Initial Environmental Examination (Draft)

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PRC: Guangxi Regional Cooperation and Integration Promotion Investment Program – Tranche 2

Prepared by the Guangxi Zhuang Autonomous Region Government for the Asian Development Bank.

CURRENCY EQUIVALENTS

(as of 12 May 2017)

Currency unit	–	yuan (CNY)
CNY1.00	=	$0.145
$1.00	=	CNY6.901

ABBREVIATIONS

ADB	-	Asian Development Bank
AP	-	affected person
AQG	-	air quality guideline
As	-	arsenic
ASEAN	-	Association of Southeast Asian Nations
ASHRAE	-	American Society of Heating, Refrigerating and Air-Conditioning Engineers
AVG	-	average
BECZ	-	border economic cooperation zone
BOD_5	-	5-day biochemical oxygen demand
CASS	-	cyclic activated sludge system
Cd	-	cadmium
CITES	-	convention on international trade in endangered species of wild fauna and fauna
CN	-	cyanide
CNY	-	Chinese yuan
CO	-	carbon monoxide
CO_2	-	carbon dioxide
COD	-	chemical oxygen demand
Cr	-	chromium
Cu	-	copper
DDT	-	dichloro-diphenyl-trichloroethane
DMBR	-	dynamic membrane bioreactor
DO	-	dissolved oxygen
EA	-	executing agency
EARF	-	environmental assessment and review framework
EEM	-	external environmental monitor
EHS	-	environment, health and safety
EIA	-	environmental impact assessment
EIR	-	environmental impact report
EIRF	-	environmental impact registration form
EIT	-	environmental impact table
EMP	-	environmental management plan
EMR	-	environmental monitoring report
EMS	-	Environmental Monitoring Station
EPB	-	Environmental Protection Bureau
EPD	-	Environmental Protection Department
EPL	-	Environmental Protection Law
ESE	-	environmental supervision engineer

ESMS	-	environmental and social management system
F^-	-	fluoride
PAM	-	project administration manual
FI	-	financial intermediary
FSR	-	feasibility study report
FYP	-	five-year plan
GDP	-	gross domestic product
GPMO	-	Guangxi Foreign Loans Project Management Office
GHG	-	greenhouse gas
GMS	-	Greater Mekong Subregion
GRM	-	grievance redress mechanism
GUAT	-	Guilin University of Aerospace Technology
GWP	-	global warming potential
GZAR	-	Guangxi Zhuang Autonomous Region
HDPE	-	high density polyethylene
HFC	-	hydrofluorocarbon
Hg	-	mercury
I_{Mn}	-	permanganate index
IA	-	implementation agency
IEE	-	initial environmental examination
IPCC	-	International Panel on Climate Change
L_{Aeq}	-	equivalent continuous A-weighted sound pressure level
LAS	-	linear alkylbenzene sulfonate
LDI	-	local design institute
LEED	-	leadership in energy and environmental design
MEP	-	Ministry of Environmental Protection
MOHURD	-	Ministry of Housing and Urban-Rural Development
MSW	-	municipal solid waste
MWR	-	Ministry of Water Resources
N	-	nitrogen
NH_3-N	-	ammonia nitrogen
Ni	-	nickel
NO_2	-	nitrogen dioxide
NO_X	-	nitrogen oxides
ODP	-	ozone depletion potential
P	-	phosphorus
PAM	-	polyacryl amide
Pb	-	lead
PCR	-	project completion report
pH	-	a measure of acidity and alkalinity
PIE	-	project implementation entity
PM	-	particulate matter
$PM_{2.5}$	-	particulate matter with diameter ≤ 2.5 μm
PM_{10}	-	particulate matter with diameter ≤ 10 μm
PMC	-	project management consultant
PME	-	powered mechanical equipment
PMO	-	project management office
PO_4^{2-}	-	phosphate
PPE	-	personal protective equipment
PPTA	-	project preparation technical assistance

PRC	-	People's Republic of China
RCI	-	regional cooperation and integration
RSP	-	respirable suspended particulate (= PM_{10})
Se	-	selenium
SEA	-	strategic environmental assessment
SME	-	small and medium enterprise
SO_2	-	sulfur dioxide
SPS	-	safeguard policy statement
SS	-	suspended solid
TN	-	total nitrogen
TP	-	total phosphorus
TPH	-	total petroleum hydrocarbon
TSP	-	total suspended particulate
USEPA	-	United States Environmental Protection Agency
UV	-	ultraviolet
VOC	-	volatile organic carbon
WBG	-	World Bank Group
WHO	-	World Health Organization
WTP	-	Water treatment plant
WWTP	-	wastewater treatment plant
YMCN	-	Youjiang Medical College for Nationalities
Zn	-	zinc

WEIGHTS AND MEASURES

Bq/m^3	-	becquerel per cubic meter
^oC	-	degree centigrade
cfu/m^3	-	colony forming units per cubic meter
dB(A)	-	A-weighted sound pressure level (decibel)
gm/cc	-	gram per cubic centimeter
gm/kg	-	gram per kilogram
ha	-	hectare
kg/m^3	-	kilogram per cubic meter
kg/s	-	kilogram per second
km	-	kilometer
km^2	-	square kilometer
km/h	-	kilometer per hour
L	-	liter
L/100 km	-	liter per 100 kilometer
m	-	meter
m^2	-	square meter
m^3	-	cubic meter
m^3/a	-	cubic meter per annum
m^3/d	-	cubic meter per day
m^3/(h-person)	-	cubic meter per hour per person
m/s	-	meter per second
m^3/s	-	cubic meter per second
mg	-	milligram

mg/L	-	milligram per liter
mg/m^3	-	milligram per cubic meter
min	-	minute
mm	-	millimeter
ng/m^3	-	nanogram per cubic meter
no./L	-	number of individuals per liter
pcu/d	-	passenger car unit per day
t	-	metric ton
t/a	-	metric ton per annum
t/d	-	metric ton per day
µ or µm	-	micron or micrometer
µg	-	microgram
$µg/m^3$	-	microgram per cubic meter

NOTES

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

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I. EXECUTIVE SUMMARY

A. Background

1. This initial environmental examination (IEE), which includes an environmental management plan (EMP), is prepared for tranche 2 of the proposed Guangxi Regional Cooperation and Integration Promotion Investment Program (hereafter referred to as the project) in the People's Republic of China (PRC). The project in its present form consists of three tranches, each containing a number of subprojects. Tranche 2 has eight subprojects, and has been classified as environment category B since it is unlikely to have potentially significant adverse environmental impacts that are irreversible, diverse, or unprecedented. An environmental assessment and review framework (EARF) has also been prepared as a guidance document for the Guangxi Zhuang Autonomous Region (GZAR) government to prepare relevant environmental safeguard documents to meet Asian Development Bank's (ADB) environmental safeguard requirements for subprojects in subsequent tranches.

2. Regional cooperation and integration is an important means for the PRC to achieve greater integration with the global economic system. This has been highlighted as a priority in the 13th Five Year Plan (FYP) for 2016-2020[1], which committed the PRC to further opening up and strengthening international and regional economic cooperation, with a special focus on its neighboring countries. The proposed project aims to support participation of Guangxi in regional cooperation and integration, especially the Greater Mekong Subregion (GMS) program, with a focus on economic corridor development. The proposed project will enhance cooperation between the PRC and Viet Nam under the GMS framework, and is expected to have high regional cooperation and integration spill-over, benefitting also Viet Nam's northern border provinces including Quang Ninh, Lang Son and Cao Bang. Regional cooperation and integration is also an integral part of ADB operations in the PRC. It is one of the five strategic priorities of the Country Partnership Strategy 2016-2020 for the PRC[2].

B. Project Design

3. The **impacts** of the project are that economic growth potential will be realized for border areas in the PRC and Viet Nam, efficient transport and trade operations along the GMS North-South Economic Corridor achieved, and economic integration between GZAR and the rest of the GMS further strengthened. The **outcome** of the project is that the benefits of regional cooperation and integration in the border areas of Guangxi and northern Viet Nam will be captured. The project will deliver five **outputs**:

(i) **SMEs development enhanced**. This includes the construction of small to medium enterprises' (SME) business development service information center, training base for aeronautic and aerospace industries, ASEAN (Association of Southeast Asian Nations) vocational education facilities and other related facilities in Guilin University of Aerospace Technology (GUAT) under subproject 7, which provides SME related training and courses both for PRC and ASEAN students. The high-demand skills are machinery and automobile

[1] Government of the People's Republic of China. 2016. The 13th Five Year Plan for National Economic and Social Development.

[2] Asian Development Bank. 2016. Transforming partnership: People's Republic of China and Asian Development Bank, 2016-2020. Manila.

making, advanced manufacturing, equipment automation and electronic information, etc. To further improve the quality of the programs, an advisory service prepared under tranche 1 will also support GUAT to improve program design and contents of business management courses, targeting SME managers and owners.

(ii) **Cross-border e-commerce platforms developed**. This includes the construction of e-commerce facilities in subproject 5, consisting of electronic business data center and cross-border merchandize exhibition center, and related facilities in Qinzhou. The relevant management information system will be installed to facilitate the function of e-commerce.

(iii) **Key infrastructure and services for border economic cooperation zones (BECZ) improved**. This includes (a) construction of roads and ancillary facilities in a new area of Longzhou BECZ under subproject 3; (b) construction of cold storage and constant temperature warehouses, inspection and detention facilities, surveillance facilities, and other related facilities in the Qinzhou Bonded Port Zone under subproject 6, which will play a key role in managing cold-chain logistics for the trade between PRC and ASEAN countries; and (c) construction and upgrading of roads and construction of a wastewater treatment plant (WWTP) in the Chongzuo Sino-Viet Nam BECZ under subproject 1, which will improve key infrastructure, particularly in the areas of Xinhe Town, Jiangzhou District, Chongzuo city in GZAR.

(iv) **Physical and people's connectivity for RCI improved.** This includes (a) construction of the eastern section road in Dongxing city under subproject 2 to improve physical connectivity with southwest crossing-border of Viet Nam; (b) construction of educational, training and laboratory facilities, logistic facilities, and other related facilities in the Youjiang Medical College for Nationalities (YMCN) under subproject 8 to meet the growing demand for health and medical human resources both in GZAR and ASEAN, particularly human resources for food pharmacy, inspection and guarantee, medical equipment management, public health management and elderly care. which are necessary to improve the secured connectivity of people and goods between GZAR and ASEAN countries; (c) road construction in cross-border point of Nonghuai Border Trade Zone designated as an import port for fruit, aquatic products, and grains, etc., resulting in improving physical connectivity at this cross-border point and enhancing trades and related economic activities between GZAR and Viet Nam.

(v) **Technical and institutional support** will be provided for the executing agency (EA), implementing agencies (IA) and project implementation entities (PIE) for project management and implementation. A project management consultant (PMC) will be recruited by the Guangxi Foreign Loans Project Management Office (GPMO) to provide such support. The PMC team will include an environment specialist who will function as an external environmental monitor (EEM) to support and also independently audit the implementation of the environmental management plant (EMP).

4. Table 1 summarizes the contents and PIEs for the eight tranche 2 subprojects. These subprojects are located in Guilin, Baise, Qinzhou, Chongzuo, Longzhou, Pingxiang and Dongxing in the GZAR (Figure 1). This IEE is prepared for the eight subprojects based on information provided in the corresponding feasibility study reports (FSR), environmental impact reports (EIR), environmental impact tables (EIT), and reconnaissance undertaken by the project preparation technical assistance (PPTA) consultants.

