demolished rural non-residential properties (m^2)		HHs	0	2	0	0	0	2
			Population	0	45	0	0	0	45
	Total		HHs	211	771	110	460	0	1552
			Population	865	3011	417	1853	0	6146
HD: Household demolition; LA Land acquisition; HH Households									

Note: The borrow areas and spoil grounds of the Project area located in Shijian Town, where unused land will be occupied temporarily, affecting no one.
Source: PPTA Resettlement Plan.

Table V.11: Summary of Resettlement Impacts Highway Subproject IV – G206 Dongliu to Yaodu

County			**Dongzhi**		
Town			**Dongliu**	**Yaodu**	**Subtotal**
Pile No.			K0+000- K8+990	K8+990- k15+434	/
Village			2	5	7
Group			13	30	43
Permanent LA (mu)	Total		212.75	497.56	710.31
	Where: cultivated land		104.31	190.05	294.36
	Non-cultivated land		108.44	307.51	415.95
Temporary land occupation (mu)			/	/	288.8
Demolished rural residential houses (m^2)			1262.41	1283.68	2546.09
Demolished rural non-residential properties (m^2)			0	0	0
Directly affected population	LA only	HHs	206	473	679
		Population	700	1686	2386
	HD only	HHs	5	2	7
		Population	24	9	33
	Both LA and HD	HHs	3	4	7
		Population	9	20	29
	Total	HHs	214	479	693
		Population	733	1715	2448
HD: Household demolition; LA Land acquisition; HH Households					

Source: PPTA Resettlement Plan.

409. **Mitigation Measures.** The impacts on affected persons have been minimised during feasibility design by avoiding existing and planning residential areas, minimising the occupation of high grade farmland, gaining access to sites along existing roads, and avoiding environmentally sensitive areas. Land acquisition will be conducted in accordance with *Land Management Method of the PRC Implemented by Anhui Province*. Compensation shall be made in accordance with the compensation rates for land expropriation for different types of land use, relocation, and income restoration. The construction companies will be required to minimise the impact on farmers. Further details are provided in the Resettlement Plans.

11. Physical Cultural Resources

410. **All Subprojects.** Literature review and field investigation did not discover the presence of physical cultural resources as defined in SPS 2009 within the assessment areas for any of the subprojects. As such, there will be no impact on physical cultural resources.

411. In the event that buried artefacts of archaeological significance are uncovered during the construction stage within the project areas, construction will be stopped and immediately reported to the Cultural Relics Bureau in accordance with PRC's *Cultural Heritage Protection Law*.

12. Occupational H&S

412. **All Subprojects.** Due to its nature, the construction industry is considered to be one of the most hazardous industries. The civil works contractors will be required to implement adequate precautions to protect the health and safety of construction workers. In addition, particular attention needs to be given to the control of schistosomiasis. Contractors will manage occupational health and safety risks by applying the following measures.

(i) Construction camps
  (a) Provide a secure supply for drinking water. This is likely to be from the existing piped water supply.
  (b) Inspect and supervise food hygiene in the cafeteria on site regularly. Cafeteria workers must have valid health permits. In the event of food poisoning, effective control measures must be implemented immediately to prevent it from spreading.
  (c) Sanitation facilities will be provided in accordance with the requirements of labour management and sanitation departments in the living areas on construction site. Designated staff will be responsible for cleaning and disinfection.

(ii) Exterminate rodents on site at least once every three months, and exterminate mosquitoes and flies at least twice each year;

(iii) Occupational safety:
  (a) Provide safety hats and safety shoes to all construction workers.
  (b) In addition, provide safety goggles and respiratory masks to workers doing asphalt road paving.
  (c) Provide ear plugs to workers working near noisy machinery, especially during piling works.

(iv) Blasting
  (a) Adopt safety operating procedures and stress worker safety.
  (b) Explosives to be procured, transported, stored, and used in strict accordance with the regulations.
  (c) Control blasts using small charges.
  (d) Programme blasting for the same time every day.
  (e) Dust suppression after blasting.
  (f) Train workforce on risks associated with blasting.

(v) Disease prevention and safety awareness:
  (a) Provide construction workers with physical examination before they start working on site. If infectious disease is found, the patient must be isolated for treatment to prevent the disease from spreading. From the second year onwards, conduct physical examination on 20% of the workers every year.
  (b) Establish health clinic at location where workers are concentrated, which should be equipped with common medical supplies and medication for simple treatment and emergency treatment for accidents.
  (c) Specify (by the IA and contractors) persons responsible for health and epidemic prevention and food hygiene and disease prevention education and awareness.

(vi) Prevention of Schistosomiaisis:

(a) Survey construction work areas, camps and offices, remove habitats where the host snails are likely to live, and if appropriate apply biocides to kill the host snails.
(b) Conduct physical checks on the workforce every six months, and if the disease is found, provide medication to the infected person, inform the local Schistosomiasis Prevention Institute and local Health Administrative Department.
(c) Select spoil disposal sites in areas where drainage can be controlled to prevent the spread of the disease.
(d) Educate the workforce about the disease. Instruct workforce to avoid water contact by working in aquatic habitats likely to support the host snail (shallow water with emergent vegetation), avoid skin contact with water, and to use the sanitary facilities provided at work camps.

13. Community Health and Safety

413. **All Subprojects.** Many of the components of the proposed subprojects will be located close to houses and villages, potentially resulting in interference between construction activities and the daily lives of local villagers. Activities include:

(i) Demolition of houses;
(ii) Temporary and permanent land-take from villagers;
(iii) Disposal of dredged material and excess spoil at sites surrounded by farmland;
(iv) Increased construction traffic on the road and river network, resulting in higher risk of accidents with local traffic;
(v) Partial road closures and need for narrow lanes to permit online upgrading of the existing highway while maintaining the road open to traffic; and
(vi) The preference for renting accommodation from villagers over building temporary construction camps.

414. Construction activities are likely to lead to nuisances for nearby residents, including sensitive receptors such as schools and hospitals from noise, dust, higher construction traffic, accidental loss of crops, or damage to assets such as irrigation canals. Traffic congestion may worsen as construction traffic in the urban area increases during rush hours, causing temporary inconvenience to traffic, residents, commercial operations, and institutions. Construction sites in urban areas, such as the highway schemes, will be located close to residential and commercial urban areas, and present a threat to public health and safety. The project may also contribute to road accidents through the use of heavy machinery on existing roads and temporarily blocking pavements for pedestrians.

415. **Mitigation measures.** The following mitigation measures are proposed.

(i) Temporary traffic management (TTM). A traffic control and operation plan will be prepared together with the local traffic management authority prior to any construction. The plan shall include provisions for identifying preferred haul routes, diverting or scheduling construction traffic to avoid morning and afternoon peak traffic hours, regulating traffic at road crossings with an emphasis on ensuring public safety through clear signs, speed controls and planning in advance.

(ii) Information disclosure. Residents, businesses, schools and hospitals will be informed in advance through media of the road improvement activities, given the dates and duration of expected disruption.

(iii) Construction sites. Clear signs will be placed at construction sites in view of the public, warning people of potential dangers such as moving vehicles, hazardous materials, excavations and raising awareness on safety issues. Heavy machinery will not be used after day light and all such equipment will be returned to its overnight storage area/position before night. All sites will be made secure, discouraging access by members of the public through security personnel or fencing, whenever appropriate. Billboards will be set up at the entrance to sites specifying the names of the construction and supervision companies, hotline and key contact entry points for the grievance redress mechanism.

(iv) Utilities provision interruption. Construction may require relocation of municipal utilities such as power, water and communication cables. Temporary suspension of services (planned or accidental) can affect the economy, industries, businesses and residents' daily life. The following mitigation measures will be adopted and will be incorporated in the bid documents and construction contracts:

(a) Contractors will assess construction locations in advance for potential disruption to services and identify risks before starting construction;

(b) If temporary disruption is unavoidable the contractor will, in collaboration with relevant local authorities such as power company, water supply company and communication company, develop a plan to minimize the disruption and communicate the dates and duration in advance to all affected people.

D. Impacts and Mitigation Measures during the Operational Stage

1. Air Quality

416. **SRWIP and Xuanzhou Multipurpose Port.** The main source of emissions to air on the Shuiyang River are (i) emissions from ships passing up and down the river and while in port, and (ii) fugitive dust emissions from the handling of cargo at Xuanzhou Port.

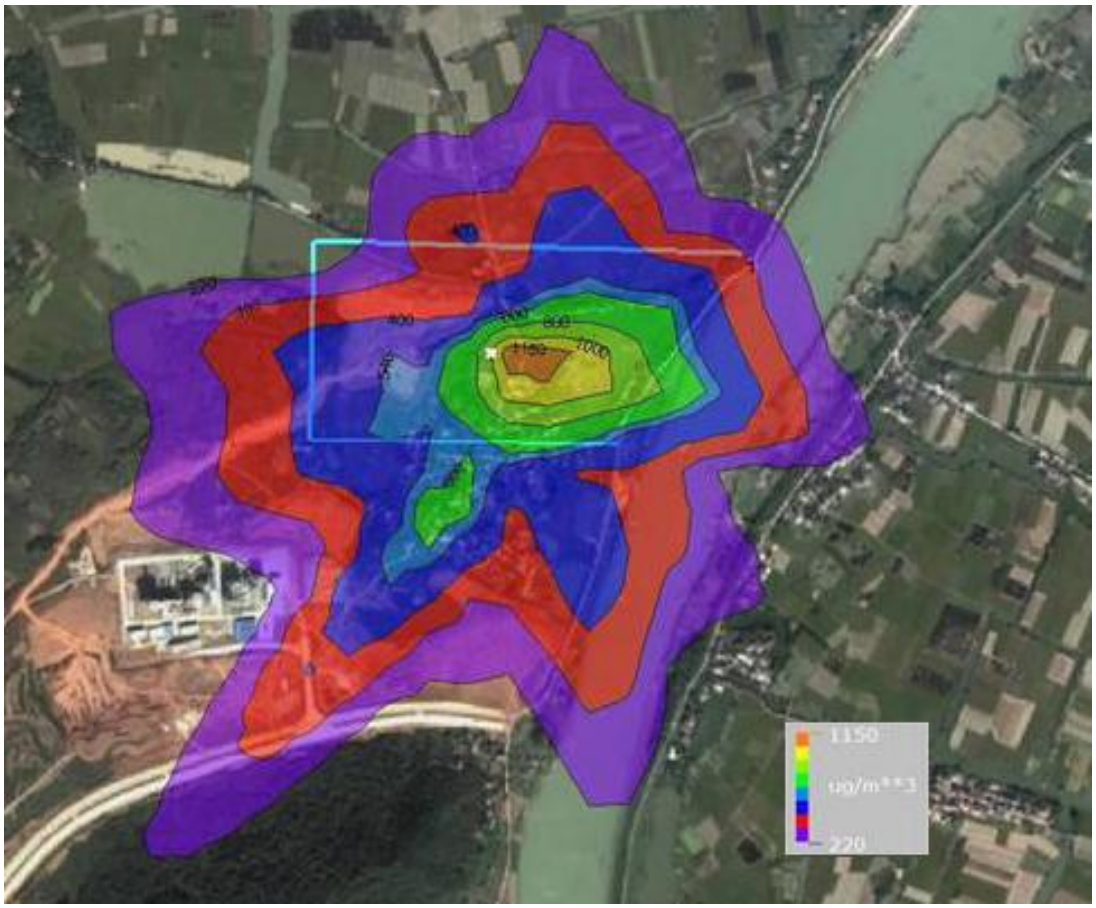
417. While the ships will emit pollutants, the total volumes are relatively small, estimated at NO_2 0.23 kg/km.d and SO_2 0.34 kg/km.d. Furthermore, given the existing good air quality, open terrain, and windy conditions, the impact of ships emissions on air quality is considered to be low and short-term. No mitigation is required.

418. At the port the local air quality would not be affected during the handling of container cargo. However, air quality may be adversely affected during the handling and stockpiling of loose fine-grained materials such as cement, non-metallic ores, grain, and fertiliser.

419. The national EIR modelled fugitive dust (TSP) emissions during the handling of coal at the port using AERMOD. The 2012 daily meteorological data were used in the model, the volume of cargo handled was assumed based on cargo projections for the design year, and no allowance was made for mitigation measures to suppress dust. The maximum daily average ground concentration of fugitive dust was 0.265 mg/m^3, which when added to the background dust levels of 0.131 mg/m^3, exceeds the standard of 0.3 mg/m^3 for Grade II Ambient Air Quality.

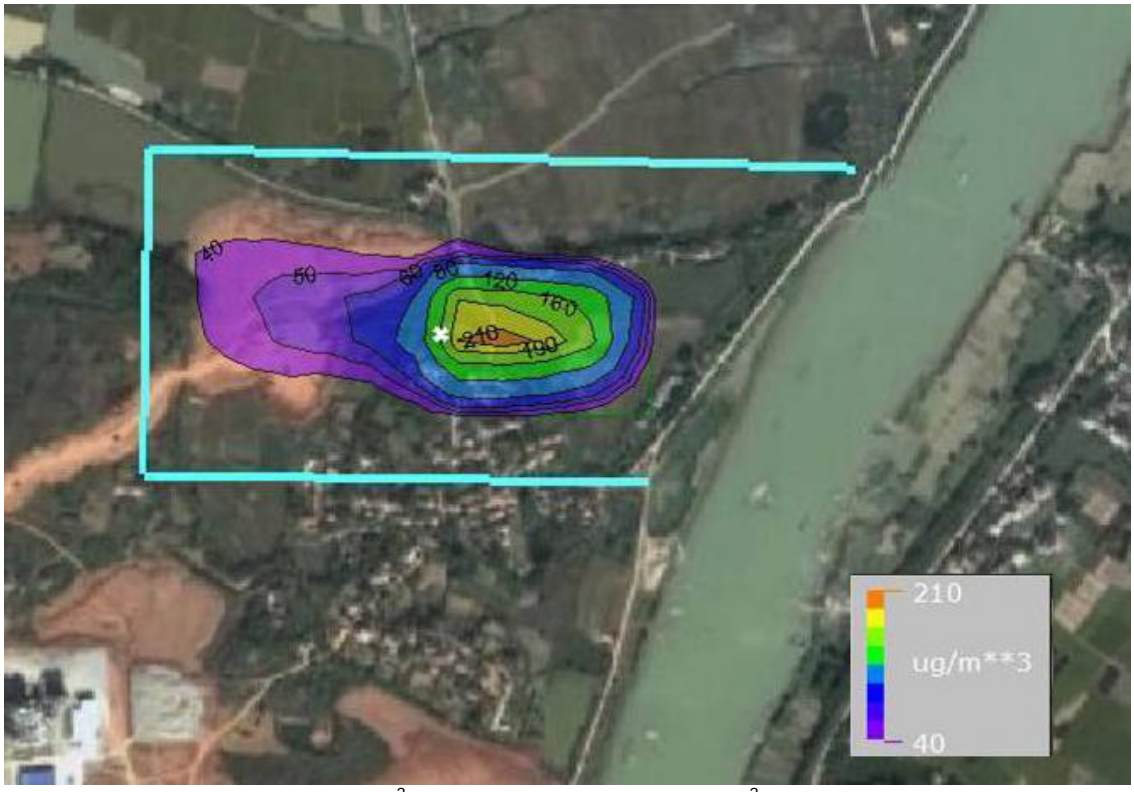
The highest concentrations of fugitive dust are within storage yard and decrease towards the site boundary. Figures V.1 and V.2 below illustrate the worst case modelled during very windy conditions (50 m/s) coinciding with a typical case for the maximum daily average dust concentration, which would occur very rarely. The Grade II Ambient Air Quality Standard (0.3 mg/m^3) would be exceeded on the site boundary for the worst case scenario modelled (see Figure V.1), but would be met on the site boundary for the typical daily concentration (see Figure V.2), which is more representative of normal operation in normal weather conditions. The maximum hourly average concentration of dust at the port boundary (for the Phase 1 of port expansion) is estimated to be 0.897 mg/m^3, which is below the standard of 1.0 mg/m^3 for fugitive dust in GB 16297-1996).

Figure V.1: Maximum daily average concentration of dust from cargo handling



Note: The key is presented in µg/m^3. The yellow represents 1mg/m^3 which is the standard for fugitive dust. The port boundary shown is for Phase 1. The cement works (no kiln) and extensive borrow area, which will be used to raise land at the port during construction, is shown to the bottom left of the port.

Figure V.2: Typical daily concentration of dust at the proposed port



Note: The key is presented in µg/m^3. The yellow represents 1mg/m^3 which is the standard for fugitive dust.The port boundary shown is for Phase 1.

420. **Mitigation measures.** The proposed mitigation measures to control air pollution at Xuanzhou Port are:

(i) Encourage container cargo.
(ii) If possible avoid handling bulk cargo during windy weather
(iii) Reduce opportunities to raise dust by reducing during the handling of bulk cargo such as reducing the drop height and avoid over-loading conveyor belts
(iv) Adopt dust suppression methods such as water spraying, covering bulk materials with felt or other materials, and installing wind breaks.
(v) Stop loading and unloading bulk, fine grained material during windy weather and cover stockpiles.
(vi) Provide watering facility in the coal and ore storage yards for dust suppression
(vii) Plant trees and install fences around the site to prevent the dispersion of dust off site.

421. **Highway Subprojects.** The main sources of air pollution for the highway schemes are vehicle emissions. However, given that these subprojects are upgrades of existing roads, the additional increase in traffic resulting from the scheme is small and related to induced growth in development areas adjoining and close to the upgraded highways. Consequently the schemes are unlikely to worsen air quality significantly over existing conditions. With time increased traffic will result in higher concentrations of air pollutants along the highway corridors.

422. According to the national EIRs, the mean hourly concentrations of NO_2 and PM_{10} for the short and mid-term traffic projections meet Class 2 air quality standard for *Ambient Air Quality* (GB3095-2012) (Tables V.12 to V.15).

423. **Mitigation Measures.** The main mitigation measure to offset the future increase in traffic-related emissions is the national imposition of increasingly stringent standards for emissions for new vehicles and fleet turnover. China implemented European No. 2 vehicle emissions standards in 2005 and No. 3 Vehicle Emission Standard in 2008.

Table V.12: Forecast Daily Average Concentration of NO_2 and PM_{10} for 2029 at Typical Receptors along Subproject I S367 - Ma'anshan North Corridor

Road Section	Receptor	Distance to Road (m)	Max. NO_2 Concentration ($\mu g/m^3$)	Applicable Air Quality Standard Limit ($\mu g/m^3$)
NO_2				
Start – Chuma Expressway	Red Line	-	1.98	80
	Dachen N1	8	0.94	
	Zhongshan Village N2	8	0.97	
Chuma Expressway – S206	Red Line	-	2.17	
	Taodian Community Hospital N21	6	1.03	
	Taodian N20	8	1.10	
S206 – S226	Red Line	-	1.67	
	Tangzhuang N44	8	0.87	
	Dajiangzhuang N45	8	0.85	
PM_{10}				
Start – Chuma Expressway	Red Line	-	0.31	150
	Dachen N1	8	0.15	
	Zhongshan Village N2	8	0.16	
Chuma Expressway – S206	Red Line	-	0.34	
	Taodian Community Hospital N21	6	0.17	
	Taodian N20	8	0.16	
S206 – S226	Red Line	-	0.26	
	Tangzhuang N44	8	0.14	
	Dajiangzhuang N45	8	0.14	

Source: SSSRI: Results modelled using ADMS.

Table V.13: Forecast Daily Average Concentration of NO_2 and PM_{10} for 2029 at Typical Receptors along Subproject II Yimu Highway Erba to Wuwei Section

Road Section	Receptor	Distance to Road (m)	Max. NO_2 Concentration ($\mu g/m^3$)	Applicable Air Quality Standard Limit ($\mu g/m^3$)
NO_2				
G205 Intersection – Wuli Traffic Island	Red Line	-	1.32	80
	Jiang Village N51	6	1.06	
	Kedian Village N52	7	0.96	
Wuli Traffic	Red Line		2.04	

Road Section	Receptor	Distance to Road (m)	Max. NO_2 Concentration ($\mu g/m^3$)	Applicable Air Quality Standard Limit ($\mu g/m^3$)
Island – S216 Intersection	Gutian Village N58	5	1.56	
	Shanggang Village N60	5	1.55	
S216 Intersection – X070 Intersection	Red Line	-	1.18	
	Wang Village N61	6	0.90	
	Shuguang Village N63	5	0.90	
X070 Intersection – Mujiating, End	Red Line	-	1.23	
	Gaoling Village N72	5	0.75	
	Guolong Village N73	5	0.76	
PM_{10}				
G205 Intersection – Wuli Traffic Island	Red Line	-	0.19	150
	Jiang Village N51	6	0.16	
	Kedian Village N52	7	0.14	
Wuli Traffic Island – S216 Intersection	Red Line		0.30	
	Gutian Village N58	5	0.23	
	Shanggang Village N60	5	0.22	
S216 Intersection – X070 Intersection	Red Line	-	0.17	
	Wang Village N61	6	0.13	
	Shuguang Village N63	5	0.13	
X070 Intersection – Mujiating, End	Red Line	-	0.16	
	Gaoling Village N72	5	0.10	
	Guolong Village N73	5	0.11	

Source: SSSRI. Results modelled using ADMS.

Table V.14: Forecast Daily Average Concentration of NO_2 and PM_{10} for 2029 at Typical Receptors along Subproject III S319 Erba – Wuwei

Road Section	Receptor	Distance to Road (m)	Max. NO_2 Concentration ($\mu g/m^3$)	Applicable Air Quality Standard Limit ($\mu g/m^3$)
NO_2				
S319	Red Line	-	1.81	80
	Gaoweiqian N83	8	1.01	
	Xiaoshangjia N84	8	1.04	
PM_{10}				
S319	Red Line	-	0.24	150
	Gaoweiqian N83	8	0.14	
	Xiaoshangjia N84	8	0.15	

Source: SSSRI. Pollutants modelled using ADMS.

Table V.15: Forecast Daily Average of the Concentration of NO_2 and PM_{10} for 2029 at Sensitive Receptors along Subproject IV G206 Dongliu – Yaodu

Pollutant	Receptor	Distance to Road (m)	Max. NO_2 Concentration ($\mu g/m^3$)	Applicable Air Quality Standard Limit ($\mu g/m^3$)
NO_2	Red Line	-	2.17	80
	Liu Village N108	8	1.53	
	Forestry Farm Dormitory N109	12	1.29	
PM_{10}	Red Line	-	0.45	150
	Liu Village N108	8	0.32	
	Forestry Farm Dormitory N109	12	0.27	

Source: SSSRI. Pollutants modelled using ADMS.

2. Noise

424. **SRWIP and Xuanzhou Multipurpose Port.** During the operation of the SRWIP, the main noise source on the channel is from ships. The horns are sounded in relation to manoeuvres or security arrangements. The level of sound from ship horns is typically about 80 dB(A). While the ship horns may be heard over 250-400m, they are sounded periodically, not continuously, and are unlikely to cause a nuisance, except perhaps in locations such as the ship lock where they may be a greater frequency of the use of ship horns. The flood embankments along the river may also help to attenuate the propagation of noise, especially for property at slightly lower elevations in the vicinity. No further mitigation is required.

425. At Xuanzhou Port a range of activities will cause noise, such as loading and unloading, movement of goods and vehicles, and the manoeuvre of ships in and out of the port. Based on the types of equipment reported in the EIR for port operation, Table V.16 shows the sound power levels of these equipment and the cumulative sound power level of 118 dB(A) assuming that all equipment will be deployed concurrently. Noise attenuation shown in Table V.16 indicates that without mitigation, the 65 dB(A) day time standard would be met at a distance of 250m from the noise source, and 55 dB(A) night time standard would be met at a distance of 800m from the noise source. According to GB 12438-2008, these noise standards should be met at the site boundary of the port. Mitigation measures are therefore necessary.

Table V.16: Operational noise attenuation at the Xuanzhou Port

Noise Source		Noise Attenuation based on Cumulative Sound Power Level	
Equipment	**Sound Power Level [dB(A)**	**Distance from Source (m)**	**Noise Level [dB(A)]**
Crane (diesel)	112	100	73.0
Crane (electric)	95	200	67.0
Bridge crane (electric)	95	**250**	**65.0**
Loader	112	300	63.5
Forklift (electric)	95	400	61.0
Trailer platform	112	500	59.0
Truck / vehicle	112	600	57.4
Cumulative	**118**	700	56.1
		800	**54.9**
According to GB12348-2008 *Emission Standard for Industrial Enterprises Noise at Boundary*, the standards for Class III functional areas (industrial setting) are 65 dB(A) in day time and 55 dB(A) in night time			

Source: Domestic EIR and PPTA consultant.

426. **Mitigation measures.** The main mitigation measures during operation are:

(i) Ships should have horns with strong directionality and only be used for short durations. At nights, lights are to be used instead of horns.

(ii) At the port, the movement of ships is to be managed to avoid the need to use their horns.

(iii) The criteria for selecting plant and equipment used at the port site will include their sound power levels (for example, electric forklifts and cranes are preferred over diesel ones). The plant and equipment will be maintained according to manufacturer's instructions.

(iv) The port layout and arrangements will be designed to maximize the use of buildings and structures to shield noisy activities from sensitive receptors. If needed perimeter walls will be erected to shield the direct line of sight between sensitive receptors and ground level noisy activities.

(v) Landscaping around the port to attenuate noise.

(vi) Restrict noisy operations at night especially those that are high above ground such as bridge cranes.

(vii) Noise monitoring will be undertaken at site boundaries to ensure that compliance with the noise standards is achieved, and if necessary, additional noise mitigation measures will be implemented.

427. **Highway Subprojects.** The main noise source on the Highway Subprojects is from traffic. Future noise levels were calculated for the year of opening 2015, a mid-year 2021, and the design year 2029. The assessment of the impact of the schemes on traffic noise and justification for mitigation are based on the number of exceedances for the medium year 2021. According to the noise functional area classification in the PRC's *Environmental Quality Standard for Noise* (GB 3096-2008), the area within 35 m from the red line of the proposed highway scheme is classified as Functional Area Category 4a with day time and night time noise limits of 70 dB(A) and 55 dB(A) respectively; while the area between 35 m and 200 m from the red line is classified as Functional Area Category 2, with day time and night time noise limits of 60 dB(A) and 50 dB(A) respectively. The traffic noise modelling results showing noise exceedances for the four highway subprojects in 2021 and 2029 are summarised in Table V.17, with the predicted noise levels at the sensitive receptors presented in Table V.18. The following observations are made based on these two tables:

- In all highway sub-projects, noise exceedance is mainly due to night time noise from road traffic, with some also showing day time exceedance mainly in the Category 2 functional area.
- **Ma'anshan North Corridor**:
  - Approximately 3/4 of the households would experience noise exceedance, with most of them in the Category 2 functional area and in the long-term (2029).
  - About 1/4 of these households would experience noise exceedance in 2021. The other 3/4 that are mainly in the Category 2 functional area would not experience exceedance until 2029.
  - Of the 782 households that would experience night time noise exceedance in 2029 in the Category 2 functional area, the exceedance at 560 households (or 72%) would be $\leqslant$1.0 dB(A). Low noise asphalt road paving, which could reduce road noise by 2-3 dB(A), should be effective in protecting these sensitive receptors.
  - The key sensitive receptor needing noise mitigation is the Taodian Health Clinic at chainage K25+000, which would experience both day time and night time noise exceedance in 2021, by more than 7 dB(A) in the night time.
- **Yimu Highway Kedian to Mujiating**:
  - Similar to the Ma'anshan North Corridor, approximately 3/4 of the households would experience noise exceedance. However, almost all would experience exceedance in 2021, mostly due to high night time noise in both Category 4a and Category 2 functional areas.
  - The key sensitive receptor needing noise mitigation is the Bowen Secondary School at chainage K18+400 to K18+500, which would experience day time noise exceedance by $\geqslant$2.0 dB(A). Although night time noise shows higher levels of exceedance, these are not applicable to the schools since there is no night time activity at the school.
- **S319 Erba to Wuwei Section**:
  - Almost all (99.1%) the sensitive receptors along this highway would experience noise exceedance and in year 2021.
  - Most of the households in the Category 2 functional area would experience noise exceedance in the day time as well.
  - The key sensitive receptor needing noise mitigation is the Bo'ai Hospital at chainage K9+270 to K9+300, with exceedances of more than 5 dB(A) in the day time and at night in 2021, increasing to more than 7 dB(A) in 2029.
  - The Changba Primary School at chainage K32+450 would only experience day time noise exceedance in 2029 by 0.1 dB(A).
- **G206 Dongliu to Yaodu Section**:
  - This highway has fewer sensitive receptors compared to the others. Approximately 85% would experience noise exceedance, and approximately 82% of these households would experience exceedance in 2021.
  - The key sensitive receptors needing noise mitigation are the households in Category 2 functional areas at Weizhuang and Zhanggang, who would experience day time noise exceedance of more than 7 dB(A) and night time noise exceedance of more than 9 dB(A).

Table V.17: Summary of the findings of noise exceedance due to traffic

	Ma'anshan North Corridor			Yimu Highway Kedian to Mujiating			S319 Erba to Wuwei			G206 Dongliu to Yaodu		
	Cat. 4a	**Cat. 2**	**Total**	**Cat. 4a**	**Cat. 2**	**Total**	**Cat. 4a**	**Cat. 2**	**Total**	**Cat. 4a**	**Cat. 2**	**Total**
No. of households	269	1112	1381	912	943	1855	196	553	749	61	59	120
% of total	19.5%	80.5%	100%	49.2%	50.8%	100%	26.2%	73.8%	100%	50.8%	49.2%	100%
Exceedance in year	**2021**	**2029**	**Total**	**2021**	**2029**	**Total**	**2021**	**2029**	**Total**	**2021**	**2029**	**Total**
No. of households	242	782	1024	1388	15	1403	707	35	742	84	18	102
% of total exceedance	23.6%	76.4%	100%	98.9%	1.1%	100%	95.3%	4.7%	100%	82.4%	17.6%	100%
% of total households	17.5%	56.6%	74.1%	74.8%	0.8%	75.6%	94.4%	4.7%	99.1%	70.0%	15.0%	85.0%

Source: domestic EIRs

Table V.18. Predicted noise levels at sensitive receptors from road traffic

No.	Name of Sensitive Receptor	Road Chainage	First Row Building to Red Line Distance (m)	Background		Functional Area Category 4a (within 35m from road red line)					Functional Area Category 2 (beyond 35m from road red line, school & medical establishment)					No. Household with Noise Exceedance	
				Time	Noise Level [dB(A)]	No. Household	Time	Noise Level [dB(A)]			No. Household	Time	Noise Level [dB(A)]			Year 2021	Year 2029
								Year 2021	Year 2029	GB3096-2008 Standard			Year 2021	Year 2029	GB3096-2008 Standard		
S367 Ma'anshan North Corridor																	
1	Dachen 大陈	K0+700~K0+900	8	Day	---	8	Day	65.2	66.7	70	17	Day	57.1	58.4	60	8	25
				Night	---		Night	57.9	59.4	55		Night	49.6	51.0	50		
2	Zhongshan Village 中山村	K1+100~K1+200	8	Day	---	3	Day	65.2	66.7	70	9	Day	57.1	58.4	60	3	12
				Night	---		Night	57.9	59.4	55		Night	49.6	51.0	50		
3	Datang Village 大塘村	K2+530~K2+700	68	Day	---	0	Day	---	---	70	25	Day	56.3	57.5	60	0	0
				Night	---		Night	---	---	55		Night	48.7	50.0	50		
4	Dayu 大禹	K3+550~K3+800	8	Day	---	10	Day	65.2	66.7	70	20	Day	57.0	58.3	60	10	30
				Night	---		Night	57.9	59.4	55		Night	49.5	50.8	50		
5	Chuomiaoji 绰庙集	K3+950~K5+420	8	Day	**---**	20	Day	65.2	66.7	70	40	Day	57.0	58.3	60	20	60
				Night	**---**		Night	57.9	59.4	55		Night	49.5	50.8	50		
6	Yingwang 英王	K3+320~K3+450	100	Day	---	0	Day	---	---	70	20	Day	54.7	55.8	60	0	0
				Night	---		Night	---	---	55		Night	46.9	48.1	50		
7	Ruiqiao 芮桥	K5+700~K5+840	8	Day	---	8	Day	65.2	66.7	70	12	Day	57.0	58.3	60	8	20
				Night	---		Night	57.9	59.4	55		Night	49.5	50.8	50		
8	Shashigang 沙石	K6+960~K7+050	17	Day	---	3	Day	62.2	63.6	70	17	Day	56.9	58.2	60	0	20