Table 1: Tranche 2 subprojects

Subproject		Summary of Subproject Content	Project Implementation Entity
No.	Title		
1	Chongzuo Sino-Vietnam Border Economic Cooperation Zone demonstration project (phase I) 崇左中越边境经济合作区示范项目（一期）	Construction of 4 new roads and upgrade of 2 existing roads totaling 19.841 km plus ancillary works, a new wastewater treatment plant with 10,000 m^3/d treatment capacity, and 21.91 km of wastewater collection pipelines in the Chongzuo Sino-Vietnam Border Economic Cooperation Zone.	Chongzuo City Xinghe Investment Development Co. Ltd. 崇左市兴合投资开发有限责任公司
2	Dongxing Changhu Road (east section) construction project 东兴市长湖路东段工程	Construction of the new 3.704 km long east section of the Changhu Road and ancillary works in Dongxing City.	Dongxing City Development Investment Co. Ltd. 东兴市开发投资有限责任公司
3	Infrastructure development for Longzhou Border Economic Cooperation Zone 龙州边境经济合作区基础设施项目	Construction of 4 new roads and upgrade of 1 existing road totaling 9.729 km plus ancillary works in the Poverty Alleviation Industrial Park, which is within the Longzhou Border Economic Cooperation Zone in Longzhou County	Guangxi Longzhou County Industry and Transportation Investment Co. Ltd. 广西龙州县工业交通投资有限公司
4	Road connectivity in Pingxiang-Viet Nam cross-border (phase 1) 凭祥中越跨境经济合作区互联互通一期工程项目	Construction of a 2.668 km new road in Pingxiang connecting Kafeng Town with Nonghuai Town at the border with Viet Nam.	Pingxiang City Urban Construction Investment Co. Ltd. 凭祥市城市建设投资有限责任公司
5	Qinzhou cross-border trade e-commerce industrial park project 钦州跨境贸易电子商务产业园项目	Construction of 5 buildings with total floor area of 50,000 m^2 next to the Qinzhou Bonded Port Zone for exhibition and sales of cross-border merchandize, business offices and ancillary commercial facilities, and e-commerce supervision platform and bonded warehouse.	Guangxi Qinbao Investment Group Co. Ltd. 广西钦保投资有限责任公司
6	Qinzhou international cold-chain logistic demonstration project 钦州国际冷链物流示范项目	Construction of 4 buildings with total floor area of 35,000 m^2 for cold storage and constant temperature warehouses, warehouse and cold chain processing, and offices and distribution areas in the Qinzhou Bonded Port Zone	
7	China-ASEAN small and medium enterprises (SMEs) synergy innovative development project 中国—东盟中小企业协同创新发展项目	Expansion of the south campus of the Guilin University of Aerospace Technology involving the construction of 3 buildings and ancillary facilities with total floor area of 125,268.25 m^2 for small and medium enterprises (SME) business development, aeronautic and aerospace industrial training, and ASEAN vocational education.	Guilin University of Aerospace Technology 桂林航天工业学院
8	China- ASEAN educational medicare cooperation project (phase I) 中国—东盟教育医疗合作项目（一期）	Phase 1 construction of the new campus of the Youjiang Medical College for Nationalities in Baise involving the construction of buildings and ancillary facilities with total floor area of 182,210 m^2 for classrooms, laboratories, library, administration, offices, auditorium, student canteens and dormitories, and housing for support staff.	Youjiang Medical College for Nationalities 右江民族医学院

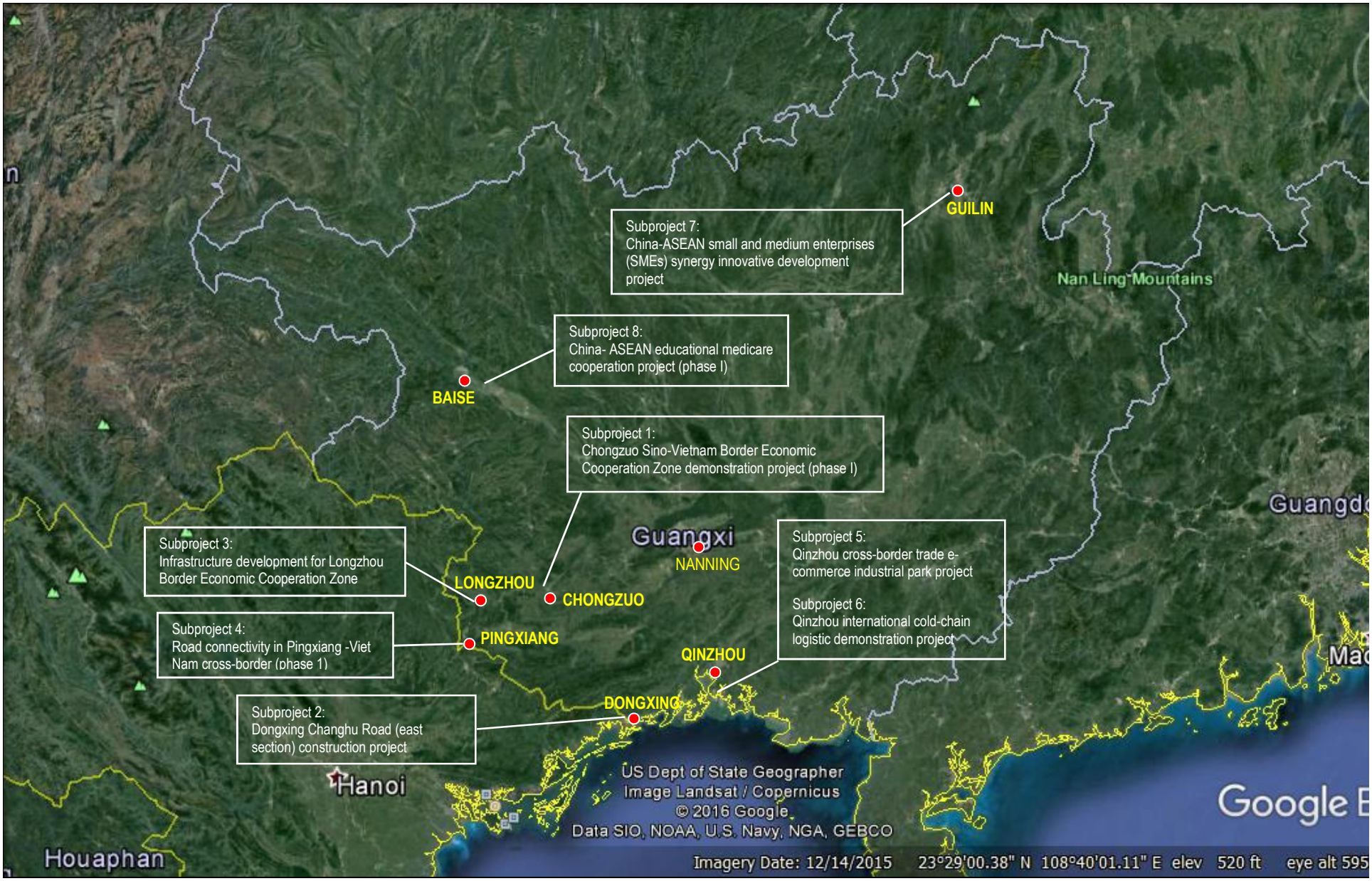


Figure 1: Map of Guangxi Zhuang Autonomous Region and locations of subprojects

C. Project Benefits

5. This project will provide training for skilled labor in aerospace, aeronautic and health professions in the PRC and ASEAN countries. It will strengthen the support to SMEs by providing business development services, training and information dissemination. The project will provide e-commerce platform to facilitate cross-border trading with Viet Nam and access to markets, at the same time enhance cold chain logistics of cross-border trading of perishable products such as meat, fresh vegetables and seafood with ASEAN countries. The project will also improve connectivity within border economic cooperation zones as well as cross-border trade with Viet Nam through provision of transport infrastructure. The provision of wastewater treatment in the Chongzuo BECZ will have environmental benefits by removing industrial and municipal pollutants from discharging into the Heishui River. Subprojects 7 and 8 also propose to adopt green building features in the design. This would have demonstration effect to their ASEAN partners and international students. The PIEs for subprojects involving building facilities have been encouraged by the ADB environmental team to seek LEED[3] (Leadership in Energy and Environmental Design) certification, an international green building certification scheme established by the Green Building Council (GBC) in the United States.

D. Project Impacts and Mitigation Measures

6. Of the eight subprojects, two are located in BECZs (subprojects 1 and 3) and two are located in a bonded port zone on land reclaimed from the sea (subprojects 5 and 6). These subproject sites are dominated by industrial setting with disturbance and influence from human activities, with few or no existing environmental sensitive receptors in the vicinities. Other subprojects also have a few existing environmental sensitive receptors in the vicinities. Subprojects 2 and 4 would each have one existing environmental sensitive receptor (Huangqiaoshu Village for subproject 2 and Kafeng Town for subproject 4). For subprojects 7 and 8, there are a few sensitive receptors within 200 m from the boundary of these sites. Despite the lack of or few sensitive receptors for the subprojects, the need to adopt best practice on environmental protection during construction and operation of the subprojects is emphasized in this IEE with environmental protection and mitigation measures specified in the EMP.

7. **Air quality**. Main air pollutants during construction of the subprojects would include fugitive dust from construction sites, fumes and exhaust from construction vehicles, asphalt fumes during road paving, and volatile organic compounds (VOC) from paints and solvents during interior fit-out of buildings. Impact distances have been assessed to be approximately 50 m and 150 m downwind of construction activities for construction vehicle exhaust and fugitive dust respectively. Asphalt fumes generated during road paving and VOC generated during interior fit-out are occupational health and safety issues where personal protection equipment could be required. The EMP specifies mitigation measures for controlling air pollution during construction. With EMP implementation, potential air quality impact during construction would comply with applicable standards.

8. Assessment results indicate that during operation of the roads in subprojects 1, 2, 3 and 4, air pollutants emitted by the vehicles travelling on these roads would comply with applicable air quality standards at road side. Carbon dioxide emissions from all roads in subprojects 1, 2, 3 and

[3] Leadership in Energy and Environmental Design: http://www.usgbc.org/leed

4 would total less than 43,000 t/a in year 2033 based on a 15-year design horizon for these roads. The quantity is less than the ADB threshold of 100,000 t/a.

9. Other potential air quality impacts during operation would include odor emissions from the wastewater treatment plant (WWTP) in subproject 1, cooking fumes from the canteens in subproject 8, and indoor air quality of the interior of the buildings in subprojects 5, 6, 7 and 8 with respect to emission of VOC such as benzene and formaldehyde from decorative items and furniture in new buildings especially during the first six months of occupancy. Subproject design has already taken into account of controlling WWTP odor and canteen cooking fumes, and assessments show compliance with applicable environmental standards. The EMP specifies indoor air quality monitoring for the new buildings in subprojects 5, 6, 7 and 8, for assessing suitability for occupancy.

10. **Noise**. Construction noise would be generated from the use of powered mechanical equipment (PME) and construction vehicles. The impact distances of noise from building construction have been assessed to be 50 m during day time and 200 m during night time; and from road construction, 100 m during day time and 300 m during night time. Restrictions on night time construction and other noise suppression measures are specified in the EMP. With EMP implementation, construction noise would comply with applicable standards.

11. Operational noise would include traffic noise from motor vehicles travelling on the roads in subprojects 1, 2, 3 and 4, as well as the plant noise from WWTP in subproject 1. Traffic noise assessment indicates night time noise exceedance in the medium term at some noise sensitive receptors in subprojects 1, 2 and 4. The EMP specifies the provision of noise insulation to these households for reducing potential traffic noise impact to acceptable levels. Operational noise assessment for the WWTP indicates compliance with applicable noise standards at the boundaries of the WWTP, since the noisy plant equipments such as pumps, blowers and sludge dewatering belt press are generally located inside buildings.

12. **Water quality**. Process wastewater and muddy runoff on construction sites would be collected and treated using sedimentation tanks. The supernatant would be used for site cleaning and dust suppression and would not be discharged. Domestic wastewater from construction workers would be treated with septic tanks on site. The EMP specifies mitigation measures for protecting water quality.

13. Domestic wastewater generated during operation of these facilities would be pre-treated by wastewater treatment system on site before discharging into public sewers for treatment at local municipal WWTPs. For subproject 8, a cyclic activated sludge system (CASS) would be installed on the campus to treat municipal wastewater from the students and staff, as well as wastewater from the canteen. The treated effluent would be re-used on campus as scenic water resulting in zero external discharge. Other wastewater from the laboratories, landscaping and other uses would also be pre-treated with an underground biochemical system before discharging to public sewer. No adverse water quality impact is anticipated.

14. The WWTP in subproject 1 is designed to treat 10,000 m^3/d of industrial (pre-treated by industrial enterprises) and municipal wastewater from the BECZ. It adopts a dynamic membrane bioreactor (DMBR) treatment process with ultra-violet irradiation disinfection. The effluent would be treated to meet PRC's Class 1B standard for discharging into the Heishui River with Category III water quality. Operation of the WWTP would result in environmental benefit, by removing 1,600 t chemical oxygen demand (COD), 1,020 t biochemical oxygen demand (BOD_5), 91 t ammonia nitrogen (NH_3-N) and 10 t total phosphorus (TP) each year from discharging into the Heishui River.

15. **Solid waste**. Solid wastes during construction include construction waste, refuse from construction workers, and spoil from site formation. Site formation is not part of subprojects 5, 6, 7 and 8 where the sites would have been formed for the construction of buildings. For subprojects 1, 2 3 and 4 involving road and WWTP construction, site formation would generate spoil from earth cut and fill. Construction waste would be reused and recycled on site where practicable. Those that cannot be reused would be transported to storage or disposal centers designated by the local municipal administration bureaus. The quantities of refuse generated by construction workers on construction sites are small (ranging from 15 kg/d to 100 kg/d) and would be collected regularly by local sanitation bureaus for disposal at local landfills. Earth cut and fill quantities would be substantial for subprojects 2 and 4 since these roads are on hilly terrain. For subproject 2, excess spoil totaling approximately 388,000 m^3 would be temporarily stored in areas near the alignment and ultimately re-used for other infrastructure projects in Dongxing, resulting in no permanent disposal of excavated spoil. For subproject 4, spoil totaling slightly over 600,000 m^3 would be permanently disposed of at an existing disposal site near the subproject site. All spoil storage/disposal sites designated solely for the subprojects will be rehabilitated upon completion of construction.

16. During operation, municipal solid waste (MSW) would be generated from the people using the buildings and facilities in subprojects 1 (WWTP), 5, 6, 7 and 8, ranging from approximately 1.28 t/a in subproject 1 to 4,500 t/a in subproject 8. MSW generated during operation of these facilities would be collected regularly by local sanitation bureaus for proper disposal at local landfills. Subprojects 7 and 8 would also generate small quantities of chemical waste and medical waste from the training facilities and laboratories. Such waste would be collected, treated and disposed of by companies licensed for the collection, transportation and treatment of chemical and medical wastes. Operation of the WWTP would generate approximately 1,450 t/a dewatered sludge with a moisture content of 75%, which exceeds the <60% moisture content requirement for landfill disposal. The EIR proposes various re-use options, such as for land improvement and agricultural use.