No.	Name of Sensitive Receptor	Road Chainage	First Row Building to Red Line Distance (m)	Background		Functional Area Category 4a (within 35m from road red line)					Functional Area Category 2 (beyond 35m from road red line, school & medical establishment)					No. Household with Noise Exceedance	
				Time	Noise Level [dB(A)]	No. Household	Time	Noise Level [dB(A)]			No. Household	Time	Noise Level [dB(A)]			Year 2021	Year 2029
								Year 2021	Year 2029	GB3096-2008 Standard			Year 2021	Year 2029	GB3096-2008 Standard		
	岗			Night	---		Night	54.9	56.3	55		Night	49.4	50.7	50		
9	Weiteng 圩腾	K7+780~K8+180	8	Day	---	2	Day	64.6	66.0	70	23	Day	57.8	59.1	60	2	25
				Night	---		Night	57.3	58.8	55		Night	49.9	51.6	50		
10	Dajing 大荆	K9+530~K9+760	8	Day	48.1	3	Day	65.0	66.4	70	15	Day	57.7	59.0	60	3	18
				Night	39.4		Night	57.7	59.2	55		Night	49.8	51.5	50		
11	Jincheng 金城	K9+900~K10+070	16	Day	---	3	Day	60.8	62.2	70	17	Day	55.0	56.1	60	0	0
				Night	---		Night	53.4	54.9	55		Night	47.3	48.5	50		
12	Dawang 大王	K9+900~K10+070	39	Day	---	0	Day	---	---	70	18	Day	57.4	58.7	60	0	18
				Night	---		Night	---	---	55		Night	49.9	51.3	50		
13	Wuqu 五区	K11+850~K11+980	8	Day	---	5	Day	60.9	62.4	70	13	Day	54.3	55.4	60	0	0
				Night	---		Night	53.6	55.0	55		Night	46.5	47.7	50		
14	Shili 仕李	K13+450~K13+750	148	Day	---	0	Day	---	---	70	18	Day	53.7	54.7	60	0	0
				Night	---		Night	---	---	55		Night	45.8	46.9	50		
15	Xu Village 徐村	K14+050~K14+230	8	Day	---	5	Day	65.2	66.7	70	10	Day	57.0	58.3	60	5	15
				Night	---		Night	57.9	59.4	55		Night	49.5	50.8	50		
16	Gong Village 龚村	K14+250~K14+350	118	Day	---	0	Day	---	---	70	18	Day	54.4	55.5	60	0	0
				Night	---		Night	---	---	55		Night	46.6	47.8	50		
17	Wali 洼李	K17+500~K17+600	60	Day	---	0	Day	---	---	70	18	Day	56.3	57.7	60	0	18
				Night	---		Night	---	---	55		Night	48.7	50.2	50		
18	Huanghe 黄河	K18+180~K18+380	8	Day	---	4	Day	65.2	66.7	70	26	Day	56.5	57.8	60	4	30
				Night	---		Night	57.9	59.4	55		Night	48.9	50.3	50		
19	Zhou Village 周村	K19+400~K19+700	8	Day	---	6	Day	65.2	66.7	70	24	Day	56.5	57.8	60	6	30
				Night	---		Night	57.9	59.4	55		Night	48.9	50.3	50		
20	Xiongzhuang 熊庄	K20+180~K20+420	8	Day	---	8	Day	65.2	66.7	70	17	Day	56.4	57.7	60	8	25
				Night	---		Night	57.9	59.4	55		Night	48.8	50.1	50		
21	Hanwang 韩王	K20+550~K20+650	8	Day	---	4	Day	65.2	66.7	70	14	Day	56.5	57.8	60	4	18
				Night	---		Night	57.9	59.4	55		Night	48.9	50.3	50		
22	Wangzhengwu 王郑吴	K21+120~K21+270	8	Day	---	4	Day	65.2	66.7	70	14	Day	56.5	57.8	60	4	18
				Night	---		Night	57.9	59.4	55		Night	48.9	50.3	50		
23	Zaolingang 枣林岗	K21+350~K21+650	49	Day	---	0	Day	---	---	70	30	Day	57.2	58.6	60	0	30
				Night	---		Night	---	---	55		Night	49.6	51.1	50		

No.	Name of Sensitive Receptor	Road Chainage	First Row Building to Red Line Distance (m)	Background		Functional Area Category 4a (within 35m from road red line)					Functional Area Category 2 (beyond 35m from road red line, school & medical establishment)					No. Household with Noise Exceedance	
				Time	Noise Level [dB(A)]	No. Household	Time	Noise Level [dB(A)]			No. Household	Time	Noise Level [dB(A)]			Year 2021	Year 2029
								Year 2021	Year 2029	GB3096-2008 Standard			Year 2021	Year 2029	GB3096-2008 Standard		
24	Zhengzhuang 郑庄	K23+080~K23+220	8	Day	---	4	Day	62.2	63.8	70	16	Day	55.4	56.7	60	0	4
				Night	---		Night	54.9	56.5	55		Night	47.7	49.1	50		
25	Xiaoyang/Jiang Village 小杨/姜村	K24+350~K24+700	8	Day	---	5	Day	62.2	63.8	70	25	Day	55.4	56.7	60	0	5
				Night	---		Night	54.9	56.5	55		Night	47.7	49.1	50		
26	Taodian 陶店	K24+880~K25+300	8	Day	---	15	Day	65.2	66.7	70	35	Day	56.5	57.8	60	15	50
				Night	---		Night	57.9	59.4	55		Night	48.9	50.3	50		
27	Taodian Health Clinic 陶店卫生院	K25+000	6	Day	---	0	Day	---	---	70	1	Day	65.0	66.6	60	1	1
				Night	---		Night	---	---	55		Night	57.7	59.3	50		
28	Taodian Primary School 陶店小学	K25+100	39	Day	---	0	Day	---	---	70	1	Day	54.6	55.8	60	0	0
				Night	---		Night	---	---	55		Night	46.8	48.1	50		
29	Bazou 坝邹	K25+450~K25+700	8	Day	---	8	Day	65.2	66.7	70	22	Day	56.5	57.8	60	8	30
				Night	---		Night	57.9	59.4	55		Night	48.9	50.3	50		
30	Xiaozhuang 小庄	K26+000~K26+300	8	Day	---	8	Day	65.2	66.7	70	17	Day	56.5	57.8	60	8	25
				Night	---		Night	57.9	59.4	55		Night	48.9	50.3	50		
31	Rui Village/Weizhuang 芮村/韦庄	K26+000~K26+300	8	Day	---	5	Day	65.2	66.7	70	13	Day	56.5	57.8	60	5	18
				Night	---		Night	57.9	59.4	55		Night	48.9	50.3	50		
32	Huang Village 黄村	K27+180~K27+350	8	Day	---	8	Day	65.2	66.7	70	12	Day	56.5	57.8	60	8	20
				Night	---		Night	57.9	59.4	55		Night	48.9	50.3	50		
33	Jiangzhuang 姜庄	K27+370~K27+600	39	Day	---	0	Day	---	---	70	20	Day	57.3	58.7	60	0	20
				Night	---		Night	---	---	55		Night	49.8	51.3	50		
34	Quanshuikouo 泉水口	K27+550~K27+750	8	Day	---	6	Day	65.2	66.7	70	14	Day	56.4	57.7	60	6	20
				Night	---		Night	57.9	59.4	55		Night	48.8	50.1	50		
35	Xiao Village 小村	K28+100~K28+200	39	Day	---	0	Day	---	---	70	15	Day	57.3	58.7	60	0	15
				Night	---		Night	---	---	55		Night	49.8	51.3	50		
36	Shanwang Village 山王村	K28+630~K28+930	8	Day	---	6	Day	65.2	66.7	70	14	Day	57.0	58.3	60	6	20
				Night	---		Night	57.9	59.4	55		Night	49.5	50.8	50		
37	Xiaolizhuang 小李庄	K29+660~K29+880	8	Day	---	5	Day	63.4	65.0	70	17	Day	57.4	58.8	60	5	22
				Night	---		Night	56.1	57.7	55		Night	49.9	51.4	50		
38	Hanqiao 韩桥	K30+060~K30+200	25	Day	49.1	3	Day	61.3	62.8	70	17	Day	55.7	57.0	60	0	3

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				Time	Noise Level [dB(A)]	No. Household	Time	Noise Level [dB(A)]			No. Household	Time	Noise Level [dB(A)]			Year 2021	Year 2029
								Year 2021	Year 2029	GB3096-2008 Standard			Year 2021	Year 2029	GB3096-2008 Standard		
				Night	39.9		Night	53.9	55.5	55		Night	48.1	49.5	50		
39	Shanghezhuang 尚和庄	K31+500~K31+700	8	Day	---	4	Day	65.2	66.7	70	12	Day	57.0	58.3	60	4	16
				Night	---		Night	57.9	59.4	55		Night	49.5	50.8	50		
40	Jibaozi 吉包子	K32+900~K33+100	8	Day	---	4	Day	65.2	66.7	70	16	Day	56.5	57.8	60	4	20
				Night	---		Night	57.9	59.4	55		Night	48.9	50.3	50		
41	Chenzhanglu 陈张陆	K33+400~K33+650	8	Day	---	10	Day	65.2	66.7	70	15	Day	57.1	58.4	60	10	25
				Night	---		Night	57.9	59.4	55		Night	49.6	51.0	50		
42	Haiwang Village 海王村	K34+500~K34+700	8	Day	---	3	Day	65.2	66.7	70	17	Day	56.5	57.8	60	3	20
				Night	---		Night	57.9	59.4	55		Night	48.9	50.3	50		
43	Zhongheji 中和集	K35+020~K35+200	8	Day	---	8	Day	64.6	66.2	70	22	Day	57.2	58.6	60	8	30
				Night	---		Night	57.3	58.9	55		Night	49.6	51.1	50		
44	Xiaoyuanzhuang 小元庄	K35+550~K35+750	8	Day	---	8	Day	65.2	66.7	70	12	Day	56.5	57.8	60	8	20
				Night	---		Night	57.9	59.4	55		Night	48.9	50.3	50		
45	Gaozuji 高祖集	K36+500~K36+900	8	Day	---	10	Day	65.2	66.7	70	40	Day	56.5	57.8	60	10	50
				Night	---		Night	57.9	59.4	55		Night	48.9	50.3	50		
46	Gaozu Primary School 高祖小学	K36+780	19	Day	---	0	Day	---	---	70	1	Day	57.5	58.9	60	0	No over-night
				Night	---		Night	---	---	55		Night	49.9	51.4	50		
47	Zhangbao Village 张保村	K37+600~K37+750	27	Day	---	3	Day	60.6	62.1	70	12	Day	55.4	56.7	60	0	0
				Night	---		Night	53.2	54.8	55		Night	47.7	49.1	50		
48	Xiwu Village 西吴村	K38+450~K38+650	89	Day	---	0	Day	---	---	70	20	Day	54.8	56.0	60	0	0
				Night	---		Night	---	---	55		Night	47.1	48.4	50		
49	Panxiao Village 潘小村	K38+800~K38+900	8	Day	---	6	Day	65.2	66.7	70	14	Day	56.5	57.8	60	6	20
				Night	---		Night	57.9	59.4	55		Night	48.9	50.3	50		
50	Baozhuang 鲍庄	K39+230~K39+720	8	Day	---	10	Day	65.2	66.7	70	35	Day	56.4	57.7	60	10	45
				Night	---		Night	57.9	59.4	55		Night	48.8	50.1	50		
51	Baozhuang Primary School 鲍庄小学	K39+500	90	Day	---	0	Day	---	---	70	1	Day	52.9	53.8	60	0	0
				Night	---		Night	---	---	55		Night	44.8	45.9	50		
52	Tangzhuang 唐庄	K40+420~K40+840	8	Day	---	12	Day	65.2	66.7	70	33	Day	56.4	57.7	60	12	45
				Night	---		Night	57.9	59.4	55		Night	48.8	50.1	50		
53	Dajiangzhuang 大蒋庄	K41+050~K41+350	8	Day	---	15	Day	65.2	66.7	70	25	Day	56.4	57.7	60	15	40
				Night	---		Night	57.9	59.4	55		Night	48.8	50.1	50		

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				Time	Noise Level [dB(A)]	No. Household	Time	Noise Level [dB(A)]			No. Household	Time	Noise Level [dB(A)]			Year 2021	Year 2029
								Year 2021	Year 2029	GB3096-2008 Standard			Year 2021	Year 2029	GB3096-2008 Standard		
54	Xiaowang Village 小汪村	K41+600~K41+750	8	Day	---	3	Day	64.0	65.6	70	10	Day	57.1	58.5	60	3	13
				Night	---		Night	56.7	58.3	55		Night	49.6	51.0	50		
55	Menlian Village 门连庄	K41+850~K41+980	8	Day	---	2	Day	64.2	65.7	70	13	Day	57.1	58.4	60	2	15
				Night	---		Night	56.9	58.5	55		Night	49.5	51.0	50		
56	Miaoqiang Village 庙强村	K42+700~K43+820	27	Day	47.4	2	Day	60.5	62.0	70	18	Day	55.0	56.3	60	0	0
				Night	39.0		Night	53.1	54.7	55		Night	47.3	48.7	50		
57	Xiaozhengzhuang 小郑庄	K43+800~K44+050	117	Day	---	0	Day	---	---	70	25	Day	54.0	55.1	60	0	0
				Night	---		Night	---	---	55		Night	46.1	47.3	50		
58	Xiaochen Village 小陈村	K44+270~K44+340	66	Day	---	0	Day	---	---	70	12	Day	56.1	57.4	60	0	0
				Night	---		Night	---	---	55		Night	48.5	49.9	50		
59	Shuangtangzhuang 双塘庄	K44+700~K44+850	66	Day	---	0	Day	---	---	70	20	Day	56.2	57.5	60	0	0
				Night	---		Night	---	---	55		Night	48.6	50.0	50		
60	Shanhao Village 山郝村	K44+800~K44+900	106	Day	---	0	Day	---	---	70	20	Day	54.4	55.5	60	0	0
				Night	---		Night	---	---	55		Night	46.5	47.9	50		
61	Xiaoyao 小姚	K45+300~K45+400	37	Day	---	0	Day	---	---	70	20	Day	55.5	56.8	60	0	0
				Night	---		Night	---	---	55		Night	47.8	49.2	50		
62	Xiaoxia Village 小夏村	K45+550~K45+680	35	Day	---	0	Day	---	---	70	25	Day	55.8	57.1	60	0	0
				Night	---		Night	---	---	55		Night	48.1	49.6	50		
Yimu Highway Kedian to Mujiating																	
1	Jiang Village 江村	K12+060~K12+180	6	Day	---	10	Day	64.2	65.0	70	15	Day	58.8	59.3	60	10	25
				Night	---		Night	56.5	57.3	55		Night	49.5	50.2	50		
2	Kedian Village 柯店村	K12+230~K12+760	7	Day	---	60	Day	64.1	64.8	70	90	Day	58.4	58.8	60	60	60
				Night	---		Night	56.4	57.2	55		Night	48.8	49.5	50		
3	China Railway Corp. #24Bureau Admin Area 中铁二十四局行政区	K12+770~K13+150	19	Day	---	30	Day	61.6	62.2	70	30	Day	58.4	58.8	60	0	0
				Night	---		Night	53.4	54.2	55		Night	48.7	49.4	50		
4	Shangtanghu 上塘湖	K13+015~K13+240	5	Day	---	30	Day	64.4	65.1	70	40	Day	58.7	59.1	60	30	30
				Night	---		Night	56.7	57.5	55		Night	49.2	45.4	50		
5	Zhanghe Village 漳河村	K13+540~K14+020	62	Day	---	0	Day	---	---	70	60	Day	58.2	58.5	60	0	0
				Night	---		Night	---	---	55		Night	48.3	48.9	50		

No.	Name of Sensitive Receptor	Road Chainage	First Row Building to Red Line Distance (m)	Background		Functional Area Category 4a (within 35m from road red line)					Functional Area Category 2 (beyond 35m from road red line, school & medical establishment)					No. Household with Noise Exceedance	
				Time	Noise Level [dB(A)]	No. Household	Time	Noise Level [dB(A)]			No. Household	Time	Noise Level [dB(A)]			Year 2021	Year 2029
								Year 2021	Year 2029	GB3096-2008 Standard			Year 2021	Year 2029	GB3096-2008 Standard		
6	Dagang Village 大港村	K14+215~K14+600	5	Day	---	30	Day	64.4	65.1	70	40	Day	58.7	59.1	60	30	30
				Night	---		Night	56.7	57.5	55		Night	49.2	49.9	50		
7	Huangwu 黄屋	K14+950~K14+980	61	Day	---	0	Day	---	---	70	15	Day	58.3	58.6	60	0	0
				Night	---		Night	---	---	55		Night	48.4	49.0	50		
8	Wangwu 王屋	K15+230~K15+275	60	Day	---	0	Day	---	---	70	16	Day	58.4	58.7	60	0	0
				Night	---		Night	---	---	55		Night	48.5	49.1	50		
9	Dafengche Kindergarten 大风车幼儿园	K16+285~K16+320	23	Day	---	0	Day	---	---	70	1	Day	58.5	58.8	60	0	0
				Night	---		Night	---	---	55		Night	48.9	49.4	50		
10	Gutian New Village 古田新村	K16+730~K17+300	7	Day	---	60	Day	67.7	68.3	70	10	Day	61.0	61.5	60	70	70
				Night	---		Night	60.3	60.9	55		Night	52.6	53.2	50		
11	Gutian Village 古田村	K17+320~K17+780	5	Day	---	70	Day	68.0	68.6	70	10	Day	60.8	61.2	60	80	80
				Night	---		Night	60.6	61.2	55		Night	52.3	52.9	50		
12	Yafutang 鸭伏塘	K17+800~K18+200	8	Day	---	30	Day	67.1	67.7	70	5	Day	60.8	61.2	60	35	35
				Night	---		Night	59.6	60.2	55		Night	52.3	52.9	50		
13	Shanggang Village 上港村	K18+340~K18+710	5	Day	---	30	Day	68.0	68.6	70	30	Day	60.8	61.2	60	60	60
				Night	---		Night	60.6	61.2	55		Night	52.3	52.9	50		
14	Bowen Secondary School 博文中学	K18+400~K18+500	37	Day	55.8	0	Day	---	---	70	1	Day	62.0	62.5	60	1	1
				Night	42.0		Night	---	---	55		Night	53.9	54.5	50		
15	Wang Village 汪村	K19+440~K19+600	6	Day	---	30	Day	65.8	65.8	70	30	Day	59.4	59.4	60	60	60
				Night	---		Night	58.2	58.2	55		Night	50.4	50.4	50		
16	Shuguang Village 1 曙光村 1	K20+675~K20+840	9	Day	---	20	Day	64.9	64.8	70	10	Day	59.4	59.4	60	30	30
				Night	---		Night	57.2	57.2	55		Night	50.4	50.4	50		
17	Shuguang Village 2 曙光村 2	K21+220~K21+280	5	Day	---	8	Day	66.0	66.0	70	4	Day	59.5	59.5	60	12	12
				Night	---		Night	58.5	58.4	55		Night	50.5	50.5	50		
18	Gongyi Village 工一村	K21+450~K22+000	7	Day	---	60	Day	65.3	65.0	70	30	Day	59.1	59.0	60	60	60
				Night	---		Night	57.7	57.3	55		Night	50.0	49.7	50		
19	MeishanVillage / MeihuaVillage 梅山村/梅花村	K22+200~K22+610	15	Day	---	20	Day	64.6	64.6	70	30	Day	59.8	59.5	60	50	50
				Night	---		Night	56.9	56.9	55		Night	50.9	50.6	50		
20	Tudiwan 土地湾	K23+160~K23+270	19	Day	---	10	Day	63.6	63.3	70	30	Day	59.8	59.5	60	40	40

No.	Name of Sensitive Receptor	Road Chainage	First Row Building to Red Line Distance (m)	Background		Functional Area Category 4a (within 35m from road red line)					Functional Area Category 2 (beyond 35m from road red line, school & medical establishment)					No. Household with Noise Exceedance	
				Time	Noise Level [dB(A)]	No. Household	Time	Noise Level [dB(A)]			No. Household	Time	Noise Level [dB(A)]			Year 2021	Year 2029
								Year 2021	Year 2029	GB3096-2008 Standard			Year 2021	Year 2029	GB3096-2008 Standard		
				Night	---		Night	55.8	55.4	55		Night	50.9	50.6	50		
21	Tangmuqiao 唐木桥	K23+750~K24+250	5	Day	---	30	Day	65.8	65.5	70	30	Day	59.5	59.3	60	60	60
				Night	---		Night	58.3	57.9	55		Night	50.6	50.2	50		
22	Huilongdun 回龙墩	K24+450~K24+740	5	Day	---	30	Day	65.8	65.5	70	40	Day	59.8	59.5	60	70	70
				Night	---		Night	58.3	57.9	55		Night	50.9	50.6	50		
23	Gongshan Town 工山镇	K25+350~ K25+500	5	Day	---	30	Day	65.8	65.5	70	10	Day	59.8	59.5	60	40	40
				Night	---		Night	58.3	57.9	55		Night	50.9	50.6	50		
24	Gongshan Village 工山村	K25+600~K26+780	10	Day	---	20	Day	68.9	68.5	70	70	Day	62.6	62.2	60	90	90
				Night	---		Night	61.5	61.1	55		Night	54.6	54.2	50		
25	Gaoling Village 1 高领村 1	K27+320~K28+130	8	Day	---	70	Day	69.6	69.3	70	50	Day	62.2	61.9	60	120	120
				Night	---		Night	62.3	61.9	55		Night	54.2	53.8	50		
26	Gaoling Village 2 高领村 2	K28+560~K29+820	5	Day	---	10	Day	69.8	69.4	70	20	Day	62.3	62.0	60	30	30
				Night	---		Night	62.4	62.0	55		Night	54.3	53.9	50		
27	Guolong 郭陇	K30+090~K30+950	5	Day	---	50	Day	69.8	69.4	70	50	Day	62.3	62.0	60	100	100
				Night	---		Night	62.4	62.0	55		Night	54.3	53.9	50		
28	Haizijia 海子夹	K30+980~K31+330	7	Day	---	50	Day	69.8	69.4	70	30	Day	62.0	61.7	60	80	80
				Night	---		Night	62.4	62.0	55		Night	53.9	53.6	50		
29	Haiquan / Haijia 海泉/海夹	K31+420~ K31+700	10	Day	---	4	Day	68.9	68.5	70	16	Day	62.6	62.2	60	20	20
				Night	---		Night	61.5	61.1	55		Night	54.6	54.2	50		
30	Tiantouwu 田头吴	K31+980~K32+060	10	Day	---	20	Day	69.0	68.6	70	30	Day	62.3	62.0	60	50	50
				Night	---		Night	61.6	61.3	55		Night	54.3	53.9	50		
31	Wuxiasi 乌霞寺	K33+040~ K33+850	5	Day	---	60	Day	65.8	65.5	70	60	Day	59.1	58.9	60	60	60
				Night	---		Night	58.3	57.9	55		Night	49.9	49.6	50		
32	Shuicun Village 水村村	K33+880~K34+260	5	Day	---	40	Day	65.8	65.5	70	40	Day	59.1	58.9	60	40	40
				Night	---		Night	58.3	57.9	55		Night	49.9	49.6	50		
S319 Erba to Wuwei Section																	
1	Datan Village 大滩村	K2+850~K3+000	8	Day	---	8	Day	69.8	71.4	70	12	Day	60.9	62.5	60	20	20
				Night	---		Night	60.8	62.5	55		Night	52.1	53.7	50		
2	Wuwei County Economic	K3+000~K3+100	8	Day	---	0	Day	---	---	70	1	Day	69.6	71.3	60	1	1

No.	Name of Sensitive Receptor	Road Chainage	First Row Building to Red Line Distance (m)	Background		Functional Area Category 4a (within 35m from road red line)					Functional Area Category 2 (beyond 35m from road red line, school & medical establishment)					No. Household with Noise Exceedance	
				Time	Noise Level [dB(A)]	No. Household	Time	Noise Level [dB(A)]			No. Household	Time	Noise Level [dB(A)]			Year 2021	Year 2029
								Year 2021	Year 2029	GB3096-2008 Standard			Year 2021	Year 2029	GB3096-2008 Standard		
	Development Zone Health Clinic 无为县经济开发区卫生院			Night	---		Night	---	---	55		Night	60.6	62.3	50		
3	Yongnan Center Primary School 雍南中心小学	K3+150~K3+450	132	Day	---	0	Day	---	---	70	1	Day	57.8	59.4	60	0	No over night
				Night	---		Night	---	---	55		Night	49.3	50.7	50		
4	Zhangwang Village 张汪村	K3+680~K3+800	47	Day	---	0	Day	---	---	70	20	Day	62.4	64.1	60	20	20
				Night	---		Night	---	---	55		Night	53.6	55.2	50		
5	Chenzhuang 陈庄	K4+320~K4+400	8	Day	---	6	Day	69.6	71.3	70	9	Day	60.8	62.4	60	15	15
				Night	---		Night	60.6	62.3	55		Night	52.1	53.6	50		
6	Xiaozhao 小赵	K5+510~K5+650	8	Day	---	8	Day	69.6	71.3	70	12	Day	60.8	62.4	60	20	20
				Night	---		Night	60.6	62.3	55		Night	52.1	53.6	50		
7	Gaoweiqian 高圩钱	K5+850~K6+000	8	Day	---	8	Day	69.8	71.4	70	17	Day	60.9	62.5	60	25	25
				Night	---		Night	60.8	62.5	55		Night	52.1	53.7	50		
8	Xiaoshangjia 小尚家	K7+160~K7+350	8	Day	---	10	Day	69.8	71.4	70	10	Day	60.9	62.5	60	20	20
				Night	---		Night	60.8	62.5	55		Night	52.1	53.7	50		
9	Lingjiawan/Dazheng 凌家湾/大郑	K8+220~K8+450	23	Day	---	5	Day	65.5	67.1	70	15	Day	58.4	59.9	60	5	20
				Night	---		Night	56.6	58.2	55		Night	49.8	51.2	50		
10	Bo'ai Hospital 博爱医院	K9+270~K9+300	23	Day	---	0	Day	---	---	70	1	Day	65.5	67.1	60	1	1
				Night	---		Night	---	---	55		Night	56.6	58.2	50		
11	Huang Village 黄村	K11+760~K12+050	8	Day	---	6	Day	69.8	71.4	70	29	Day	60.9	62.5	60	35	35
				Night	---		Night	60.8	62.5	55		Night	52.1	53.7	50		
12	Jiajiazhuang / Xiaozhang 贾家庄/小章	K12+400~K12+730	8	Day	---	6	Day	69.8	71.4	70	9	Day	60.9	62.5	60	15	15
				Night	---		Night	60.8	62.5	55		Night	52.1	53.7	50		
13	Linghou / Xiaowang 凌后/小汪	K13+640~K13+880	43	Day	---	0	Day	---	---	70	20	Day	62.8	64.5	60	20	20
				Night	---		Night	---	---	55		Night	54.0	55.6	50		
14	Wanxu 湾旭	K14+870~K15+000	38	Day	---	0	Day	---	---	70	20	Day	63.4	65.0	60	20	20
				Night	---		Night	---	---	55		Night	54.5	56.1	50		
15	Xiaotanjia 小谈家	K16+050~K16+200	8	Day	---	8	Day	69.8	71.4	70	17	Day	60.9	62.5	60	25	25

No.	Name of Sensitive Receptor	Road Chainage	First Row Building to Red Line Distance (m)	Background		Functional Area Category 4a (within 35m from road red line)					Functional Area Category 2 (beyond 35m from road red line, school & medical establishment)					No. Household with Noise Exceedance	
				Time	Noise Level [dB(A)]	No. Household	Time	Noise Level [dB(A)]			No. Household	Time	Noise Level [dB(A)]			Year 2021	Year 2029
								Year 2021	Year 2029	GB3096-2008 Standard			Year 2021	Year 2029	GB3096-2008 Standard		
				Night	---		Night	60.8	62.5	55		Night	52.1	53.7	50		
16	Xiaodaijia / Jiangjia 小戴家/蒋家	K17+850~K18+200	8	Day	---	8	Day	69.6	71.3	70	17	Day	60.8	62.4	60	25	25
				Night	---		Night	60.6	62.3	55		Night	52.1	53.6	50		
17	Hualong / Xiaoyangjia 华龙/小杨家	K18+450~K19+000	8	Day	---	20	Day	69.8	71.4	70	40	Day	60.9	62.5	60	60	60
				Night	---		Night	60.8	62.5	55		Night	52.1	53.7	50		
18	Wuyi Village 五一村	K20+000~K20+350	8	Day	---	8	Day	69.8	71.4	70	12	Day	60.9	62.5	60	20	20
				Night	---		Night	60.8	62.5	55		Night	52.1	53.7	50		
19	Shazhuang Village 沙庄村	K21+100~K21+300	8	Day	---	3	Day	69.8	71.4	70	12	Day	60.9	62.5	60	15	15
				Night	---		Night	60.8	62.5	55		Night	52.1	53.7	50		
20	Zhangyu / Hudun 章余/胡墩	K21+800~K22++000	8	Day	---	5	Day	69.8	71.4	70	10	Day	60.9	62.5	60	15	15
				Night	---		Night	60.8	62.5	55		Night	52.1	53.7	50		
21	Yangmaozui 杨毛嘴	K22+720~K22+830	43	Day	---	0	Day	---	---	70	20	Day	62.8	64.5	60	20	20
				Night	---		Night	---	---	55		Night	54.0	55.6	50		
22	Zhangni Village 张倪村	K24+790~K25+200	8	Day	---	5	Day	69.6	71.3	70	25	Day	60.8	62.4	60	30	30
				Night	---		Night	60.6	62.3	55		Night	52.1	53.6	50		
23	Lijiatan 李家滩	K25+850~K26+150	8	Day	---	3	Day	69.6	71.3	70	9	Day	60.8	62.4	60	12	12
				Night	---		Night	60.6	62.3	55		Night	52.1	53.6	50		
24	Nianxi 碾西	K27+670~K27+920	8	Day	---	6	Day	69.8	71.4	70	19	Day	60.9	62.5	60	25	25
				Night	---		Night	60.8	62.5	55		Night	52.1	53.7	50		
25	Dingwu 丁吴	K28+200~K28+430	8	Day	---	8	Day	69.8	71.4	70	17	Day	60.9	62.5	60	25	25
				Night	---		Night	60.8	62.5	55		Night	52.1	53.7	50		
26	Xinjianzhuang 新建庄	K29+450~K29+650	8	Day	---	8	Day	69.8	71.4	70	22	Day	60.9	62.5	60	30	30
				Night	---		Night	60.8	62.5	55		Night	52.1	53.7	50		
27	Hexi / Xu Village 河西/许村	K30+220~K30+750	8	Day	---	12	Day	69.8	71.4	70	33	Day	60.9	62.5	60	45	45
				Night	---		Night	60.8	62.5	55		Night	52.1	53.7	50		
28	Xingeng 新埂	K30+900~K31+100	8	Day	---	5	Day	69.8	71.4	70	13	Day	60.9	62.5	60	18	18
				Night	---		Night	60.8	62.5	55		Night	52.1	53.7	50		
29	Fengxu 冯旭	K31+300~K31+600	8	Day	---	15	Day	69.8	71.4	70	25	Day	60.9	62.5	60	40	40
				Night	---		Night	60.8	62.5	55		Night	52.1	53.7	50		
30	Weigeng / Changba	K31+650~ K32+350	8	Day	---	8	Day	69.6	71.3	70	27	Day	61.0	62.6	60	35	35

No.	Name of Sensitive Receptor	Road Chainage	First Row Building to Red Line Distance (m)	Background		Functional Area Category 4a (within 35m from road red line)					Functional Area Category 2 (beyond 35m from road red line, school & medical establishment)					No. Household with Noise Exceedance	
				Time	Noise Level [dB(A)]	No. Household	Time	Noise Level [dB(A)]			No. Household	Time	Noise Level [dB(A)]			Year 2021	Year 2029
								Year 2021	Year 2029	GB3096-2008 Standard			Year 2021	Year 2029	GB3096-2008 Standard		
	Village 圩埂/长坝村			Night	---		Night	60.6	62.3	55		Night	52.2	53.7	50		
31	Changba Primary School 长坝小学	K32+450	83	Day	47.9	0	Day	---	---	70	1	Day	58.6	60.1	60	0	1
				Night	42.9		Night	---	---	55		Night	50.0	51.4	50		
32	Jijiaxu 季家旭	K32+550~ K32+900	8	Day	---	6	Day	69.4	71.1	70	19	Day	60.0	61.6	60	25	25
				Night	---		Night	60.5	62.1	55		Night	51.3	52.8	50		
33	Liwei 梨圩	K33+100~ K33+500	8	Day	---	5	Day	69.3	70.9	70	20	Day	59.8	61.4	60	25	25
				Night	---		Night	60.3	62.0	55		Night	51.1	52.6	50		
34	Makou 马口	K35+850~K35+920	7	Day	47.7	6	Day	57.6	59.2	70	19	Day	57.9	59.4	60	0	19
				Night	41.3		Night	49.1	50.5	55		Night	49.4	50.8	50		
G206 Dongliu to Yaodu Section																	
1	Weizhuang 卫庄	K0+000 K0+400	12	Day	66.4	10	Day	70.4	71.8	70	12	Day	67.1	67.6	60	22	22
				Night	59.2		Night	63.5	65.0	55		Night	60.0	60.5	50		
2	Zhazui 炸嘴	K0+600 K0+700	28	Day	45.8	6	Day	60.7	62.8	70	4	Day	56.2	58.2	60	0	10
				Night	40.8		Night	54.2	56.3	55		Night	49.8	51.7	50		
3	Yangjia 杨家	K0+800~K1+000	15	Day	45.8	8	Day	61.4	63.6	70	8	Day	56.1	58.1	60	0	8
				Night	40.8		Night	54.9	57.0	55		Night	49.6	51.6	50		
4	Zhanggang 张岗	K4+000~K4+300	10	Day	68.2	15	Day	70.5	71.6	70	17	Day	68.5	68.7	60	32	32
				Night	58.8		Night	62.5	63.9	55		Night	59.3	59.6	50		
5	Liu Village 刘村	K5+550~K5+950	8	Day	49.9	12	Day	68.5	70.7	70	8	Day	59.3	61.2	60	20	20
				Night	43.3		Night	61.9	64.0	55		Night	52.7	54.6	50		
6	Forest Farm Dormitory 林杨宿舍	K15+400~K15+700	12	Day	56.9	10	Day	58.7	59.6	70	10	Day	57.8	58.3	60	10	10
				Night	50.4		Night	52.2	53.0	55		Night	51.3	51.8	50		

Note: exceeds the relevant noise standard

Source: domestic EIRs

428. **Mitigation Measures.** The proposed mitigation for noise along the highway subprojects is summarised in Table V.19, mainly consisting of using low noise asphalt pavement on the carriageway and installation of double-glazed windows. The use of low noise asphalt pavement would reduce road traffic noise by 3~8 dB(A), while the installation of double-glazed windows at the sensitive receptors would reduce the noise level at the sensitive receptor by 20~25 dB(A). The type of double-glazed windows recommended in the EIR is the "ventilation sound-proof window" that is being used in the PRC and that there are domestic suppliers. The window has a noise reduction louver on the side pane between the outer and inner window panes, thus allowing air to ventilate but with noise reduction when the outer window pane is ajar.

Table V.19: Summary of proposed noise mitigation measures

Project name	Traffic noise measures
Highway subproject I	(1) Provide noise insulation for windows at the Taodian Health Centre. (2) Erect warning and no horn signs at 3 schools (Taodian Primary School, Gaozu Primary School and Baozhuang Primary School) and the Taodian Health Centre. (3) Lay low noise pavement over 23.43 km (191,925 m^2) at the following locations: • K0+700 to K5+840 • K18+180 to K21+270 • K24+880 to K36+900 • K38+800 to K41+980 This will reduce noise levels by at least 3 dB(A) and up to 8 d(B)A. Beneficiaries live in the following villages: Dachen, Zhongshan Village, Dayu, Chaomiaoji, Ruiqiao, Weiteng, Dajing, Xucun, Huanghe, Zhoucun, Xiongzhuang, Hanwang, Wangzhengwu, Taodian, Bazou, Xiaozhuang, Ruicun/Weizhuang, Huangcun, Quanshuikou, Shanwang Village, Xiaolizhuang, Shanghezhuang, Jibaozi, Chenzhanglu, Haiwang Village, Zhongheji, Xiaoyuanzhuang, Gaozuji, Panxiao Village, Baozhuang, Tanzhuang, Dajiangzhuang, Xiaowang Village and Menlianzhuang.
Highway subproject II	(1) Provide noise insulation for windows at 1147 households in 22 sensitive receptors clusters: Jiangcun, Kedian Village, Shangtanghu, Dagang Village, Wangcun, Shuguang Village 1, Shuguang Village 2, Gongyi Village, Meishan Village/Meihua Village, Tudiwan, Tangmuqiao, Huilongdun, Gongshan Town, Gongshan Village, Gaoling Village 1, Gaoling Village 2, Guolong, Haizijia, Haiquan/haijia, Huitouwu, Wuxia Temple and Shuicun Village. (2) Lay low noise pavement over 1800 m covering (40,500 m^2) between K16+700 to K18+500. This will reduce noise levels by at least 3 dB(A) and up to 8 dB(A). Beneficiaries are the 4 villages and school: Gutianxincun, Gutian Village, Yafutang, Shanggang Village and Bowen High School. (3) Erect warning and no horn signs by Bowen High School and Dafengche Kindergarten.
Highway subproject III	(1) Provide noise insulation for windows at 700 households, two hospitals (the Economic Development Zone Wuwei County Health Centre and Boai Hospital) and 1 school (Banqiao Primary School). The beneficiaries reside in the following villages: Datan Village, Zhangwang Village, Chenzhuang, Xiaozhao, Gaoweiqian, Shangs, Lingjiawan / Dazhen, Huangcun, Jiajiazhuang / Xiaozhang, Linghou / Xiaowang, Wanxu, Tans, Dais/Jiangs, Hualong/Yangs, Wuyi Village, Shazhuang Village, Zhangyu/Hudun, Yangmaozui, Zhangni Village, Lijiatan, Nianxi, Dingwu, Xinjianzhuang, Hexi/Xucun, Xingeng, Fengxu, Weigeng/Changba Village, Lijiaxu, and Liwei. (2) Erect warning and no horn signs by 2 schools Yongnan Central Primary School and Changba Primary School, the Health Center in the Economic Development Zone of Wuwei County and at Boai Hospital.

Project name	Traffic noise measures
Highway subproject IV	Provide noise insulation for windows at 94 households in the sensitive receptor clusters in Weizhuang, Zhanggang, Liuchun Village and the farm dormitory.

Source: National EIRs.

429. Affected householders who are relocated must build their new house away from the highway. Under the Resettlement Plan, affected householders have two options, either cash compensation or land / property exchange where government provides them with exchange land or a government apartment with a like-for-like floor space. In the future, new buildings along the highways must be constructed with suitable noise insulation properties, and shall be located at least 35m from the highway red line.

3. Solid Waste

430. **SRWIP and Xuanzhou Multipurpose Port.** During operations, solid waste will arise at Xuanzhou Port, comprising office/domestic waste, damaged cargo, unused / used containers and packaging, oily wastes such as oily rags and oil contaminated soils following maintenance or clean up after accidents. In the national EIR, the amount of domestic solid waste is estimated at 32.2 tonnes (t) annually from a staff complement of 92 and domestic waste from ship staff was estimated at 23.25 t. There would be little other solid wastes from ships.

431. **Mitigation Measures.** The following mitigation measures are proposed:

(i) Prior to commissioning, estimates of the volumes of different waste streams should be made, including hazardous waste, and suitable environmentally acceptable disposal routes identified for each waste stream. Records and statistics on the volume and disposal of wastes should be collected routinely during operations.

(ii) Solid waste should be separated on site and temporarily stored in separate containers, which may be different coloured bins to denote different types of waste. Different operators may be required to dispose of different waste streams. For example, office waste would be sent to a licensed Municipal waste disposal site; ship garbage has to be dealt with by a qualified organisation under the Environmental Management Regulations of Prohibiting Ships from Contaminating Inland Water Areas of PRC; and hazardous wastes such as oily rags would be collected and disposed of by a suitably qualified company.

(iii) Ships' crews are forbidden to dispose of solid wastes in the inland rivers.

432. **Highway Subprojects.** None of the schemes require permanent offices or toll booths, so domestic solid waste will not be generated. Littering may occur along the highway which will be collected as part of routine maintenance.

4. Water Quality

433. **SRWIP and Xuanzhou Multipurpose Port.** The SRWIP could impact on the water quality of the Shuiyang River as a consequence of wastewater arising from the staff operating the navigation ship lock at Shuiyang Town, various activities at Xuanzhou Comprehensive Wharf, and disposal of ship wastes in the Shuiyang River.

434. The operation of the navigation lock will require a staff complement of 15 persons while the projected staff at Xuanzhou Port is estimated at 92. The facilities at the port will also include

a canteen, although there will be no accommodation on site. At the ship lock, the sanitation facilities will be connected to Shuiyang Town sewerage system. The domestic wastewater arising at the Port will be treated at an on-site wastewater treatment works to Grade 3 prior to discharge to the Municipal wastewater collection network serving the Xuanzhou Economic and Technological Development Zone. Consequently, there will be no impact of domestic wastewater on surface water resources.

435. Industrial wastewater may arise at Xuanzhou Port due to oil wastewater from washing machinery and wash down of workshop areas, stormwater runoff, and wastewater from ships in port.

436. It is illegal for ships to discharge domestic wastewaters that exceed the discharge standards into rivers and ships have to be equipped with sufficient storage to hold wastewaters for a voyage.

437. **Mitigation Measures.** The proposed mitigation measures are as follows:

(i) Domestic wastewater arising at Xuanzhou Port will be treated on site to Grade 3 level and discharged to the wastewater collection system. Stormwater runoff will be treated in settlement tanks and re-used on site for dust suppression and other activities. Oily wastewater from engine rooms and domestic sewage from ships will be passed through oil separators prior to re-use or discharge to sewer.
(ii) Emergency response equipment will be kept by the Maritime authorities.
(iii) Inspection of ships needs to be strengthened to ensure that the operators comply with the regulations Ship Pollution Discharge Standards.
(iv) Training of the ship's crew on the correct procedures for the safe disposal of solid waste and wastewaters is required.

438. **Highway Subprojects.** None of the highway schemes include ancillary facilities such as toll stations, service areas, or administrative buildings. Surface water resources may potentially be affected by polluted runoff from highways and bridges due to highway drainage and spillages following traffic accidents. Research studies have shown the highway runoff during drainage initially carries dirt and pollution, but after 30mins the concentration of pollutants decreases rapidly. Discharge from bridges is often a small proportion of river flow and unlikely to affect water quality. The impact of highway drainage on surface water is generally low, but special precautions are required to protect drinking water and the aquatic environment on high quality water bodies.

439. **Mitigation Measures.** Proposed mitigation measures are as follows.

(i) The water quality of the Zhanghe River is Class II and water quality of the Xihe River is Class III. Both rivers are designated a Secondary Water Protection Zone in the vicinity of the proposed bridges. Both bridges will be designed with piped drainage and discharge to land either side.
(ii) Highway discharge direct to farmland and fishponds will be prohibited.
(iii) Vehicles carrying dangerous goods must hold three certificates – Transport licence, driver's licences and security officer certificate. Vehicles must be appropriately marked. In the event of an accident, the emergency services must be notified.

5. Greenhouse Gas Emissions

440. **SRWIP and Xuanzhou Port.** GHG emissions were estimated with and without the project, by comparing a journey of over 250 km for trucks and barges sized 650 to 1000 dwt. The calculations indicate a wide range in values and considerable overlap, but overall the ranges for CO_2 are lower for inland waterway transport (Table V.20).

Table V.20: GHG emissions in g/tonne-km by mode

Containment	Bulk		Break bulk	
	Truck	IWT 650 – 1,000 dwt	Truck	IWT 650 – 1,000 dwt
CO2	55-80	40-70	55-260	60-110
NOx	0.6-0.9	0.5-0.8	0.7-2.6	1.0-1.5
PM10	0.02-0.03	0.03-0.05	0.02-0.1	0.05-0.08

441. **Highway Subprojects.** GHG emissions were estimated for the four highway schemes for the design year 2029 with and without the project (see Table V.21). In all cases, the estimated GHG emissions are below the ADB threshold of 100,000 CO_2 tonnes, which triggers the requirement for mitigation. However, the cumulative emission for the highway subprojects will exceed 100,000 CO_2 tonnes per year, quantifying and reporting of CO_2 emissions will be required annually.

Table V.21: Estimate of GHG emissions

Highway Subprojects	Without Project Tonnes in 2029	With Project Tonnes in 2029
Ma'anshan		
Subsection A	22,614	19,149
Subsection B	51,412	48,750
Total	**74,026**	**67,899**
Yimu Kedian to Mujiating		
Section A	23,954	20,705
Section B	35,510	31,342
Section C	25,312	25,039
Total	**84,776**	**77,086**
S319 Erba to Wuwei	**80,802**	**86,537**
G206 Dongliu to Yaodu[1]	**44,423**	6,984
		36,610
		43,594

Notes: The sections refer to subdivisions reflecting changes in highway design standards and capacity.
[1] The With Project scenario for the G206 Dongliu to Yaodu includes the GHG emissions from vehicles that remain on the old G206.
Source: PPTA's calculations.

E. Cumulative Impacts

442. Cumulative effects are defined as the impacts on the environment that result from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions, regardless of the agency (central or non-central) or person undertaking such other actions. The various projects under consideration are spread out geographically west to east along the Yangtze valley. They are considered to be sufficiently distant from each other,

that there will be no in combination impacts or interference during construction, for example from demand on raw construction materials, traffic congestion, or labour constraints.

443. The SRWIP and Xuanzhou Port projects form part of a number of construction projects related to the Shuiyang River, including the new flood alleviation channel and other flood defence works currently under construction. It is understood that the flood alleviation works have to be completed prior to commencement of the SRWIP and Port. This would avoid cumulative works associated with concurrent construction projects. However, it would mean on-going construction for several years, resulting in ongoing disturbance for local communities. For example, works are currently ongoing at Shuiyang Town to straighten the river channel, which would be followed by construction of the ship lock and barrage for this scheme. One of the proposed spoil disposal sites for dredging is located close to the northern end of the new flood alleviation channel. The industrial site around Xuanzhou Port will be developed over the coming decade, which may result in higher construction nuisances such as noise, construction traffic and dust. Similarly, ongoing or planned construction projects close to the highways could potentially impact on local communities.

444. The proposed alignment for the G206 highway will create a third highway in the area, adding to the existence of a transportation corridor. The new alignment for the G206 would draw traffic off the existing road, but some traffic local will remain on the old G206. There would be a reduction in nuisance from noise, air quality, severance, accidents, and disturbance to wildlife along the old G206 with the expected decrease in traffic.

F. Indirect and Induced Impacts

445. The policy *Anhui Wanjiang Demonstration Zone for Industrial Relocation into Cities along the Yangtze River* is specifically aimed at encouraging industry in the coastal provinces to relocate inland to Anhui to promote economic development. As such, the SRWIP is intended to induce industrial development in Xuangheng City through increased trade and manufacturing. It is proposed to develop Xuanzhou Port in two phases, with only the first phase being addressed in this project. Phase 2, to create a further six berths and associated land-based support facilities, would represent a considerable expansion of facilities. Successful growth at the port may act as a stimulus to the development of the Xuancheng Industrial Zone itself, which in turn may lead to increased air pollution, noise, wastewater discharge and solid waste production. Through masterplanning, utilities would be provided on site, such as safe drinking water supply, sewerage and solid waste collection and disposal, to reduce environmental impacts. Successful growth of the port operations may also lead decision-makers to invest in the proposed new super large bridge over the Shuiyang River and ring roads. Consequently, there is potential for the SRWIP to significantly alter the environment in Xuanzhou. Three issues should be borne in mind. Firstly, the bottleneck in the lower Shuiyang River in Jiangsu Province has to be relieved for the SRWIP to reach its potential. Secondly, the PPTA's view is that the Feasibility Study over-estimates the growth in cargo, which implies that industrial growth would not be as rapid as implied in the masterplans for the city. Thirdly, the masterplanning allows for induced development in the port area by zoning it for industrial development and improving the associated transport links.

446. The highway schemes are all concerned with upgrading the existing highways, even the G206, which is a new build, but will provide an alternative route between Dongliu and Yaodo. As such the highway schemes are unlikely to attract new traffic immediately after opening.

However, in the medium to longer term the schemes may well attract increased traffic due to: (i) growing ownership of vehicles in the surrounding area, (ii) the re-direction of traffic off toll roads, and (iii) the location of traffic-generating development in the urban areas close to the upgraded highways. These issues have been considered in the traffic forecasts developed for these projects.

G. Associated Facilities

447. One associated facility has been identified on the SRWIP, comprising a ship maintenance and building yard, upstream of Shuiyang River in the vicinity of the proposed ship lock. The activities at the ship yard have the potential to pollute the soil due to accidental spillages of hydrocarbons, paints and chemicals used in maintenance of the ships, and litter the site with waste metals and other materials. The ship yard will have to be relocated and the site decontaminated and cleared prior to the construction of the ship lock.

VI. ANALYSIS OF ALTERNATIVES

A. Project Alternatives

1. Shuiyang River Waterway Improvement Project and Xuanzhou Multipurpose Port Projects

448. The 'Do-nothing' alternative assumes that while the SRWIP does not go ahead, other works being undertaken by the local Water Resources Bureau would be completed. Consequently, the flood control improvements on the Shuiyang River, currently under construction would be finished, bringing benefits to the local population in the towns and villages from reductions in the risk of flooding and flood related damages to land, crops and property. However, the river would continue as a Class V and VI navigable river, with navigation restricted to smaller vessels during the wet season and ceasing in the summer. The towns and villages along the river would not be able to take advantage of the regional improvements being made to the inland waterways and the benefits that come with improved trade and economic development.

449. In the longer term, the navigability of the river will deteriorate, as sediment deposition and the movement of sediment would infill the channel reaches and reduce the channel depth. This process would be slow, as the Tonggong dam upstream has reduced the suspended sediment load in the river, but flood flows would mobilize the river bed resulting in localized re-working of sediments.

450. The existing port at Haitangwan would continue to operate similar to current levels. However, there is limited scope to extend the port due to the railway embankment to the back of the site. Consequently, future growth at this site is constrained by the physical size. This port is currently handling aggregate dredged from the river, and is not currently laid out to handle other types of goods being manufactured in the area.

451. Industrial development in Xuancheng City would be increasingly dependent on the movement of raw materials and manufactured products via railway and highway, both of which result in higher levels of air emissions, greenhouse gases, and noise compared to the movement of freight by inland waterway. Poor transportation from the hinterland to the eastern provinces would frustrate the PRC's policy to translocate industry from the eastern coastal provinces to areas such as Xuancheng City as a catalyst for economic development.

452. With the Project, Xuancheng City and the Industrial Development Zone would benefit from an inland waterway system connecting the area with the main ports on the Yangtze River, and, via the Wushen canal, with the Yangtze River Delta and Shanghai. The improved navigation would allow year-round navigation of ships up to 1000 dwt, except during high flows for security reasons. The construction of a new port would create a facility capable of handling much larger volumes of cargo than the current port, which would continue as at present as a site for handling aggregate from the river. The growth of cargo entering and leaving the port would help in the development of the industrial site. If successful, the port would be expanded in a second phase. The use of waterway for freight transport will also have environmental benefits in reducing road traffic noise and emissions of air pollutants and greenhouse gas.

2. Highway Subprojects

453. The 'Do Nothing' scenarios assume that as a minimum the only works along the highway schemes are related to routine maintenance. In the short term, there would be little change. As traffic flow increased, journey times would become longer and more unreliable, traffic accident rates would be expected to increase, and there would be increases in vehicle emissions, traffic noise, and severance for local traffic, pedestrians and communities.

454. As all the schemes are included in the 12th FYPs, it is possible that these sections, or adjoining sections, could get national and regional funding within the next few years.

455. With the Projects, the highway schemes would result in shorter journey times, improved flow of traffic, safer environments for NMT (including separation of cyclists and pedestrians, improved crossings and lighting) and reduced accidents. These projects are part of a larger suite of highway improvements, so they would contribute to province-wide improvements in journey times. Smoother traffic flows at higher and constant speed (compared to traffic congestion with stop-and-go traffic) would reduce exhaust emissions of air pollutants. This would result in less carbon emissions per vehicle per mile travelled. According to Bai, Eisinger and Niemeier (2009),[20] CO_2 emission factors for both gasoline and diesel motor vehicles would decrease from approximately 500 gm CO_2/mi to approximately 250 gm CO_2/mi when the vehicle speed increases from 25 mph to 75 mph, with diesel motors having a slightly lower emission factor than gasoline motors.

456. The Ma'anshan North Corridor and S319 Erba to Wuwei include minor adjustments to the alignment, while the G206 improvements would be a new road. These schemes would bring relief of traffic noise and community severance to numerous properties in the re-aligned sections. The G206 improvement scheme may help to reduce traffic on the old G206, which would be left for local traffic, which may reduce traffic-related impacts within the Provincial Tiantai Forest Park.

457. The schemes are all in compliance with the local town and county plans and will help to provide much needed road capacity and support land development within the town areas, leading to economic development. Traffic-generating proposed land-uses have been taken into account in the forecasts of traffic growth, which have fed into scheme designs.

B. Alternatives Considered

1. Shuiyang River Waterway Improvement Project and Xuanzhou Multipurpose Port Projects

458. **Alternatives to provide sufficient draught.** Consideration was given to dredging the whole channel compared to an alternative comprising a mix of dredging and rubber dam, with two sites considered for the location of the rubber dam on the main river at Shuiyang Town and downstream at Zhaochun.

[20] Bai S., D. Eisinger and D. Niemeier. 2009. MOVES vs. EMFAC: a comparison of greenhouse gas emissions using Los Angeles County. Transportation Research Board 2009 Annual Meeting. 15 pp.

459. Dredging all 43.9 km of river is very expensive, with scheme estimate in the order of 543 million Yuan, compared with 284.6 million Yuan for a combination of dredging and the ship lock at Shuiyang Town, and 204.7 million Yuan for a combination of dredging and the downstream dam.

460. The main permanent impact of the dredging is the need to dispose of large volumes of spoil. So the greater the amount of dredging, the greater the risks around identifying and controlling the spoil disposal process. Dredging also results in the loss of shallows and associated aquatic habitats, although the EIR indicates that there are no commercially significant spawning areas in the river. The temporary impacts include turbidity of the water, the need to protect drinking water in-take works, and the noise from the dredger.

461. The preferred option is to locate the rubber dam at Shuiyang Town and undertake some dredging. While this option is more expensive than locating the dam downstream at Zhaochun, it has the advantage of keeping the scheme within Anhui Province, and the associated simplification of obtaining the necessary permissions.

462. **Alternatives for the connection between the SRWIP and the Wushen Canal.** Two options were considered. Downstream of Yanchi the Shuiyang River breaks into two arms, where one flows into Jiangsu Province and connects with the Wushen Canal at Xidoumen and the the other arm flows from Yanchi to Xigeng through Xiaocaihe where it connects with the Wushen Canal in Anhui. The preferred option is the connection through Jiangsu Province as more economic and less environmentally intrusive. This section is currently Class VI so an accord is required between Anhui and Jiangsu Provinces, for Jiangsu Province to improve this reach of the Shuiyang River to Class IV restricted in order to maximise the benefits of the SRWIP for Anhui Province. The alternative is a secondary channel of the Shuiyang River, which would require considerably more widening and deepening to reach the requisite navigation standard. Extensive land-take would be required, resulting in higher socio-economic impacts.

463. **Alternatives for the location of the secondary rubber dam on the Qiugong River.** Two options have been considered, one near the mouth of the confluence with the Shuiyang River and the second 20 km downstream. Consideration of the downstream location was requested by local government to permit irrigation abstractions. The preferred site is located at the juncture between the two rivers for hydraulic reasons. A downstream location would result in more water diverting down the Qiugong River and potentially greater difficulty in co-ordinating the operation of the two dams to maintain water levels in the river upstream to Xuanzhou Port.

464. **The location of Xuanzhou Port.** Two locations were considered for the new port. One site on the Shuiyang River near Xiashi Mountain was discounted because the mountain was designated as a “Green Area” and an industrial port would not be appropriate in this setting. The preferred site is located within the Xuanzhou Economic and Technological Development Zone designated in the Xuancheng City masterplan. The port site would benefit from utilities which would be provided to the site – electricity, drinking water supply and sewerage. The preferred site is ideally located to import raw materials and construction materials and export manufactured products from Xuancheng. It also lies c150m from the proposed ring road, which wouldhave a spur into the port site, which would connect the port with the wider hinterland around Xuanzhou.

2. Highway Subprojects

465. **Highways Subproject I – Ma'anshan North Corridor.** Three alternative modifications were considered for the Ma'anshan North Corridor, which are summarised in **Table VI.1** below.

Table VI.1: Alternative Alignments for Upgrading the Ma'anshan North Corridor

No.	Location	Preferred Option	Alternative
1	Chuomiao Section	• Upgrading the existing X032 over 6.5 km through or alongside several villages. • Requires 6.27 ha of land, demolition of 18070 m^2 of houses, 87,600 m^3 of embankment and 6100 m^3 of cutting, and two medium sized bridges. • Scale of construction smaller than alternative, with 30% less earthworks, but does require more house demolition. • On line widening more convenient for local traffic and residents. • Cost 51.4 million Yuan	• New build bypass over 5.961 km avoiding villages • Less disruption to traffic and residents during construction • Requires 14.24 ha of land, demolition of 4240 m^2 of houses, 277,000 m^3 of embankment and 12,000m^3 of cutting, and two small bridges. • Allows for expansion of urban areas • Would require extension of connecting roads. • Cost 53.6 million Yuan
2	Sima River and Shiyang Town	• New build section over 10.664 km to the north of the existing S206 including a new bridge over the Sima River • Bypasses Jincheng Village and Shiyang Township • Requires 23.05 ha land, demolition of 4140 m^2 houses, 366,800 m^3 of embankments and 84,100 m^3 of cutting, two major bridges and two medium bridges,. • Cost 156.3 million Yuan • Links into the Chuma Highway intersection • Provides a faster route more suitable for Class II road	• Upgrade the existing S206 over 10.653 km plus 1.4 km of new build • New bridge over the Sima River replacing the Xingfu Bridge • Requires 19 ha of land, demolition of 52,620m^2 of houses, 17,600 m^3 of embankments and 23,500 m^3 of cutting, two major bridges, three medium bridges and 1 small bridge. • Considerable disruption to local residents and traffic during construction. • Construction requires demolition of a school and several industrial plants. • Cost 172.6 million Yuan
3	Xianzhong Town Section	• New build 5.774 km section • Requires 12.56 ha land, demolition of 3200 m^2 of buildings, 214,000 m^3 of embankments and 3,400 m^3 of cutting, and two medium bridges • Closer connection to the S226 on the outskirts of Xianzhong Town, thereby avoiding congestion in the town • Less impact during construction • Less impact on town planning. • Cost 50.9 million Yuan	• Upgrade existing X004 over 5.857 km • Passes through Xieji Town and Haoliu Village and into Xianzhong town centre before joining the S226. • Requires 10.85 km of land, demolition of 24,980 m^2 of buildings, 76,900 m^3 of embankments and 3,500 m^3 of cutting and two medium bridges. • Disruption to residents and local traffic during construction. • Traffic congestion and traffic related impacts in urban areas on opening (air quality, noise, severance) • Cost 50.8 million Yuan

Source: Domestic EIRs.

466. **Highways Subproject II – Yimu Highway Kedian to Mujiating Section.** No options for route alignment were considered.

467. **Highways Subproject III – S319 Erba to Wuwei Highway.** Only one option was considered between K0+000 and K31+600 comprising symmetrical widening along the existing highway. Two options were considered between K31+600 and the end of the scheme, an on line and off-line option, both requiring a new bridge over the Xihe River. The options are compared in Table VI.2 below.

Table VI.2: Comparison of Alternative Crossings of the Xi River for S319 Improvement Scheme

No.	Location	Preferred Option	Alternative
1	Xi River Crossing	• New build section over 4.92 km including a new bridge. • Crossing within the Xi River second grade protection zone for drinking water protection. • Requires 17 ha of land, demolition of 4394 m^2 of houses, and 329,400 m^2 of land raising. • Links into newly expanding part of Wuwei county. • Compliant with local plan and future capacity for traffic growth.	• On line widening along S319 and new bridge over Xi River at existing crossing over 4.3 km. • River crossing at boundary of the Xi River second grade protection zone for drinking water. • Requires 3 ha of land, demolition of 3957 m^2 of houses, and 24,300 m^3 of land raising. • Highway continues through town centre • Greater disruption to residents and local traffic during construction • Greater disruption in the town centre from traffic and associated impacts (noise, air quality, etc.) on opening. • Limited capacity to accommodate traffic growth.

Source: Domestic EIRs.

468. **Highway Subproject IV – G206 Dongliu to Yaodu Section.** Consideration was given to on-line improvement of the G206 and an off line option, together with the connections to the existing G206 at either end of the scheme as summarised in Table VI.3 below.

Table VI.3: Alternative Alignments for Improving the G206 Dongliu to Yaodu Section

No.	Location	Preferred Option	Alternative
1	Dongliu Economic Development Zone	• New build section 5.21 km long, from the start of the scheme to Anjin highway intersection. • The scheme bypasses the central area of the Dongliu Economic Development Zone and villages • The scheme requires 25.2 ha of land, demolition of 868 m^2 of houses and 1107.03 thousand m^3 of earthworks • Cost 243.2 million Yuan This route is better suited to a high speed urban road	• A longer route from the start of the scheme to Anjin highway comprising 5.5 km upgrade along the existing G206 and 1.505 km new build. • The route passes through the Dongliu Economic Development Zone, resulting in the need for road junctions and interference with urban traffic. • The scheme requires 25.0 ha of land, demolition of 874 m^2 of houses, and 1488.44 thousand m^3 of earthworks. • Cost 277.7 million Yuan
2	Main part of the route	• New build from Anjin highway intersection to connection with old G206 • Good vertical / horizontal alignment suitable for high speed urban road • Avoids the Province Tiantai Mountain Forest Park • Follows the Yaodu River flood	• Upgrade existing G206 • Would require considerable house demolition and modifications to highway curvature along existing road resulting in disruption to farming • Part of the road goes through the Province Tiantai Mountain Forest Park

No.	Location	Preferred Option	Alternative
		embankment and lakes, but these are not drinking water protection zones	• Not in compliance with the Dongzhi County plans for a main trunk road between Dongliu and Yaodu
3	Connection to G206	• Connects to G206 at K16+580 • Requires two bridges 207 m long in total, 18.86 ha of land, and demolition of 1650 m^2 of houses • Cost 260.5 million Yuan	• Connects to G206 at K17+308 • Slightly longer route • Requires one bridge 65 m long, 18.15 ha of land, and demolition of 1090 m^2 of houses • More complicated crossing of high speed rail and super highway • Cost 273.8 million Yuan

Source: Domestic EIRs.

469. **Highway Cross Section.** The road cross sections were determined by the engineering standards for the class of highway.

470. Highway Subproject II Kedian to Mujiantiang Section comprises Class I Highway in the rural section and Urban Highway in the urban section.

471. For Highway Subproject III S319 Erba to Wuwei Section it was decided to adopt a slightly wider sub-based and carriageway than the standard, which would provide for upgrading from Class II to Class I under the present scheme, and a further upgrade from dual two to dual three lanes in the future without the need to widen the sub-base.

472. For highway Subproject IV G206 Dongliu to Yaodu Section consideration was given to the type of highway under consideration. Given the proposed plans for urbanisation and industrialisation in the Dongliu Economic Development Zone, and the need to improve transportation between Dongliu and downtown Yaodu, it was decided to design an Urban Highway with provision for NMT, despite the lack of current demand, to future-proof demand.

473. **Road Pavement.** Bituminous concrete pavement, cement concrete pavement and block stone pavement were considered. Block stone pavement was readily discounted as it has a short service life (5 to 6 years), is easily damaged, does not provide a comfortable ride and is noisy. Cement concrete pavement has a longer life (10–20 years) and is comfortable for driving on, but it is not suitable for high volume HGVs, is difficult to maintain, and relatively noisy. The preferred option was bituminous concrete pavement, which has a moderate life (8–10 years), is suitable for all kinds of vehicles, is easy to maintain, comfortable for driving and produced comparatively low noise levels.

474. **Noise Mitigation.** Options for noise mitigation are low noise road surfaces, noise barriers along the side of the road, and noise insulation on property. The preferred option is noise insulation on property. Low noise road surface was also selected for sections of the Ma'anshan North Corridor and Yimu Highway. Consideration has not been given to noise barriers.

VII. INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION

A. Legislative Framework for Consultation, Participation and Information Disclosure

475. The Environmental Protection Law of PRC and the Regulations on the Administration of Construction Project Environmental Protection (Order of the State Council, No. 253) require that an “Environmental Impact Report formulated by construction unit shall in accordance with relevant laws solicit the opinions of units concerned and inhabitants of project construction site". ADB Safeguard Policy Statement also requires meaningful consultation with affected people, facilitation of their informed participation in consultation and information disclosure. The information disclosure, consultation and participation processes for this project are in line with PRC and ADB requirements.

476. The Environmental Impact Assessment Public Participation Interim Guideline (2006) requires that the public be involved in the EIA process. Information about the four Highway Subprojects was posted on two separate occasions on the websites of the relevant authorities during 2012 (see Table VII.1 for details) and local government officials and residents along the route were invited to respond to a questionnaire about the projects. Information about the SRWIP was posted on the Xuancheng government traffic affairs website in September and October 2007. Information about the new Xuanzhou Port was first posted in Shishan Village in November 2012, followed by postings on the website of the Anhui Transportation Network in November 2012 and January 2013. The PPTA Consultant conducted two public consultation meetings, on 16th and 17th April 2013 in Xuancheng Port and Nanling Country Bureau of Transportation (Highway Subproject II), respectively. On both occasions, representatives from local government and the affected communities were invited. The findings of the public consultations were incorporated into the EIRs.

477. Information disclosure and public consultation have been undertaken during the preparation of the domestic EIRs for the highways and waterway transport sub-projects. This included: publication of notices and documents on government websites (see **Table VII.1** for details); meetings with key stakeholders including government departments, local authorities, sector-specific institutions and authorities, and local representatives; interviews with local residents; and a questionnaire survey. The objectives of the information disclosure, consultation and participation activities were to:

(i) Provide details of the proposed project and the associated environmental impacts and mitigation measures, and seek the views and requirements of the government departments, general public and other interested parties;
(ii) Facilitate communication between the project proponent, the general public and other relevant parties in relation to the overall project through the EIA process; and
(iii) Fill any information gaps within the EIRs to inform the assessment of impacts and the development of mitigation and monitoring proposals to deliver environmental, social and economic benefits.

B. Information Disclosure

478. Two rounds of information disclosure for each sub-project were conducted by the domestic EIR authors, details of which are summarised in Table VII.1. The first round of information disclosure was carried out during the early stage of EIR preparation for each sub-project. This introduced the proposed works, set out the proposed consultation process, provided a response form and contact details for the project proponent (see example in Figure VII.1). The second round of information disclosure was undertaken following the preparation of the EIR to solicit public comments and suggestions using a questionnaire on the preliminary findings of the assessment, including the potential impacts identified, proposed mitigation measures and conclusions. Copies of the abridged versions of the EIRs were loaded onto websites from where they could be downloaded for up to ten days.

Table VII.1: Summary of Information Disclosure

Sub-project	Information Disclosure	Date	Location Posted
Highways sub-project I	1st time	12 September 2012	Ma'anshan Municipal Bureau of Communications website (http://www.masjt.gov.cn)
	2nd time	25 March 2013	
Highways sub-project II	1st time	6 September 2012	Nanling County People's Government website (http://www.nlx.gov.cn)
	2nd time	14 October 2012	
Highways sub-project III	1st time	28 September 2012	Wuwei County People's Government website (http://www.ww.gov.cn)
	2nd time	31 October 2012	
Highways sub-project IV	1st time	24 May 2012	Dongzhi County People's Government website (http://www.ahdongzhi.gov.cn)
	2nd time	11 July 2012	
SRWIP	1st time	27 September 2007	Xuancheng government affairs of traffic website (http://www.xcjt.gov.cn)
	2nd time	18 October 2007	
Xuanzhou Port	1st time	27 November 2012	Public announcements outside the village committee in Shishan Village
		Supplement 16 January 2013	Anhui transportation network website (http://www.ahjt.gov.cn)
	2nd time	24 January 2013	

Source: Domestic EIRs.

479. A third round of information dissemination was conducted by the EIR authors, with the participation of the ADB PPTA national environmental specialist in April 2013. This is described in more detail in the section below, Public Participation Meetings with PPTA Team.