17. **Biological resources**. The subproject sites have been assessed in the EIRs and EITs to have low ecological value. Subprojects 1 and 3 are in industrial areas already disturbed and influenced by human activities. Subprojects 5 and 6 are on land that was reclaimed from the sea with no native vegetation. Other subproject sites are dominated by shrubs, weeds and planted economic species. Literature review and site survey of these locations indicate the absence of protected plant and animal species, natural and critical habitat, and protected area such as nature reserve and drinking water protection zone. Potential impact on biological resources and ecology is anticipated to be minimal.

18. **Physical cultural resources**. Assessment undertaken revealed the absence of physical cultural resources as defined in ADB's Safeguard Policy Statement (SPS, 2009) within the project area of influence of the subproject sites. Should buried artifacts of archaeological significance be uncovered during construction within the project areas, construction will be stopped and immediately reported to the local cultural bureaus in accordance with the PRC's *Cultural Relics Protection Law* (2002) and the *Cultural Relics Protection Law Implementation Ordinance* (2003).

19. **Climate change and adaptation measures**. Climate risk and vulnerability assessment conducted for the subprojects indicates that potential climate change impacts would include heavy rainfall causing flooding and landslide, and sea level rise. Hard (engineering) and soft adaptation measures are recommended for consideration during detailed design.

E. Information Disclosure, Consultation and Participation

20. Public consultations in the form of discussion forums were conducted by the PPTA consultants on five subprojects in April 2017. Public consultations on the other three subprojects were conducted by the domestic environmental institutes during EIR/EIT preparation. Approximately 200 people participated in these consultations representing local village communities, enterprises and government departments. Information on subproject scopes, ADB's environmental safeguard requirements, potential environmental impacts and mitigation measures, environmental management plan (EMP) and grievance redress mechanism (GRM) was disclosed and discussed during the meetings. All participants supported the subprojects. Most of the concerns expressed by the participants were related to potential dust, noise and water quality impacts during construction; and potential flooding impact on nearby villages from roads constructed on hilly terrain (especially subproject 2). The local PIEs and PPTA consultants advised affected persons how the concerns raised would be addressed, as documented in Chapter VII Information Disclosure, Consultation and Participation.

F. Grievance Redress Mechanism

21. This report and the EMP describe a project grievance redress mechanism to document and resolve complaints from affected persons. The GRM will be coordinated by the GPMO, who should have already set up a complaint center with a hotline for receiving environmental and resettlement grievances under tranche 1. The tranche 2 GRM would be integrated into and combined with the tranche 1 GRM, and will be accessible to diverse members of the community, including 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.

G. Key EMP Implementation Responsibilities

22. The GZAR government is the executing agency (EA) and has established the GPMO, who on behalf of the EA will be responsible for the day-to-day management of the project. GPMO will have overall responsibility for supervision of the implementation of environmental mitigation measures, coordinate the project level GRM, and report to ADB. GMO has already appointed two staff members as environment coordinators for tranche 1 to supervise the effective implementation of the EMP and to coordinate the project level GRM. These individuals will act as the environmental coordinators for tranche 2 and if needed, more staff will be appointed for tranche 2. GPMO will engage the technical engineering design institutes, hire the project management consultant (PMC), and manage the procurement process. To ensure that the contractors comply with the EMP provisions, GPMO will ensure that the environmental contract clauses listed in the EMP will be incorporated into all civil works tender documents and contracts. GPMO will prepare annual environment monitoring reports (EMR) with assistance from the external environmental monitor (EEM) under the PMC service and submit the EMRs to ADB.

23. The implementing agencies (IA) for the subprojects will consist of seven PIEs (see Table 1). The PIEs will each appoint a staff member as the environmental coordinator to coordinate and ensure the implementation of the EMP. Each PIE will engage an external environmental supervision engineer (ESE) for independent compliance monitoring of EMP implementation. The PIEs will contract the local environmental monitoring stations (EMS) to implement environmental quality monitoring in accordance with the environmental monitoring program in the EMP.

H. Risks and Key Assurances

24. The main project risks include the low institutional capacity of the PIEs, and contractors and their failure to implement the EMP effectively during construction and operational stages. Although the GPMO should have built up institutional capacity to some extent via tranche 1 experience and implementation, additional capacity could be needed for tranche 2 implementation. These risks will be mitigated by (i) providing training in environmental management and monitoring, (ii) appointing qualified PMC and qualified environmental coordinators, (iii) following appropriate project implementation monitoring and mitigation arrangements, and (iv) ADB conducting project implementation review missions.

25. Key assurances cover ADB environmental safeguard requirements during project implementation. The EMP also includes a list of environmental contract clauses for incorporation into all civil works tender documents and contracts, thus making the implementation of environmental mitigation measures during construction legally binding for the contractors.

I. Overall Conclusion

26. This IEE shows that potential environmental impacts can be reduced to acceptable levels with appropriate mitigation. The EMP has specified mitigation measures to be implemented and responsible parties, and how the impacts are to be monitored during construction and operation. The project will have positive benefits in achieving better regional cooperation and investment between the PRC and Viet Nam by improving the skills of Chinese and ASEAN workers and students and SMEs, improving the hardware and software for cross-border trade and commerce, and strengthening the support for SME development in the border areas of GZAR.

II. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

A. Policy Framework

27. **Regional perspective**. The Greater Mekong Subregion (GMS) Cooperation Program envisions a subregion that is more integrated, prosperous and equitable. This vision is pursued through a "3C" strategy of enhancing connectivity, improving competitiveness, and promoting a greater sense of community. To implement this strategy, the GMS countries have adopted an economic corridor approach whereby transport corridors will be expanded, trade and investment promoted, and economic growth stimulated. The PRC and Viet Nam are active participants in developing the GMS North-South Economic Corridor.

28. As one of the two PRC provinces directly involved in the GMS cooperation, GZAR has formulated a strategy and action plan for participation in the GMS program[4]. The medium term plan aims to (i) further enhance connectivity with the rest of the GMS; (ii) accelerate development of economic corridors with a special focus on developing border economic zones in partnership with Viet Nam; and (iii) further improve trade and investment facilitation to promote cross-border economic activities.

[4] Government of the Guangxi Zhuang Autonomous Region. 2014. Strategy and action plan for participation in the Greater Mekong Subregion Economic Cooperation Program, 2014-2022. Nanning.

29. The proposed project aims to support participation of Guangxi in regional cooperation and integration, especially the GMS program, with a focus on economic corridor development. The proposed project will enhance cooperation between the PRC and Viet Nam under the GMS framework, and is expected to have high regional cooperation and integration spill-overs, benefitting also Viet Nam's northern border provinces including Quang Ninh, Lang Son and Cao Bang.

30. **PRC perspective**. Regional cooperation and integration is an important means for the PRC to achieve greater integration with the global economic system. This has been highlighted as a priority in the 13th Five Year Plan (FYP) for 2016-2020[5], which committed the PRC to further opening up and strengthening international and regional economic cooperation, with a special focus on its neighboring countries.

31. In 2015, the PRC announced plans to develop the so-called Silk Road Economic Belt and 21st Century Maritime Silk Road (the Belt and Road Initiative)[6]. This strategic initiative aims to promote connectivity and strengthen economic partnerships between and among Asian, European and African continents in the spirit of open regionalism. It cites five priorities for cooperation: (i) fostering economic and development policy coordination; (ii) strengthening connectivity by developing energy, transport and telecommunication infrastructure and harmonizing standards; (iii) promoting trade and investment through customs, sanitary and phyto-sanitary cooperation, implementation of World Trade Organization's *Trade Facilitation Agreement*, and development of economic zones and industry clusters; (iv) deepening financial cooperation and integration; and (v) promoting people-to-people exchanges. To implement the Belt and Road Initiative, Guangxi has developed its own action plan with special emphasis on strengthening cooperation with the members of the ASEAN, particularly the GMS countries[7].

32. **ADB perspective**. Regional cooperation and integration is an integral part of ADB operations in the PRC. It is one of the five strategic priorities of the Country Partnership Strategy 2016-2020 for the PRC[8].

B. Legal and Administrative Framework

33. The administrative framework for environmental impact assessment (EIA) in the PRC consists of national, provincial, and local (city and county) environmental protection authorities. The national authority is the Ministry of Environmental Protection (MEP), which promulgates laws, regulations, administrative decrees, technical guidelines, and environmental quality and emission standards on EIA and pollution prevention and control. At the provincial level are the Environmental Protection Departments (EPD), acting as the gatekeeper for EIA and pollution prevention and control in the province. They are often delegated the authority by MEP to approve EIA reports for development planning and construction projects in the provinces, except those with national interest and those that cross provincial boundaries that would need MEP approval. The local (city or county level) Environmental Protection Bureaus (EPB) enforce environmental

[5] Government of the People's Republic of China. 2016. The 13th Five Year Plan for National Economic and Social Development.

[6] National Development Reform Commission, Ministry of Foreign Affairs, and Ministry of Commerce. 2015. Vision and actions on jointly building the Silk Road Economic Belt and the 21st Century Maritime Silk Road. Issued on 28 March 2015 with authorization from the State Council of the PRC.

[7] Government of the Guangxi Zhuang Autonomous Region. 2016. Recommendations on implementing the initiative of building Silk Road Economic Belt and 21st Century Maritime Silk Road. Nanning.

[8] Asian Development Bank. 2016. Transforming partnership: People's Republic of China and Asian Development Bank, 2016-2020. Manila.

laws and conduct environmental monitoring within city or county limits. Local EPBs could be delegated the authority to approve EIA reports by the provincial EPDs.

34. EPDs and EPBs are supported by Environmental Monitoring Stations (EMS), which are subsidiaries of EPDs or EPBs and are qualified entities to carry out environmental monitoring[9]. The PRC has a qualification and registration system for EIA and only qualified and registered institutes and individuals are allowed to undertake EIA. Under the recently issued *Management Measures for the Qualification of Environmental Impact Assessment for Construction Projects* (MEP decree [2015] No. 36), qualified institutes for conducting EIAs for construction projects in the PRC can no longer be a subsidiary of an environmental authority responsible for approving domestic environmental impact reports or tables as of 1 November 2015.

C. Laws, Regulations, Guidelines and Standards

35. **PRC requirements.** Table lists 141 PRC environmental and infrastructure development laws, regulations, decrees and announcements, guidelines, and standards relevant to this project. These comprehensive requirements cover environmental protection and impact assessment; pollution prevention and control of air, noise, water and wastewater, ecology, solid waste and hazardous waste; soil and water conservation; cultural relics; and occupational diseases. They are supported by technical guidelines and standards for assessing atmospheric, noise, water, wastewater, solid waste, ecological and environmental hygiene impacts for infrastructure development projects, as well as energy conservation and green building design.

Table 2: Relevant PRC laws, regulations, decrees, guidelines, and standards

Laws	
1	*Water Pollution Prevention and Control Law*, 1984 (amended in 2008)《中华人民共和国水污染防治法》2008 修订
2	*Wild Animal Protection Law*, 1988 (amended in 2004) 《中華人民共和國野生動物保護法》2004 修订
3	*Environmental Protection Law*, 1989 (amended in 2014) 《中华人民共和国环境保护法》2014 修订
4	*Soil and Water Conservation Law*, 1991 (amended in 2010) 《中华人民共和国水土保持法》2010 修订
5	*Labor Law*, 1994 《中华人民共和国劳动法》1994
6	*Solid Waste Pollution Prevention and Control Law*, 1995 (amended in 2004) 《中华人民共和国固体废物污染防治法》2004 修订
7	*Environmental Noise Pollution Prevention and Control Law*, 1996 《中华人民共和国环境噪声污染防治法》1996
8	*Atmospheric Pollution Prevention and Control Law*, 2000 (amended in 2015) 《中华人民共和国大气污染防治法》2015 修订
9	*Occupational Disease Prevention and Control Law*, 2001 《中华人民共和国职业病防治法》2001
10	*Water Law*, 2002 (amended in 2016) 《中华人民共和国水法》2016 修订
11	*Environmental Impact Assessment Law*, 2002 (amended in 2016) 《中华人民共和国环境影响评价法》2016 修订
12	*Cultural Relics Protection Law*, 2002 (amended in 2015) 《中华人民共和国文物保护法》2015 修订
Regulations	
13	*Soil and Water Conservation Law Implementation Ordinance*, 1993 (amended in 2011) 《中華人民共和國水土保持法實施條例》 2011 修订
14	*Natural Reserve Ordinance*, 1994 《中华人民共和国自然保护区条例》1994

[9] In this report, “environmental monitoring” refers to the activity of collecting environmental data either through *in-situ* measurements or through sampling followed by laboratory testing of samples.