Figure VII.1: Screenshot of the Public Notice Posted Online for the First Round of Information Disclosure for the SRWIP

C. Consultation and Participation during Project Preparation

480. The second round of consultation included a questionnaire to obtain the views of local people located within the vicinity of the proposed project. The numbers of questionnaires distributed for each sub-project and returned are shown in Table VII.2. The return rate ranged between 90% and 100% and averaged 98%. The level of approval for Highway Subprojects I-III was very high, being 99%, 100%, and 100%. The level of approval for Highway Subproject IV was slightly lower, 76% firmly approved the scheme, 90% conditionally approved it, with a further 10% not showing interest. For the SRWIP, 95% of respondents approved it and 5% were not concerned. There were no recorded disapprovals for any of the schemes.

Table VII.2: Summary of questionnaires issued and returned for each sub-project

Project name	Number of forms issued	Number of forms returned
Highway subproject I	70	69
Highway subproject II	105	101
Highway subproject III	75	75
Highway subproject IV	52	49
SRWIP	100	100
Xuanzhou Port	80	76
Total	***482***	***470***

481. **Public Opinion.** The following sections summarise the responses and issues raised in the questionnaire surveys and the responses from the project proponent and the EIA team.

482. The questionnaire responses received in relation to the SRWIP indicate that:

(i) There is a high level of awareness of the project.
(ii) There is a high level of support for the project, with no objections.
(iii) Respondents consider that the existing environment is fair (68%) or fine (15%).
(iv) Respondents indicated that their main concerns about the impacts of construction on the environment were water quality (27%), soil and water conservation (22%), vegetation and odour control (21%), and sludge disposal (19%).
(v) The main concerns during operation were water pollution (45%), sediment pollution (24%), and groundwater and soil contamination (22%).
(vi) The majority of respondents felt the project would improve their living conditions (74%).

483. The questionnaire responses received for the Xuanzhou Port indicate that:

(i) There is a high level of awareness of the works.
(ii) The majority (95%) of respondents supported the project and considered that it will deliver socio-economic benefits (97%). There were no objections.
(iii) All respondents considered the quality of the local environment to be favourable (91%), although half considered there to be some existing environmental problems mainly air pollution (29%) and water pollution (18%).
(iv) The majority (91%) considered that associated impacts during construction and operation are acceptable. Their concerns were mainly in terms of water quality (25%) and ecological damage (22%).
(v) The priorities for mitigation measures were the adherence to emission limits to minimise pollution (wastewater discharges, exhaust emissions and noise) and environmental risk prevention.

484. The questionnaire responses regarding the highway sub-projects are summarised below.

(i) The majority of respondents view their current living and working environment as good for Highway Projects I and II, but ordinary for Highway Subproject III.
(ii) The majority consider the existing traffic conditions to be ordinary or good, with surprisingly small proportions (8-24%) considering the conditions to be poor or unsatisfactory.
(iii) Respondents are concerned about a range of potential construction impacts, particularly construction noise and dust, and to a lesser extent construction waste, wastewater, water and soil erosion.
(iv) Most respondents are willing to relocate to facilitate the development, although compensation will be required.
(v) The main environmental concerns during operation would be traffic noise and air pollution as a result of vehicle exhaust emissions.
(vi) Respondents support a range of noise mitigation measures, with the most popular measures being, low road noise surface, restrictions on the use of the horn, noise barriers and property insulation. Some 80% of respondents on the Yimu Highway scheme expect to see afforestation, although it was noted that wide planting belts are required to achieve noise reduction benefits.
(vii) There were high levels of agreement with the mitigation measures proposed.

485. **Public Participation Meetings with PPTA Team.** Two public meetings were held in April 2013 for the waterway and highway sub-projects comprising formal discussion sessions and informal interviews/discussions with representatives from the affected local communities. The main purpose of the consultations was to present the predicted environmental impacts of the project, request stakeholder feedback on identified impacts and environmentally sensitive features, and solicit suggestions for improvements to the EMP and grievance redress mechanism (GRM). A questionnaire (in the same format/questions as used for the public consultation) was provided to stakeholders one week ahead of the formal workshops to facilitate provision of feedback.

486. The public meeting for the SRWIP was held on 16 April 2013. This workshop comprised two sessions: a discussion meeting held at the Xuancheng Port and Shipping Administration Bureau (XPSAB) office attended by representatives from relevant government departments and local communities; and a second open discussion session at Shishan village (see **Plate VII.1**) where the port will be sited. Village/community representatives were informally interviewed by the EIA team and XPSAB representatives. Across both sessions, a total of 18 people attended or were consulted, including representatives from XPSAB, Xuancheng Maritime Bureau (XMB) (two representatives), Xuancheng Municipal Planning Bureau (XMPB), Xuancheng Disease Control and Prevention Centre (XDCPC), Xuancheng Agriculture Commission (XAC), Xuancheng Forestry Bureau (XFB), Xuancheng Municipal Water Resource Bureau (XMWRB), Xuancheng Municipal Environmental Protection Bureau (XMEPB), Shishan Village (two community representatives and three villagers), Shuiyang Community (Shuiyang Township); villagers from Sanja Group (two) and a villager from Dahedu Group.

487. The public consultation event for the Highway Subproject II Yimu Highway Kedian – Mujiating Highway Subproject was held on 17 April 2013 (see **Plate VII.1**). This workshop comprised two sessions: a discussion meeting held at the Nanling Transport Bureau (NTB) office attended by representatives from relevant government departments and local communities; and a second open discussion session at the Gongyi Village Committee of Gongshan Township attended by the village and NTB representatives. Across both sessions, a total of 18 people attended or were consulted, including representatives from NTB (three representatives), Nanling Environmental Protection Bureau (NEPB), Nanling Land Resource Bureau (NLRB), Nanling Disease Control & Prevention Centre (NCDPC), Nanling Schistosomiasis Prevention Station (NSPS), Nanling Agriculture Bureau (NAB), Nanling Water Resource Bureau (NWRB), Nanling Planning Bureau (NPB), Gongshan Township Government (GTG), Gaoling Village Committee (Gingship Township) (four representatives) and Jishan Township Government.

Plate VII.1: Public consultation sessions held on 16 and 17 April 2013

Consultation Meeting in Meeting Room of NTB

Dialogue with Villager Representatives of Gongyi Village Committee of Gongshan Township

Home Interviews in Shishan Village (Xuanzhou Multipurpose Port site)

488. Summaries of comments from these meetings are presented in **Tables VII.3** and **VII.4** below.

Table VII.3: Summary of comments on the SRWIP

Stakeholder	Opinions and Suggestions	Response from the EA and their Advisors
Municipal Planning Department	• According to the landscape plan (2010) for the Shuiyang River corridor, the north bank of the river would be an ecosystem conservation zone and should be kept in its existing condition. • Green belt had been planned to the south of the new port and needs to be protected. • The sludge disposal sites should not be located in urban / township areas.	• Eco-friendly bank slope is designed for the sections through urban areas. • There will be no dredging upstream of Xinhezhuang (including the port). • There will be no dump site near densely populated areas.
Fishery Division, Xuancheng Agriculture Commission	• There are about 1,300 fishermen living in the catchment area whose livelihood will be affected by busier shipping. • It was suggested to provide employment on the project for some of the fisherman. • There are no protected spawning areas on the river • There are several species of migratory fish, e.g. silvery carp and long-tailed anchovy so the facilities must be designed to avoiding presenting an obstacle to migratory fish.	• XPSAB promised to make efforts to employ some fishermen in the construction and operation of the project. • The rubber dam would be inflated from December to March and deflated during the fish migratory season.
Land Resource Bureau	• The primary concern is recovery of the temporary land use, which must be restored after construction. • Measures must be taken to minimize the potential for soil pollution resulting from the dredged spoil disposal sites. • The IA should prepare restoration plans for the sludge disposal sites in advance of construction.	XPSAB and the DI agreed with these requirements and committed to take them into account.
Water Resources Bureau	• The main concern of the WRB is flood control, followed by soil and water conservation. • The IA should fulfill all the requirements related to these topics. • The irrigation canals should be well protected.	• Flood control is largely due to other projects, including reservoir building upstream, building sluice gates, widening the river bed and changing the bed slope in the downstream direction. These works are being implemented prior to the SRWIP. • All soil and water conservation measures as per the approved plans will be implemented and irrigation canals will be secured.
Forestry Bureau	• The project does not encroach on any nature reserve or protected woodland / wetlands. • The Jingting Mountain Scenic Spot is the only sensitive hotspot in the wider area, and is not affected by the scheme. • No specific requirements were raised.	No response needed
Environmental Protection Bureau	• The EPB will cooperate with the EA/IA to minimize environmental impacts of the project. • The locations for the dredged spoil disposal sites should have an adequate buffer to prevent any nuisance for local people. • Construction wastewater should be treated and discharged in line with agreed method statements to avoid polluting drinking water in-takes. • From the start of operations, the environmental risks associated with hazardous cargo goods	• The dredged spoil disposal sites will be located away from villages and communities. • Temporary mobile drinking water in-take pontoons will employed during construction to avoid turbid water during dredging. • An emergency response team will be set up to respond to accidents during operation. • The EA/IA will collaborate with the

Stakeholder	Opinions and Suggestions	Response from the EA and their Advisors
	must be managed. • The indirect impacts relating to industrial development in the catchment area need to be managed through an environmentally sound master plan.	relevant authorities to ensure environmental protection is considered in regional and industrial development plans.
Disease Control & Prevention Centre (DCPC)	• Xinhezhuang is the main epidemic centre for schistosomiaisis (bilharzia). • During the construction, the dredged and excavated spoil should be treated and transported carefully to prevent the spread of the host snail. • The construction contractor should take measures to strengthen protection and immunization of the workers from schistosomiasis with the help of the DCPC.	• The spoils dredged from potentially infected reaches will be disposed of and treated with lime and allowed to dry out to kill the molluscs. • The labour force will receive training on the causes and prevention of schistosomiaisis. • Manual work in water in infected areas will be recorded and tracked, particularly in the spring as the main infection season.
Community Representative from Shuiyang Township	• There are urban dwellers, farmers, and more than 400 fishermen living in Shuiyang Township. All the residents have been informed about the project and are positive about it. Only three householders will have to be resettled to facilitate building of the ship lock. The communities expect the project to stimulate economic development and provide employment for local people. • The key environmental concerns of the residents are the locations for the dredged spoil disposal sites, the disposal of domestic waste, and other solid wastes produced during construction.	• XPSAB confirmed that the affected householders will be resettled and compensated in line with PRC regulations and ADB SPS. • The project would employ as many local people as possible during the construction and operation phase. • The project will benefit local communities and the economy. • There are no proposed dredged spoil disposal sites near residential blocks and villages. • Domestic wastes and construction solid wastes will be collected, sorted, and disposed of at licensed facilities.
Director of Villager Committee of Shishan Village	• The new port will require land-take of about 41 ha (26.7 ha will be temporary) belonging to the village, resulting in resettlement of 149 householders from 5 village groups. • All the affected households will be settled in a block of flats just north of the port. • The village committee will provide every support to project implementation and would like villagers to be employed during construction and operation of the new port.	• XPSAB confirmed that local labor will be hired during the construction and some villagers may be able to obtain work associated with port operations, such as warehouse services and goods transfer. • Most of the resettled villagers will be transferred to urban residents and find new livelihoods, typically as workers in the surrounding industrial development.
Villager Representative from Shishan Village	• Most of the young and middle aged male villagers have left to obtain higher income employment in urban areas. Only some of the old villagers, women and children are left at home to take care of the houses and farmland. • The villagers welcome the project and expect a more prosperous urbanized life style. They are satisfied with the new block of flats for resettlement. • The priority environmental concern is to secure the drinking water intake which is located 4 km downstream of the port. They also requested that the dredged spoil disposal sites should not be located near their households.	• XPSAB committed that the project will benefit the villagers by providing appropriate compensation to the affected households and more employment opportunities. • Measures will be taken to ensure that the project construction and operation does not pollute the drinking water intake. • There will be no dredged spoil disposal sites near the villages around Xuanzhou Port.
Villager of Shishan	• Only a few villagers were interviewed since most of them were out working in factories	• XPSAB guaranteed that the project will promote the welfare of the

Stakeholder	Opinions and Suggestions	Response from the EA and their Advisors
	nearby. The interviewees said that they enjoy their lifestyles as part farmer and part worker. They grow rice, vegetables, rape and other crops in quantities to feed themselves. There is a cement plant (without kiln) close to the village which produces packaged cement. Many villagers are employed at this plant, which they do not consider to be polluting. • Their main environmental concern is to secure their drinking water supply.	villagers and the drinking water safety will be secured.

Table VII.4: Summary of comments on Subproject II Yimu Highway Kedian-Mujiating Section

Stakeholder	Opinions and Suggestions	Response from the EA and their Advisors
Planning Bureau	• The highway alignment is in compliance with the Nanling County master plan. • The 'at grade' crossings should be designed to ensure safety and efficiency for vehicles and pedestrians. • The green belt along the alignment was also highlighted.	• NTB confirmed they would co-ordinate with the designers to optimize the design of the 'at grade' crossing and make sure that the green belts along the alignment would be restored and enhanced.
Agriculture Bureau	• The rivers crossed by the highway do not support rare and endangered / protected aquatic species. There are no spawning grounds or winter / feeding grounds near the bridges. • Farmland and woodland acquisition should be minimized and a specific permit is required for land acquisition.	• NTB promised to supervise the contractor(s) to protect the rivers. • The IA and contractors will follow the legal procedures for land acquisition and will not start works onsite before obtaining the permit for occupying farmlands and woodlands.
Land Resource Bureau (LRB)	• The priority concern is protection of the farmland which stretches widely on both sides of the highway. • All temporarily land-take should be recovered to its original use. • LRB has taken into account of the land-take requirements for the highway in their land resource plans. • All land acquisition must obey the relevant legal requirements.	• NTB will coordinate with the DI to strengthen the restoration of the temporary land use and follow best practice in the rehabilitation of farmlands. • NTB also agreed to full legal compliance for land acquisition.
Water Resource Bureau	• The soil and water conservation plan has been reviewed and at the time of the workshop was awaiting approval. It has since been approved. • It will be strictly forbidden to dispose of dredged spoil on the river benchland and allow wastewater to drain directly to the river. The contractor must have an environmental contingency plan in place to cope with any accidental discharge. • A new drinking water in-take was identified about 4 km downstream of the Hongjiaba Bridge.	• NTB confirmed the soil and water conservation plans would be approved soon. • NTB committed that no spoil would be dumped close to the river and that construction wastewater would be pre-treated to meet the applicable standards and discharged to public sewer or the irrigation canals. • The EIA team will consider the implications of the bridge construction on the in-take works.
Schistosomiasis Prevention Station	• There is a schistosomiasis infection area in the upstream reach of the Zhanghe River. • The construction labour force would not be exposed to the risk of schistosomiasis for this project but the contractor should strengthen the education and personal protection of the workers.	• NTB committed to supervise the contractors in fulfilling their duties for the prevention and control of schistosomiaisis.
Disease Control & Prevention Center	• Construction and farm workers are a high incidence group for the sex trade and venereal disease (VD). It was suggested to strengthen the education of workers on HIV AIDS and VD, and provide contraceptives. • The local DCPC offered to help in epidemic disease control and public education.	• NTB will coordinate the contractors to follow DCPC's instructions for minimizing the incidence of VD and prevent HIV AIDS infection.
Environmental Protection Bureau	• The EPB has established good working relationships with the EIA team and cooperated with them in the project EIA, e.g.	• The EIA team committed to keep in close touch with the county EPB throughout the project

Stakeholder	Opinions and Suggestions	Response from the EA and their Advisors
	baseline information collection and monitoring. • There is heavy transport of chemicals in the proposed highway section and there have been many serious environmental accidents due to trucks and tankers overturning. The bridges, especially Zhanghe Bridge, must be designed with piped drainage and sediment tanks to protect river water. • Contractors to commit to environmental protection and carrying out the mitigation prescribed in the EMP.	implementation. • The bridges have been designed with drainage systems and sediment tanks where they are close to water intakes or where more stringent water quality standards apply. NTB guaranteed that Zhanghe River would be well protected. • NTB will include environmental provisions in the tender documents and construction contracts and make sure the contractors comply with their contractual and legal obligations.
Gongshan Township Government	• Most of the highway lies in Gongshan Township. There have been a lot of casualties caused by traffic accidents which have seriously impaired the safety and livelihood of the local community. Once upgraded, faster vehicles and higher traffic volume may result in more accidents. The local community strongly appeals to NTB to improve highway safety design. • To mitigate noise for nearby households, abatement measures should be provided for the houses near the highway red line. • The resettled villagers should be well compensated.	• NTB will work closely with the DI to improve highway safety design and management. • Houses very close to the highway and exposed to traffic noise levels in exceedance of the applicable standards will be provided with double glazing. • NTB promised to compensate resettled villagers in line with PRC regulations and ADB SPS.
Jishan Township Government	• The priority concern is compensation for the properties to be demolished. The compensation rate looks satisfactory for residential houses but low for shops.	• NTB explained the resettlement policies and promised to make the best offer for villagers in line with PRC regulations and ADB SPS.
Villager Committee of Gaoling Village of Gongshan Township	• The villagers are very concerned about the project schedule, scope and scale of land acquisition and resettlement. More complete and transparent information disclosure was requested. • Highway safety, noise impact and mitigation (particularly for night-time construction), disruption to local traffic, and dust pollution should be highlighted in the project design, construction, and operation.	• NTB committed to provide regular publicity on the project including advertisements in local media and posters in affected communities and villages. . • NTB committed to coordinate with the DI and contractors to improve highway safety, adopt appropriate noise mitigation measures, manage traffic during construction to control impact on local communities, and deploy dust suppression measures.
Villager Representatives of Gongyi Village of Gongshan Township	• The total population of the village is about 4,500 comprising 1,200 households in 33 groups. One third of the villagers in 10 groups live close to the highway. • The village has been planned as a part of the Nanling Economic Development Zone, with Kaidi Power Plant, Qirui Farm Machinery Factory, and other large industrial enterprises located along the highway and employing many villagers. • A proposed copper mine would provide more employment for local people in the future. • The majority are traditional farmers mainly growing rice, wheat, cotton, and vegetables in	• NTB committed to require contractors to employ as many villagers as possible in construction and also to provide some positions for the local people in highway maintenance. • Adequate compensation will be paid to affected householders, in line with PRC regulations and ADB SPS. • NTB confirmed that highway safety would be improved as part of highway improvements. Traffic noise and dust pollution would be mitigated in accordance with the EIA and EMP.

Stakeholder	Opinions and Suggestions	Response from the EA and their Advisors
	addition to poultry, pig raising and fish farming. • The priority concerns of the villagers are improvement of highway safety and compensation for resettlement. Noise and dust pollution could be problems but they were considered minor concerns because most of the villagers considered that they could be easily mitigated.	

D. Future Plans for Public Participation

489. Information obtained during the public consultations has been used to improve the baseline data, inform the design, and develop the environmental assessment, mitigation and monitoring measures. The public's views as received through ongoing consultation will continue to be taken into consideration during the detailed design and project implementation.

490. Meaningful consultation to safeguard the environment and local residents will continue throughout detailed design, construction and operation phases. The APDOT PPMO, ESE and the IA LPMOs will be responsible for organizing the public consultations. The contractors will be required to communicate and consult with the communities in the project area of influence, especially those near road alignments. Eye-catching public notice boards will be set at each work site to provide information on the purpose of the project activity, the duration of disturbance, the responsible entities on-site (contractors, IA), and the project level Grievance Redress Mechanism (GRM). Contact information of all GRM entry points and the APDOT PPMO and the relevant LPMO will be disclosed on the construction site information boards. Consultation will focus on public complaints about nuisances from construction and operation activities, such as noise, asphalt fumes, dust, traffic disturbance, as well as public concerns about the environment and resettlement.

491. Future consultation and participation will also include (i) involvement of affected people during inspection and monitoring of EMP implementation during construction and operation phases, (ii) participatory evaluation on the environmental and social-economic benefits and impacts, and (iii) consultation with the public after the project completion.

492. The project environmental information will be disclosed by ADB in line with the Safeguard Policy Statement (2009) and the Public Communications Policy (2011) as follows: (i) this EIA will be available for review on ADB's website 120 days before Board consideration of the project, (ii) copies of the domestic EIR (in Chinese) are available on request at the APDOT PPMO, and (iii) environment progress will be reported in the quarterly project progress reports and the semi-annual environmental monitoring reports which will be disclosed on ADB's project website (www.adb.org) upon receipt from the borrower.

VIII. GRIEVANCE REDRESS MECHANISM

493. Public participation, consultation and information disclosure undertaken as part of the environmental and resettlement assessment process have identified and addressed community concerns about the project. Given the level of public and stakeholder participation during the development of the project and proposed ongoing information disclosure and consultation during implementation major issues of grievance are not expected, however, unforeseen issues may occur. To settle such issues effectively, a transparent grievance redress mechanism (GRM) for receiving and managing complaints has been defined for project environment related issues.

494. In addition to serving as a platform to resolve grievances, the GRM has been designed to help achieve the following objectives: (i) open channel for effective communication, including the identification of new environmental issues of concern arising from the project, (ii) prevent and mitigate any adverse environmental impacts on communities caused by project implementation and operations, (iii) improve mutual trust and respect and promote productive and transparent relationships with local communities, and (iv) build community acceptance of the project.

495. The GRM will be accessible to diverse members of the community, including more vulnerable groups such as women and youth. Multiple points of entry and modes of access, including face-to-face meetings, written complaints, telephone conversations, or e-mail, will be available. Opportunities for confidentiality and privacy for complainants will be honored where this is requested. A more detailed description of the GRM is provided in the environmental management plan (EMP) (Appendix 1) and was also explained during public consultation carried out by the PPTA Consultants. The GRM will be operational prior to commencement of construction works.

496. In addition to this GRM, ADB's overall accountability mechanism (2012) applies.[21] The mechanism provides opportunities for people adversely affected by ADB-financed projects to express their grievances; seek solutions; and report alleged violations of ADB's operational policies and procedures, including safeguard policies. ADB's accountability mechanism comprises two separate, but related, functions: (i) consultation, led by ADB's special project facilitator, to assist people adversely affected by ADB-assisted projects in finding solutions to their problems; and (ii) providing a process through which those affected by projects can file requests for compliance review by ADB's Compliance Review Panel.

[21] The revised accountability mechanism became effective on 24 May 2012.

IX. ENVIRONMENTAL MANAGEMENT PLAN

A. Objectives

497. The EMP for the Project is presented in Appendix 1. The EMP defines mitigation measures and describes the involved institutions and mechanisms to monitor and ensure compliance with environmental regulations and implementation of the mitigation measures. Such institutions and mechanisms will seek to ensure continuous improvement of environmental protection activities during preconstruction, construction, and operation of the project in order to prevent, reduce, or mitigate adverse impacts. The EMP draws on the domestic EIRs and on the discussions and agreements with the relevant government agencies. The EMP will be reviewed and updated at the end of the detailed design in order to be consistent with the final detailed design. The updated EMP will be disclosed on ADB's project website.

B. Organizational Structure for Environmental Management

498. As executing agency (EA), the Anhui Province Department of Transport (APDOT) will be responsible for the overall implementation and compliance with loan assurances and the EMP (including Environmental Monitoring Plan). The APDOT has two subordinate divisions, the Anhui Province Port Shipping Administration Bureau (APPSAB) and the Anhui Province Highways Administration Bureau (APHAB). The EA has established a PPMO who will be responsible, on behalf of the EA, for the day-to-day management of the project. The PPMO will have the overall responsibility delegated by the EA for (amongst others) supervising the implementation of environment mitigation and monitoring measures, coordinating the project level Grievance Redress Mechanism (GRM) and reporting to ADB. The PPMO will engage technical engineering design institutes and project implementation consultants and will manage the procurement process. The PPMO will appoint one environment specialist on its staff to supervise the effective implementation of the EMP and to coordinate the project level GRM. The PPMO will prepare quarterly project progress reports and semi-annual environmental monitoring reports and submit them to ADB.

499. **Environmental Supervision.** The APDOT PPMO will appoint a single company through competitive tendering to undertake the environmental supervision for all the subprojects, referred to as the 'Environmental Supervision Engineer (ESE)'. The ESE will:

(i) assess the project components' environmental readiness prior to implementation based on the readiness indicators defined in Table A.3 in the EMP;
(ii) support the APDOT PPMO in updating the EMP mitigation and monitoring measures as necessary, to revise or incorporate additional environmental mitigation and monitoring measures, budget and institutional arrangements that may be required based on the detailed design; submit to ADB for approval and disclosure; ensure compliance with the PRC's environmental laws and regulations, ADB's Safeguard Policy Statement (2009) and Public Communications Policy (2011), and the World Bank Group's Environmental, Health and Safety Guidelines;
(iii) if required, update the EIA and EMP reports based on changes in the project during detailed design (for example if there is a major scope change) that would result in adverse environmental impacts not within the scope of the approved EIA/EMP;

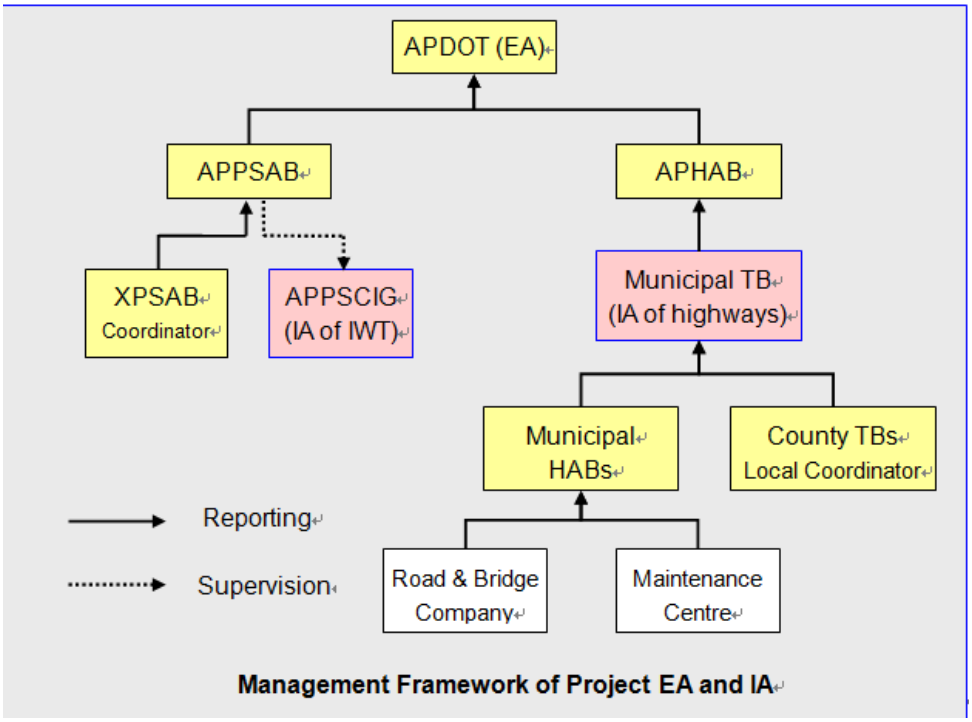
(iv) support the APDOT PPMO, IA LPMOs and procurement companies in preparing tender documents; ensure that the bidding documents and civil works contracts contain provisions requiring contractors to comply with the mitigation and monitoring measures in the EMP and that relevant sections of the project EMP (or updated EMP, if prepared) are incorporated in the bidding and contract documents;
(v) assist the APDOT and IAs to establish a Grievance Redress Mechanism (GRM), and provide training for the PPMO, LPMOs and GRM entry points;
(vi) conduct regular EMP compliance assessments, undertake site visits as required, identify any environment-related implementation issues, propose necessary corrective actions, reflect these in a corrective action plan;
(vii) assist the APDOT PPMO to prepare semi-annual environmental monitoring and progress reports to ADB;
(viii) provide training to APDOT PPMO, the IA LPMOs and contractors on environmental laws, regulations and policies, SPS 2009, EMP implementation, and GRM in accordance with the training plan defined in the EMP; and
(ix) assist the APDOT PPMO and IA LPMOs in conducting consultation meetings with relevant stakeholders as required, informing them of imminent construction works, updating them on the latest project development activities, GRM.

500. **Implementing Agency (IA).** The IA will implement project components, administer and monitor contractors and suppliers, and be responsible for construction supervision and quality control and will establish LPMOs. The LPMOs will ensure that the EMP is implemented proactively and respond to any adverse impacts beyond those foreseen in the EIA. The LPMOs will also attend to requests from relevant agencies and ADB regarding the mitigation measures and monitoring program.

501. There will be five IAs. The Anhui Province Ports and Shipping Construction Investment Group Co. Ltd (APPSCIG) will act at the IA for the Shuiyang River Inland Waterway Project and Xuanzhou Multi-purpose Port. The IAs for the Highways Subprojects will be Ma'anshan Highways Administration Bureau for the Ma'anshan North Corridor, Nanling County Transport Bureau for the Yimu Highway Kedian to Mujiating Section, Wuwei Country Transport Bureau for the S319 Erba to Wuwei and Chizhou Highways Administration Bureau for the G206 Dongliu to Yaodu Section. The construction, maintenance and management (including environmental management) will be done at the county level. The county level Transport Bureaux will assist in land acquisition, resettlement, use of local resources, and balancing the interests of various stakeholders during project implementation.

502. Each of the five IAs will establish a LPMO who will assign one environment specialist on its staff to (i) supervise contractors and ensure compliance with the EMP; (ii) conduct regular site inspections; (iii) coordinate environmental quality monitoring in compliance with the approved monitoring plan ; (iv) act as local entry point for the project grievance redress mechanism (GRM); (vi) submit quarterly monitoring results to the contractors for information, and to the PPMO and the province and local EPBs for verification and confirmation.

Figure IX.1: Overview of management organisations



Note: TB= Transport Bureau, HAB= Highways Agency Bureau.

503. To ensure that contractors comply with the provisions in the EMPs, the PPMO and IA LPMOs will prepare and provide the following for incorporation into the bidding procedures: (i) a list of environmental management and monitoring requirements to be budgeted by the bidders in their proposals, (ii) environmental clauses for contractual terms and conditions, and (iii) full EIA and EMP for compliance.

504. Environmental training will be essential for the APDOT PPMO, IA LPMOs and contractors to implement the EMP. Training will be provided in two stages, firstly before implementation by the SSSRI who undertook the EIRs and secondly during implementation by the ESEs. Training will cover (i) environmental laws, regulation, and policies; (ii) implementing mitigation measures; (iii) environmental technologies and procurement; (iv) environmental monitoring, and supervision; and (v) documentation and reporting.

C. Inspection, Monitoring and Reporting

505. **Internal environmental monitoring** will include monitoring of air quality, noise, water quality and other parameters described in the EMP. Internal environmental monitoring during construction and operation will be conducted by one or more licensed Environmental Monitoring Stations[22] to be contracted by the APDOT PPMO and assisted by the ESE. The monitoring results will be submitted to the APDOT PPMO, ESE and IA LPMOs, significant compliance issues will be highlighted in the quarterly project progress reports and results will be fully

[22] In the PRC, only the monitoring data from licensed environmental monitoring stations are recognized by the environmental authorities.

reported in the semi-annual environmental monitoring reports prepared by the PPMO and submitted to ADB.

506. **External environmental monitoring** will be periodically conducted by the local environmental authorities in the framework of their legal mandate to check compliance with applicable environmental regulations. They will be responsible for undertaking regular and random environmental monitoring and inspection activities before, during, and after construction as well as in the event of emergencies.

507. **Compliance monitoring.** EMP compliance monitoring / verification will be undertaken by the APDOT PPMO and IA staff environmental specialists with support of the ESE. The PPMO will report to ADB on the progress of the EMP implementation, environmental performance of the contractors and environmental compliance in the semi-annual environmental monitoring reports. Quarterly project progress reports will include a summary of EMP implementation progress and compliance and highlight any significant compliance issues. The ESE and IA LPMO staff environmental specialists will support the APDOT PPMO staff environmental specialist in developing the semi-annual environmental monitoring reports. The reports should confirm the project's compliance with the EMP mitigation and monitoring measures, local legislation such as EIA requirements, and identify any environment related implementation issues and necessary corrective actions, which should be reflected in a corrective action plan. The performance of the contractors will also be reported with respect to environmental protection and impact mitigation. The operation and performance of the project GRM, environmental institutional strengthening and training, and compliance with environmental covenants under the project will also be included in the report.

508. Within three months after each component completion, or no later than one year with permission of the APEPD, environmental acceptance monitoring and audit reports of each component completion shall be: (i) prepared by a licensed environmental monitoring station in accordance with the PRC *Regulation on Project Completion Environmental Audit* (MEP, 2001), (ii) reviewed for approval by environmental authorities prior to the official commencement of component operation, and (iii) finally reported to ADB. The environmental acceptance reports for completed components will indicate the timing, extent, effectiveness of completed mitigation and of maintenance, and the needs for additional mitigation measures and monitoring during operation. These environmental acceptance reports will be provided to the APDOT PPMO and ESE who are responsible for preparing an environmental completion report and inputs for the Project Completion Report for ADB.

D. Risks and Assurances

509. The Project has no unusual technical risks and conventional engineering designs with proven reliability and performance will be adopted for all the components.

510. From an environment safeguards point of view, the main risk relates to the failure of the APDOT PPMO, the IA LPMOs and O&M units to monitor environmental impacts and implement the EMP effectively during construction and operational stages. This risk will be mitigated by (i) providing training in environmental management under the project, (ii) appointing qualified project implementation consultants, (iii) following appropriate project implementation monitoring and mitigation arrangements, (iv) ADB conducting regular project reviews, and (v) project assurances covenanted in the loan and project agreement with ADB.

511. General and specific environmental project assurances are required to ensure that the project can achieve its envisaged outcome. The following sections define the assurances that will be included in the loan and project agreements.

1. General Environmental Assurances

512. APDOT shall ensure and shall cause the IAs to ensure that the preparation, design, construction, implementation, operation and decommissioning of the Project and all Project facilities comply with (a) all applicable laws and regulations of the Borrower and Anhui Province relating to environment, health and safety; (b) the Environmental Safeguards; and (c) all measures and requirements set forth in the EIA, the EMPs, and any corrective or preventative actions (i) set forth in a Safeguards Monitoring Report, or (ii) which are subsequently agreed between ADB and APDOT.