15	*Wild Plant Protection Ordinance* 1996 《中华人民共和国野生植物保护条例》1996
16	*Construction Project Environmental Protection Management Ordinance*, 1998 《中华人民共和国建设项目环境保护管理条例》1998
17	*Cultural Relics Protection Law Implementation Ordinance*, 2003 (amended in 2016) 《中华人民共和国文物保护法实施条例》 2016 修订
18	*Scenic Area Ordinance*, 2006《中华人民共和国风景名胜区条例》 2006
19	*Plan Environmental Impact Assessment Ordinance*, 2009 《中华人民共和国规划环境影响评价条例》2009
20	*Ozone Layer Depleting Substances Management Ordinance,* 2010 《消耗臭氧层物质管理条例》2010
21	*Highway Safety Protection Ordinance* 2011 《公路安全保护条例》2011
22	*Hazardous Chemical Safe Management Ordinance* 2011《危险化学品安全管理条例》 2011
23	*Urban Drainage and Wastewater Treatment Ordinance,* 2013 《城镇排水与污水处理条例》 2013
Decrees and Announcements	
24	*Circular on strengthening the management of environmental impact assessment for construction projects financed by international financial organizations*, (MEP Announcement [1993] No.324) 《关于加强由国际金融机构提供资金的建设项目的环境影响评估管理的通知》环发[1993］324 号
25	*Circular on certain ideas in strengthening environmental supervision* (SEPA Announcement [1999] No. 141) 《关于进一步加强环境监理工作若干意见的通知》 环发［1999］141 号
26	*Management measures for inspection and acceptance of environmental protection at construction project completion* (MEP Decree [2001] No. 13 and 2010 Amendment) 《建设项目竣工环境保护验收管理办法》环令[2001］13 号；2010 修改
27	*Circular on environmental noise issues related to the environmental impact assessment of highway and railway (including light rail) construction projects (MEP Announcement [2003] No. 94)* 《关于公路、铁路（含轻轨）等建设项目环境影响评价中环境噪声有关问题的通知》 环发［2003］94 号
28	*Environmental protection management measures for transportation construction projects* (MOT Decree [2003] No. 5) 《交通建设项目环境保护管理办法》交通部令［2003］5 号
29	*Circular on launching environmental supervision for transportation engineering* (MOT & MEP Announcement [2004] No. 314) 《关于开展交通工程环境监理工作的通知》（交环发［2004］314 号）
30	*Specifications on the management of urban construction waste* (Ministry of Construction Decree [2005] No. 139) 《城市建筑垃圾管理规定》建设部令[2005］139 号
31	*Interim measure for environmental impact assessment public participation* (SEPA [2006] No. 28) 《环境影响评价公众参与暂行办法》 环发[2006］28 号
32	*Technical policy for sludge treatment and pollution control in urban municipal wastewater treatment plant (on trial)* (MOHURD [2009] No. 23) 《城镇污水处理厂污泥处理处置及污染防治技术政策（试行）》 建城[2009]23 号
33	*Circular on management measures for the supervision, inspection and environmental acceptance of construction projects under the "Three Simultaneities"* (on trial) (MEP Announcement [2009] No. 150) 《环境保护部建设项目“三同时”监督检查和竣工环保验收管理规程（试行）的通知》环发[2009］150 号
34	*Technical policy on the prevention and control of at grade traffic noise pollution* (MEP Announcement [2010] No. 7) 《地面交通噪声污染防治技术政策》 环发［2010］7 号
35	*Management measures for the operation of environmental complaint hotline* (MEP Decree [2010] No. 15) 《环保举报热线工作管理办法》环令[2010］15 号
36	*Circular on the issue of interim management measure for Emergency Environmental Incident Contingency Plan* (MEP Announcement [2010] No. 113) 关于印发《突发环境事件应急预案管理暂行办法》的通知 （环发[2010］113 号）
37	*Technical guideline for treatment of municipal solid waste* (MOHURD [2010] No. 61)《生活垃圾处理技术指南》 建城[2010]61 号
38	*Water and soil conservation requirements for highway construction projects* (MWR & MOT 2011) 《公路建设项目水土保持工作规定》 水利部、交通部 2011

39	*Opinion from the State Council on important tasks for strengthening environmental protection* (State Council Announcement [2011] No. 35 《国务院关于加强环境保护重点工作的意见》国发[2011] 35 号
40	*Circular on strengthening plan environmental impact assessment for industrial parks* (MEP Announcement [2011] No. 14) 《关于加强产业园区规划环境影响评价有关工作的通知》 环发[2011] 14 号
41	*Measures for environmental supervision* (MEP Decree [2012] No. 21) 《环境监察办法》 环令[2012] 21 号
42	*Requirement for the preparation of environmental impact report summary* (MEP Announcement [2012] No. 51)《建设项目环境影响报告书简本编制要求》环告[2012] 51 号
43	*Opinion on strengthening environmental protection for industrial parks* (MEP Announcement [2012] No. 54) 《关于加强化工园区环境保护工作的意见》 环发[2012] 54 号
44	*Circular on stepping up the strengthening of environmental impact assessment management for the prevention of environmental risk* (MEP Announcement [2012] No. 77 《关于进一步加强环境影响评价管理防范环境风险的通知》环发[2012] 77 号
45	*Technical policy for the pollution prevention of volatile organic compounds (VOCs)* (MEP Announcement, [2013] No. 31) 《挥发性有机物（VOCs）污染防治技术政策》 环告[2013] 31 号）
46	*Atmospheric pollution prevention and control action plan* (State Council Announcement [2013] No. 37) 《大气污染防治行动计划》国发〔2013〕37 号
47	*Policy on integrated techniques for air pollution prevention and control of small particulates* (MEP Announcement [2013] No. 59) 《环境空气细颗粒物污染综合防治技术政策》环发[2013] 59 号
48	*Guideline on government information disclosure of construction project environmental impact assessment (on trial)* (MEP Announcement [2013] No. 103) 《建设项目环境影响评价政府信息公开指南（试行）》环办[2013] 103 号
49	*Measures for the disclosure of environmental information by enterprises and business entities* (MEP Decree [2014] No. 31) 《企业事业单位环境信息公开办法》 环令 [2014] 31 号
50	Key technical points for environmental impact assessment of highway network planning (on trial) (MEP [2014] No. 102) 《公路网规划环境影响评价技术要点（试行）》 环办[2014]102 号
51	*Management measure for the registration of emergency environmental incident contingency plan from enterprises and business entities (on trial)* (MEP Announcement [2015] No. 4) 《企业事业单位突发环境事件应急预案备案管理办法（试行）》 环发[2015] 4 号
52	*Directory for the management of construction project environmental impact assessment categorization* (MEP Decree [2015] No. 33) 《建设项目环境影响评价分类管理名录》环令[2015] 33 号
53	*Measures for public participation in environmental protection* (MEP Decree [2015] No. 35) 《环境保护公众参与办法》 环令[2015] 35 号
54	*Management measures for environmental impact post assessment of construction projects* (on trial) (MEP decree [2015] No. 37) 《建设项目环境影响后评价管理办法（试行）》环令[2015] 37 号
55	*Circular on the environmental impact assessment management of significant changes in construction projects for some industrial sectors* (MEP Announcement [2015] No. 52) 《关于印发环评管理中部分行业建设项目重大变动清单的通知》环办[2015] 52 号
56	*Guiding ideas for strengthening environmental protection for industrial parks (public consultation version)* MEP 2015 《关于加强工业园区环境保护工作的指导意见》（公开征求意见稿）环保部 2015
57	*National hazardous waste list* (MEP Decree [2016] No. 39) 《国家危险废物名录》 环令 [2016] 39 号
Guidelines	
58	HJ 2.1-2011 *Technical guidelines for environmental impact assessment – general program*《环境影响评价技术导则 总纲》
59	HJ 2.2-2008 *Guidelines for environmental impact assessment – atmospheric environment* 《环境影响评价技术导则 大气环境》
60	HJ/T 2.3-93 *Technical guidelines for environmental impact assessment – surface water environment* 《环境影响评价技术导则 地面水环境》
61	HJ 2.4-2009 *Technical guidelines for noise impact assessment* 《环境影响评价技术导则 声环境》

62	HJ 19-2011 *Technical guidelines for environmental impact assessment – ecological impact* 《环境影响评价技术导则 生态影响》
63	HJ 130-2014 *Technical guidelines for plan environmental impact assessment - general principles* 《规划环境影响评价技术导则 总纲》
64	HJ/T 131-2003 *Technical guidelines for environmental impact assessment of development area* 《开发区区域环境影响评价技术导则》
65	HJ/T 169-2004 *Technical guidelines for environmental risk assessment on projects* 《建设项目环境风险评价技术导则》
66	HJ 192-2015 *Technical criterion for ecosystem status evaluation* 《生态环境状况评价技术规范》
67	HJ/T 298-2007 *Technical specifications on identification for hazardous waste* 《危险废物鉴别技术规范》
68	HJ/T 393-2007 *Technical specifications for urban fugitive dust pollution prevention and control* 《防治城市扬尘污染技术规范》
69	HJ 552-2010 *Technical guidelines for environmental protection in highway projects for check and accept of completed construction project* 《建设项目竣工环境保护验收技术规范 - 公路》
70	HJ 610-2011 *Technical guidelines for environmental impact assessment – groundwater environment* 《环境影响评价技术导则 地下水环境》
71	HJ 616-2011 *Guidelines for technical review of environmental impact assessment on construction projects* 《建设项目环境影响技术评估导则》
72	HJ 623-2011 *Standard for the assessment of regional biodiversity* 《区域生物多样性评价标准》
73	HJ 630-2011 *Technical guideline on environmental monitoring quality management* 《环境监测质量管理技术导则》
74	HJ 663-2013 *Technical regulation for ambient air quality assessment* (on trial) 《环境空气质量评价技术规范（试行）》
75	HJ 710.1-2014 *Technical guidelines on biodiversity monitoring - terrestrial vascular plants* 《生物多样性观测技术导则-陆生维管植物》
76	HJ 710.2-2014 *Technical guidelines on biodiversity monitoring - lichens and bryophytes* 《生物多样性观测技术导则-地衣和苔藓》
77	HJ 710.3-2014 *Technical guidelines on biodiversity monitoring - terrestrial mammals* 《生物多样性观测技术导则-陆生哺乳动物》
78	HJ 710.4-2014 *Technical guidelines on biodiversity monitoring – birds* 《生物多样性观测技术导则-鸟类》
79	HJ 710.5-2014 *Technical guidelines on biodiversity monitoring – reptiles* 《生物多样性观测技术导则-爬行动物》
80	HJ 710.6-2014 *Technical guidelines on biodiversity monitoring – amphibians* 《生物多样性观测技术导则-两栖动物》
81	HJ 710.7-2014 *Technical guidelines on biodiversity monitoring - inland water fish* 《生物多样性观测技术导则-内陆水域鱼类》
82	HJ 710.8-2014 *Technical guidelines on biodiversity monitoring - freshwater benthic macroinvertebrates* 《生物多样性观测技术导则-淡水底栖大型无脊椎动物》
83	HJ 710.9-2014 *Technical guidelines on biodiversity monitoring – butterflies* 《生物多样性观测技术导则-蝴蝶》
84	HJ 2000-2010 *Technical guidelines for air pollution control projects* 《大气污染治理工程技术导则》
85	HJ 2015-2012 *Technical guidelines on water pollution control engineering* 《水污染治理工程技术导则》
86	HJ 2018-2012 *Technical specifications for sugar industry wastewater treatment* 《制糖废水治理工程技术规范》
87	HJ 2025-2012 *Technical specifications for collection, storage, transportation of hazardous waste* 《危险废物收集、贮存、运输技术规范》
88	HJ 2038-2014 *Technical specification for management of municipal wastewater treatment plant operation* 《城镇污水处理厂运行监督管理技术规范》
89	HJ 2042-2014 *General specifications of engineering and technology for hazardous waste disposal* 《危险废物处置工程技术导则》
90	HJ 2034-2013 *Technical guidelines for environmental noise and vibration control engineering* 《环境噪声与振动控制工程技术导则》

91	JTG B03-2006 Specifications for environmental impact assessment of highways 《公路建设项目环境影响评价规范》
92	JT/G B04-2010 *Highway environmental protection design specification* 《公路环境保护设计规范》
93	*Technical guidelines for environmental impact assessment – highway construction project (public comment version*, (MEP 2008) 《环境影响评价技术导则 公路建设项目》 （征求意见稿）环境保护部 2008
94	*Assessment guideline for green industrial building* (MOHURD 2010 《绿色工业建筑评价导则》住房及城乡建设部 2010
95	*Technical guidelines for environmental impact assessment - public participation (public comment version)*, (MEP 2011) 《环境影响评价技术导则 公众参与》（征求意见稿）环境保护部 2011
96	*Technical guideline for evaluation of green industrial building* (MOHURD 2015) 《绿色工业建筑评价标准》住房及城乡建设部 2015
97	*Technical guideline for evaluation of green data center building* (MOHURD 2015) 《绿色数据中心建筑评价技术细则》住房及城乡建设部 2015
98	*Assessment guidelines for green building materials* (on trial) (MOHURD 2015) 《绿色建材评价技术导则（试行）》住房及城乡建设部 2015
Standards	
99	CJ/T 289-2008 *The disposal of sludge from municipal wastewater treatment plant – The quality of sludge used in making brick* 《城镇污水处理厂污泥处置 制砖用泥质》
100	CJ/T 291-2008 *The disposal of sludge from municipal wastewater treatment plant – Sludge quality for land improvement* 《城镇污水处理厂污泥处置 土地改良用泥质》
101	CJ/T 309-2009 *The disposal of sludge from municipal wastewater treatment plant – Control standards for agricultural use* 《城镇污水处理厂污泥处置 农用泥质》
102	CJ 3082-1999 *Discharge standard for municipal wastewater* 《污水排入城市下水道水质标准》
103	GB 3095-2012 *Ambient air quality standards* 《环境空气质量标准》
104	GB 3096-2008 *Environmental quality standard for noise*《声环境质量标准》
105	GB 3097-1997 *Sea water quality standard* 《海水水质标准》
106	GB 3838-2002 *Environmental quality standards for surface water* 《地表水环境质量标准》
107	GB 4284-84 *Control standards for pollutants in sludges from agricultural use* 《农用污泥中污染物控制标准》
108	GB 5085.6-2007 *Identification standards for hazardous wastes – Identification for toxic substance content* 《危险废物鉴别标准 毒性物质含量鉴别》
109	GB 8978-1996 *Integrated wastewater discharge standard* 《污水综合排放标准》
110	GB 10070-88 *Standard of environmental vibration in urban area* 《城市区域环境振动标准》
111	GB 12348-2008 *Emission standard for industrial enterprises noise at boundary* 《工业企业厂界环境噪声排放标准》
112	GB 12523-2011 *Emission standard of environmental noise for boundary of construction site*《建筑施工场界环境噪声排放标准》
113	GB/T 14529-93 *Principle for categories and grades of nature reserves* 《自然保护区类型与级别划分原则》
114	GB 14554-93 *Emission standards for odor pollutants* 《恶臭污染物排放标准》
115	GB/T 14848-93 *Quality standard for ground water* 《地下水质量标准》
116	GB/T 15190-2014 *Technical specifications for regionalizing environmental noise function* 《声环境功能区划分技术规范》
117	GB 15618-1995 *Environmental quality standard for soils* 《土壤环境质量标准》
118	GB 16297-1996 *Air pollutant integrated emission standards* 《大气污染物综合排放标准》
119	GB 18483-2001 *Emission standard of cooking fume* (on trial) 《饮食业油烟排放标准》（试行）
120	GB 18597-2001 *Standard for pollution control on hazardous waste storage* 《危险废物贮存污染控制标准》
121	GB 18598-2001 *Standard for pollution control on the security landfill site for hazardous wastes* 《危险废物填埋污染

	控制标准》
122	GB 18599-2001 *Standard for pollution control on the storage and disposal site for general industrial solid wastes* 《一般工业固体废物贮存、处置场污染控制标准》
123	GB/T 18883-2002 *Indoor air quality standard* 《室内空气质量标准》
124	GB 18918-2002 *Discharge standard of pollutants for municipal wastewater treatment plant* 《城镇污水处理厂污染物排放标准》
125	GB/T 18920-2002 *Reuse of recycling water for urban – Water quality standard for urban miscellaneous water consumption* 《城市污水再生利用 城市杂用水水质》
126	GB/T 18921-2002 *The reuse of urban recycling water – Water quality standard for scenic environment use* 《城市污水再生利用景观环境用水水质》
127	GB/T 19923-2005 *The reuse of urban recycling water – Water quality standard for industrial uses* 《城市污水再生利用 工业用水水质》
128	GB/T 21010-2007 *Current land use classification* 《土地利用现状分类》
129	GB 22337-2008 *Emission standard for community noise* 《社会生活环境噪声排放标准》
130	GB/T 23485-2009 *Disposal of sludge from municipal wastewater treatment plant – Quality of sludge for co-landfilling* 《城镇污水处理厂污泥处置 混合填埋用泥质》
131	GB 50118-2010 *Design specifications for noise insulation of buildings for civil use* 《民用建筑隔声设计规范》
132	GB 50189-2015 *Design standard for energy efficiency of public buildings* 《公共建筑节能设计标准》
133	GB 50325-2010 *Code for indoor environmental pollution control of civil building engineering* 《民用建筑工程室内环境污染控制规范》
134	GB/T 50378-2014 *Assessment standard for green building* 《绿色建筑评价标准》
135	GB 50433-2008 *Technical code on soil and water conservation of development and construction projects* 《开发建设项目水土保持技术规范》
136	GB 50434-2008 *Control standards for soil and water loss on development and construction projects* 《开发建设项目水土流失防治标准》
137	GB 50763-2012 *Code for accessibility design* 《无障碍设计规范》
138	GB/T 50878-2013 *Evaluation standard for green industrial building* 《绿色工业建筑评价标准》
139	JG/J 146-2004 *Environmental and hygiene standards for construction sites* 《建筑施工现场环境与卫生标准》
140	JGJ/T 229 *Code for green design of civil buildings*《民用建筑绿色设计规范》
141	*List of controlled ozone layer depleting substances in China* (2010) 《中国受控消耗臭氧层物质清单》2010

36. **Environmental protection.** The most far-reaching law on pollution prevention and control is the *Environmental Protection Law* (EPL) (1989, amended in 2014) (item #3 in Table 2). When promulgated in 1989, it set out key principles for the nation's pollution control system, including the policy known as the "Three Simultaneities[10]", the application of pollution levy, and requirements for EIA. The EPL was amended in 2014 and the amended EPL took effect on 1 January 2015. The implementation of "Three Simultaneities" was further strengthened by the decree on its management procedures (items #26 and #33) and the *Construction Project Environmental Protection Management Ordinance* (item #16).

37. Public participation and environmental information disclosure provisions are among the most significant changes introduced in the amended EPL, further supported by the decrees on the measures (items # 31 and #53) and technical guidelines (item #94) for public participation during the EIA process, preparation of EIA report summary for disclosure (item #42), information

[10] The "Three Simultaneities Policy" requires the design, construction, and operation of pollution control and treatment facilities to occur simultaneously with the project design, construction, and operation.

disclosure on construction project EIAs by government (item #48), and environmental information disclosure by industries and enterprises (item # 49).

38. The amended EPL further defines enforcement and supervision responsibilities of all levels of environmental protection authorities, imposes stricter obligations and more severe penalties on enterprises and construction units regarding pollution prevention and control, and allows for environmental public interest litigation including through nongovernment organizations. Environmental inspection and enforcement on design, installation, and operation of project-specific environmental protection and control measures are regulated under the "Three Simultaneities" (items #3, #16, #26, and #33).

39. For grievance redress, a hotline number 12369 has been established at each level of environmental protection authority throughout the nation since March 2011 for receiving and resolving environmental complaints in accordance with the *Management measures for the operation of the environmental complaint hotline* (MEP Decree [2010] No. 15] (item #35).

40. The EPL also provides protection for community health, with protection of occupational health and safety provided by the *Labor Law* (1994) (item #5), the *Occupational Disease Prevention and Control Law* (2001) (item #9), and environmental and hygiene standards for construction sites (item #139).

41. Other relevant laws and regulations include those for protecting (i) air quality (item #8) including ozone depleting substances (item #20) and decrees on volatile organic carbons (VOC) (item #45), small particulates (item #47) and an action plan to prevent and control atmospheric pollution (item #46); (ii) noise (item #7); (iii) water (items #1 and #10), biological resources (items #2, #14 and #15); (iv) solid waste (item #6) including decrees on construction waste (item #30), municipal solid waste (MSW) (item #37) and hazardous waste (item #57); soil and water loss (items #4 and #13); and (v) cultural relics (items #12 and #17).

42. **Environmental impact assessment.** EIA is governed by the *Environmental Impact Assessment Law* (2002, amended in 2016[11]) (item #11), covering EIAs for (i) plans (such as new development areas and new industrial parks) and strategic studies which could also be deemed as strategic environmental assessments (SEA), and (ii) construction projects. This was followed by the promulgation of two regulations: the *Construction Project Environmental Protection Management Ordinance* (1998) (item #16) and the *Plan Environmental Impact Assessment Ordinance* (2009) (item #19). Both require early screening and environmental categorization. Relevant decrees include those related to EIAs for construction projects financed by international financial organizations (item #24), plan EIAs for industrial parks (#40), prevention of environmental risks (item #44), significant changes in construction projects requiring EIA revisions (item #55) and follow up EIA after commissioning of construction projects (item #54); as well as those decrees on public participation and information disclosure during the EIA process described above.

43. A recent MEP decree, the *Directory for the management of construction project environmental impact assessment categorization* (MEP Decree [2015] No. 33) (item #52), classifies 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)

[11] The 2016 amendment revised the penalty for projects without EIA from fixed amounts to percentages of the project cost.

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. Environmentally sensitive areas, as defined in the Decree, include three categories: (i) nature reserves and protected areas, scenic areas, world cultural and natural heritage sites, drinking water source protection zones; (ii) basic farmland and grassland, forest parks, geological parks, important wetland, natural woodland, critical habitats for endangered plant and animal species, important aquatic spawning/nursery/ wintering/migration grounds, regions suffering from water resource shortage, serious soil erosion areas, desertification protection areas, eutrophic water bodies; and (iii) inhabited areas with major residential, health care, scientific research, and administration functions, cultural heritage protection sites, and protection areas with historical, cultural, scientific, and ethnic values.

44. **Guidelines and standards.** MEP has issued a series of technical guidelines for preparing EIAs. These include impact assessment guidelines on general EIA program (item #58) and principles (item #63), atmospheric environment (item #59) and ambient air quality (item #74), noise (item #61), surface water (item #60), ground water (item #70), ecology (items #62 and #66) and regional biodiversity (item #72), biodiversity monitoring of various biota (items #75 to #83), plan EIA (item #63) and EIA for development area (item #64), environmental risk (item #65), environmental monitoring (item #73), and public participation (item #95). Besides technical guidelines for EIAs, there are also technical guidelines for pollution prevention and control. These include air pollution (item #84) and dust (item #68), noise and vibration (item #90), water pollution (item #85), hazardous waste (items #67, #87 and #89), operation of wastewater treatment plant (WWTP) (item #88), wastewater treatment for sugar industry[12] (item #86) and highway design[13] (item #92)

45. Standards issued by MEP generally consist of environmental quality (ambient) standards (applicable to the receiving end) and emission/discharge standards (applicable to the pollution source). The former includes standards for ambient air quality (item #103) and indoor air quality (item #123), noise (item #104), vibration (item #110), categorization of noise functions (item #116), sea water (item #105), surface water (item #106), groundwater (item #115) and soil (item #117). The latter includes standards for municipal wastewater (item #102), integrated wastewater (item #109), pollutants discharging into municipal wastewater treatment plant (item #124); recycled water for various uses (items #125, #126 and #127); wastewater sludge quality for disposal at landfill (item #130) and for various uses (items #99, #100, #101 and #107); hazardous identification (item #108), storage (item #120) and disposal (item #121); industrial solid waste disposal (item 122); integrated emission of air pollutants (item #118); ozone depleting chemicals (item #141); odor (item #114); cooking fume from canteens (item #119), indoor environment (item #133); construction noise (item #112); operational noise (item #111); community noise (item #129); building noise insulation (item #131); and soil and water loss (items #135 and #136).

46. **Energy conservation and green building**. In recent years, the Ministry of Housing and Urban-Rural Development (MOHURD) has issued a number of design, assessment and evaluation guidelines for energy conservation and green buildings. These include design codes and standards for energy efficiency (item #132) and green buildings (item #140); as well as assessment and evaluation guidelines and standards for green buildings (item #134), industrial

[12] Relevant to subproject 4 in Chongzuo where the project area in the Chongzuo Sino-Vietnam Border Economic Cooperation Zone is predominated by sugar cane industries.

[13] Relevant to subprojects 4, 6, 7 and 8 which involve road design and construction.

buildings (items #94, #96 and #138), data centers (item #97) and building materials (item #98).

47. **PRC laws, regulations, decrees, guidelines and standards relevant to the project**. The eight subprojects would involve the construction and operation of buildings, roads and wastewater treatment plant (see Table 1), mostly located in industrial parks. PRC laws, regulations, decrees, technical guidelines and standards relevant to these subprojects include the (i) environmental protection management and acceptance inspection of construction projects and industrial parks (items #16, #26 and #56); (ii) management and control of ozone layer depletion substances[14] (items #20 and #141); (iii) industrial solid waste (item #122), construction waste (item #30) and municipal solid waste (item #37); (iv) safe management of hazardous chemicals (item #22) and storage and disposal of hazardous wastes[15] (items #108 and #120); (v) environmental impact assessment and information disclosure for construction projects and for industrial parks (items #24, #40, #48, #52 and #71); (vi) design, environmental impact assessment, soil and water conservation, environmental supervision and environmental acceptance inspection for road projects (items #27, #28, #29, #38, #50, #69, #91, #92 and #93); (vii) building accessibility design, noise insulation and indoor environmental quality (items #137, #131, #123 and #133); (viii) sugar industry wastewater treatment (item #8); (ix) wastewater treatment plant operation and effluent and sludge standards including the use of recycled water and sludge (items #32, #88, #102, #109, #124, #125, #126, #127, #99, #100, #101, #107 and #130) and (x) energy conservation and green building design and assessment (items #94, #96, #97, #98, #132, #134, #138 and #140).