513. The APDOT PPMO assisted by the ESE will cause the IA LPMOs to prepare, at the outset of component implementation, detailed internal monitoring programs to be implemented by the contractors during construction and the operators during operation phases, and to incorporate such mitigation and monitoring measures into the design of components, relevant bidding documents and construction contracts.

514. Throughout project implementation, the APDOT PPMO, ESE and the IA LPMOs will review any changes to the project design that may potentially cause negative environmental impacts, and in consultation with ADB, update the EIA and CEIA by revising mitigation measures as necessary to assure full environmental compliance.

515. The APDOT PPMO, ESE and the IA LPMOs will ensure that sufficient resources and full time personnel are provided for monitoring EMP implementation,

516. The APDOT PPMO and the IA LPMOs will ensure that each sub-project takes the necessary actions to minimise the impact of interruptions to water supply, wastewater collection, irrigation canals, and other utility services during the course of the project.

517. The APDOT PPMO will ensure that the IAs are obliged to provide quarterly and semi-annual environmental monitoring reports throughout the construction period to the APDOT PPMO, which will in turn prepare and submit to ADB semi-annual environmental monitoring reports in a format acceptable to ADB.

2. Specific Environmental Assurances

a. Facilities Associated with IWT Output (output 3)

518. The APDOT PPMO and the IA LPMO will ensure that the associated project on the relocation of the ship yard from the ship lock upstream of Shuiyang Town is relocated, that the level of contamination at the site is assessed through soil sampling, a programme of remediation is prepared and implemented as appropriate for the level and type of contamination, and the site goes through due diligence to confirm that it is clear of soil contamination, before the commencement of construction works.

519. The APDOT PPMO and IA LPMOs must liaise with the Schistosomiasis Prevention Offices in the study area to identify disease hotspots, agree on locations for the dredged spoil disposal sites, control mechanisms to stop infection and the spread of the disease, and implement information education and disclosure programmes for the workforce.

b. Highway Subprojects

520. The APDOT PPMO will ensure that the IAs supervise the ecological impacts of construction works, with particular reference to (i) environmental education of workforce, (ii) periodic surveys of camps to ensure workers are not poaching or hunting or collecting wild animals, (iii) that the construction companies are taking measures to minimise land clearance in semi natural habitats, and (iv) avoid impacting on protected species during construction.

c. Other Issues

521. The APDOT will ensure that within 60 days from the loan effectiveness, the PPMO establishes the project grievance redress mechanism relating to safeguards in line with the EMP and Resettlement Plan and establishes a task force functioning effectively to: (i) review and document eligible complaints of project stakeholders; (ii) proactively address grievances; (iii) agree with the complainants the chosen mechanism for redress; and (iv) prepare periodic reports to summarise the number of complaints received and resolved, and final outcomes of the grievances and chosen actions and make these reports available to ADB on request. Eligible complaints include those related to the Project, any of the service providers, any person responsible for carrying out the Project, complaints on misuse of funds and other irregularities and grievances due to any safeguard issues, including resettlement, environment, and gender.

X. CONCLUSIONS AND RECOMMENDATIONS

A. The Proposed Projects

522. The Anhui Intermodal Sustainable Transport Project comprises two subcomponents, (i) the Shuiyang River Waterway Improvement Project (SRWIP) and Xuanzhou Multi-purpose Port Development Project; and (ii) a highway improvement component to improve four sections of roads totalling 122.18 km in Anhui Province, namely (a) the Ma'anshan North Corridor, (b) Yimu Highway Kedian to Mujiatang, (c) the S319 Erba to Wuwei, and (d) the G206 Dongliu to Yaodu Section.

B. The Study Area

523. The study area is located along the Yellow River valley in southern Anhui Province. The SRWIP and Xuanzhou Port study are centred on the Shuiyang River, a Class III River, with good water quality and drinking water source for the many communities living along the river. Much of the surrounding area is intensively farmed for a range of crops with extensive paddy and fishponds in the downstream area. Little natural habitat remains, although the area supports a variety of birds, small mammals, reptiles, and amphibians and fish associated with a mix of farmland and riverine habitat. Although there are no designated nature conservation sites in the area, there is potential to find protected species. The main urban centre is Xuancheng City, a growing city with plans for industrial and commercial expansion based on increased trade. There are no cultural heritage sites or scenic spots in the study area.

524. The four highway schemes are located on both the northern and southern shores of the Yellow River. The terrain varies from low lying and flat, to undulating and hilly, drained by tributaries of the Yangtze. The Ma'anshan North Corridor and S319 pass through rural countryside, with extensive farming along their alignments. The Yimu Highway also crosses farmland, together with a short woodland section and urban areas. The re-aligned G206 would pass through hilly countryside, skirting the Yaodu river flood bank, lakes, and passing 200m from the Tiantai Mountain Forest Reserve. The lakes and forest reserve support several species of bird and the pangolin which are afforded national and province level protection. There are no known cultural heritage sites or scenic spots in the study area.

C. Expected Project Benefits

525. The Shuiyang River Waterway Improvement Project and Xuanzhou Multi-purpose Port will directly benefit the regional economy in and around Xuancheng City, through the opening up of the inland waterway to year round trade, the increase in shipping on the Shuiyang River, the potential to develop industry and manufacturing in Xuancheng, and develop trade and transportation links with the Yangtze River Delta and Shanghai. The scheme will benefit the environment by promoting a low carbon transportation system that would transport bulk cargo for significantly lower carbon emissions per kilometre travelled compared to highways and rail, helping to reduce the contribution of transportation to greenhouse gases, while improving transport capacity. The scheme will indirectly benefit the people and environment in Xuancheng City by encouraging a modal shift of cargo from HGVs to ships, thereby helping to offset the growth of highway freight on the local and regional road network to the benefit of local travel and people living and working in the city.

526. The Highway Schemes will benefit the current and future users of the local and regional road network, through improved journey times, more reliable journeys and safer more comfortable journeys. Traffic flow is predicted to rise by a multiple of three to five fold between now and 2029 on these schemes, except for the Yimu Highway where future growth may be depressed by the opening of the TongNanXuan Expressway in about 2020. The high forecasts are largely due to the increase in car traffic from relatively low ownership levels. While the current traffic flows represent a mixture of local and regional traffic, the local traffic component is already important and likely to grow. For example the Yimu Highway Kedian to Mujiating Section already exhibits commuter flow traffic. The G206 Dongliu to Yaodu section, which connects the new Dongliu Economic Development Zone with downtown Yaodu, will attract local commuter traffic and support urban development in the Dongliu area and along the new alignment. All the highway schemes are compliant with the local town plans and improved regional transport links will support development of designated development land in local communities.

527. The highways also carry commercial and regional traffic. Both the Ma'anshan North Corridor and the Yimu Highway Kedian to Mujiating Sections carry disproportionate volumes of heavy goods vehicles, which affect the quality of the road, create environmental impacts due to noise, air emissions and severance of communities, and increase the risk of accidents. Improvements in the road design will help to mitigate the adverse effects of HGVs.

528. Various aspects of design will improve the safety conditions for travellers and pedestrians. These include the separation of vehicular traffic, cyclists and pedestrians on the urban expressways for the Yimu Highway and the G206; pedestrian crossings; increase in over-taking capacity from dual single to dual two lane carriageways; and lighting in urban areas.

529. Minor route alignments to bypass towns and villages on the Ma'anshan North Corridor, S319 Wihe Bridge Crossing and the G206 new build will provide relief from noise, air emissions and severance to local communities. The re-aligned G206 will also remove traffic from the Tiantai Mountain Forest Park, reducing the adverse effects of traffic noise, severance, and disturbance from the movement of vehicles on wildlife.

D. Adverse Impacts and Mitigation Measures

1. Shuiyang River Waterway Improvement Project and Xuanzhou Multi-purpose Project

530. The SRWIP and new port will require 429.8 mu (28.7 ha) of permanent land take which is an irreversible impact and a further 1501 mu (100 ha) of temporary land, mostly for the temporary spoil disposal sites. Some 156 households or an estimated population of 478 will be affected by land acquisition, house demolition or both. It will be necessary to demolish villagers' houses, relocate short sections of utilities and other assets, and relocate a ship yard currently occupying the proposed site of the ship lock near Shuiyang Town. Compensation and resettlement will fully meet the PRC and ADB applicable policies and requirements.

531. Various design measures have been taken into consideration to mitigate the potential impacts of the scheme:

a) The proposed scheme provides for sufficient water depth for year round traffic by balancing the volume of dredging required with raising water levels in the

summer months with a deflatable barrage. This approach reduces the impacts associated with dredging a longer section of river, without compromising fish migrations, long term water quality on the river, or creating newly inundated areas and waterlogging.

b) The river barrage is inflatable, so that it can be filled with water at the start of the dry season to raise water depths upstream, and deflated with the onset of the wet season, allowing the passage of floods downstream and fish migrations. This is a more flexible, environmentally friendly design compared with a built barrage.
c) The dredging method proposed using a cutter suction dredger which draws the sediment and water through the dredger and along a pumping main to the final disposal site. This approach minimises turbidity levels in the river, which in turn help to avoid impacting on the drinking water in-takes. As the sediment is pumped to the dredged disposal sites, there is little road traffic.
d) The new port has been located at the Xuancheng Industrial Park where wastewater, solid waste, power and water will be provided through the services to the Park. The location of the port will help to stimulate industrial development at the Park and provide employment.

532. Construction of the scheme is not expected to affect rare, threatened, or protected species, although fauna with Province level II protection have been recorded as occurring in the area. No mature trees will be affected by the scheme. No known physical cultural resources would be affected by this Project.

533. During construction, the main adverse environmental impacts will be increased turbidity in the river about 100m up and downstream of the dredger, noise from the dredging and other construction activities, the loss of seven ponds which will be infilled with the dredged waste and converted to farmland, odour and wastewater drainage from the dredge spoil disposal ponds, the loss of farmland and semi-natural habitats in the vicinity of the Port, dust around earthworks especially at the port site, the safe treatment and disposal of construction wastewater and sewage, and solid waste disposal. Good housekeeping and effective mitigation measures will be implemented to reduce these impacts to acceptable levels. The temporary land take areas will be returned to their former use, vegetated and landscaped, or restored to farmland upon completion of the construction stage.

534. The project is located in an area where Schistosomiasis is endemic. Special measures will be implemented to minimise contact with the disease by the workforce and control the spread of the disease vectors. Occupational health and safety measures will be implemented to minimise accidents and injury during construction.

535. The main adverse impacts on the river during operation are the elevation of water levels upstream of the rubber barrage during low flows and the associated changes in velocity; noise, wastewater and solid waste discharges from ships; and wastewater and solid waste disposal from the administrative offices at the shiplock. The discharge of waste from ships is controlled by law, and ship inspections and law enforcement will need to be carried out. The administrative building will be served by the Shuiyang Town sewerage system and domestic solid waste will be disposed at the Shuiyang Town municipal tip. The scheme is not considered likely to impact adversely on fisheries or the Qiugong Flood Channel.

536. At Xuanzhou Port the main operational impacts are noise, dust especially during the loading and unloading of bulk materials, wastewater and solid waste. Noise and air quality will be mitigated through the selection of operational plant and operational procedures. Oily wastewater will be treated on site and discharged to the Industrial Zone wastewater collection system together with sewage arising in the port precinct. Stormwater will drain to the river. Solid waste will be segregated on site and disposed of as appropriate for the waste streams.

537. Based on information gathered and assessments performed by the domestic environmental design institute, it is concluded that environmental impacts during the construction and operational stages of the project would be acceptable and in compliance with PRC regulations and standards and ADB's Safeguard Policy Statement (2009) if the prepared EMP is implemented and monitored diligently. The EMP defines mitigation measures and monitoring requirements for the design, construction, and operational stages of the project. Appropriate environmental safeguards for the planned works are proposed and form part of a comprehensive set of project management documents.

538. Consideration was given to project alternatives for raising water levels in the river, the location of the port, the downstream connection to the Wushen Canal and the placement of the secondary barrage on the Qiugong River.

539. Three options were considered for the waterway, dredging along the whole channel, combining a rubber barrage at Shuiyang Town with dredging, and combining a rubber barrage downstream with dredging. The preferred option optimised the security of the operation of a barrage with an intermediate volume of dredging.

540. Two options were considered for the connection to the Wushen Canal where the Shuiyang River breaks into two branches. The preferred option follows the main channel, but goes through Jiangsu Province and depends on another province to upgrade the waterway within their jurisdiction to achieve the benefits of the scheme upstream. The alternative was to follow a secondary channel through Anhui Province which provided greater administrative security of completing the works, but would require much greater dredging to obtain the necessary channel dimensions and considerable re-settlement.

541. Two options were considered for the proposed port. The old port is located close to Jingting Mountain Provincial Level Scenic Spot, but the port does not have sufficient land for expansion. An alternative site at Xia Shi Mountain was not suitable as the area was designated a green area. The preferred port is located in a designated industrial zone which is suitable for port activities.

542. Two options were considered for the secondary barrage on the overflow river. The option close to the juncture of the two rivers is preferred to maintain water levels and avoid additional inundation.

2. Highway Subprojects

543. The total permanent land-take for the four highway schemes is 3525.24 mu (235ha), of which 55% is cultivated land, and the remainder includes woodland and grassland. The loss of this land is an irreversible impact. A further 2563.89 mu (171 ha) of temporary land take will be required, for spoil and borrow pits and also temporary haul roads. Some 4,302 households and

17,023 people will be impacted by land acquisition, house demolition or both. Compensation and resettlement will be carried out in line with the PRC and ADB applicable policies and requirements.

544. Various design considerations were developed to mitigate the potential adverse impacts on the scheme.

(i) Ma'anshan North Corridor is being upgraded from Class III/IV to Class I. Key features are: dual single lane road with provision of a hard shoulder along each carriageway which will improve travel safety for NMTs; provision of low noise surface over 23.43 km; and off-line sections which will remove traffic-related impacts from householders along the old road.

(ii) Yimu Highway Kedian to Mujiating. This scheme will improve conditions for vehicle travellers and NMTs. The Class I Highway (8.8 km) will be dual two lane with hard shoulder, improving the road space for vehicular traffic and NMTs. The Urban Trunk Road (13.56 km) will be dual three lane with a separate lane for NMTs, improving safety for NMTs by having a physical barrier from the highway. Both sections will be lit. The design also includes 1.8 km of low noise surface asphalt.

(iii) S319 Erba to Wuwei. This route will be upgraded to dual two lanes with hard shoulder, but with provision to convert the road to dual three lanes without having to widen the sub-base further. The scheme allows for improvements in pedestrians crossings.

(iv) G206 Dongliu to Yaodu Section. The propose scheme offers improved vertical and horizontal alignments suitable for a Class I Highway. The design is for a dual three lane highway with provision for a NMT lane, improving safety for cyclists and pedestrians, and lighting.

545. Construction of the highway subprojects is not expected to affect rare, threatened, or protected species. The Ma'anshan North Corridor and S319 Erba to Wuwei Projects predominantly affect farm land. The Yimu Highway Kedian to Mujigting and G206 Dongliu to Yaodu Subprojects do cross natural habitats including woodland and grassland, where valuable trees may occur. The G206 Dongliu to Yaodu also passes lakes and the Tiantai Mountain Forest Park which supports National Grade II protected species of birds including the White fronted goose, Black kite and Black baza and the Chinese pangolin. No known physical cultural resources would be affected by this Project.

546. The main impacts during construction will be noise, dust, deep cuttings on the G206 and the need for slope stabilisation, borrow and spoil sites, reduced water quality during the in-channel works for bridges, the collection and disposal of site drainage, construction wastewater, and sewage, and solid waste disposal. Good housekeeping and effective mitigation measures will be implemented to reduce these impacts to acceptable levels. The temporary land take areas will be returned to their former use, vegetated and landscaped, or restored to farmland upon completion of the construction stage.

547. Community health and safety and occupational health and safety measures will be implemented to safeguard the workforce and the local communities nearby. Measures will include hygiene and secure drinking water source for construction camps, health and safety training for the workforce, and medical checks for staff.

548. The main impacts from start of operations would be traffic noise and air emissions from vehicles. In the year of opening, the traffic levels with and without the scheme are likely to be small to negligible, such that the additional increase in air quality and noise resulting from the project is small. Air quality from motor vehicle emissions has been predicted to be in compliance with applicable standards at existing sensitive receptors along the project roads. For traffic noise, mitigation measures include the installation of double-glazed windows at some 1942 sensitive receptors along the project roads that will experience exceedance of applicable noise standards by 2021, and the provision of low asphalt surfacing on sections of the Ma'anshan North Corridor and Yimu Highway.

549. The alternatives were based around route alignments.

(i) Ma'anshan North Corridor. Three alternative sub-alignments were considered along the route. In the Chuomiao Section on line widening was preferred to a new build section despite the greater numbers of house demolition, as the on line option had better connections with the existing highway network and required less earthworks. Off-line options were chosen for Sima River and Shiyang Town and Xianzhong Town, where the bypasses reduced impacts on people, made for better alignments, and at Xianzhong Town connected well into the S226 without going into the centre of the town.

(ii) Yimu Highway Kedian to Mujiating. On line widening was selected and no alternatives were considered.

(iii) S319 Erba to Wuwei. Most of the route is on line widening. However, two options were considered for the crossing of the Xihe River and entry into Wuwei Country. A new alignment and bridge, 2 km upstream from the existing was preferred, as the new crossing linked into the newly expanding area of Wuwei and avoided the congested town centre.

(iv) G206 Dongliu to Yaodu Section. The proposed scheme is an alternative alignment to the existing G206. The new alignment bypasses the centre of Dongliu and nearby villages, and avoids the Tiantai Mountain Forest Park, bringing a better alignment for a Class I highway while providing social and ecological benefits.

E. Information Disclosure, Consultation and Participation

550. Information disclosure and public consultation have been undertaken during the preparation of the domestic EIRs for the highways and waterway transport sub-projects. This included: publication of notices and documents on government websites; meetings with key stakeholders including government departments, local authorities, sector-specific institutions and authorities, and local representatives; interviews with local residents; and a questionnaire survey.

551. Two rounds of information disclosure were conducted by the domestic EIA institute during May 2012 to March 2013 on each subproject. Project information was posted on relevant government web-sites in the first round. The second round included questionnaire surveys in addition to posting project information on government web-sites. The purpose of the questionnaire surveys was to obtain the views of local people located in the vicinity of the sub-project areas. Over 480 survey forms were issued with a return rate of 98%. Concerns raised were environmental impacts from construction activities and traffic noise and vehicle emissions during operation of the roads. Respondents supported a range of traffic noise mitigation

measures, with low noise road surface being the most popular followed by restriction on the use of horn, noise barriers and property insulation.

552. In addition to information disclosure, two public meetings were conducted by the domestic EIA institute with assistance from the PPTA consultant in April 2013 for the highway subprojects and the waterway project, respectively. These meetings comprised of discussion sessions and interviews with representatives from the affected local communities. The purpose was to present the EIR findings and recommendations and to solicit feedback. The project specific grievance redress mechanism (GRM) was explained during the meetings. Concerns raised include obstruction of rubber dam to migratory fish, restoration of temporary land take areas, and prevention on the spread of host snails in the waterway dredging areas causing schistosomiasis. Mitigation measures for these were described by the EIA institute during the meetings and included in this report.

553. Information obtained during public consultations has been used to improve the baseline data, inform the design, and develop the environmental assessment, mitigation and monitoring measures. The public's views as received through ongoing consultation will continue to be taken into consideration during the detailed design and project implementation.

F. Risks and Assurances

554. The Project has no unusual technical risks and conventional engineering designs with proven reliability and performance will be adopted for all the components.

555. From an environment safeguards point of view, the main risk relates to the failure of the APDOT PPMO, IA LPMOs and O&M units to monitor environmental impacts and implement the EMP effectively during construction and operational stages, which will be mitigated by institutional strengthening.

556. The general environmental assurances are concerned with ensuring that APDOT, ESE, IAs, contractors and other organisations implement the appropriate measures such that: the project complies with all legal and other obligations of the PRC and ADB; appropriate environmental management staff resources are committed to the project; the monitoring programmes are prepared and implemented; changes to project designs are reviewed and further EIA undertaken if required; during construction actions are taken to avoid interruptions with utilities and irrigation canals; and all the parties comply with their reporting requirements under the loan.

557. Specific environmental assurances are provided on the timely and environmentally acceptable relocation of the shipyard and subsequent clean up; on the implementation of environmental health measures appropriate to the level of risk to prevent the spread of schistotomiasis in the study area; that appropriate level of attention is paid to the conservation of the environment, particularly all species of flora and fauna that are afforded protection under national and international legislation and Conventions; and that the APDOT implements the GRM within 60 days from the loan effectiveness.

G. Overall Conclusion

558. The project will improve the transportation networks in Anhui Province, promote a modal switch from highways to low carbon inland waterways for bulk cargo, improve journey times, comfort and safety on county and regional roads, and facilitate local and regional economic development.

559. The domestic EIR and this EIA conclude that all identified environmental impacts can be mitigated to acceptable levels if the measures defined in the EMP are carefully implemented and monitored. The Project is feasible from an environmental safeguards point of view.

APPENDIX 1

ENVIRONMENTAL MANAGEMENT PLAN

January 2014

People's Republic of China: Anhui Intermodal Sustainable Transport Project

Prepared by Anhui Provincial Department of Transport for the Asian Development Bank. This is a final version of the draft originally posted in July 2013 available on http://www.adb.org/projects/45021-002/documents

LIST OF ABBREVIATIONS

ADB	Asian Development Bank
APDOT	Anhui Province Department of Transport
APEPD	Anhui Province Environmental Protection Department
APHAB	Anhui Province Highways Administration Bureau
APPSAB	Anhui Province Port Shipping Administration Bureau
APPSCIG	Anhui Province Ports and Shipping Construction Investment Group
DMF	Design and monitoring framework
EA	Executing Agency
EIA	Environmental impact assessment
EIR	Environmental impact report
EMP	Environmental management plan
EMS	Environmental monitoring station
EPB	Environmental Protection Bureaux
ESE	Environmental supervision engineer
FSR	Feasibility study report
GRM	Grievance redress mechanism
IA	Implementing Agency
LPMO	local project management office
MEP	Ministry of Environmental Protection
MEPB	Municipal Environmental Protection Bureau
MG	Municipal government
NOx	Nitrogen oxides
O&M	Operation and maintenance
PAM	Project administration manual
PME	Powered mechanical equipment
PPMO	provincial project management office
PPTA	Project preparation technical assistance
PRC	People's Republic of China
RP	Resettlement plan
SO2	Sulphur dioxide
SPS	Safeguard policy statement
SS	Suspended solids
TSP	Total suspended particulates (dust)
XPSAB	Xuancheng Port and Shipping Administration Bureau

Units

CNY1 = USD 0.16415

USD 1 = CNY6.0919

ENVIRONMENTAL MANAGEMENT PLAN

I. Introduction

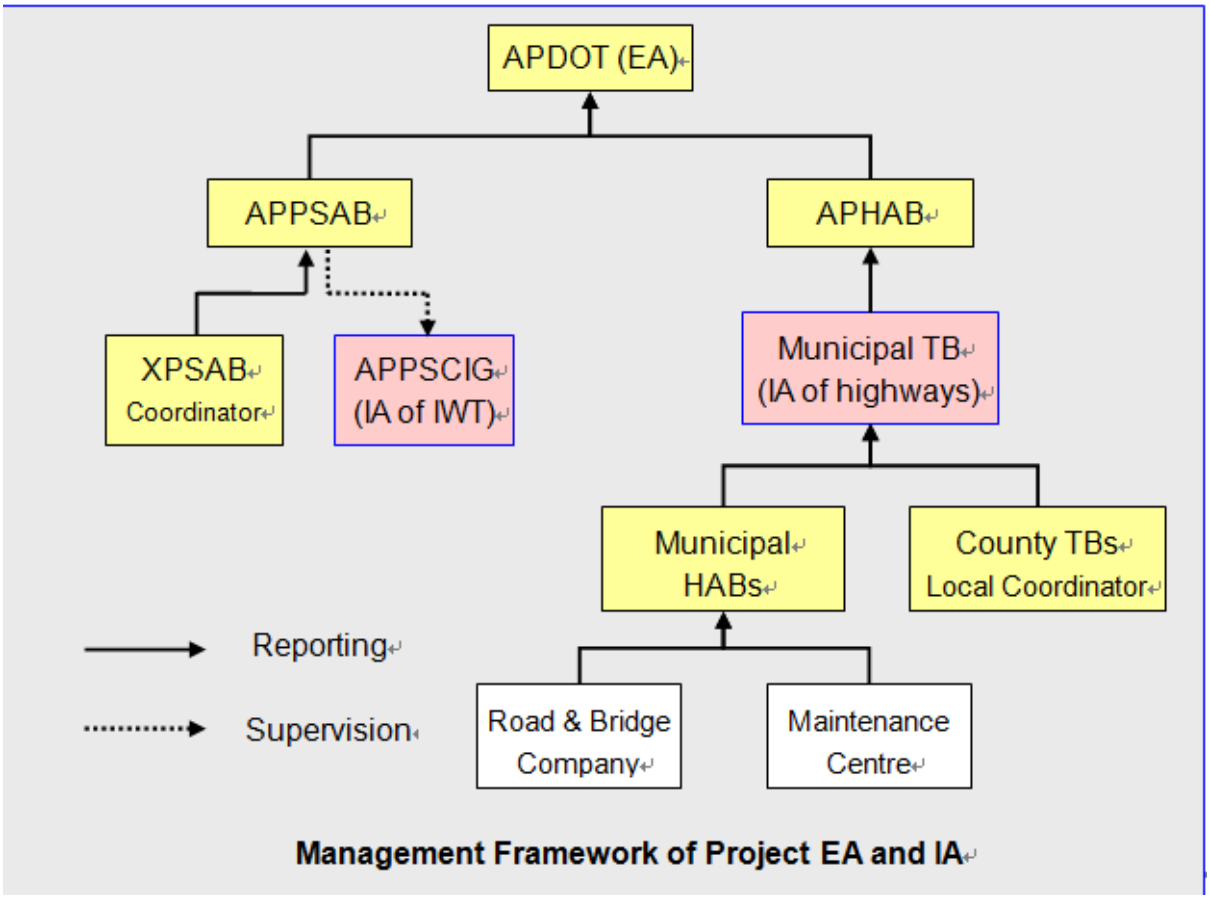
1. This Environmental Management Plan (EMP) has been developed for the Anhui Inter-Modal Transport Project (the Project) and defines all potential impacts of the project components and the mitigation and protection measures with the objective of avoiding or reducing these impacts to acceptable levels. The EMP also defines the institutional arrangements and mechanisms, the roles and responsibilities of different institutions and procedures and budgets for implementation of the EMP. The EMP seeks to ensure effective implementation of environmental protection activities during preconstruction, construction, and operation in order to prevent, reduce, or mitigate adverse impacts and risks. The EMP draws on the findings of the project EIA, the domestic EIR, PPTA and ADB review mission discussions and agreements with the relevant government agencies.

2. The EMP will be reviewed and updated at the end of the detailed design in order to be consistent with the final technical design. The updated EMP will be disclosed on the ADB project website and included in the Project Administration Manual (PAM). The updated EMP will also be included as a separate annex in all bidding and contract documents. The contractors will be made aware of their obligations to implement the EMP and to budget EMP implementation costs in their proposals.

3. Environmental monitoring results will be used to evaluate (i) the extent and severity of actual environmental impacts against the predicted impacts, (ii) the performance of the environmental protection measures and compliance with regulations, (iii) overall effectiveness of the project EMP; and (iv) need for adjustment of the project EMP.

II. Institutional Responsibilities related to EMP implementation

4. As **Executing Agency** (EA), the Anhui Province Department of Transport (APDOT) will be responsible for the overall implementation and compliance with loan assurances and the EMP (including the Environmental Monitoring Plan). The APDOT has two subordinate divisions, the Anhui Province Port Shipping Administration Bureau (APPSAB) and the Anhui Province Highways Administration Bureau (APHAB).



Management Framework of Project EA and IA

5. The APDOT has established a **Provincial Project Management Office (PPMO)**, which will have an over-arching responsibility, on behalf of the EA, for the management of the various subprojects. The PPMO has overall responsibility delegated by the EA for supervising the implementation of environment mitigation measures, coordinating the project level Grievance Redress Mechanism (GRM) and reporting to ADB. The PPMO will engage the technical engineering design institutes, project implementation consultants, and manage the procurement process.

6. The APDOT PPMO will appoint one environment specialist on its staff to supervise the effective implementation of the EMP and to coordinate the project level GRM. They will also appoint a single company through competitive tendering to undertake the environmental supervision for all the subprojects ('Environmental Supervision Engineer') to ensure consistency in environmental management and monitoring. The APDOT will also appoint local Environmental Monitoring Stations (EMS) to undertake environmental quality monitoring for the subprojects according to the environmental monitoring plans (as set out in Tables A.11a-f).

7. To ensure that the contractors comply with the EMP provisions, the PPMO and staff environmental specialist, with the help and technical support of Environmental Supervision

Engineer (ESE), will prepare and provide the following documents for incorporation into the bidding procedures: (i) a list of environmental management requirements to be budgeted for by the bidders in their proposals; (ii) environmental clauses for contractual requirements; and (iii) major items in the EIA and EMP.

8. APDOT will prepare quarterly project progress reports (that include an environment section) and semi-annual environment monitoring reports for submission to ADB. The ESE will support the APDOT and IA staff environmental specialists with the preparation of these reports.

9. **Implementing Agencies (IA).** The IAs will assume the debt servicing responsibility as the end-user of the ADB loan. They will implement project components, administer and monitor contractors and suppliers, and be responsible for construction supervision and quality control and will establish Local Project Management Offices (LPMOs). The IA LPMOs will ensure that the EMP is implemented proactively and respond to any adverse impacts beyond those foreseen in the EIA. The IA LPMOs will also attend to requests from PPMO, relevant agencies and ADB regarding the mitigation measures and monitoring program.

10. There will be five IAs as shown in **Table A.1**. The Anhui Province Ports and Shipping Construction Investment Group Co. Ltd (APPSCIG) will act at the IA for the Shuiyang River Inland Waterway Project and Xuanzhou Multi-purpose Port. Four city or county level transport bureau or highway administration bureau will be the IAs for the four highway subprojects. Each of these five IAs will establish a LPMO which will assign one environment specialist on its staff to (i) supervise contractors and ensure compliance with the EMP; (ii) conduct regular site inspections; (iii) coordinate environmental quality monitoring in compliance with the approved monitoring plan[23]; (iv) act as local entry point for the project grievance redress mechanism (GRM); (vi) submit quarterly monitoring results to the contractors for information, and to the PPMO and the province and local EPBs for verification and confirmation.

Table A.1: Summary of responsibilities

Scheme	Jurisdiction	IA	EPA
SRWIP and Xuanzhou Port	Xuancheng City	APPSCIG	APEPD
S367 Ma'anshan City North Corridor	Hanshan County Hexian County	Ma'anshan City Highway Administration Bureau	Ma'anshan Municipal EPB
Yimu Highway Kedian to Mujiating Section	Nanling County	Nanling County Transport Bureau	Wuhu Municipal EPB
S319 Erba to Wuwei Section	Wuwei County	Wuwei County Transport Bureau	Wuhu Municipal EPB
G206 Dongliu-Yaodu Section	Dongzhi County	Chizhou City Highway Administration Bureau	APEPD

Note: EPA = Environmental Protection Authority, APEPD = Anhui Province Environmental Protection Department, EPB = Environmental Protection Bureau.

[23] The Environmental Monitoring Stations have not yet been appointed and will be selected through tendering.

11. **Construction contractors** will be responsible for implementing the mitigation measures during construction under supervision of the IA LPMOs and the APDOT PPMO. In their bids, contractors will be required to respond to the environmental management requirements defined in the EMP. Each contractor will be required to develop site specific EMPs and will assign a person responsible for environment, health and safety. After construction completion, environmental management responsibilities will be handed over to the IAs.

12. **Environmental Supervision Engineer (ESE).** The ESE will report directly to the APDOT staff environmental specialist and PPMO and support them in the project with (i) project preparation, including EMP update; (ii) EMP training, (iii) semi-annual EMP compliance verification; (iv) inputs for quarterly project progress reports and semi-annual environment monitoring reporting; (v) identifying environment-related implementation issues and necessary corrective actions to be reflected in an action plan; and (v) undertaking site visits as required. The ESE will:

i. assess environmental readiness of the project components prior to implementation based on the readiness indicators defined in Table A.3;

ii. support APDOT PPMO in updating the EMP including monitoring plan to revise or incorporate additional environmental mitigation and monitoring measures, budget and institutional arrangements that may be required based on the detailed design; submit to ADB for approval and disclosure; ensure compliance with the PRC's environmental laws and regulations, ADB's Safeguard Policy Statement (2009) and Public Communications Policy (2011), and the World Bank Group's Environmental, Health and Safety Guidelines;

iii. support the IA LPMOs, APDOT PPMO and procurement companies in preparing tender documents; ensure that the bidding documents and civil works contracts contain provisions requiring contractors to comply with the mitigation measures in the EMP and that relevant sections of the project EMP (or updated EMP, if prepared) are incorporated in the bidding and contract documents;

iv. assist the IA LPMOs, APDOT PPMO and contractors to establish a Grievance Redress Mechanism (GRM), and provide training for the GRM access points;

v. conduct regular EMP compliance assessments, undertake site visits as required, identify any environment-related implementation issues, propose necessary corrective actions, reflect these in a corrective action plan;

vi. assist the APDOT PPMO in preparing semi-annual environmental monitoring and inputs for quarterly project progress reports for ADB;

vii. provide training to the IA LPMOs, APDOT PPMO and contractors on environmental laws, regulations and policies, SPS 2009, EMP implementation, and GRM in

accordance with the training plan defined in the EMP; and

viii. assist the APDOT PPMO in conducting consultation meetings with relevant stakeholders as required, informing them of imminent construction works, updating them on the latest project development activities, GRM and environmental quality monitoring work.