48. **ADB environmental safeguard requirements.** The proposed project is classified as category B for environment for tranche 2 subprojects as it is considered that the tranche 2 subprojects are unlikely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. This project therefore requires the preparation of an IEE report for tranche 2 which includes an EMP. ADB's SPS 2009 requires a number of considerations that are over and above the domestic EIR or EIT requirements. These include, among others, (i) project risks and respective mitigation measures and project assurances; (ii) project-level GRM; (iii) definition of the project area of influence; (iv) consideration of physical cultural resources; (v) climate change mitigation and adaptation; (vi) occupational and community health and safety requirements; (vii) economic displacement that is not part of land acquisition; (viii) consideration of biodiversity conservation and natural resources management requirements; (ix) provision of justification if local environmental quality standards are used; (x) meaningful consultation and participation; and (xi) implementation schedule and (measurable) performance indicators in the EMP. An environmental assessment and review framework (EARF) has been prepared to guide the EA in conducting rapid environmental assessment for categorization and in preparation of EIA or IEE for tranche 3.

49. **Relevant International Agreements.** The PRC is a signatory to a number of international agreements relevant to environment protection. Those relevant to the project, along with the dates of signing by the PRC, are listed in Table 3.

Table 3: International agreements with the PRC as a signatory

No.	Name of Agreement	PRC Signing Date	Agreement Objective
1	*Montreal Protocol on Substances That Deplete the*	1989.01.01	To protect the ozone layer by controlling emissions of substances that deplete it. Relevant to subproject 6

[14] Relevant to subproject 5 where the cold storage warehouse would use coolant that have ozone depletion potential.
[15] Relevant to subprojects 1 and 2 where the laboratories would generate small amounts of hazardous wastes such as spent solvents, waste oil and lubricants.

No.	Name of Agreement	PRC Signing Date	Agreement Objective
	Ozone Layer		
2	*Convention on Biological Diversity*	1993.12.29	To develop national strategies for the conservation and sustainable use of biological diversity. Relevant to all subprojects.
3	*United Nations Framework Convention on Climate Change*	1994.03.21	To achieve stabilization of greenhouse gas concentrations in the atmosphere at a low enough level to prevent dangerous anthropogenic interference with the climate system. Relevant to all subprojects.
4	*Kyoto Protocol to the United Nations Framework Convention on Climate Change*	2005.02.23	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. Relevant to all subprojects.

D. Evaluation Standards

50. In the PRC, ambient conditions of air, noise, and water quality in the project area determine the appropriate category of emissions and effluent standards for the construction and operational phases of built infrastructure. The World Bank Group (WBG) Environmental Health and Safety (EHS) guidelines[16] (see below) are based on international best practice construction and operational procedures. Both the PRC standards and EHS guidelines are used in the assessments.

51. **Air quality.** The PRC ranks air quality into two classes according to its *Ambient air quality standard* (GB 3095-2012). Class 1 standard applies to nature reserves, scenic areas, and regions requiring special protection. Class 2 standard applies to residential areas, mixed residential/commercial areas, cultural areas, industrial zones, and rural areas. The WBG adopted the World Health Organization (WHO) standards for its EHS standards for air quality.

52. The WHO established air quality guideline (AQG) standards for various air quality parameters for the protection of public health. Yet recognizing 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.

53. Table 4 compares PRC's GB 3095–2012 *Ambient air quality standards* and the World Bank Group's EHS standard which has adopted the WHO AQG. The longer averaging period such as one year is more applicable to assessing impacts from multiple as well as regional sources; while shorter averaging periods such as 24 hours and one 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.

[16] World Bank Group. 2007. Environmental, health and safety guidelines-General EHS guidelines. Washington, DC

Table 4: Comparison of PRC and WBG ambient air quality standards

Air Quality Parameter	Averaging Period	PRC GB 3095-2012 (μg/m³)		WHO/World Bank Group EHS[17] (μg/m³)	
		Class 1	Class 2	Interim Targets	AQG
SO_2	1-year	20	60	n/a	n/a
	24-hour	50	150	50 - 125	20
	1-hour	150	500	n/a	n/a
TSP	1-year	80	200	n/a	n/a
	24-hour	120	300	n/a	n/a
PM_{10}	1-year	40	70	30 - 70	20
	24-hour	50	150	75 - 150	50
$PM_{2.5}$	1-year	15	35	15 - 35	10
	24-hr	35	75	37.5 - 75	25
NO_2	1-year	40	40	n/a	40
	24-hour	80	80	n/a	n/a
	1-hour	200	200	n/a	200
CO	24-hour	4,000	4,000	n/a	n/a
	1-hour	10,000	10,000	n/a	n/a
Note: n/a = not available					

54. The following observations are made comparing PRC and WBG ambient air quality standards as shown in Table 4, showing that WBG interim targets are comparable to PRC's GB 3095–2012 Class 2 standards:

(i) 24-hr SO_2: upper limit of EHS interim target (125 μg/m³) is more stringent than GB Class 2 standard (150 μg/m³);
(ii) 24-hour PM_{10}: the upper limit of the EHS interim target (125 μg/m³) is the same as GB Class 2 standard;
(iii) 24-hr $PM_{2.5}$: the upper limit of the EHS interim target (75 μg/m³) is the same as GB Class 2 standard; and
(iv) 24-hour NO_2: the EHS AQG (200 μg/m³) is the same as GB Class 2 standard.

55. PRC's *Indoor air quality standard* (GB/T18883-2002) prescribes the concentrations of 19 parameters for indoor air quality (Table 5). These standards are applicable to the indoor environment inside the buildings constructed under subprojects 5, 6, 7 and 8, especially upon initial occupancy where indoor decoration and new furniture could emit various air pollutants such as formaldehyde, benzene and volatile organic compounds. WBG EHS has no standard for indoor air quality but describes air pollutants such as volatile organic carbons (VOC) in the work place and appropriate preventive measures

[17] World Bank Group 2007, ibid.

Table 5: Indoor air quality standard (GB/T 18883-2002)

No.	Type	Parameter	Unit	Standard	Remark
1	Physical	Temperature	°C	22 - 28	Summer with air conditioning
				16 - 24	Winter with heating
2		Relative humidity	%	40 - 80	Summer with air conditioning
				30 - 60	Winter with heating
3		Air flow speed	m/s	0.3	Summer with air conditioning
				0.2	Winter with heating
4		New wind volume	m^3/(h-person)	30	
5	Chemical	Sulfur dioxide (SO_2)	mg/m^3	0.50	Hourly average
6		Nitrogen dioxide (NO_2)	mg/m^3	0.24	Hourly average
7		Carbon monoxide (CO)	mg/m^3	10	Hourly average
8		Carbon dioxide (CO_2)	%	0.10	Daily average
9		Ammonia (NH_3)	mg/m^3	0.20	Hourly average
10		Ozone (O_3)	mg/m^3	0.16	Hourly average
11		Formaldehyde (HCHO)	mg/m^3	0.10	Hourly average
12		Benzene (C_6H_6)	mg/m^3	0.11	Hourly average
13		Methylbenzene (C_7H_8) (=toluene)	mg/m^3	0.20	Hourly average
14		Dimthylbenzene(C_8H_{10}) (=xylol)	mg/m^3	0.20	Hourly average
15		Benzo[a]pyrene [B(a)P] ($C_{20}H_{12}$)	ng/m^3	1.0	Daily average
16		Respirable suspended particulate (PM_{10})	mg/m^3	0.15	Daily average
17		Total volatile organic compound (TVOC)	mg/m^3	0.60	8-hour average
18	Biological	Total bacterial colony count	cfu/m^3	2500	
19	Radioactive	Radon (^{222}Rn)	Bq/m^3	400	Annual average

56. Emission standards of fugitive particulate matter (such as dust) from construction sites are regulated under the PRC's *Air Pollutant Integrated Emission Standard* (GB 16297–1996). For particulate matter, the maximum allowable emission concentration is 120 mg/m^3 and the concentration limit at the boundary of construction sites is ≤ 1.0 mg/m^3, with no specification on the particulate matter's particle diameter.

57. For odor emitted from the newly constructed WWTP in subproject 1, PRC's *Emission standards for odor pollutants* (GB 14554-93) specifies that the fugitive emission of odor in the WWTP shall not exceed 20 odor units at the boundary of the WWTP.

58. Emission of fumes from the canteens in subproject 8 are controlled by PRC's *Emission standard of cooking fume (on trial)* (GB 18483-2001). Fumes emitted from the canteens shall not exceed a concentration of 2.0 mg/m^3 and the fume removal equipment shall have a minimum removal rate of 75% for canteens with 3 to 6 cooking stoves and 85% for those with more than 6 cooking stoves.

59. **Noise.** GB 3096–2008 *Environmental quality standard for noise* 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 environment and therefore has 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 centers.

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 railways, and is subdivided into 4a and 4b with the former applicable to major road (road class 2 and above) and marine traffic noise, and the latter applicable to rail noise.

60. Standards for various functional area categories are compared with the WBG's EHS guidelines in Table 6, showing that the EHS guidelines have lower noise limits for residential, commercial, and industrial mixed areas but higher noise limits for industrial areas. The EHS guidelines do not have separate noise limits for major roads but apply the same noise limits based on whether the areas are for residential or industrial use.

Table 6: Environmental quality standards for noise [L_{Aeq}: dB(A)]

Noise Functional Area Category	Applicable Area	GB 3096-2008 Standards		WBG EHS[18] Standards	
		Day 06:00-22:00	Night 22:00-06:00	Day 07:00-22:00	Night 22:00-07:00
0	Areas needing extreme quiet, such as convalescence areas	50	40	55	45
1	Areas mainly for residence, hospitals, cultural and educational institutions, administration offices	55	45		
2	Residential, commercial and industrial mixed areas	60	50		
3	Industrial areas, warehouses and logistic parks	65	55	70	70
4a	Area within 35 m on both sides of trunk road (class II and above)	70	55	55	45

61. The PRC's *Emission Standard of Environmental Noise for Boundary of Construction Site* (GB 12523–2011) regulates construction noise, limiting construction noise levels at the construction site boundary to 70 dB(A) in the day time (0600–2200 hours) and 55 dB(A) at night (2200–0600 hours). The WBG does not have standards for construction noise *per se*, but applies the same noise standards listed in Table 6 above to the receptors during construction activities.

62. Operational noise, such as the noise from operating the WWTP, is regulated by the *Emission standard for industrial enterprises noise at boundary* (GB12348-2008). Different standards are applicable to different noise functional categories defined under GB 3096-2008 described above. In fact the noise standards for controlling operational noise at the boundary of industrial enterprises are the same numerically (for both day time and night time) for various noise functional categories as those prescribed in GB 3096-2008 (see Table 6).

63. **Surface water quality and wastewater discharge.**, Standards for water quality assessment are prescribed in PRC's *Environmental quality standards for surface water* (GB 3838–2002) (Table 7). It defines five water quality categories for different environmental functions. Category I is the best, suitable for head waters and national nature reserves. Category II is suitable for drinking water sources in Class 1 protection areas, habitats for rare aquatic organisms, breeding grounds for fish and crustaceans, and feeding grounds for fish fry. Category III is suitable for drinking water sources in Class 2 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

[18] World Bank Group 2007, ibid.

V is the worst which is only suitable for agricultural and scenic water uses.

Table 7: Environmental quality standards for surface water GB 3838–2002

Parameter	Water Quality Category				
	I	II	III	IV	V
pH	6 ~ 9	6 ~ 9	6 ~ 9	6 ~ 9	6 ~ 9
Dissolved oxygen (DO) [mg/L]	90% saturation or ≥7.5	≥6	≥5	≥3	≥2
Permanganate index (I_{Mn}) [mg/L]	≤2	≤4	≤6	≤10	≤15
Chemical oxygen demand (COD) [mg/L]	≤15	≤15	≤20	≤30	≤40
5-day Biochemical oxygen demand (BOD_5) [mg/L]	≤3	≤3	≤4	≤6	≤10
Ammonia nitrogen (NH_3-N) [mg/L]	≤0.15	≤0.5	≤1.0	≤1.5	≤2.0
Total phosphorus (as P) [mg/L]	≤0.02	≤0.1	≤0.2	≤0.3	≤0.4
Lakes & reservoirs	≤0.01	≤0.025	≤0.05	≤0.1	≤0.2
Total nitrogen (lakes, reservoirs, as N) [mg/L]	≤0.2	≤0.5	≤1.0	≤1.5	≤2.0
Copper (Cu) [mg/L]	≤0.01	≤1.0	≤1.0	≤1.0	≤1.0
Zinc (Zn) [mg/L]	≤0.05	≤1.0	≤1.0	≤2.0	≤2.0
Fluoride (as F^-) [mg/L]	≤1.0	≤1.0	≤1.0	≤1.5	≤1.5
Selenium (Se) [mg/L]	≤0.01	≤0.01	≤0.01	≤0.02	≤0.02
Arsenic (As) [mg/L]	≤0.05	≤0.05	≤0.05	≤0.1	≤0.1
Mercury (Hg) [mg/L]	≤0.0005	≤0.0005	≤0.0001	≤0.001	≤0.001
Cadmium (Cd) [mg/L]	≤0.001	≤0.005	≤0.005	≤0.005	≤0.01
Chromium (Cr, hexavalent) [mg/L]	≤0.01	≤0.05	≤0.05	≤0.05	≤0.1
Lead (Pb) [mg/L]	≤0.01	≤0.01	≤0.05	≤0.05	≤0.1
Cyanide (CN) [mg/L]	≤0.005	≤0.05	≤0.2	≤0.2	≤0.2
Volatile phenol [mg/L]	≤0.002	≤0.002	≤0.005	≤0.01	≤0.1
Total petroleum hydrocarbon (TPH) [mg/L]	≤0.05	≤0.05	≤0.05	≤0.5	≤1.0
Anionic surfactant (=LAS) [mg/L]	≤0.2	≤0.2	≤0.2	≤0.3	≤0.3
Sulfide [mg/L]	≤0.05	≤0.1	≤0.2	≤0.5	≤1.0
Fecal coliform bacteria [number/L]	≤200	≤2000	≤10000	≤20000	≤40000

64. Discharge of wastewater from construction sites and industrial enterprises is regulated under the *Integrated wastewater discharge standard* (GB 8978–1996) (Table 8). Class 1 standard applies to discharge into Category III water bodies under GB 3838–2002. Class 2 standard applies to discharge into categories IV and V water bodies. Class 3 standard applies to discharge into municipal sewers going to municipal wastewater treatment plants (WWTPs) with secondary treatment. No new discharge of wastewater into Categories I and II water bodies is allowed. The WBG does not have ambient water quality standard, and recognizes the use of national and local ambient water quality criteria for EHS purpose.