13. Overall environmental responsibilities are outlined in **Table A.2**.

Table A.2: Environmental Responsibility

Phase	Responsible Agency	Environmental Responsibility
Project preparation	Design Institutes on behalf of APDOT PPMO	Prepare project Feasibility Study Reports (FSRs), EIR and EMP, Resettlement Plans (RPs), conduct public consultation
	APEPD and Municipal EPB	Review and approve the project EIR and EMP
	PPTA consultant	Provide technical assistance, review EIR, prepare EIA report
	ADB	Review and approve the EIA and EMP and disclose
	APDOT	Recruit ESE through competitive tendering
Engineering detail design	Design Institutes on behalf of APDOT PPMO	Incorporate mitigation measures defined in the EMP into engineering detailed designs; Update the EMP in cooperation with the APDOT PPMO and ESE.
	APDOT PPMO	Recruit ESE through competitive tendering
	APDOT PPMO, ESE	Review updated EMP, confirm that mitigation measures have been included in engineering detail design.
	ADB	Approve updated EMP and disclose.
Tender & contracting	APDOT PPMO, ESE	Incorporate EMP clauses in tender documents
	APDOT PPMO	Recruit environmental monitoring station(s) through tendering
	Contractors	Prepare tenders for the construction contracts, to include staffing and costs for environmental management to comply with the EMP
	ADB, APDOT PPMO, ESE	Review bidding documents; confirm project's readiness
Construction	Each IA	Establish a LPMO who appoints one staff environment specialist; supervises contractors and ensures compliance with the EMP; approves method statements; coordinates construction supervision and quality control; coordinates periodic environmental quality monitoring in compliance with the approved monitoring plan; acts as local entry point for the project grievance redress mechanism (GRM); submits quarterly monitoring results to APDOT PPMO.
	APDOT PPMO	Appoint one staff environment specialist; supervise the effective implementation of the EMP; coordinate the project level GRM; prepare quarterly project progress and semi-annual environment progress reports and submit them to ADB; conduct public consultation and inspect implementation of mitigation measures.
	ESE	Advise on the mitigation measures; provide comprehensive technical support to PPMO and APDOT for environmental management; assist with preparation of tender/contract documents; conduct training; conduct semi-annual EMP compliance review; prepare corrective action plans; support PPMO in preparing quarterly project progress reports and semi-annual environmental progress reports for ADB. Review domestic environmental acceptance reports and prepare environmental completion report.
	Contractors	Assign EMP implementation responsibilities; ensure health and safety; implement mitigation measures; prepare method statements
	EMS(s) (contracted by APDOT)	Undertake environmental quality monitoring
	APEPD and local EPBs depending on the subproject	Conduct periodic inspections of all construction projects relative to compliance with PRC regulations and standards.
	ADB	Review quarterly project progress reports, semi-annual environmental monitoring reports and completion report. Undertake review missions. Advise on compliance issues, as

Phase	Responsible Agency	Environmental Responsibility
		required. Disclose semi-annual environmental monitoring reports on ADB project website.
Operation	O&M Units	Ensure proper operation of component facilities according to design standards, implement mitigation measures and conduct post-construction public consultation.
	APDOT PPMO, ESE	Conduct EMP compliance review, instruct APDOT and O&M units on environmental management requirements; prepare quarterly project progress reports and semi-annual environmental monitoring report for first year of operation Coordinate environmental quality monitoring
	EMSs (contracted by ADPOT)	Undertake environmental quality monitoring for the first year of operation
	APEPD and local EPB	Undertake periodic and random environmental monitoring and inspect environmental compliance with PRC regulations and standards.
Notes: **ADB** = Asian Development Bank; **EMS** = Environment Monitoring Station; **ESE** = Environmental Supervision Engineer **APEPD** = Anhui Province Environmental Protection Department; **O&M Units** = Operation and Maintenance Units; **APDOT** = Anhui Province Department of Transport; **PPMO** = Provincial Project Management Office; **LPMO** = Local Project Management Office.		

III. Summary of Potential Impacts and Mitigation Measures

14. General environmental management measures are presented in **Table A.3**. Potential environmental issues and impacts during the pre-construction, construction and operation phases, as identified in the EIA as well as corresponding mitigation measures designed to minimize the impacts are summarized in **Table A.4** for the Shuiyang River Improvement Scheme and Xuanzhou Multi-purposed Port and in **Tables A.5 to 8** for the Highway Subprojects.

15. Mitigation and safeguard measures that will permanently become part of the infrastructure such as landscape planting, road signage and markings should be included within the main civil work contract costs and are not double-counted as part of the EMP costs.

16. The EMP includes costs for temporary construction mitigation measures such as dust suppression. These measures need to be included in the tender documents to ensure they are included in contractor estimations. Estimates for these budgets are provided in **Tables A.9a** and **A.9b** based on costing information provided in the domestic EIRs. Those costs that should have been included in the infrastructure engineering costs such as re-vegetation and landscaping of temporary land take areas were not included in the EMP costs to avoid double counting. The domestic EIRs also included estimated costs for soil and water conservation measures at approximately $4.13 million, which are separately itemized in this report and not grouped under environmental mitigation costs (see Table A.17).

17. The mitigation measures defined in the EMP will be (i) checked and where necessary updated by the design institutes; (ii) incorporated into tender documents (where appropriate), construction contracts, and O&M manuals; and (iii) implemented by contractors, specialist environmental personnel, APDOT and IAs under supervision of the PPMO and relevant LPMOs. The effectiveness of these measures will be evaluated based on the results of the environmental quality monitoring conducted by the EMSs, and through EMP compliance verification conducted by the PPMO and ESE.

Table A.3: Generic Impacts and Mitigation Measures Item

	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
Detailed Design Stage					
See Project Specific EMPs		Ensure that the mitigation measures are adopted in detailed design	● APDOT PPMO to appoint ESE	APDOT PPMO	ADB
Pre-construction Phase					
Institutional strengthening	-	Lack of environment management capacity within APDOT PPMO	● Appoint one qualified environment specialists to APDOT PPMO. ● Appoint one Environmental Monitoring Station to conduct environment quality monitoring during construction stage. ● ESE to conduct first phase of environment management training for APDOT PPMO staff and environmental specialists. ● ESE to conduct environmental management training for contractors	APDOT PPMO	ADB
	-	Lack of environment management and monitoring capacity within IA LPMOs	● Each IA establishes LPMO and appoints one qualified environmental specialist to staff ● ESE to conduct initial environment management training for the IA LPMOs. ● ESE to provide follow on training.	APDOT PPMO, ESE	ADB
EMP update	-	-	● Review mitigation measures defined in the EMP. ● Update as required to reflect detailed design. ● Submit to ADB/PPMO for approval and disclose updated EMP on project website. ● Prepare an environmental compliance monitoring plan to meet the environmental requirements in the EIA and EMP.	APDOT PPMO, ESE	MG, ADB
Grievance	Social &	Handling and	● Establish a GRM, appoint a	APDOT	ADB

	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
redress mechanism	environmental	resolving complaints by contractors	GRM coordinator within APDOT PPMO, each IA LPMO and each contractor. ● Brief and provide training to GRM access points. ● Disclose GRM to affected people before construction begins at the main entrance to each construction site.	PPMO, ESE, MHAB, NCTB, WCTB, CHAB, Contractor	
Tender documents		Environmental and social impacts	Ensure that the construction-related environmental and social mitigation measures are incorporated into the tender documents. This should include a clause to employ a proportion of locally sourced workforce.	Design Institute	APDOT PPMO, ESE
Construction traffic	Traffic	Construction vehicles causing traffic congestion	● Plan transport routes for construction vehicles. ● Specify approved routes in the tender documents and forbid vehicles from using other roads especially during peak traffic hours. ● Inform drivers of haulage routes ● Separate construction traffic from pedestrians. Do not allow local villages to walk through construction sites.	Design Institute, Local traffic police	APDOT PPMO, ESE
Construction Stage					
Construction site good practice	Soil resources	Soil stripping	● Strip topsoil and subsoil and store the soil horizons separately, protecting the top soil for reuse in restoration. ● Stockpiles are not to exceed 2m with side slopes at the natural angle of repose. ● Topsoil to be stored for a long time may be seeded with grass. ● Windbreaks and tarpaulins may be used to reduce wind blown dust and erosion of the stockpile.	Contractors	APDOT PPMO, APPSCIG, MHAB, NCTB, WCTB, CHAB, ESE, APEPD / local EPB
	Soil resources	Soil erosion	● Ensure contractors are aware of all soil erosion requirements as set out in the approved	Contractors	APDOT PPMO; APPSCIG;

	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			Water and Soil Conservation Plans and have developed appropriate method statements and management proposals. ● Where possible, avoid construction during periods of high rainfall. If necessary, construct berms to direct rainwater runoff away from exposed surface. ● Install drainage ditches and sedimentation pits in temporary construction areas to prevent soil erosion and to manage site run-off. ● Stabilise all cut slopes, embankments and other erosion-prone working areas while works are ongoing. Implement permanent stabilisation measures as soon as possible, at least within 30 days. ● Pay close attention to drainage provision and establishment of vegetation cover on backfilled areas to prevent soil erosion. ● If restoration is carried out during periods of hot or extreme weather, ensure adequate aftercare to maximise survival of plants.		MHAB, NCTB, WCTB, CHAB, ESE, APEPD / local EPBs
	Soil resources	Soil contamination	● Properly store petroleum products, hazardous materials and wastes on an impervious surface and preferably with a tray or bund to contain any leaks. ● Develop spill response plan. Keep a stock of absorbent materials (e.g. sand, earth or commercial products) on site to deal with spillages and train staff in their use. ● If there is a spill, take immediate action to prevent pollution entering drains,	Contractor	APDOT PPMO; APPSCIG, MHAB, NCTB, WCTB, CHAB, ESE; EPBs

	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			watercourses, unmade ground or porous surfaces. Do not hose the spillage down or use any detergents. Use oil absorbents and dispose of used absorbents at a licensed waste management facility. ● Record any spill events and actions taken in environmental monitoring logs and report to ESE; and ● Remove all construction waste from the site to licensed waste disposal sites.		
Construction site good practice	Air quality	Dust (TSP) during construction	● Erect hoarding / screens around dusty activities such as demolition; ● Frequent watering of unpaved areas, backfill areas and haul roads to suppress dust; (at least twice per day and during windy weather, once every two hours) ● Pay particular attention to dust suppression near sensitive receptors such as schools, hospitals, residential areas and natural areas; ● Manage stockpile areas to avoid mobilisation of fine material, cover with tarpaulin and/or spray with water; ● Minimise storage time of construction materials and wastes on site by regularly removing them off site; ● Do not overload trucks transporting earth materials on public roads; ● Equip trucks transporting fine grained materials with covers or tarpaulin to cover loads during transport; ● Bulk materials transported by highway should be compacted and the packing height must not exceed the protective	Contractor	APDOT PPMO; APPSCIG; MHAB, NCTB, WCTB, CHAB; ESE; EPBs

	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			guard on the vehicle; ● Install wheel washing equipment or conduct wheel washing manually at each exit of the works area to prevent trucks from carrying muddy or dusty substances onto public roads; ● Immediately cleanup all muddy or dusty materials on public roads outside the exits of the works areas; ● The main haul roads and access roads should be sealed to prevent dust raising. Unsealed roads should be watered daily; ● Plan the transport routes and timing to avoid busy traffic and heavily populated areas; ● Harden the main construction roads and sites; ● Mud dumping, transport and other construction activities likely to give rise to dust are not permitted during windy weather (level 4 wind); and ● Immediately plant vegetation in all temporary landtake areas upon completion of construction to prevent dust and soil erosion.		
		Fumes and PM from asphalt mixing plant, concrete batching plant and other equipment and machinery	● Locate asphalt plants and mixers at least 300m downwind from residential areas and other sensitive receptors. ● Enclose these plants and equip them with bag house filter or similar air pollution control equipment. ● Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays. ● Regularly inspect and certify	Contractor	APDOT PPMO; APPSCIG; MHAB, NCTB, WCTB, CHAB; ESE; EPBs

	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			vehicle and equipment emissions and maintain to a high standard.		
	Air Quality	Emissions from vehicles and equipment	● Procurement of new vehicles and plant should take account of low emission alternatives; ● All vehicles and plant to be kept in good order and maintained in compliance with the manufacturer's instructions; ● Minimise movement of construction traffic around the site; ● Impose speed limits of 10 kph on unsurfaced haul roads and working areas and 15kph on surfaced roads and working areas; ● Set up speed limit signs on construction sites; ● On road vehicles are to comply with vehicle emissions standards; ● Prohibit the burning of waste on site; and ● Vehicles and plant shall be switched off when not in use.	Contractor	APDOT PPMO; APPSCIG; MHAB, NCTB, WCTB, CHAB; ESE; EPBs
	Noise	Noise from powered mechanical equipment and vehicles	● Sensibly schedule construction activities, avoid noisy equipment working concurrently. ● Specify equipment and machinery that conforms to PRC noise standard GB12523-90 and ensure regular maintenance. ● Select advanced quiet equipment and construction method, and tightly control the use of self-provided generators. ● Comply with local requirements in areas with sensitive receptors very close by, avoiding construction works, particularly noisy	Contractor	APDOT PPMO; APPSCIG; MHAB, NCTB, WCTB, CHAB; ESE; EPBs

	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			activities such as piling and compaction from 2200 to 0600. ● If night time construction needed, inform nearby residents beforehand, obtain permission of local government, keep local communities informed through bulletins, avoid using noisy equipment and set up temporary noise barriers. ● Control the speed of bulldozer, excavator, crusher and other heavy plant travelling on site. ● Specify equipment and machinery that conforms to PRC noise standard GB12523-90 and ensure regular maintenance. ● Adopt noise reduction devices and measures for works in proximity to sensitive noise receptors to ensure required standards are maintained. ● Locate sites for rock crushing, concrete mixing and other noisy activities at least 300m away from sensitive noise receptors. ● Minimize the use of whistles and horns, and prohibit the use of horns on construction sites at night. ● Maintain regular communication with sensitive receptors such as schools within 200m of the construction sites to avoid noisy activities within sensitive periods, such as examination periods.		
	Natural drainage lines	Control of drainage and flooding on site	● Locate temporary working and storage areas away from drainage lines ● Provide temporary drainage at construction sites ● Provide pollution control such	Contractor	APDOT PPMO; APPSCIG; MHAB, NCTB, WCTB,

	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			as oil and silt traps at discharge points where hydrocarbons and aggregate may contaminate runoff ● Take measures to reduce the risk of soil erosion on exposed surfaces prior to the start of the heavy summer rains.		CHAB; ESE; EPBs
	Water Quality	Management of works in and adjacent to watercourses	● Programme in channel works during the dry season. ● Use coffer dams for construction of bridge foundations for ease of construction in the dry and minimize turbidity in the river. ● Construction water is treated via settlement pit prior to re-use or discharge to surface waters ● Erect berms or sandbags during bridge foundation works if necessary to contain runoff polluting the rivers. ● Avoid locating administrative buildings or storage areas on the floodplain during the summer monsoon season ● Maintain adequate flood flow during the rainy season. ● All camps, fuel storage, refuelling and maintenance areas to be located at least 200m from watercourses. ● Construction materials such as aggregate and cement must be protected from rainfall and runoff to prevent erosion ● Scour protection to be provided on the pier footings and on the flood banks on the outside curve of meanders	Contractor	APDOT PPMO; APPSCIG; MHAB, NCTB, WCTB, CHAB; ESE; EPBs
		Construction site wastewater discharge	● Provide temporary toilets sufficient for the size of the workforce at canteens, construction camps and major construction sites. ● Septic tanks must be emptied	Contractor	APDOT PPMO; APPSCIG; MHAB, NCTB, WCTB,

	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			periodically and the contents transported to the Municipal wastewater treatment plant for treatment or be spread on agricultural land. ● All construction wastewater to be treated to appropriate PRC standard prior to discharge to surface waters. ● Stockpiles should have temporary drainage provisions to minimise run-off. ● Reuse equipment and wheel wash wastewater for dust suppression. ● Install sedimentation tanks on site to treat process water and muddy runoff.		CHAB; ESE; EPBs
	Solid waste	Spoil	● Balance cut and fill on construction sites to minimize the amount of spoil to be disposed; ● Ensure that spoil is disposed of carefully at dump sites, to create stable landforms; ● Spoil disposal sites must be approved in advance; ● Revegetate spoil disposal sites at the earliest opportunity.	Contractor	APDOT PPMO; APPSCIG; MHAB, NCTB, WCTB, CHAB; ESE; EPBs
		Construction site refuse	● Set up centralized domestic and construction waste collection point(s). ● Sort material on site, for reuse, recycling and disposal. ● Identify final disposal routes and approved sites. ● Use covered dump truck to remove construction and demolition waste. ● Appoint a named individual to manage the waste disposal. ● Prohibit the burning of waste on construction sites.	Contractor	APDOT PPMO; APPSCIG; MHAB, NCTB, WCTB, CHAB; ESE; EPBs

	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
	Ecology	Protection of vegetation and restoration of disturbed areas	● Demarcate the construction working area to prevent encroachment and damage to adjacent areas. ● Ensure any valuable trees that are being retained are protected with fencing and/or put conspicuous markings and warning signs on these trees to prevent workers from inadvertently damaging or destroying them. ● Ensure sufficient aftercare for landscape planting to maximise survival.	Contractor	APDOT PPMO; APPSCIG; MHAB, NCTB, WCTB, CHAB; ESE; EPBs
		Protected species	● Prohibit any injury to key protected animals, such as the Asiatic toad and turtle. ● If any injured animals are found, report to local wildlife protection department.	Contractor	APDOT PPMO; APPSCIG; MHAB, NCTB, WCTB, CHAB; ESE; EPBs
			● Qualified ecologist will be on site prior to start of construction to check construction sites for protected species and translocate any discovered on site	ESE	APDOT PPMO
		Greening	● Implement the revegetation plans, which may include seeding with grass and planting trees and shrubs.	Contractor	APDOT PPMO; APPSCIG; MHAB, NCTB, WCTB, CHAB; ESE; EPBs
	Physical cultural resources	Destruction of cultural relics	● Contractor to comply with PRC's Cultural Relics Protection Law and Cultural Relics Protection Law Implementation Regulations ● If relics are discovered, stop work immediately and protect the site; notify the supervising entities and the local Cultural Relics Bureau; and only start construction after approval by	Contractor	APDOT PPMO; APPSCIG; MHAB, NCTB, WCTB, CHAB; ESE; Cultural Relics Bureau

	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			the Cultural Relics Bureau; ● Educate workforce on these procedures.		
Health and Safety	Occupational health and safety	Construction site sanitation	● Effectively clean and disinfect the site, including disinfection of toilets and waste disposal sites, and ensure timely removal of solid waste; ● Exterminate rodents on site at least once every 3 months, and exterminate mosquitoes and flies at least twice each year; ● Provide public toilets in accordance with the requirements of labor management and sanitation departments in the living areas on construction site, ● Appoint designated staff responsible for cleaning and disinfection.	Contractor	APDOT PPMO; APPSCIG; MHAB, NCTB, WCTB, CHAB; ESE; EPBs
		Occupational safety	● Appoint Environment, Health and Safety Officer to develop and implement environmental, health and safety management plan, maintain records concerning health, safety and welfare and regularly report on accidents, incidents and near misses. ● Train all construction workers in general health and safety matters and on emergency preparedness and response procedures. ● Provide personal protective equipment (hard hats, shoes, eye goggles, respiratory masks, and high visibility vests) to all construction workers and enforce their use. ● Provide goggles and respiratory masks to workers doing asphalt road paving. ● Provide ear plugs to workers working near noisy powered mechanical equipment (PME),	Contractor	APDOT PPMO; APPSCIG; MHAB, NCTB, WCTB, CHAB; ESE; EPBs

	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			especially during piling of bridge foundations. ● Ensure safe handling, transport, storage and application of explosives for blasting. ● Provide a clean and sufficient supply of fresh, potable water for all camps and work sites. ● Provide an adequate number of latrines and other sanitary arrangements at the site and work areas and ensure that they are cleaned and maintained in a hygienic state. ● Safe working in confined spaces for foundations such as the ship lock. ● Measures to prevent the collapse of walls, such as the chambers for the ship lock ● Provide adequate waste receptacles and ensure regular collection and disposal. ● Ensure that Contractors have adequate worker and third party insurance cover. ● No children (less than 14 years of age) to work on any contract.		
		Food safety	● Provide a secure source for drinking water at the construction camps ● Inspect and supervise food hygiene in canteens on site regularly. ● Canteen workers must have valid health permits. ● Once food poisoning is discovered, implement effective control measures immediately to prevent it from spreading	Contractor	APDOT PPMO; APPSCIG; MHAB, NCTB, WCTB, CHAB; ESE; EPBs
		Disease prevention and safety awareness	● Construction workers must have physical examination before start working on site. ● Provide annual health checks.	Contractor	APDOT PPMO; APPSCIG; MHAB,

	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			● If infectious disease is found, the patient must be isolated for treatment to prevent the disease from spreading. ● Establish health clinic at location where workers are concentrated, which should be equipped with common medical supplies and medication for simple treatment and emergency treatment for accidents. ● Specify the person responsible for health and epidemic prevention responsible for the education and propaganda on food hygiene and disease prevention to raise the awareness of workers. ● Regularly inspect works to ensure there are no areas of stagnant water that could provide breeding grounds for malaria, encephalitis and dengue fever mosquitoes. ● Regularly inspect works to ensure that there are no breeding grounds for the host snail for schistosomiasis ● Provide training to the workforce on disease prevention and safety awareness ● Undertake checks every six months for workforce working in areas / tasks with a moderate to high risk of contact with schistosomiasis and medicate if the disease is found. ● Inform the local Schistosomiasis Prevention and Treatment Office and report the incidence to the local Health Administrative Department		NCTB, WCTB, CHAB; ESE; EPBs

	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
	Community health and safety	Temporary traffic management	A traffic control and operation plan will be prepared together with the local traffic management authority prior to any construction. The plan shall include provisions for identifying preferred haul routes, diverting or scheduling construction traffic to avoid morning and afternoon peak traffic hours, regulating traffic at road crossings with an emphasis on ensuring public safety through clear signs, speed controls and planning in advance.	Contractor, local traffic police, IA LPMOs	APDOT PPMO, APPSCIG; MHAB, NCTB, WCTB, CHAB, ESE
		Information disclosure	Residents and businesses will be informed in advance through publicity about the construction activities and provided with the dates and duration of expected disruption.	APPSCIG; MHAB, NCTB, WCTB, CHAB	APDOT PPMO, ESE
		Access to construction sites	● Clear signs will be placed at construction sites in view of the public, warning people of potential dangers such as moving vehicles, hazardous materials, excavations and raising awareness on safety issues. ● All sites will be made secure, discouraging access by members of the public through fencing or security personnel, as appropriate.	Contractor	APDOT PPMO; APPSCIG; MHAB, NCTB, WCTB, CHAB, ESE
		Utility services interruptions	● Assess construction locations in advance for potential disruption to services and identify risks before starting construction. ● If temporary disruption is unavoidable, develop a plan to minimize the disruption in collaboration with relevant local authorities such as power company, water supply company, water bureau (for irrigation canals), and communication company. ● Communicate the dates and duration in advance to all	Contractor, local service providers	APDOT PPMO; APPSCIG; MHAB, NCTB, WCTB, CHAB; ESE

	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			affected people.		
Demobilisation	Site cleanup	Site remediation and restoration	● Contractor to keep a schedule of all temporary land prior land use, and land occupiers ● At the end of construction, all buildings, stockpiles, and litter on temporary land is to be removed. ● Temporary land is to be restored to its original land use, unless agreed otherwise with the land occupier. ● Borrow pits and spoil disposal sites are to be restored according to the approved plans and will be subject to approval by APEPD / local EPB during the environmental acceptance review on completion. ● Latrines must be removed and the site disinfected and infilled. Sewage sludges may be spread on agricultural land.	Contractor	APDOT PPMO; APPSCIG; MHAB, NCTB, WCTB, CHAB; ESE; APEPD / local EPB
Grievance redress mechanism	Social & environmental	Handling and resolving complaints by contractor, IA LPMOs and APDOT PPMO	● Disclose GRM to affected people before construction begins at the main entrance to each construction site. ● Maintain and update a Complaints Register to document all complaints. ● Ensure satisfactory resolution of complaints within specified timescales.	APDOT PPMO, APPSCIG; MHAB, NCTB, WCTB, CHAB, Contractor	ADB
Operational Stage					
Environmental management	Operation activiteies	EMP	● Prepare an EMP to address potential impacts, mitigation and monitoring needs, and institutional requirements for the operations phase	APPSCIG; MHAB, NCTB, WCTB, CHAB	APDOT PPMO, ESE
		Emergency planning	● Prepare an emergency response plan		

Notes: **ADB** = Asian Development Bank; EIR = Environmental Impact Report; **O&M** = operation & maintenance; **APEPD** = Anhui Province Environmental Protection Department; **EPB** = Environmental Protection Bureau **MG** =

	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
Municipal Government; **APDOT PPMO** = Anhui Province Department of Transport Project Management Office; **APPSCIG** = Anhui Province Ports and Shipping Construction Investment Group; **MHAB** = Ma'anshan Highway Administration Bureau; **NCTB** = Nanling County Transport Bureau; **WCTB** = Wuwei County Transport Bureau; **CHAB** = Chizhou Highway Administration Bureau; **ESE** = Environmental Supervision Engineer; **ESE** = Environmental Supervision Engineer; **LPMO** = Local Project Management Office.					

Table A.4: Specific Mitigation Measures for the Shuiyang River Improvement Scheme and Xuanzhou Port

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
Detailed Design Stage					
Dredging Works on the Shuiyang River	Capital dredging	Volume of spoil to be disposed of and river bank protection	● Confirm the reaches that need to be dredged and the estimates of volumes of dredged spoils ● Detailed design for plan form of the new meanders ● Detailed design for the bank protection works, including species of plants to be used	Design Institute	APPSCIG, ESE
	Land resources	Selection of dredged sludge disposal sites	● Minimise the area of permanent and temporary land-take required ● Verify ponds for disposal of dredged sludges and restore to agricultural land.	Design Institute	APPSCIG, ESE
Design of rubber dams and ship lock	Operational impacts	Fisheries	● Develop operating rules for the two rubber barrages, including description of environmental constraints and environmental mitigation measures such as lowering the barrage in the event of fish migrations	Design Institute	APPSCIG, ESE
Removal of ship building yard	Delay in the construction program for the ship lock and rubber dam	Contaminated land	● Relocate ship building yard from the proposed ship lock site to a new location and conduct an EIR for the relocation and environmental impact to the new site. ● Sample the soils and assess the level of soil contamination ● On the basis of the results of the contaminated land	Xuancheng WRB, APPSCIG,	APDOT PPMO, ESE

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			assessment, develop and implement a remedial action plan ● Clean up the site, including the removal of all wastes and litter ● Collect and treat or dispose contaminated soils at a designated site to be agreed with the APDOT, WRB and APPSCIG ● The following MEP guidelines will be followed: *a. Guidelines for Risk Assessment of Contaminated Sites (consultation document)* *b. Guidelines for Soil Remediation of Contaminated Sites (consultation document)* *c. Temporary Method for Environmental Management of Soil on Contaminated Sites (consultation document)* *d. Technical Guidelines for Environmental Monitoring of Sites (consultation document)*		
Design of Xiaohekou Bridge	Extreme weather events due to climate change	Extended dry season, more frequent high flows due to higher summer rainfall	● Design vertical alignment of Xiaohekou Bridge sufficient to allow for Class IV navigation plus an allowance for increased conveyance of stormwaters due to more frequent extreme	Design Institute	APDOT PPMO; APPSCIG

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			weather during wet season ● Review the design for scour protection on bridge piers and re-formed channel banks for more frequent, high magnitude flows. ● Provide piped drainage off the bridge		
	Health and Safety	Promote access for non-motorised transport and pedestrians	● Design must ensure public health and safety. ● Promote non-motorized traffic with 2m lane for NMT along both carriageways.	Design Institute	APDOT PPMO; APPSCIG
Xuanzhou Multipurpose Port	Soil resources	Land raising	● Confirm volume of spoil required for land-raising and the capacity of the donor site	Design Institute	APPSCIGAPPSCIG
	Air quality	Dust	● Design the port layout so the bulk loading facilities are screened by other buildings or permanent fences, and located away from sensitive receptors ● Select loading / unloading equipment that minimizes the entrainment of fine grained materials ● Include measures such as screening and dust suppression into the design of the facility	Design Institute	APPSCIG
	Noise	Noisy activities during construction and operation	● Calculate construction noise during typical and noisy activities, and identify further mitigation required to attenuate noise levels ● Plan the layout of the site and the	Design Institute;	APPSCIG; APDOT PPMO; ESE

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			scheduling of construction, so that buildings and other features on site shield sensitive receptors from noise during construction and operation activities ● Select plant and equipment with low noise levels. ● Site noisy operational equipment in acoustic housing and away from sensitive receptors ● Design fencing and landscaping around the port perimeter		
	Solid wastes	Safe disposal of solid wastes arising during operation	● Identify type and volume of different waste streams ● Make provisions for waste segregation and temporary storage prior to disposal off site ● Identify licensed off-site disposal routes, including re-use, recycling and final disposal to landfill	Design Institute	APPSCIG; APDOT PPMO; ESE
	Water quality	Wastewater discharge	● Review the need to treat wastewater from ships ● Design a small package plant on site to treat domestic wastewater ● Design systems for stormwater drainage, collection and treatment of water used on site eg wash down water and oil separators	Design Institute	APPSCIG; APDOT PPMO; ESE

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
	Construction traffic	Reduce the impact of construction traffic on road network	● Investigate sources and volumes of construction materials required ● Investigate scope of bringing materials to site by river rather than overland by truck	Design institute	APPSCIG; APDOT PPMO; ESE
Energy efficiency	Air emissions	Construction transport emissions	● Specify local materials from licensed providers that minimise transport distance or modal shift from road to inland waterway.	Design Institute	APPSCIG; APDOT PPMO; ESE
Health and Safety	Community Health and Safety	Spread of the disease Schistosomiasis	● Verify locations where schistosomiasis is present in villages along the Shuiyang River ● Liaise with the local health authorities to develop a suite of mitigation measures to prevent the spread of infected host snails during dredging and the temporary stockpiling of dredged sediments, to include controls on the width of river bed to be dredged; controls on the disposal of dredged materials and drainage water; and training for the workforce and local communities	Design Institute	APPSCIG; APDOT PPMO; ESE; Municipal Schistosomiasis Prevention and Treatment Office; local Health Administration Department
Conservation of soil and land resources	Soil resources	Loss of land and topsoil and increased risk of erosion	● Minimise permanent and temporary landtake for development. ● Retain/incorporate landscape features of interest in design. ● Maximise reuse of spoil within the	Design Institute	APPSCIG; APDOT PPMO

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			construction or adjacent construction works. ● Agree spoil disposal sites, management and rehabilitation plan with Xuancheng WRB. ● Detailed design of bank revetment works ● Detailed design of soil and water conservation works ● Specify vegetation that serves specific bio-engineering functions. ● Design appropriate drainage systems for the dump sites for the dredged spoil to control runoff and sedimentation.		
Pre-construction Stage					
Construction Stage					
Shuiyang River Improvement Works	Water Quality	Turbidity in the Shuiyang River during dredging	● Use cutter suction dredger with dredged material conveyed by pipeline to the spoil disposal site ● Use grab dredger for specific spot works. ● Operate the dredger to avoid over-spill of turbid water ● Ensure correct connection of the pipeline including good seals to prevent leakage of turbid water along the pipeline ● Test the dredger and pipeline for leaks prior to start ● Investigate loss of pressure along the pipeline immediately and in the event of a leak, stop pumping	Contractor	APPSCIG; ESE; EPB

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			and take action to clean up the spillage		
		Protection of the drinking water in-take works	● Prior to start of dredging activity, liaise with the relevant Health Administration Bureaux, local EPB, or local township / town to inform them of the works and the programme ● Continue to inform the local authorities during the dredging ● Provide temporary water in-take works on floating pontoons connected to the main water conveyance pipeline ● Close the permanent in-take works and position the floating pontoon at least 600m upstream or 300m downstream of the dredging works ● Monitor river water quality during the dredging	Contractor	APPSCIG; ESE; EPB
	Spoil sites	Drainage from the dredged spoil sites	● For the seven pond disposal sites, drawdown the existing water levels in the ponds, to avoid overspilling from the dredger pumping line ● Control the drainage of water from the ponds to avoid discharge of turbid water to canals and	Contractor	APPSCIG; ESE; EPB;

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			drainage channels ● In the later stages of reclamation of the dump sites, use flocculants to speed up sedimentation ● Regularly inspect the drainage channels to check for blockage of the drains and risk of localized flooding ● Rehabilitate and restore spoil disposal sites in accordance with agreed plan (agriculture or woodland). ● Conduct project completion audit to confirm that spoil disposal site rehabilitation meets required standard, contractor liable in case of non-compliance.		
	Spoil sites	Spread of disease vector	● Dump the dredged spoil from sections of the channel where schistosomiasis is a risk at specially designated dump sites (one of the seven ponds). ● Contain the site to avoid the spread of the host snail and schistosomes.	Contractor	APPSCIG; ESE; EPB
	Air Quality	Odour from the dredged spoil sites	● Undertake the dredging during the winter dry season as low temperatures help reduce generation of bad odour ● Locate the dump sites for the dredged spoil at least 100m from sensitive receptors	Contractor;	APPSCIG ; ESE; EPB

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
	Noise	Dredging and bank protection works	● Select models of dredger with lower sound power levels ● Prohibit dredging and piling at night if possible	Contractor	APPSCIG; ESE; EPB
	Bank protection	Soil erosion	● Realign Shuiyang River meanders during low flows ● Install bank protection including concrete formations and infill with soil and plants	Contractor	APPSCIG; ESE; EPB
Xuanzhou Multi-purpose Port	Water quality	Turbidity in Shuiyang River	● Programme piling works for the new port during the dry season ● Install sheet piling and pile the foundations for the port in the dry to avoid creating turbidity in the river	Contractor;	APDOT PPMO; APPSAB APPSCIG; ESE: EPB
	Soil resources	Land raising	● Drain the existing pond in the port area prior to land raising. ● Excavate spoil from the designated donor site close to the port and use it to raise the land in the port area. ● Install temporary drainage and settlement tanks prior to discharge of stormwater off site. ● Ensure that the material used in land raising is compacted. ● Implement dust suppression measures throughout the land raising activities.	Contractor;	APPSCIG; ESE; EPB
		Disease prevention and safety awareness	● Construction workers must have physical examination before start working on site. ● Provide annual health checks.	Contractor;	APPSCIG; ESE; EPB

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			• If infectious disease is found, the patient must be isolated for treatment to prevent the disease from spreading. • Establish health clinic at location where workers are concentrated, which should be equipped with common medical supplies and medication for simple treatment and emergency treatment for accidents. • Specify the person responsible for health and epidemic prevention responsible for the education and propaganda on food hygiene and disease prevention to raise the awareness of workers. • Regularly inspect works to ensure there are no areas of stagnant water that could provide breeding grounds for malaria, encephalitis and dengue fever mosquitoes. • Regularly inspect works to ensure that there are no breeding grounds for the host snail for schistosomiasis • Provide training to the workforce on disease prevention and safety awareness • Undertake checks every six months for workforce working in areas / tasks with a		

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			moderate to high risk of contact with schistosomiasis and medicate if the disease is found. ● Inform the local Schistosomiasis Prevention and Treatment Office and report the incidence to the local Health Administrative Department		
Operational Stage					
Shipping	Shipping	Waste from ships	● Ships have to be equipped with sufficient storage for sewage and solid waste; ● Discharge of wastewater to inland waterways in exceedance of the standards is prohibited; ● Train ships' crews on the correct procedures for the safe disposal of solid waste and wastewaters; ● Strengthen inspection of ships in compliance with the relevant standards; and ● Wastewater and solid waste from ships can be accepted at the port for collection and treatment.	Ship operators	APPSCIG ; Maritime Bureau
		Noise	● Ships horns should have a strong directionality and only be sounded for short durations, during the day, and in response to specific requirements ● Avoid unnecessary	Ship operators	APPSCIG, Maritime Bureau

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			use of horn near residential areas ● Use lights at night to signal rather than horns.		
		Navigation safety	● Strictly enforce navigation lanes, temporary waiting and anchorage areas, and manoeuvres to use the ship lock	Ship operators, Port operator	APPSCIG ; Maritime Bureau
Shuiyang River Improvement Works	Ship lock	Wastewater	● Discharge of wastewater to Shuiyang Town sewerage system	APPSCIG	APDOT PPMO
		Solid domestic waste	● Waste streams to be collected, stored and disposed of separately. ● Domestic waste to be segregated using different coloured bins (organic, recyclable, and non-recyclable) and disposed of appropriately ● Hazardous waste eg oily rags, oil contaminated soils, to be stored and disposed of separately	APPSCIG	APDOT PPMO
		Fisheries	● Ensure that the operating rules for the barrage include consideration of migratory fish so that the barrage could be partially or fully deflated to allow upstream migrations	Port operator APPSCIG	APDOT PPMO
	Rubber barriers	Loss of head	● Ensure co-ordinated management of the two rubber barriers to maintain water levels in the Shuiyang River	APPSCIG	APDOT PPMO
Xuanzhou Multipurpose Port	Port operations	Air quality	● Attract container freight If possible, avoid loading /	APPSCIG	APDOT PPMO, local EPB

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			unloading of bulk loose material on windy days ● Minimize drop heights and avoid over loading conveyor belts ● Adopt dust suppression methods such as water spraying, covering bulk materials with felt, and installing windbreaks around stockpiles ● Provide watering facility in coal storage yard and ore storage yard for dust suppression ● Plant trees and fences around the site to prevent the dispersion of dust off site		
		Noise	● Direct the ships in and out of the port to avoid the need for ships to use their horns ● Maintain mobile and stationery plant according to the manufacturer's instructions ● Monitor noise levels during routine and abnormal conditions, and in response to complaints. ● Implement further mitigation measures in the event of exceedances of noise standards.	Port operator	APPSCIG
		Solid wastes	● Hazardous and non-hazardous waste streams to be collected, stored and disposed of separately .	Port operator	APPSCIG, local EPB

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			• Domestic waste to be segregated using different coloured bins (organic, recyclable, and non-recyclable) and disposed of regularly in accordance with local EPB instructions • Hazardous waste eg oily rags, oil contaminated soils, to be stored and disposed of separately		
		Water quality	• Periodic cleaning of the oil separators and silt traps on stormwater drainage systems around the port [CHECK] • Oily wastewater from maintenance sheds and other places to pass through oil separator and mix with domestic sewage. • Periodic maintenance of the small package plant installed within the port precincts, including disposal of sewage sludges to the Municipal wastewater treatment plant • Discharge wastewater treated to Grade III to the sewerage system serving the Xuanzhou Economic and Technological Development Zone	Port operator	APPSCIG
		Emergency planning	• Prepare an emergency response plan • Keep oil spillage equipment at the port • Ships wishing to unload flammable,	Port operator	APPSCIG, Maritime authorities

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			explosives, corrosive, poisonous and dangerous cargo are required to hang the required signal in compliance with the *Regulations for Supervision and Administration for Ships Carrying Dangerous Goods.* ● In the event of an emergency, the drinking water in-takes downstream must be closed		

Notes: **ADB** = Asian Development Bank; **EIR** = Environmental Impact Report; **O&M** = operation & maintenance**;** **APEPD** = Anhui Province Environmental Protection Department; **EPB** = Environmental Protection Bureau **MG** = Municipal Government; **APDOT PPMO** = Anhui Province Department of Transport Project Management Office; **APPSCIG** = Anhui Province Ports and Shipping Construction Investment Group; **ESE** = Enviroinmental Supervision Engineer, **LPMO** = Local Project Management Office.

Table A.5: Specific Mitigation Measures for the Highway Improvement Schemes I Ma'anshan North Corridor

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
Detailed Design Stage					
General Highway Design Issues	Land and soil resources	Loss of land, impact on agriculture, loss of topsoil and increased risk of erosion	• Fine tune vertical and horizontal alignments • Balance cut and fill as far as possible • Avoid deep cuts and high embankments to minimise earthworks • Minimise permanent and temporary land-take. • Retain/incorporate landscape features of interest in design. • Maximise reuse of spoil within the construction or adjacent construction works. • Agree spoil disposal sites, management and rehabilitation plan with APEPD / local EPB. • Remove and store topsoil (10-30cm) for restoration works prior to main earthworks. • Specify vegetation that serves specific bio-engineering functions. Design appropriate drainage systems for slopes to reduce soil erosion.	Design Institute	APDOT PPMO;
	Extreme weather events due to climate change	Road surface cracking due to extreme hot or cold weather, landslide and flooding due to torrential rainfall	• Consider potential impacts from extreme weather events due to climate change in designing road subgrade, pavement, road-side slopes, drainage system, bridges and culverts. • Adopt appropriate protective measures such as vegetation cover, geotextiles, settling basins, permeable paving, infiltration ditches, stepped slopes, riprap, crib walls, retaining walls and intercepting ditches to reduce the speed of surface run-off.	Design Institute	APDOT PPMO

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
	Health and safety	Promotion of non-motorized transport, protection of vulnerable road users	● Design must ensure public health and safety. ● Promote non-motorized traffic. ● Where possible, separate vehicles and NMT, and separate cyclists and pedestrians. ● Promote safe crossings for pedestrians ● Promote scheme lighting, where there is a H&S case and it does not cause light pollution in rural areas	Design Institute	PMO; APDOT
	Air emissions	Construction transport emissions	● Specify local materials from licensed providers that minimise transport distance.	Design Institute	APDOT PPMO
	GHG emissions	Energy efficiency	● Consider energy efficient street lighting, such as LEDs or solar-powered lights	Design Institute	APDOT PPMO
Design of bridge crossings	River erosion	Scour of river bed and banks	● Design scour protection for the bridge piers and river banks	Design Institute	APDOT PPMO
Ma'anshan North Corridor	Traffic noise	Protection of sensitive receptors	● Design of low noise road pavement of 191,925 m^2 in front of 34 sensitive points at Dachen, Zhongshan Village, Dayu, Chaomiaoji, Ruiqiao, Weiteng, Dajing, Xucun, Huanghe, Zhoucun, Xiongzhuang, Hanwang, Wangzhengwu, Taodian, Bazou, Xiaozhuang, Ruicun/Weizhuang, Huangcun, Quanshuikou, Shanwang Village, Xiaolizhuang, Shanghezhuang, Jibaozi, Chenzhanglu, Haiwang Village, Zhongheji, Xiaoyuanzhuang, Gaozuji, Panxiao Village, Baozhuang, Tanzhuang, Dajiangzhuang, Xiaowang Village and Menlianzhuang.	Design Institute	APDOT PPMO
	Health and Safety and Community	Local communities NMT	● In urban areas, consider replacing the hard shoulder with pavements to separate	Design Institute	APDOT PPMO

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			pedestrians from the traffic ● Town and village authorities to consider lighting in urban areas		
	Construction nuisance	Haul roads	● Identify the locations of the 53 km of haul roads to minimise environmental impacts and disturbance of local communities	Design Institute	APDOT PPMO
	Infrastructure	Protection of assets	● Ensure the design for Sima Bridge allows for the upgrading of navigation on the river to Class IV	Design Institute	APDOT PPMO
Pre-construction Stage					
Construction Stage					
Implementation of mitigatioin measures	Agricultural land	Minimize impact on farmland from land take and haulage	● Minimise disruption outside of approved permanent and temporary land-take areas, install barriers and protective fencing, if appropriate to prevent encroachment on adjacent areas. ● Follow procedures for top soil stripping (see general good site practice guidance above) ● Use existing field roads as access roads where possible ● Temporary land-take areas to be cleared up and revegetated after the end of construction.	Contractor	MHAB; ESE; EPB
	Noise	Protection of noise sensitive receptors	● Lay low noise asphalt during construction ● Install noise insulation at the Taodian Health Clinic ● Erect warning and no horn signs at 3 schools (Taodian Primary School, Gaozu Primary School and Baozhuang Primary School) and the Taodian Health Clinic	Contractor	MHAB; ESE; EPB
Operational Stage					
Road maintenance and safety	Traffic	Road condition	Regularly inspect and maintain the road surface and clean up the drains.	O&M units	MHAB

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
		Road safety and traffic accidents	Strictly enforce traffic laws to improve road safety and reduce traffic accidents.	Anhui Traffic Police	MHAB; MG
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Notes: **ADB** = Asian Development Bank; **EIR** = Environmental Impact Report; **O&M** = operation & maintenance; **APEPD** = Anhui Province Environmental Protection Department; **MG** = Municipal Government; **APDOT PPMO** = Anhui Province Department of Transport Project Management Office; **MHAB** = Ma'anshan Highway Administration Bureau; **ESE** = Environmental Supervision Engineer, **LPMO –** Local Project Management Office.

Table A.6: Specific Mitigation Measures for the Highway Improvement Schemes II Yimu Highway Kedian to Mujinting

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
Detailed Design Stage					
General Highway Design Issues	Land and soil resources	Loss of land, impact on agriculture, loss of topsoil and increased risk of erosion	● Fine tune vertical and horizontal alignments ● Balance cut and fill as far as possible ● Avoid deep cuts and high embankments to minimise earthworks ● Minimise permanent and temporary land-take. ● Retain/incorporate landscape features of interest in design. ● Maximise reuse of spoil within the construction or adjacent construction works. ● Agree spoil disposal sites, management and rehabilitation plan with APEPD / local EPB. ● Remove and store topsoil (10-30cm) for restoration works prior to main earthworks. ● Specify vegetation that serves specific bio-engineering functions. ● Design appropriate drainage systems for slopes to reduce soil erosion.	Design Institute	APDOT PPMO
Design of road alignment, road surface, drainage and lighting	Extreme weather events due to climate change	Road surface cracking due to extreme hot or cold weather, landslide and flooding due to torrential rainfall	● Consider potential impacts from extreme weather events due to climate change in designing road subgrade, pavement, road-side slopes, drainage system, bridges and culverts. ● Adopt appropriate protective measures such as vegetation cover, geotextiles, settling basins, permeable paving, infiltration ditches, stepped slopes, riprap, crib walls, retaining walls and intercepting ditches to reduce	Design Institute	APDOT PPMO

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			the speed of surface run-off.		
	Health and safety	Promotion of non-motorized transport, protection of vulnerable road users	● Design must ensure public health and safety. ● Promote non-motorized traffic. ● Ensure barrier-free design for disabled people. ● Where possible, separate vehicles and NMT, and separate cyclists and pedestrians. ● Promote safe crossings for pedestrians	Design Institute	APDOT PPMO
	Air emissions	Construction transport emissions	● Specify local materials from licensed providers that minimise transport distance.	Design Institute	APDOT PPMO
	GHG emissions	Energy efficiency	● Consider energy efficient street lighting, such as LEDs or solar-powered lights	Design Institute	APDOT PPMO
Design of bridge crossings	River erosion	Scour of river bed and banks	● Design scour protection for the bridge piers and river banks ● Zhanghe bridge with piped drainage and discharge to land	Design Institute	APDOT PPMO
Access	Construction nuisance	Haul roads	● Identify the locations of the haul roads to minimise environmental impacts and disturbance of local communities	Design Institute	APDOT PPMO
Yimu Highway	Traffic noise	Protection of sensitive receptors	● Design of low noise road pavement over 1800 m covering 40500 m^2 at 5 sensitive points - Gutianxincun, Gutian Village, Yafutang, Shanggang Village and Bowen High School. ● Design noise insulation for 1147 households in 22 sensitive receptor villages. Jiangcun, Kedian Village, Shangtanghu, Dagang Village, Wangcun, Shuguang Village 1, Shuguang Village 2, Gongyi Village, Meishan Village/Meihua Village, Tudiwan, Tangmuqiao, Huilongdun, Gongshan Town,	Design Institute	APDOT PPMO

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			Gongshan Village, Gaoling Village 1, Gaoling Village 2, Guolong, Haizijia, Haiquan/haijia, Huitouwu, Wuxia Temple and Shuicun Village.		
	H&S and community	NMT and pedestrians	● Review the provision for pedestrian crossings over the Class I highway section ● Review pedestrian safety for crossing Wuli intersection. Consider light-controlled crossing (without vehicle turning), overpasses and underpasses.	Design Institute	APDOT PPMO
	Construction nuisance	Haul roads			
	Infrastructure	Protection of assets		Design Institute	APDOT PPMO
Pre-construction Stage					
Construction Stage					
Implementation of noise mitigation measures	Noise	Potection of noise sensitive receptors	● Install noise insulation in 1147 properties ● Lay low noise asphalt	Contractor	NCTB; ESE; EPB
Operational Stage					
Road maintenance and safety	Traffic	Road condition	Regularly inspect and maintain the road surface and clean up the drains.	O&M units	NCTB
		Road safety and traffic accidents	Strictly enforce traffic laws to improve road safety and reduce traffic accidents.	Anhui Traffic Police	NCTB; MG
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Notes: **ADB** = Asian Development Bank; **EIR** = Environmental Impact Report; **O&M** = operation & maintenance; **APEPD** = Anhui Province Environmental Protection Department; **MG** = Municipal Government; **APDOT PPMO** = Anhui Province Department of Transport Project Management Office; **NCTB** = Nanling County Transport; **ESE** = Environmental Supervision Engineer, **LPMO** = Local Project Management Office.

Table A.7: Specific Mitigation Measures for the Highway Improvement Schemes III S319 Erba to Wuwei

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
Detailed Design Stage					
Conservation of soil and land resources	Soil resources	Loss of land and topsoil and increased risk of erosion	● Minimise permanent and temporary landtake for development. ● Retain/incorporate landscape features of interest in design. ● Optimise balance between cut and fill and avoid deep cuts and high embankments to minimise earthworks. ● Maximise reuse of spoil within the construction or adjacent construction works. ● Agree spoil disposal sites, management and rehabilitation plan with APEPD/local EPB. ● Remove and store topsoil (10-30cm) for restoration works prior to main earthworks. ● Specify vegetation that serves specific bio-engineering functions. ● Design appropriate drainage systems for slopes to reduce soil erosion.	Design Institute	APDOT PPMO
Design of road alignment, road surface, drainage and lighting	Extreme weather events due to climate change	Road surface cracking due to extreme hot or cold weather, landslide and flooding due to torrential rainfall	● Consider potential impacts from extreme weather events due to climate change in designing road subgrade, pavement, road-side slopes, drainage system, bridges and culverts. ● Adopt appropriate protective measures such as vegetation cover, geotextiles, settling basins, permeable paving, infiltration ditches, stepped slopes, riprap, crib walls, retaining walls and intercepting ditches to reduce the speed of surface run-off.	Design Institute	APDOT PPMO
	Health and safety	Promotion of non-motorized transport, protection of vulnerable	● Design must ensure public health and safety. ● Promote non-motorized traffic. ● Ensure barrier-free design for disabled people.	Design Institute	APDOT PPMO

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
		road users			
	Air emissions	Construction transport emissions	● Specify local materials from licensed providers that minimise transport distance.	Design Institute	APDOT PPMO
	GHG emissions	Energy efficiency	● Consider energy efficient street lighting, such as LEDs or solar-powered lights	Design Institute	APDOT PPMO
Design of bridge crossings	River erosion	Scour of river bed and banks	● Design scour protection for the bridge piers and river banks	Design Institute	APDOT PPMO
	Noise	Traffic noise	● Design noise insulation for windows at 700 households, two hospitals (the Economic Development Zone Wuwei County Health Centre and Boai Hospital) and 1 school (Banqiao Primary School). The beneficiaries reside in the following villages: Datan Village, Zhangwang Village, Chenzhuang, Xiaozhao, Gaoweiqian, Shangs, Lingjiawan / Dazhen, Huangcun, Jiajiazhuang / Xiaozhang, Linghou / Xiaowang, Wanxu, Tans, Dais/Jiangs, Hualong/Yangs, Wuyi Village, Shazhuang Village, Zhangyu/Hudun, Yangmaozui, Zhangni Village, Lijiatan, Nianxi, Dingwu, Xinjianzhuang, Hexi/Xucun, Xingeng, Fengxu, Weigeng/Changba Village, Lijiaxu, and Liwei.	Design Institute	APDOT PPMO
S319 Erba-Wuwei Section	H&S	Accident risks	● Review the treatment of the edge of the highway and the avenue of trees, and the risk of off-road collisions ● Review the need for the removal of the avenue or trees or provision of safety barriers ● Develop the design of junctions along the rural section, to improve safety for movements to rural roads ● Review the need for lighting in the rural section	Design Institute	APDOT PPMO
Pre-construction Stage					

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
Construction Stage					
Implementation of noise mitigation measures	Traffic noise	Protection of noise sensitive receptors	● Install noise insulation for properties ● Erect warning and no horn signs at the following locations: ■ Wuwei County Economic Development Zone Health Clinic ■ Bo'ai Hospital ■ Yongnan Center Primary School ■ Changba Primary School	WCTB	APDOT PPMO
Operational Stage					
Road maintenance and safety	Traffic	Road condition	Regularly inspect and maintain the road surface and clean up the drains.	O&M units	WCTB
		Road safety and traffic accidents	Strictly enforce traffic laws to improve road safety and reduce traffic accidents.	Anhui Traffic Police	WCTB; MG

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Notes: **ADB** = Asian Development Bank; **EIR** = Environmental Impact Report; **O&M** = operation & maintenance; **APEPD** = Anhui Province Environmental Protection Department; **MG** = Municipal Government; **APDOT PPMO** = Anhui Province Department of TransporT Project Management Office; **WCTB** = Wuwei County Transport Bureau; **ESE** = Environmental Supervision Engineer, **LPMO** = Local Project Management Office.

Table A.8a: Specific Mitigation Measures for the Highway Improvement Schemes IV G206 Dongliu to Yaodu

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
Detailed Design Stage					
Conservation of soil and land resources	Soil resources	Loss of land and topsoil and increased risk of erosion	● Minimise permanent and temporary landtake for development. ● Retain/incorporate landscape features of interest in design. ● Optimise balance between cut and fill and avoid deep cuts and high embankments to minimise earthworks. ● Maximise reuse of spoil within the construction or adjacent construction works. ● Agree spoil disposal sites, management and rehabilitation plan with APEPD/local EPB. ● Remove and store topsoil (10-30cm) for restoration works prior to main earthworks. ● Specify vegetation that serves specific bio-engineering functions. ● Design appropriate drainage systems for slopes to reduce soil erosion.	Design Institute	APDOT PPMO
Design of road alignment, road surface, drainage and lighting	Extreme weather events due to climate change	Road surface cracking due to extreme hot or cold weather, landslide and flooding due to torrential rainfall	● Consider potential impacts from extreme weather events due to climate change in designing road subgrade, pavement, road-side slopes, drainage system, bridges and culverts. ● Adopt appropriate protective measures such as vegetation cover, geotextiles, settling basins, permeable paving, infiltration ditches, stepped slopes, riprap, crib walls, retaining walls and intercepting ditches to reduce the speed of surface run-off.	Design Institute	APDOT PPMO
	Health and safety	Promotion of non-motorized transport, protection of vulnerable	● Design must ensure public health and safety. ● Promote non-motorized traffic. ● Ensure barrier-free design for disabled people.	Design Institute	APDOT PPMO

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
		road users			
	Air emissions	Construction transport emissions	● Specify local materials from licensed providers that minimise transport distance.	Design Institute	APDOT PPMO
	GHG emissions	Energy efficiency	● Consider energy efficient street lighting, such as LEDs or solar-powered lights	Design Institute	APDOT PPMO
Design of bridge crossings	River erosion	Scour of river bed and banks	● Design scour protection for the bridge piers and river banks	Design Institute	APDOT PPMO
	Noise	Traffic noise	● Design noise insulation for 94 households in the sensitive receptor clusters in Weizhuang, Zhanggang, Liuchun Village and the farm dormitory.	Design Institute	APDOT PPMO
G206 Dongliu to Yaodu Section	H&S	NMT and pedestrians	● Fine tune the vertical and horizontal alignments, to reduce the impacts on land-take, balance cut and fill, reduce the need for extensive slope remediation works, and increase the distance from sensitive receptors ● Consider the possibility of using the spoil in land contouring to attenuate noise ● Review the need for pedestrian walkways along this alignment and provision of pedestrian crossings for this dual three lane highway ● Review the need to separate cyclists and pedestrians ● Review the need for lighting in the rural sections	Design Institute	APDOT PPMO
Pre-construction Stage					
Construction Stage					
Implementation of mitigation measures	Traffic Noise	Protection of noise sensitive receptors	● Provide noise insulation for windows at 94 households in the sensitive receptor clusters in Weizhuang, Zhanggang, Liuchun Village and the farm dormitory.	Contractor	CHAB; ESE
	Slope Stability	Protection of new cuttings	● Take care during excavations of deep cuttings to avoid creating slope collapse and mass movements. ● Use appropriate techniques to	Contractor	CHAB;ESE; EPB

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
			stabilize the slopes, including geo-technical, slope reinforcement and planting options. ● Install drainage to the top of the slope.		
	Ecology	Protection of natural habitats	● Minimize the construction programme for the sections between K0+000 to K2+300 and K15+000 to K16+580 to reduce impact on ecological features. ● Avoid noisy activities such as blasting between the main bird nesting season May and June. ● Prohibit blasting in the morning and at night. ● Walkover survey prior to construction by trained wildlife and forestry experts to confirm works can go ahead. ● Identify trees to be preserved and clearly mark them, translocate other trees to new locations, and ensure adequate aftercare ● If any protected species are observed along the alignment, take advice from ecologist on appropriate measures for translocation. ● Provide environmental training on the importance of protecting habitats and wildlife to construction workforce ● Prohibit the collection of timber, non-timber forestry products, hunting, and fishing in the Forestry Reserve by the construction workforce. ● Prohibit the setting of fires in the woodland sections of the alignment.	Contractor	CHAB;ESE; Local Forestry Bureau
Operational Stage					
Road maintenance and safety	Traffic	Road condition	Regularly inspect and maintain the road surface and clean up the drains.	O&M units	CHAB
		Road safety	Strictly enforce traffic laws to improve	Anhui Traffic	CHAB; MG

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity
		and traffic accidents	road safety and reduce traffic accidents.	Police	

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Notes: **ADB** = Asian Development Bank; **EIR** = Environmental Impact Report; **O&M** = operation & maintenance; **APEPD** = Anhui Province Environmental Protection Department; **MG** = Municipal Government; **APDOT PPMO** = Anhui Province Department of Transport Project Management Office; **CHAB** = Chizhou Highway Administration Bureau; **ESE** = Environmental Supervision Engineer, **LPMO** = Local Project Management Office.

Table A.8b: Summary of costs for implementing EMP for the Shuiyang River Inland Waterway Improvement Scheme (Units, RMB ten thousand)

S/N	Name of works or item cost	Works cost	Other costs	Total	Remarks
	Part I: Works cost				
1	Ambient air pollution prevention during construction period	20		20	
	200 m barriers	5			
	Temporary road hardening	5			
	Watering and dust suppression	4			
	Temporary factory sheds	6			
	Watering cart, spray facilities around storage yard	80		80	
2	Noise pollution prevention in the construction period	50		50	
	Mobile sound barrier	35			
	Closed machinery sheds	15			
3	Water pollution prevention in construction and operation period	40		40	
	Septic tank, grit chamber	40			Calculated in 20 thousand yuan / place, about setting 20 places
4	Solid waste pollution prevention in construction and operation period	50		50	
	Temporary storage yard of building waste	50			
5	Remained water treatment in mud-pumping area	70		70	
	7 grit chambers	70			100 thousand yuan/ place
6	Ecological restoration of mud-pumping areas and borrow area/spoil ground	450		450	
	Surface soil transfer and coverage	150			
	Planting	300			
7	Environmental monitoring	62.2		62.2	
	Environmental monitoring during construction period	51.2			
	Environmental monitoring during operation period	11			Pro rata for 3 years
8	Personnel training cost		40	40	
	Part II: Preliminary work and survey and design cost				

S/N	Name of works or item cost	Works cost	Other costs	Total	Remarks
1	Environmental supervision		180	180	
	Part III: Water and soil conservation				
1	Greening	300		300	
	Total	1162.2	220	1382.2	

Table A.9a: Summary of costs for implementing environmental mitigation measures for the Shuiyang River Inland Waterway Improvement Scheme

Item No.	Description	Mitigation Cost		Remark
		CNY	USD	
1	Ambient air pollution prevention during construction period	1,000,000	158,700	Barriers and hoardings, temporary road paving, watering and spraying equipment and temporary sheds
2	Noise pollution prevention in the construction period	500,000	79,350	Mobile noise barrier and enclosed machinery sheds
3	Water pollution prevention in the construction period	400,000	63,480	Septic tanks and grit chambers at approximately 10 locations
4	Solid waste pollution prevention	500,000	79,350	Temporary storage yards and facilities
5	Wastewater treatment at dredged sediment storage site	700,000	111,090	Grit chambers, sedimentation basin
	Total	**3,100,000**	**491,970**	

Table A.9b: Summary of costs for implementing the envirionmental mitigation measures for the Highway Schemes

Item No.	Description	Mitigation Cost		Remark
		CNY	USD	
1	Ambient air pollution prevention during construction period	530,000	84,111	Barriers and temporary hoardings, watering and dust suppression
2	Noise pollution prevention in the construction and operation periods	17,710,000	2,810,577	Mobile noise barriers, sound insulation windows and additional cost for low noise road paving materials
3	Water pollution prevention in the construction period	1,000,000	158,700	Septic tanks and grit chambers
4	Solid waste pollution prevention	400,000	63,480	Temporary storage yards and facilities
	Total	**19,640,000**	**3,116,868**	
Note: Noise mitigation measures include the provision of sound insulation windows at CNY 10,510,000 (USD 1,667,937) and additional cost for applying low noise road paving at CNY 6,000,000 (USD 952,200)				

IV. Environmental Monitoring and Reporting

18. The project monitoring programme focuses on the environment within the project's area of influence. Monitoring will include project readiness monitoring (to be conducted by the ESE), environmental quality monitoring (to be conducted by a licensed entity), as well as EMP compliance verification during project implementation and operation (to be conducted by PMO and ESE during implementation and first year of operation and then APEPD or local EPB in subsequent years). Monitoring and reporting arrangements defined for this project are described

below.

19. **Assessment of project readiness.** Before construction, the ESE will assess the project's readiness in terms of environmental management based on a set of indicators (**Table A.10**) and report it to ADB, IA and the PPMO. This assessment will demonstrate that environmental commitments are being carried out and environmental management systems are in place before construction starts, or suggest corrective actions to ensure that all requirements are met.

Table A.10: Project Readiness Assessment Indicators

Indicator	Criteria	Assessment
EIA approval	• The project EIRs have all been approved by APEDP/local EPBs. The EIA has been approved by ADB and satisfied the 120 day disclosure rule prior to board consideration.	Yes No
EMP update	• The EMP was updated after technical detail design, and approved by ADB	Yes No
Compliance with loan covenants	• The borrower complies with loan covenants related to project detailed design and pre-construction requirements.	Yes No
Public involvement effectiveness	• Meaningful consultation completed	Yes No
	• GRM established with entry points	Yes No
Environmental Supervision in place	• ESE is in place	Yes No
	• Environment specialist appointed by APDOT PPMO	Yes No
	• Environment specialists appointed by IA LPMOs	Yes No
	• EMSs contracted by APDOT	Yes No
Bidding documents and contracts with environmental safeguards	• Bidding documents and contracts incorporate the requirements as set out in the environmental loan assurances	Yes No
	• Bidding documents incorporate the EMP mitigation and monitoring requirements	Yes No
	• Construction contracts incorporate the EMP mitigation and monitoring requirements	Yes No
EMP financial support	• The required funds have been set aside to support the EMP implementation	Yes No

20. **Internal Environmental Monitoring. Tables A.11a-f** show the internal environmental monitoring program specifically designed for this project, defining the requirements, including, scope, location, parameter, duration and frequency of monitoring during the construction and operational stages. Internal environmental monitoring will include monitoring of air quality, noise and water quality as described in **Tables A.11a-f**. Internal environmental monitoring during construction and operation (first two years) will be contracted by APDOT PPMO. The budget for internal environmental monitoring has been estimated at RMB 1.344million (USD 220,618). The APDOT PPMO, the contractor and the ESE will, at the outset of project implementation, prepare more detailed internal environmental monitoring programs for construction and operational phases if necessary. The monitoring program and budgets will be included in the project tender

documents and budgets, as well as the construction and operation contracts.

21. The internal environmental monitoring results will be compared with relevant PRC performance standards (**Table A.12**), and non-compliance with these standards will be highlighted in the monitoring reports. Monitoring results will be submitted by the EMSs to the APDOT PPMO on a quarterly basis, any significant issues will be highlighted in the quarterly project progress reports, otherwise they will be reported in the semi-annual environmental monitoring reports by the APDOT PPMO (with the support of the ESE, see reporting plan in **Table A.13**).

22. **External Environmental Monitoring.** External environmental monitoring will also be periodically conducted by the environmental authorities, APEPD and local EPBs, in the framework of their legal mandate to check compliance with applicable environmental regulations. They will be responsible for undertaking regular and random environmental monitoring and inspection activities before, during, and after construction as well as in the event of emergencies.