Table 8: Standards for discharging wastewater from construction sites GB 8978–1996

Parameter		Class 1 (for discharging into Category III water body)	Class 2 (for discharging into Categories IV and V water body)	Class 3 (for discharging into municipal sewer)
pH	no unit	6 ~ 9	6 ~ 9	6 ~ 9
Suspended solid (SS)	mg/L	70	150	400
Biochemical oxygen demand (BOD_5)	mg/L	20	30	300
Chemical oxygen demand (COD)	mg/L	100	150	500
Total petroleum hydrocarbon (TPH)	mg/L	5	10	20
Volatile phenol	mg/L	0.5	0.5	2.0
Ammonia nitrogen (NH_3-N)	mg/L	15	25	---
Phosphate [PO_4^{2-} (as P)]	mg/L	0.5	1.0	---
LAS (= anionic surfactant)	mg/L	5.0	10	20

65. Discharge of treated wastewater from municipal WWTPs is regulated under the *Discharge standard of pollutants for municipal wastewater treatment plant* (GB 18918-2002) and amendment (MEP Announcement [2006] No. 21). Table 9 shows the three classes of effluent standards (with Class 1 further divided into 1A and 1B) applicable to municipal WWTPs. Class 1A standard applies to discharges for reuse or into rivers and lakes with comparatively low dispersive capacity, semi-enclosed water bodies and designated major watersheds and lakes by the State and provinces. Class 1B standard applies to discharges into Category III water bodies except those designated for drinking water source protection or swimming activities. Class 2 standard applies to discharges into categories IV and V water bodies. Class 3 standard applies to discharges from enhanced primary treatment in township WWTPs not located in major controlled watershed or drinking water source protection zone. However, these WWTPs are required to reserve adequate space for upgrading to secondary treatment meeting Class 2 effluent standard progressively.

Table 9: Standards for discharges from municipal wastewater treatment plant

No.	Parameter		Standard (Daily Average)			
			Class 1		Class 2	Class 3
			A	B		
1	Chemical oxygen demand (COD)	mg/L	50	60	100	120
2	Biochemical oxygen demand (BOD_5)	mg/L	10	20	30	60
3	Suspended solids (SS)	mg/L	10	20	30	50
4	Animal & plant oil and grease	mg/L	1	3	5	20
5	Total petroleum hydrocarbon (TPH)	mg/L	1	3	5	15
6	LAS (= anionic surfactant)	mg/L	0.5	1	2	5
7	Total nitrogen (TN, as N)	mg/L	15	20	---	---
8	Ammonia nitrogen (NH_3-N, as N)					
	Water temperature >12°C	mg/L	5	8	25	---
	Water temperature ≤12°C	mg/L	8	15	30	---
9	Total phosphorus (TP, as P)	mg/L	0.5	1	3	5
10	Color (number of dilutions)	times	30	30	40	50
11	pH	no unit	6 - 9	6 - 9	6 - 9	6 - 9

No.	Parameter		Standard (Daily Average)			
			Class 1		Class 2	Class 3
			A	B		
12	Coliform bacteria	no./L	10^3	10^4	10^4	---

66. **Soil 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 (Table 10). The WBG does not have EHS standards for soil quality.

Table 10: Soil quality standard GB 15618-1995

Parameter		Maximum Allowable Concentration (mg/kg dry weight)				
		Class 1	Class 2			Class 3
	Soil pH	Back ground	<6.5	6.5~7.5	>7.5	>6.5
Cadmium (Cd)		0.20	0.30	0.30	0.60	1.0
Mercury (Hg)		0.15	0.30	0.50	1.0	1.5
Arsenic (As)	Paddy	15	30	25	20	30
	Dry land	15	40	30	25	40
Copper (Cu)	Farm land	35	50	100	100	400
	Orchard	---	150	200	200	400
Lead (Pb)		35	250	300	350	500
Chromium (Cr)	Paddy	90	250	300	350	400
	Dry land	90	150	200	250	300
Zinc (Zn)		100	200	250	300	500
Nickel (Ni)		40	40	50	60	200
DDT		0.05	0.50			1.0
666 (Lindane)		0.05	0.50			1.0

E. Assessment Area (Project Area of Influence), Assessment Period, and Evaluation Standards for the Project

67. The **assessment area**, or the project area of influence, was determined based on potential impact distances of various environmental parameters, the assessment levels assigned by the local environmental authorities for various environmental media, and guidance provided in the PRC's series of Technical Guidelines for EIA (see Table 2, items #58-62). Table 11 shows the assessment areas and the PRC evaluation standards adopted for this project. A comparison of the PRC standards with internationally accepted standards (as defined in the World Bank's Environment Health and Safety Guidelines) was conducted for the IEE and described below. The comparison confirmed that the PRC standards are either internationally acceptable or have comparable standard limits with most of the international standards.

Table 11: Assessment area and PRC evaluation standards adopted for this project

Type of Standard	Environmental Media	Applicable PRC Standard	Project Area of Influence
Environmental quality standard	Ambient air quality	Class II standard in *Ambient air quality standard* (GB 3095-2012)	Up to 200 m beyond the "footprint" of the permanent and temporary land take areas
		Indoor air quality standard (GB/T 18883-2002)	Inside buildings
	Noise	Functional Area Categories 2 and 4a standards in *Environmental quality standard for noise* (GB 3096-2008)	Up to 200 m beyond the "footprint" of the permanent and temporary land take areas
	Surface water quality	Categories III, IV and V standards in *Environmental quality standards for surface water* (GB 3838-2002) depending on the water quality category of the water body.	Up to 300 m beyond the "footprint" of the permanent and temporary land take areas
	Ecology	No numerical standard. Assessment based on *Technical guidelines for environmental impact assessment – ecological impact* (HJ 19-2011)	"Footprint" of the permanent and temporary land take areas
	Physical cultural resources	No numerical standard but controlled under PRC's *Cultural Relics Protection Law* and *Cultural Relics Protection Law Implementation Ordinance.*	"Footprint" of the permanent and temporary land take areas
	Occupational health and safety	No numerical standard but controlled under PRC's *Labor Law* and *Environmental and hygiene standards for construction sites* (JG/J 146-2004)	Construction sites within the "footprint" of the permanent and temporary land take areas
	Community health and safety	No numerical standard	Up to 200 m beyond the "footprint" of the permanent and temporary land take areas
Pollutant emission standard	Air pollutant	*Air pollutant integrated emission standard* (GB 16297-1996), Class II and fugitive emission standards	Construction sites within the "footprint" of the permanent and temporary land take areas
		Emission standards for odor pollutants (GB 14554-93)	At the boundary of the WWTP
		Emission standard of cooking fume (on trial) (GB 18483-2001)	At the canteen flue gas exit point
	Noise	*Emission Standard of Environmental Noise for Boundary of Construction Site* (GB 12523-2011)	Construction sites within the "footprint" of the permanent and temporary land take areas
	Wastewater	*Integrated Wastewater Discharge Standard* (GB 8978-1996): (i) Class 1 standard for discharging into Category III water bodies; (ii)Class 2 standard for discharging into Categories IV and V water bodies; (iii) Class 3 standard for discharging into municipal sewers; (iv) No discharge into Categories I and II water bodies.	Construction sites within the "footprint" of the permanent and temporary land take areas during construction. Effluent discharge standards for the facilities during operation
		Class 1B standard in *Discharge standard of pollutants for municipal wastewater treatment plant* (GB 18918-2002)	At the outfall of the WWTP

68. The **assessment period** covers both construction and operation stages of the subprojects (Table 12). Construction durations would range from 12 to 26 months, with most of the subprojects less than two years. Assessment periods for the operation stage would be three years for the buildings and the WWTP, and 15 years for the roads based on their design horizon.

Table 12: Assessment periods for the subprojects

Subproject		Assessment Period	
No.	Title	Construction Stage	Operation Stage
1	Chongzuo Sino-Vietnam Border Economic Cooperation Zone demonstration project (phase I)	12 months	15 years for roads 3 years for WWTP
2	Dongxing Changhu Road (east section) construction project	12 months	15 years
3	Infrastructure development for Longzhou Border Economic Cooperation Zone	12 months	15 years
4	Road connectivity in Pingxiang-Viet Nam cross-border (phase 1)	24 months	15 years
5	Qinzhou cross-border trade e-commerce industrial park project	18 months	3 years
6	Qinzhou international cold-chain logistic demonstration project	22 months	3 years
7	China-ASEAN small and medium enterprises (SMEs) synergy innovative development project	22 months	3 years
8	China- ASEAN educational medicare cooperation project (phase I)	26 months	3 years

Source: FSRs

F. Justification for the Use of PRC Standards

69. ADB's *Safeguard Policy Statement (2009)* requires projects to apply pollution prevention and control technologies and practices consistent with international good practices as reflected in internationally recognized standards such as the World Bank Group's *Environmental, Health and Safety Guidelines*. Table 13 compares PRC standards with the World Bank Group's EHS guidelines, and concludes that the application of PRC legislated standards was justified. The justification is based on several observations:

70. The World Bank Group's EHS guidelines endorse the use of internationally recognized standards when there is no applicable national legislated standard. In this project, this clause applies to ambient air quality and ambient water quality standards: (i) The General EHS Guidelines on Air Emissions and Ambient Air Quality state that "Projects with significant sources of air emissions, and potential for significant impacts to ambient air quality, should [apply] national legislated standards, or in their absence, the current WHO Air Quality Guidelines or other internationally recognized sources". The availability of national legislated standards overrides the adoption of other internationally recognized standards; (ii) The General EHS Guidelines on Air Emissions and Ambient Air Quality state that "Projects with significant sources of air emissions, and potential for significant impacts to ambient air quality, should prevent or minimize impacts by ensuring that emissions do not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standards by applying national legislated standards, or in their absence, the current WHO Air Quality Guidelines or other internationally recognized sources". The availability of national legislated standards overrides the adoption of other internationally recognized standards.

71. **Some PRC standards are more stringent than internationally accepted standards.** PRC standards of relevance to the project include ambient CO and NO_2 concentrations (Table 13) from motor vehicle emissions on the roads, which are more stringent than the United States Environmental Protection Agency (USEPA) standards.

72. **PRC standards are not always comparable to standards suggested in the World Bank Group's EHS Guidelines.** Some ambient air quality standards, including NO_2 and H_2S, are defined for different time periods (exposures), and are thus not directly comparable (see Table

13). PRC ambient acoustic quality standards are defined for categories as well as by taking into consideration influencing factors such as road and rail traffic, and are different to the classification of the WBG that does not take influencing factors into consideration. As standard limits are not significantly different (e.g. noise levels), a shift to alternate classifications or time periods, which would require an adaptation of the monitoring procedures by nationally accredited monitoring stations, does not seem to be justified.

73. **Some PRC standards are not defined in the World Bank Group's EHS Guidelines.** Internationally accepted standards for NH_3 and TSP, which are defined in PRC ambient air quality standards, could not be identified. Other parameters which could not be compared to international standards include surface and marine water quality standards.