Table A.11a: Internal Environmental Monitoring Programme for the Shuiyang River Inland Waterway Project

Item	Monitoring Parameter	Monitoring Location	Monitoring, Frequency & Duration	Implementing Entity	Supervising Entity
Construction Stage					
Air quality	TSP	1) 1 site in the village closest to the bridge re-construction 2) Located 10m from the construction site boundary	During Construction Monitor for +12 hrs / day over 3 days once a quarter	EMS	APPSCIG; ESE
Noise	L_{Aeq}	1) For each of three dredging sections identify one site 5m from flood wall and one site by nearest sensitive receptor. 2) One site at the nearest sensitive receptor to each of the five 7 dump sites. 3) One site 5m from the bridge re-construction site and one site at the nearest sensitive receptor.	During Construction Monitor for 20 mins once during the day and once at night, every quarter	EMS	APPSCIG; ESE
Water quality	pH, SS, ammoniacal nitrogen, permanganate index, and petroleum	Dredging For each of three dredging sections monitor 50m upstream, and 50m, 100m and 200m downstream	During Dredging Sample over 2 days every quarter	EMS	APPSCIG; ESE
	SS	Dump Sites Monitor the drainage exit at each of the No. 5 dump sites	During Construction Take a composite sample of the drainage water over 2 days, once a quarter.	EMS	APPSCIG; ESE
Operational Stage (for 15 years)					
Water quality	Discharge, pH, SS, CODcr, ammoniacal nitrogen, petroleum and BOD5	Discharge from the wastewater treatment plant.	Sample over 2 days, every 6 months	EMS	APPSCIG; APDOT PPMO
Noise	L_{Aeq}	Choose 5 paired locations, one 5m from the flood bank and one at the sensitive receptor. Located two at Shuiyang Town including the ship lock, and one each at Xinhezhuang, Baiguoshu, and Gonweizhui.	Monitor once a year, over two days, during the day and at night	EMS	APPSCIG; APDOT PPMO
					Total estimated cost: 732,000RMB

Notes: **EMS** = Environmental Monitoring Station; **APDOT PPMO** = Anhui Province Department of Transport Project Management Office; **APPSCIG** = Anhui Province Ports and Shipping Construction Investment Group**; ESE** = Environmental Supervision Engineer

Table A.11b: Internal Environmental Monitoring Programme for the Xuanzhou Multi-purpose Port

Item	Monitoring Parameter	Monitoring Location	Monitoring, Frequency & Duration	Implementing Entity	Supervising Entity
Construction Stage					
Air quality	TSP	1) 1 site at the nearest sensitive receptor to the construction works 2) 1 site located 10m from the enclosed concrete mixing station at the port site	During Construction Monitor for +12 hrs / day over 3 days once a quarter	EMS	APPSCIG, ESE
Noise	L_{Aeq}	1) Set 1 site 5m outside the construction boundary 2) Set 1 site at the nearest sensitive receptor.	During Construction Monitor for 20 mins once during the day and once at night, every quarter	EMS	APPSCIG, ESE
Water quality	pH, SS, ammoniacal nitrogen, permanganate index, and petroleum	Port Construction Select three monitoring points in front of the dock structure, 50m upstream (control point), and 50m and 100m downstream.	Construction Sample over 2 days every quarter	EMS	APPSCIG, ESE
Operational Stage (for 15 years)					
Water quality	Discharge, pH, SS, CODcr, ammoniacal nitrogen, petroleum and BOD5	Discharge from the wastewater treatment plant.	Sample over 2 days, every 6 months	EMS	APPSCIG; APDOT PPMO
Noise	L_{Aeq}	Chose 3 points on the west, southern and northern boundaries of the port	Monitor once a year, over two days, during the day and at night	EMS	APPSCIG; APDOT PPMO
Air	TSP	Chose a site 10m from the boundary of the storage yard	Continuous sampling for more than 12 hrs/ day, for 3 days, every 6 months	EMS	APPSCIG; APDOT PPMO
					Total estimated cost: 335,000RMB

Notes: EMS = Environmental Monitoring Station; **APDOT PPMO** = Anhui Province Department of Transport Project Management Office; **APPSCIG** = Anhui Province Ports and Shipping Construction Investment Group**; ESE** = Environmental Supervision Engineer

Table A.11c: Internal Environmental Monitoring Programme for the Highway Subproject I – Ma'anshan North Corridor

Item	Monitoring Parameter	Monitoring Location	Monitoring, Frequency & Duration	Implementing Entity	Supervising Entity
Construction Stage					
Air quality	TSP	1) 1 site near an asphalt / concrete mixing station 2) 1 site near an unpaved section of road under construction 3) 1 site at the Taodian Health Centre and Chuomiaoji	Pre-Construction Monitor consecutively over 3 days During Construction Monitor for +12 hrs / day over 3 days once a quarter	EMS	MHAB, ESE
Noise	L_{Aeq}	1) 1 site by concrete / asphalt mixing station 2) 6 Sensitive receptors including • Taodian health centre • Gaozu elementary school • Baozhuang elementary school • Chumiaoji	Pre-construction Consecutive monitoring for 2 days during the day and at night During Construction Monitor over two days during the day and at night once a quarter	EMS	MHAB, ESE
Water quality	pH, SS, ammoniacal nitrogen, permanganate index, and petroleum	Bridge construction: 1) Sima River: 1 location 50m upstream, 1 location 50m downstream 2) Dongfeng River: 1 location 50m upstream, 1 location 50m downstream	Pre-Construction Sample over two consecutive days to obtain control During Construction Sample once over 2 days every quarter	EMS	MHAB, ESE
Operational Stage (annually for 15 years)					
Air quality	TSP, NO_2	1) Taodian health centre 2) Chuomiao bazaar	Monitor consecutively over 3 days, once every 2 years. TSP has to be monitored over 12 hrs / day. NO_2 has to be monitored consecutively for 18hrs / day	EMS	MHAB; APDOT PPMO
Noise	L_{Aeq}	6 sensitive receptors including: 1) Taodian Health Centre 2) Gaozu elementary school 3) Baozhuang elementary school 4) Chuomiaoji	Monitor over 5 days in the first year and subsequently once a year, over two days, during the day and at night	EMS	MHAB; APDOT PPMO
GHG emissions	Annual CO_2 emissions	Calculate and report to ADB annual emissions of CO_2 from traffic on the project road	Report to ADB annually	MHAB	APDOT PPMO
					Total estimated cost: 378,000RMB
Notes: **EMS** = Environmental Monitoring Station; **ADB** = Asian Development Bank; EIR = Environmental Impact Report; **APDOT**					

Item	Monitoring Parameter	Monitoring Location	Monitoring, Frequency & Duration	Implementing Entity	Supervising Entity
PPMO = Anhui Province Department of Transport Project Management Office; **MHAB** = Ma'anshan Highway Administration Bureau; **ESE** = Environmental Supervision EngineerManagement Office. MEPB **=** Ma'anshan Municipal Environmental Protection Bureau; **GHG** = Greenhouse gas					

Table A.11d: Internal Environmental Monitoring Programme for the Highway Subproject II – Yimu Highway Kedian to Mujiating Section

Item	Monitoring Parameter	Monitoring Location	Monitoring, Frequency & Duration	Implementing Entity	Supervising Entity
Construction Stage					
Air quality	TSP	1) 1 site near an asphalt / concrete mixing station 2) 1 site near an unpaved section of road under construction 3) 1 site at the Bowen Junior High School and Wuxia Temple	Pre-Construction Monitor consecutively over 3 days During Construction Monitor for +12 hrs / day over 3 days once a quarter	EMS	NCTB; ESE
Noise	L_{Aeq}	1) 1 site by concrete / asphalt mixing station 2) 6 Sensitive receptors including • Bowen Junior High School • Wuxia Temple	Pre-construction Consecutive monitoring for 2 days during the day and at night During Construction Monitor over two days during the day and at night once a quarter	EMS	NCTB; ESE
Water quality	pH, SS, ammoniacal nitrogen, permanganate index, and petroleum	Bridge construction: 1) Zhang River: 1 location 50m upstream, 1 location 50m downstream 2) Water intake works on Zhang River 3) Hougang River: 1 location 50m upstream, 1 location 50m downstream	Pre-Construction Sample over two consecutive days to obtain control During Construction Sample once over 2 days every quarter	EMS	NCTB; ESE
Operational Stage (for 15 years)					
Air quality	TSP, NO_2	1) Bowen Junior High School 2) Wuxia Temple	Monitor consecutively over 3 days, once every 2 years. TSP has to be monitored over 12 hrs / day. NO_2 has to be monitored consecutively for 18hrs / day	EMS	NCTB; APDOT PPMO
Noise	L_{Aeq}	6 sensitive receptors including: 1) Bowen Junior High School 2) Wuxia Temple	Monitor over five days in the first year and subsequently once a year, over two days, during the day and at night	EMS	NCTB; APDOT PPMO
GHG emissions	Annual CO_2 emissions	Calculate and report to ADB annual emissions of CO_2 from traffic on the project road	Report to ADB annually	NCTB	APDOT PPMO
					Total estimated cost: 369,000RMB
Notes: **EMS** = Environmental Monitoring Station; **ADB** = Asian Development Bank; EIR = Environmental Impact Report; **APDOT**					

Item	Monitoring Parameter	Monitoring Location	Monitoring, Frequency & Duration	Implementing Entity	Supervising Entity
PPMO = Anhui Province Department of Transport Project Management Office; **NCTB** = Nanling County Transport Bureau; **ESE** = Environmental Supervision EngineerManagement Office. MEPB = Ma'anshan Municipal Environmental Protection Bureau; **GHG** = Greenhouse gas					

Table A.11e: Internal Environmental Monitoring Programme for the Highway Subproject III – S319 Erba to Wuwei Section

Item	Monitoring Parameter	Monitoring Location	Monitoring, Frequency & Duration	Implementing Entity	Supervising Entity
Construction Stage					
Air quality	TSP	1) 1 site near an asphalt / concrete mixing station 2) 1 site near an unpaved section of road under construction 3) 1 site each at the Yongnan Central Elementary School, Bo'ai Hospital and Changba Elementary School	Pre-Construction Monitor consecutively over 3 days During Construction Monitor for +12 hrs / day over 3 days once a quarter	EMS	WCTB; ESE
Noise	L_{Aeq}	1) 1 site by concrete / asphalt mixing station 2) 6 sensitive receptors including • Yongnan Central Elementary School • Bo'ai Hospital • Changba Elementary School	Pre-construction Consecutive monitoring for 2 days during the day and at night During Construction Monitor over two days during the day and at night once a quarter	EMS	WCTB; ESE
Water quality	pH, SS, ammoniacal nitrogen, permanganate index, and petroleum	Bridge construction: 1) Bridge across West River: 1 location 50m upstream, 1 location 50m downstream	Pre-Construction Sample over two consecutive days to obtain control During Construction Sample once over 2 days every quarter	EMS	WCTB; ESE
Operational Stage (for 15 years)					
Air quality	TSP, NO_2	1) Health centre for Economic Development Zone of Wuwei County 2) Yongnan Central Elementary School 3) Bo'ai hospital 4) Changba Elementary School 5) Hualong Village	Monitor consecutively over 3 days, once every 2 years. TSP has to be monitored over 12 hrs / day. NO_2 has to be monitored consecutively for 18hrs / day	EMS	WCTB
Noise	L_{Aeq}	1) Health centre for Economic Development Zone of Wuwei County 2) Yongnan Central Elementary School 3) Bo'ai hospital 4) Changba Elementary School 5) Hualong Village 6) TBC	Monitor over five days in the first year and subsequently once a year, over two days, during the day and at night	EMS	WCTB
GHG emissions	Annual CO_2 emissions	Calculate and report to ADB annual emissions of CO_2 from traffic on the project road	Report to ADB annually	WCTB	APDOT PPMO

Item	Monitoring Parameter	Monitoring Location	Monitoring, Frequency & Duration	Implementing Entity	Supervising Entity
					Total estimated cost: 513,000RMB

Notes: **EMS** = Environmental Monitoring Station; **ADB** = Asian Development Bank; EIR = Environmental Impact Report; **APDOT PPMO** = Anhui Province Department of Transport Project Management Office; **WCTB** = Wuwei County Transport Bureau; **ESE** = Environmental Supervision EngineerManagement Office. MEPB = Ma'anshan Municipal Environmental Protection Bureau; **GHG** = Greenhouse gas

Table A.11f: Internal Environmental Monitoring Programme for the Highway Subproject IV – G206 Dongliu to Yaodu Section

Item	Monitoring Parameter	Monitoring Location	Monitoring, Frequency & Duration	Implementing Entity	Supervising Entity
Construction Stage					
Air quality	TSP	1) 1 site near an asphalt / concrete mixing station 2) 1 site near an unpaved section of road under construction 3) 1 site each at Zhazui and Yangjia	Pre-Construction Monitor consecutively over 3 days During Construction Monitor for +12 hrs / day over 3 days once a quarter	EMS	CHAB, ESE
Noise	L_{Aeq}	1) 1 site by concrete / asphalt mixing station 2) 3 Sensitive receptors • Zhazui • Yangjia • Liucun Village	Pre-construction Consecutive monitoring for 2 days during the day and at night During Construction Monitor over two days during the day and at night once a quarter	EMS	CHAB, ESE
Water quality	pH, SS, ammoniacal nitrogen, permanganate index, and petroleum	Bridge construction: 1) Bridge across Xiaohuangni Lake 1 location 50m upstream, 1 location 50m downstream 2) Tributary of Yaodu River 1 location 50m upstream, 1 location 50m downstream	Pre-Construction Sample over two consecutive days to obtain control During Construction Sample once over 2 days every quarter	EMS	CHAB, ESE
Ecology	Bird species and bird counts	Within the section between K6+000 and K15+000 along the lakesides	Two consecutive days each month between 0700-0900 hr	Ornithologist	CHAB, ESE
Operational Stage (for 15 years)					
Air quality	TSP, NO_2	1) Zhazui 2) Yangjia	Monitor consecutively over 3 days, once every 2 years. TSP has to be monitored over 12 hrs / day. NO_2 has to be monitored consecutively for 18hrs / day	EMS	CHAB
Noise	L_{Aeq}	1) Zhazui 2) Yangjia 3) Liucun Village	Monitor over five days in first year, once a year, over two days, during the day and at night	EMS	CHAB
GHG emissions	Annual CO_2 emissions	Calculate and report to ADB annual emissions of CO_2 from traffic on the project road	Report to ADB annually	CHAB	APDOT PPMO

Item	Monitoring Parameter	Monitoring Location	Monitoring, Frequency & Duration	Implementing Entity	Supervising Entity
					Total estimated cost: 432,000RMB

Notes: **EMS** = Environmental Monitoring Station; **ADB** = Asian Development Bank; EIR = Environmental Impact Report; **APDOT PPMO** = Anhui Province Department of Transport Project Management Office; **CHAB** = Chizhou Highway Administration Bureau; **ESE** = Environmental Supervision EngineerManagement Office. MEPB **=** Ma'anshan Municipal Environmental Protection Bureau; **GHG** = Greenhouse gas

Table A.12: Monitoring Indicators and Applicable PRC Standards

Period	Indicator	Standard
Construction	TSP	Class II Ambient Air Quality Standard (GB 3095-1996)
	Fume from asphalt mixing plant (SO_2, NOx)	Air Pollutant Integrated Emission Standard (GB 16297-1996)
	Noise limits of PME at boundary of construction site	Emission Standard of Environmental Noise for Boundary of Construction Site (GB 12523-2011)
	Discharge of wastewater from construction sites	Class I standard of Integrated Wastewater Discharge Standard (GB 8978-1996)
Operation	Traffic noise at sensitive receptor within 35 m of road red line	Noise standard for Category 4a Functional Area in Environmental Quality Standard for Noise (GB 3096-2008)
	Traffic noise at sensitive receptor beyond 35 m of road red line	Noise standard for Category 2 Functional Area in Environmental Quality Standard for Noise (GB 3096-2008)

23. **Compliance Monitoring.** EMP compliance monitoring will be undertaken by the APDOT PPMO, with support of the ESE. The APDOT PPMO will report to ADB the project's adherence to the EMP, information on project implementation, environmental performance of the contractors, and environmental compliance through quarterly project progress reports and semi-annual environmental monitoring reports (Table A.6). Quarterly project progress reports by the APDOT PPMO to ADB will highlight any specific issues with EMP implementation progress and compliance. The ESE will support the APDOT PPMO in developing the semi-annual environmental monitoring reports. The reports should confirm the project's compliance with the EMP, local legislation such as PRC EIA requirements, and identify any environment related implementation issues and necessary corrective actions. The performance of the contractors in respect of environmental compliance will also be reported. The operation and performance of the project GRM, environmental institutional strengthening and training, and compliance with environmental covenants under the project will also be included in the report. The costs for the ESE to conduct independent environmental supervision and compliance verification of EMP implementation have been estimated to be $682,410 (consisting of $285,660 for the Shuiyang River Inland Waterway Improvement Scheme and $396,750 for the Highway Subprojects).

24. **Monitoring by ADB.** Besides reviewing the quarterly project progress reports and the semi-annual environment monitoring reports from the APDOT PPMOs and the verification reports from the ESE, ADB missions will inspect the project progress and implementation on site at least once a year. For environmental issues, inspections will focus mainly on (i) monitoring data; (ii) the implementation status of project performance indicators specified in the loan documents for environment, environmental compliance, implementation of the EMP, and environmental institutional strengthening and training; (iii) the environmental performance of contractors, ESE, the APDOT PPMO and the IA LPMOs; and (iv) operation and performance of the project GRM. The performance of the contractors in respect of environmental compliance will be recorded and will be considered in the next bid evaluations.

25. **Environmental Acceptance and Completion Monitoring and Reporting.** Within three months after completion, or no later than one year with permission of the APEPD/ relevant local EPB, environmental acceptance reports shall be prepared by a licensed institute in accordance with the PRC Regulation on Project Completion Environmental Audit (MEP, 2001) and approved by the relevant environmental authority, and finally reported to ADB (**Table A.13**). The environmental acceptance report will indicate the timing, extent, effectiveness of completed mitigation and of maintenance, and the need for additional mitigation measures and agreed monitoring during operation. These environmental acceptance reports will be provided to the ESE who will prepare an environmental completion report and inputs for the Project Completion Report for ADB.

26. **Project Design and Monitoring Framework.** At the outset of project implementation, the APDOT PPMO will develop (i) a comprehensive project design and monitoring framework (DMF) procedures to systematically generate data on inputs and outputs of the project components, and (ii) detailed environmental and related social economic indicators to measure project impacts. The DMF indicators for the project include (i) public satisfaction with the living environment; (ii) increased employment; (iii) water quality in the Shuiyang River, (iv) wastewater collection and treatment rate; (v) increased shipping and cargo handling at Xuanzhou Port and traffic flow on project roads; (vi) increased or decreased traffic accidents; and (vii) increased local GDP. Under the DMF, baseline and progress data will be reported at the requisite time intervals by APDOT PPMO. APDOT PPMO will be responsible for analyzing and consolidating the data through its management information system. The DMF will be designed to permit adequate flexibility to adopt remedial actions in relation to project design, schedules, activities, and development impacts. The APDOT PPMO will refine the DMF, confirm achievable goals, firm up monitoring and recording arrangements, and establish systems and procedures no later than six months after loan effectiveness.

Table A.13: Reporting Plan

Reports		From	To	Reporting Frequency
Construction Phase				
Internal progress reports by contractors	Internal project progress report by construction contractors	Contractors	APDOT PPMO	Monthly
Environmental quality monitoring	Environmental quality monitoring report	EMS	EPB, APDOT PPMO	Quarterly
Reports to ADB	Project progress report (including section highlighting any EMP implementation and monitoring issues)	PPMO	ADB	Quarterly
	Environmental monitoring reports	PPMO	ADB	Semi-annual
Acceptance report	Environmental acceptance monitoring and audit report	Licensed	APEPD/	Once, not later than

Reports		From	To	Reporting Frequency
		institute	Local EPB	one year after completion of physical works
Completion report	Environmental completion report for ADB	ESE	ADB	Once, one year after completion of physical works
Operational Phase				
Environmental quality monitoring	Environmental quality monitoring report	EMS	EPB, APDOT PPMO	Quarterly
Reports to ADB	Project progress report (including section on EMP implementation and monitoring)	APDOT PPMO	ADB	Quarterly
	EMP progress and monitoring report	APDOT PPMO	ADB	Once (after first year of operation)
Notes: **ADB** = Asian Development Bank; **EMS** = Environment Monitoring Station; PPMO = Provincial Project Management Office; APDOT = Anhui Province Department of Transport; **EPB** = Environmental Protection Bureau.				

V. Institutional Capacity Building and Training

27. The capacity of the APDOT PPMO and contractors' staff responsible for EMP implementation and supervision will be strengthened. All parties involved in implementing and supervising the EMP must have an understanding of the goals, methods, and practices of project environmental management. The project will address the lack of capacities and expertise in environmental management through (i) institutional capacity building, and (ii) training.

28. At this stage it is difficult to comment on specific requirements for institutional strengthening as the responsible organisations have not been appointed and it is not possible to assess their needs. However, it would be safe to assume that the IAs and associated institutions would need strengthening in a variety of environmental capacities, including understanding and enforcement of ADB and PRC environmental safeguards, supervision and monitoring, implementation of mitigation measures, operation and management of environmental installations.

29. **Institutional Strengthening.** The capacities of the APDOT PPMO to coordinate environmental management will be strengthened through a set of measures:

i. The appointment of one qualified environment specialist within the APDOT PPMO in charge of EMP coordination, including GRM;

ii. The appointment of ESE to guide APDOT PPMO in implementing the EMP and ensure compliance with ADB's Safeguard Policy Statement (SPS 2009); and

iii. The appointment of one environment specialist by each IA to conduct regular site inspections and coordinate internal environmental monitoring.

30. **Training.** The APDOT PPMO, IA LPMOs, contractors and O&M units will receive training in EMP implementation, supervision, and reporting, and on the GRM (**Table A.14**). Training will be facilitated by the ESE. The estimated budget is 40,000 RMB (USD 6,556) for the Shuiyang River Inland Waterway Improvement Project and Xuanzhou Multi-purpose Port and 28,000 RMB (USD 4,596) for the four Highway Subprojects.

Table A.14: Training Programme

Stage	Training contents	Personnel	Total time	Time	Cost (RMB 10,000)
Shuiyang River Inland Waterway Improvement Project					
Construction period	Environmental management and relevant policies	1 for FEO of APDOT, APPSCIG and design institute respectively	1 month	2014-2015	15
	1. Environmental protection laws, regulations and relevant policies; 2. Heritage conservation knowledge; 3. Highway environmental impact assessment and environmental management plan; 4. Daily environmental monitoring method; 5. Environmental supervision	2 for each construction bid section and construction supervision organization respectively and 5 for design organization	4 days	2014	5
	Environmental management emergency plan and measures	2 for APPSCIG and FIO of APDOT respectively and Xuancheng Port and Waterway Bureau respectively	3 days	2014	5
Operation period	Environmental management and relevant policies	1 for FIO of APDT, APPSCIG and Xuanzheng Port and Waterway Bureau respectively	1 month	2015-2016	15
	Subtotal				40

Stage	Training contents	Personnel	Total time	Time	Cost (RMB 10,000)
Highway Subprojects					
Construction period	Environmental management and relevant policies	1-2 for each municipal project office and design institute respectively	30 days	2013-2015	15
	1. Environmental protection laws, regulations and relevant policies; 2. Heritage conservation knowledge; 3. Highway environmental impact assessment and environmental management plan; 4. Daily environmental monitoring method; 5. Environmental supervision	2 for each construction bid section and construction supervision unit respectively and 4 for design unit	4 days	2013	4
	Environmental management emergency plan and measures	2 for each municipal project office and FIO of APDT respectively and 2 for each construction bid section and construction supervision unit respectively	3 days	2013	4
Operation period	Environmental management and relevant policies	1 for each municipal project office	15 days	2014-2015	5
	Subtotal				28

31. The institutional components of the project will also involve training by loan consultants in operation and maintenance of completed facilities. Part of this training will focus on teaching staff how to use a set of indicators to monitor performance of the completed facilities. These indicators will be designed by loan implementation consultants prior to operation start-up.

VI. Consultation, Participation and Information Disclosure

32. **Consultation during Project Preparation.** Section VII of the EIA report describes the meaningful public participation and consultation implemented during project preparation.

33. **Future Public Consultation Plan.** Plans for public involvement during construction and operation stages are to be developed during project preparation. These plans include public participation in (i) monitoring impacts and mitigation measures during the construction and

operation stages; (ii) evaluating environmental and economic benefits and social impacts; and (iii) interviewing the public after the project is completed. These plans will include several types of public involvement, including site visits, workshops, investigation of specific issues, interviews, and public hearings, as indicated in **Table A.15**. The budget for public consultation is estimated at approximately RMB 60,919 (USD 10,000).

Table A.15: Public Consultation Plan

Organizer	Format	No. of Times	Subject	Attendees	Budget
Construction Stage					
APDOT PPMO, IA LPMOs	Public consultation & site visit	4 times: 1 time before construction commences and 1 time each year during construction	Adjusting of mitigation measures, if necessary; construction impact; comments and suggestions	Residents adjacent to project sites, representatives of social sectors	$2,500
APDOT PPMO, IA LPMOs	Expert workshop or press conference	As needed based on public consultation	Comments and suggestions on mitigation measures, public opinions	Experts of various sectors, media	$2,500
Operational Stage					
APDOT PPMO, O&M units	Public consultation and site visits	Once in the first year	Effectiveness of mitigation measures, impacts of operation, comments and suggestions	Residents adjacent to project sites, representatives of residents and representatives of social sectors	$2,500
APDOT PPMO, O&M units	Expert workshop or press conference	As needed based on public consultation	Comments and suggestions on operational impacts, public opinions	Experts of various sectors, media	$2,500
				Total budget:	**$10,000**

Notes: PPMO = Provincial Project Management Office; APDOT = Anhui Province Department of Transport; O&M = operation and maintenance

VII. Grievance Redress Mechanism

34. Public participation, consultation and information disclosure undertaken as part of the environmental and resettlement assessment process have identified and addressed community concerns about the project. Given the level of public and stakeholder participation during the development of the project and proposed ongoing information disclosure and consultation during project implementation major issues of grievance are not expected, however, unforeseen issues may occur. A Grievance Redress Mechanism (GRM) providing effective and transparent channels for receiving and managing complaints has been defined to address project environment related issues. The GRM will be established prior to construction. The GRM is responsive to ADB's Safeguard Policy Statement (2009) and PRC legislation (**Table A.16**).

Table A.16: ADB and PRC Requirements for Grievance Redress

Safeguard Policy Statement (2009) of the Asian Development Bank	ADB requires that the borrower/client establish and maintain a grievance redress mechanism to receive and facilitate resolution of affected peoples' concerns and grievances about the borrower's/client's social and environmental performance at project level. The grievance redress mechanism should be scaled to the risks and

(ADB)	impacts of the project. It should address affected people's concerns and complaints promptly, using an understandable and transparent process that is gender responsive, culturally appropriate, and readily accessible to all segments of the affected people at no cost and without retribution.
2005 PRC Decree 431; 2007 MEP Decree 34	The 2005 PRC Decree 431: the Petition System (by letter or visit), established provisions for a Complaint Handling Mechanism by all levels of government, and for protection of petitioners from any retaliation. This was adopted for environmental matters by the Ministry of Environment Protection (MEP) in 2007, under MEP Decree 34: Environmental Petition System. This Decree delegates to provincial governments the responsibility to establish local Complaint Handling Mechanism. Under this mechanism, contractor, the local EPB, the local government and the court are main access points. The role of the local EPB is to provide leadership and coordination in handling complaints.

35. **The Proposed Project GRM.** In consultation with the APDOT PPMO, APEPD, local EPBs and potentially affected people, it was agreed that the APDOT PPMO will establish a complaints center for the project. Other GRM entry points will include: (i) the contractors; (ii) IA LPMOs and local EPBs; and (iii) APDOT PPMO and APEPD. Contact details for the complaints hotline, complaints center and the entry points will be publicly disseminated on information boards at construction sites and nearby communities/villages. The mechanism will be accessible to diverse members of the community, including more vulnerable groups such as women and youths. Multiple means of using this mechanism, including face-to-face meetings, written complaints, telephone conversations, or e-mail, will be available. Confidentiality and privacy for complainants should be honored where this is requested. In the construction period and the initial operational period covered by loan covenants, the APDOT PPMO will report progress to the ADB, and this will include reporting complaints received and their resolution.

36. **Basic steps for grievance redress** are as follows and illustrated in **Figure A.1**:

i. Step 1: For environmental issues during the construction stage, the affected persons can register their complaints directly with the contractors. Contractors are required to set up a complaint hotline and designate a person in charge of handling complaints, and advertise the hotline number at the main entrance to each construction site. The contractors are required to maintain and update a Complaints Register to document all complaints. The contractors are also required to respond to the complainant in writing within seven calendar days on their proposed solution and how it will be implemented. If the problem is resolved and the complainant is satisfied with the solution, the grievance is considered addressed. The contractors are required to report complaints received, handled, resolved and unresolved to APDOT PPMO monthly.

ii. Step 2: For environmental issues that cannot be resolved by the contractors, the affected person can take the grievance to the IA LPMOs and local EPBs. On receiving complaints by the IA LPMOs or local EPBs, the party receiving the

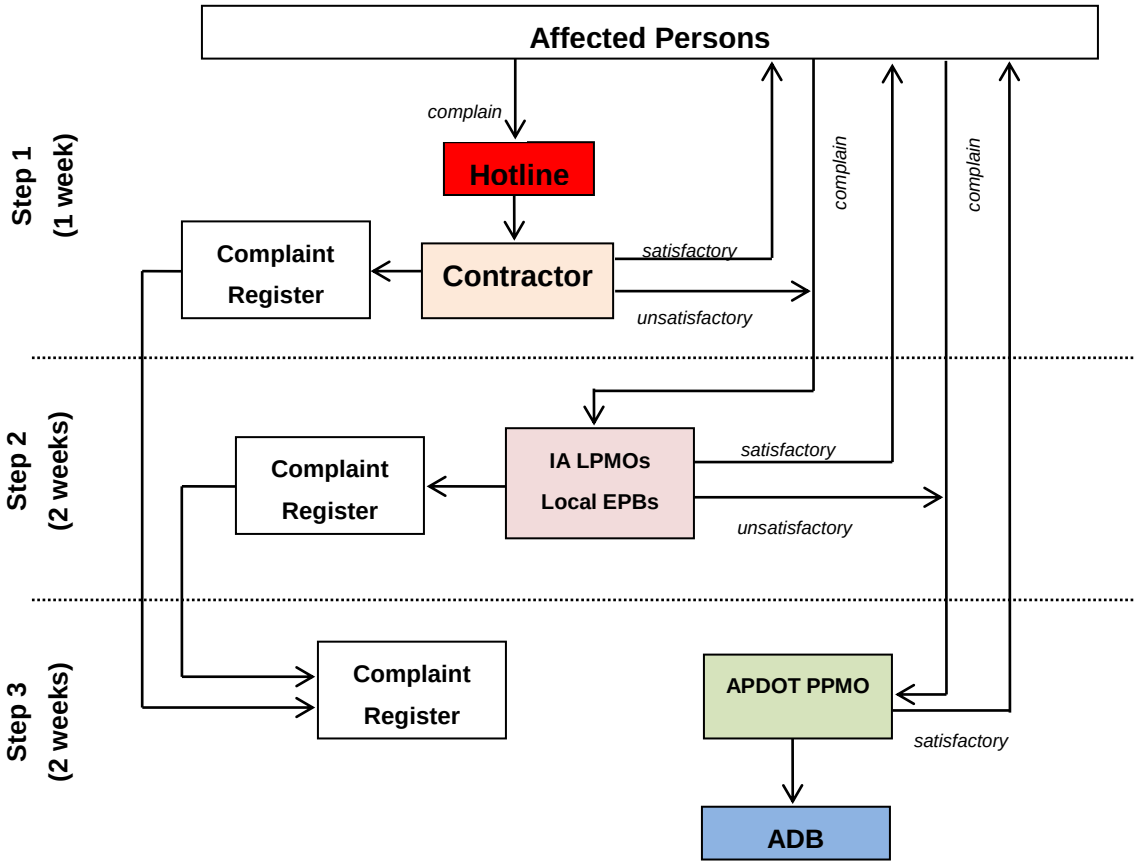
complaints must notify the other party and document the complaint in writing in a Complaints Register. The IA LPMOs and local EPBs must reply to each complainant in writing within 14 calendar days with the proposed solution and method of implementation. If the issue is resolved and the complainant is satisfied with the solution, the IA LPMOs and local EPBs should document the complaint and resolution process in its Complaint Register, with monthly reporting to APDOT PPMO.

iii. Step 3: If the complainant is not satisfied with the proposed solutions in Step 2, he/she can, upon receiving the reply, take the grievance to the APDOT PPMO complaints center. Upon receiving the complaint, the center must deal with it within 14 calendar days. Once a complaint is documented and put on file, the APDOT PPMO complaints center will immediately notify ADB. After discussing the complaint and potential solutions amongst ADB, APDOT PPMO and the ESE, the complainant and the contractor, APDOT PPMO must propose a resolution strategy within 14 calendar days from when the complaint is registered.

37. The tracking and documenting of grievance resolution by the APDOT PPMO (through its complaints center) will include the following elements: (i) tracking forms and procedures for gathering information from project personnel and complainant(s); (ii) dedicated staff to update the database routinely; (iii) systems with the capacity to analyze information so as to recognize grievance patterns, that can identify systemic causes of grievances, promote transparency, publicize how complaints are being handled, and periodically evaluate the overall functioning of the mechanism; (iv) processes for informing stakeholders about the status of a case; and (v) procedures to retrieve data for reporting purposes, including the periodic reports to the ADB.

38. The APDOT PPMO will record the complaint, investigation, and subsequent actions and report results in the monthly internal Environmental Management Plan reports. In the construction period and the initial operational period covered by loan covenants the EA will periodically report complaints and their resolution to ADB in the quarterly project progress reports and the semi-annual environmental monitoring reports.

Figure A.1: Flow Diagram of the Project Grievance Redress Mechanism



VIII. Cost Estimates

39. Cost estimates for EMP implementation, including mitigation measures, internal environmental monitoring, training and public consultation are summarized in **Table A.17.** Excluded from the costs estimates are:

i. infrastructure costs which relate to environment and public health but which are already included in the main civil works contract.

ii. remuneration costs for environment specialists within APDOT PPMO and IA LPMOs,

iii. loan implementation consultants, and

iv. technical experts on equipment operation and maintenance, which are covered elsewhere in the project budget.

Table A.17: Estimated Budget for Implementation of the Environmental Management Plan

	EMP Item	Shuiyang River and Xuanzhou Port	Highway Subprojects	Total
1	Mitigation measures	$491,970	$3,116,868	$3,608,838
2	Environmental monitoring	$169,333	$268,520	$437,853
3	Training	$63,480	$44,436	$107,916
4	Public consultation	$5,000	$5,000	$10,000
5	External compliance monitoring by ESE	$285,660	$396,750	$682,410
6	Soil and water conservation measures	$47,610	$4,085,684	$4,133,294
	Total	**$1,063,053**	**$7,917,258**	**$8,980,311**

40. APDOT will bear all internal environmental monitoring costs during construction and the first year of operation and will ensure the necessary budgets are available for the Environmental Monitoring Station. Contractors will bear the costs for all mitigation measures during construction, including those specified in the tender and contract documents as well as those to mitigate unforeseen impacts due to their construction activities. The O&M units will bear the costs related to mitigation measures during operation, except the indirect mitigation measures of resettlement and provision of double-glazed windows, which will be borne by APDOT. APDOT will also bear the costs related to environmental supervision during construction and operation. The project as a whole (through PPMO and LPMOs) will bear the costs for training, for coordinating the Grievance Redress Mechanism (GRM), and contract costs associated with the PPMO Environmental Supervision Engineer.

IX. Mechanisms for Feedback and Adjustment

41. The EMP is a live document. The need to update and adjust the EMP will be reviewed when there are design changes, changes in construction methods and program, unfavorable environmental monitoring results or inappropriate monitoring locations, and ineffective or inadequate mitigation measures. Based on environmental monitoring and reporting systems in place, the PPMO (with the support of the ESE) and LPMOs shall assess whether further mitigation measures are required as corrective actions or improvements in environmental management practices are required. PPMO will inform ADB promptly on any changes to the project and needed adjustments to the EMP. The updated EMP will be submitted to ADB for review and approval, and will be disclosed on the project website.