Table 13: Comparison of PRC standards with World Bank Group's EHS guideline

Parameter	PRC standards	International standards	*Remarks*
Ambient Air Quality	**GB-3095-2012**	**WHO Air Quality Guidelines Global Update (2005); USEPA**	
TSP	0.12 mg/m^3 (Class 1, 24h) 0.30 mg/m^3 (Class 2, 24h)	WHO: No standard USEPA: No standard	*No comparison possible*
CO	4.0 mg/m^3 (Class 1, 24h) 4.0 mg/m^3 (Class 2, 24h)	WHO: No standard USEPA: 10 mg/m^3	*PRC standard is more stringent than USEPA*
NO_2	0.08 mg/m^3 (Class 1, 24h) 0.08 mg/m^3 (Class 2, 24h) 0.20 mg/m^3 (Class 1, 1h) 0.20 mg/m^3 (Class 2, 1h)	WHO: 0.04 mg/m^3 (365d); 0.20 mg/m3 (1h) USEPA: 0.14 mg/m^3 (24h)	*PRC and WHO standards are either not compatible given the different time periods, or the same for same time period.* *PRC standard is more stringent than USEPA standard*
PM_{10}	0.05 mg/m^3 (Class 1, 24h) 0.15 mg/m^3 (Class 2, 24h)	WHO: 0.05 mg/m^3 (24h) USEPA: 0.15 mg/m^3 (24h)	*PRC standards are comparable to EPA standard.*
Ambient Acoustic Quality Standard	**GB-3096-2008**	**World Health Organization (1999)**	
L_{Aeq} (dBA)	45/55 (night/day, Category 1) 50/60 (night/day, Category 2) 55/65 (night/day, Category 3) 55/70 (night/day, Category 4a) 60/70 (night/day, Category 4b)	Class 1: 45/55 (night/day) Class 2: 70/70 (night/day)	*WHO Class 1: Residential, institutional, educational* *WHO Class 2: Industrial, commercial*
Surface Water Quality Standard	**GB-3838-2002**		*No comparable standard identified/suggested in the EHS guideline*
COD	15 mg/L (Category II) 20 mg/L (Category III) 30 mg/L (Category IV)		
NH_3-N	0.5 mg/L (Category II) 1.0 mg/L (Category III) 1.5 mg/L (Category IV)		
TP	0.1 mg/L (Category II) 0.2 mg/L (Category III) 0.3 mg/L (Category IV)		

Parameter	PRC standards	International standards	*Remarks*
Sea Water Quality Standard	**GB-3097-1997**		*No comparable standard identified/suggested in the EHS guideline*
COD	2 mg/L (Category I) 3 mg/L (Category II) 4 mg/L (Category III) 5 mg/L (Category IV)		
Inorganic. N	0.2 mg/L (Category I) 0.3 mg/L (Category II) 0.4 mg/L Category III) 0.5 mg/L (Category IV)		
Active P	0.015 mg/L (Category I) 0.030 mg/L (Category II) 0.030 mg/L (Category III) 0.045 mg/L (Category IV)		
Noise Standards for Industrial Enterprise Boundary	**GB 12348-2008**	**World Health Organization (1999)**	*WHO Class I: Residential, institutional, educational* *WHO Class II: Industrial, commercial*
L_{Aeq} (dBA)	55/45 (day/night, Category 1) 60/50 (day/night, Category 2) 65/55 (day/night, Category 3) 70/55 (day/night, Category 4)	Class 1: 45/55 (night/day) Class 2: 70/70 (night/day)	
Noise Limits for Construction Sites	**GB 12523-2011**	**USEPA**	
L_{Aeq} (dBA)	70/55 (day/night)	85 (day, 8h exposure)	

III. DESCRIPTION OF THE PROJECT

A. General

74. The proposed project consists of eight subprojects in tranche 2 (see Table 1) involving the construction and operation of buildings, roads and a wastewater treatment plant. This IEE and attached EMP therefore focus on assessing and mitigating potential environmental impacts during construction and operation of these facilities. Table 14 shows the domestic environmental assessment reporting and approval for these subprojects. Three environmental impact reports (EIR) and six environmental impact tables (EIT) have been prepared for the eight subprojects. The approval authorities for these EITs are the respective city or county EPBs. This IEE is prepared based on information provided in these EIRs and EITs, feasibility study reports (FSRs) for these subprojects, as well as site reconnaissance by the PPTA consultants.

Table 14: Domestic environmental assessment reporting for tranche 2 subprojects

Tranche 1 Subproject		Reporting	Preparation		Approval	
No.	Title	Category	By	Date	By	Date
1	Chongzuo Sino-Vietnam Border Economic Cooperation Zone demonstration project (phase I) 崇左中越边境经济合作区示范项目（一期）	EIR for the WWTP	Guangxi Yuhong Environmental Protection Consulting Co. Ltd. 广西宇宏环保咨询有限公司	April 2017	Chongzuo EPB	pending
		EIR for whole economic industrial park	Guangxi Yuhong Environmental Protection Consulting Co. Ltd. 广西宇宏环保咨询有限公司	April 2017	Chongzuo EPB	pending
2	Dongxing Changhu Road (east section) construction project 东兴市长湖路东段工程	EIT	Shanxi Qingyuan Environmental Consulting Co. Ltd. 山西清源环境咨询有限公司	September 2014	Dongxing EPB	2014.09.30
3	Infrastructure development for Longzhou Border Economic Cooperation Zone 龙州边境经济合作区基础设施项目	EIT	Guangxi Beibuwan Environmental Impact Assessment Co. Ltd. 广西北部湾环境影响评价有限公司	May 2017	Longzhou EPB	pending
4	Road connectivity in Pingxiang-Viet Nam cross-border (phase 1) 凭祥中越跨境经济合作区互联互通一期工程项目	EIR	Guangxi Transportation Science Research Institute 广西交通科学研究院	December 2016	Pingxiang EPB	2017.03.24
5	Qinzhou cross-border trade e-commerce industrial park project 钦州跨境贸易电子商务产业园项目	EIT	Chongqing Jiutian Environmental Impact Assessment Co. Ltd. 重庆九天环境影响评价有限公司	April 2017 (revised for ADB)	Qinzhou EPB	2016.10.28
6	Qinzhou international cold-chain logistic demonstration project 钦州国际冷链物流示范项目	EIT	Chongqing Jiutian Environmental Impact Assessment Co. Ltd. 重庆九天环境影响评价有限公司	April 2017 (revised for ADB)	Qinzhou EPB	2016.10.28
7	China-ASEAN small and medium enterprises (SMEs) synergy innovative development project 中国—东盟中小企业协同创新发展项目	EIT (for whole new campus)	Guangxi Qintianjing Environmental Technology Co. Ltd. 广西钦天景环境科技有限公司	October 2016	Guilin EPB	2016.11.10
8	China- ASEAN educational medicare cooperation project (phase I) 中国—东盟教育医疗合作项目（一期）	EIT (for whole phase 1)	Guangxi Shengchuan Environmental Protection Engineering Co. Ltd. 广西圣川环保工程有限公司	September 2015	Baise Youjiang District EPB	2015.11.10

Notes: ASEAN = Association of Southeast Asian Nations; **EIR** = environmental impact report; **EIT** = environmental impact table; **EPB** = Environmental Protection Bureau; **SME** = small and medium enterprise; **WWTP** = wastewater treatment plant

Source: EIRs & EITs

B. Project Rationale

75. **Unrealized potential in regional cooperation and investment**. The border areas of both the PRC and Viet Nam have been identified as key areas of accelerated development, taking advantage of opportunities offered by regional cooperation and investment, particularly in terms of improving cross-border connectivity and promoting cross-border economic activities. However, opportunities for regional cooperation and investment in the border areas of Guangxi and its neighboring provinces in Viet Nam have not been fully tapped. This has resulted in inefficient transport and trade operations along the GMS North-South Economic Corridor and unrealized economic growth potential in the border areas and beyond in both Guangxi and northern Viet Nam. This project will improve connectivity in these border areas thus achieving better regional cooperation and investment.

76. **Difficulties in attracting investment for small and medium enterprises (SMEs) in border areas**. SMEs are generally less developed in border areas with weaker capacities and competitiveness, especially in their start-up phases. They have limited access to bank credit and often have difficulties in hiring and retaining managerial staff and skilled labor. This project will provide support to help these SMEs operate in border areas, develop growth strategies, train Chinese and Vietnamese workers, and improve their organizational and management capacities. Business development services are a critical element in supporting SME development in border areas, which will be strengthened via this project. In tranche 2, education and training will also be provided for highly specialized skills in the aerospace and aeronautic industries and the medical and pharmaceutical professions.

77. **Difficulties in adopting new technologies**. New technologies such as e-commerce are important for accessing markets at and beyond borders. Guangxi still faces constraints in cross-border e-commerce development. These constraints include (i) high start-up costs and technological complexities discouraging investments in e-commerce; (ii) fragmented market without market leaders to provide demonstration effect; (iii) lack of dedicated e-commerce parks to provide one-stop services covering information and communications technology, payment and settlement, logistics and customs clearance; and (iv) weak capacity in terms of lack of trained professionals and actual practitioners with sufficient knowledge of international best practices. This project will improve the e-commerce platforms for cross-border trade, transaction settlement, customs clearance and other items.

78. **Poor connectivity in linking key economic points of interest across the border**. While physical connectivity between Guangxi and Viet Nam has been generally improved in recent years, there are still gaps in cross-border transport links. These include (i) the lack of expressways or high-grade trunk roads linking the economic enters in Guangxi and Viet Nam; (ii) low density and poor conditions of feeder roads in the border area, particularly those linking the border economic zones on both sides of the border; and (iii) insufficient number of border bridges with low through-put capacity. This project will improve the transport network and road conditions in the border area, and through-put capacities at selected border control points.

C. Subproject 1: Chongzuo Sino-Vietnam Border Economic Cooperation Zone demonstration project (phase I)

79. This subproject is located in the Chongzuo Sino-Vietnam Border Economic Cooperation Zone in Xinhe Town in Chongzuo (see Figure 1), involving the (i) construction of four new roads and upgrading of two existing roads totaling 19.847 km with total land take area of 54.21 ha, (ii)

construction of a new wastewater treatment plant with 10,000 m^3/d design treatment capacity and having a land take of 2.47 ha, and (iii) installation of 21.91 km of wastewater collection pipelines. It is in accordance with the *Chongzuo Jiangzhou District Urban Master Plan (amendment) (2014-2030)* and the *Xinhe Town Master Plan*. Table 15 describes the scope of this subproject. The BECZ has a planned area of 28.4 km2 (= 2,840 ha) under the management of the Chongzuo Jiangzhou District Economic Industrial Park Management Committee. Total land take from this subproject constitutes approximately 2% of the size of the BECZ. Planned land uses within the BECZ include residential, commercial, recreational, municipal services such as schools and hospitals etc, tourism, logistics and warehouse, and industrial. Industrial land use has been planned to occupy 206.35 ha (= 7.3%), mainly consists of a manganese and aluminum processing industrial park and a sugar cane circular economy industrial park. The proposed subproject is located in the sugar cane circular economy industrial park involving sugar cane product processing enterprises with mainly locally harvested sugar canes, and circular economy in the sense that the waste products from sugar cane processing are used by other enterprises in the industrial park for the processing of agricultural fertilizers and animal feeds. A plan environmental impact report[19] has been prepared for the BECZ in April 2017 assessing potential impacts from the construction and operation of the BECZ, and provided measures to manage and mitigate potential environmental impacts arising from the development and operation of the BECZ. The plan EIR concluded that with sound management and diligent implementation of environmental management measures, potential environmental impacts from the development and operation of the BECZ. These measures include separation of storm water and wastewater collection and treatment, emphasis on water re-use and energy conservation, rejection of industrials with high water and energy consumption as tenants, collection and treatment of chemical waste and municipal solid waste in accordance with applicable regulations. All industrial enterprises in the BECZ will have to undergo environmental impact assessment process in accordance with the *Directory for the management of construction project environmental impact assessment categorization* (MEP Decree [2015] No. 33) (item #52 in Table 2) and all industrial wastewater will have to be pretreated to comply with the Class 3 standard of the *Integrated Wastewater Discharge Standard* (GB 8978-1996) (see Table 11) before discharging into public sewers.

Table 15: Description of subproject 1 components

	Subproject Component	Description
1	Roads	4 primary trunk roads with dual-2 lane and design speed of 40 km/h: • Xinde Road: new, 2,630 m long, 26 m wide • Xingong Avenue: new, 2,710 m long, 30 m wide • Xinghe Avenue: upgrade, 4,604 m long, 30 m wide • Huaqiao Avenue: upgrade, 1,040 m long, 30 m wide 2 secondary trunk roads with dual-1 lane and design speed of 30 km/hr: • Huancheng South Road: new, 3,481 m long, 18 m wide • Binjiang Avenue: new, 5,382 m long, 18 m wide TOTAL ROAD LENGTH = 19.847 km TOTAL LAND TAKE = 54.21 ha
2	Wastewater treatment plant	10,000 m^3/d treatment capacity TOTAL LAND TAKE = 2.47 ha
3	Wastewater collection pipeline	21.91 km wastewater collection pipelines

Source: FSR

[19] Guangxi Yuhong Environmental Protection Consulting Co. Ltd. 2017. Chongzuo City Jiangzhou District Economic Industrial Park environmental impact report (for review version). Prepared for the Chongzuo Jiangzhou District Economic Industrial Park Management Committee. April 2017.

80. **Roads and traffic flow forecast**. All six roads will be paved with asphalt concrete. Figure 2 shows the locations of these roads within the BECZ. Figure 3 shows the cross-sectional views of the roads. Table 16 presents the traffic flow forecast for the six subproject roads, indicating that by the design horizon year 2033, the four primary trunk roads would have more than 11,000 vehicles per day dominated by small and mid-size passenger cars with large and container trucks making up less than 10% of the traffic.

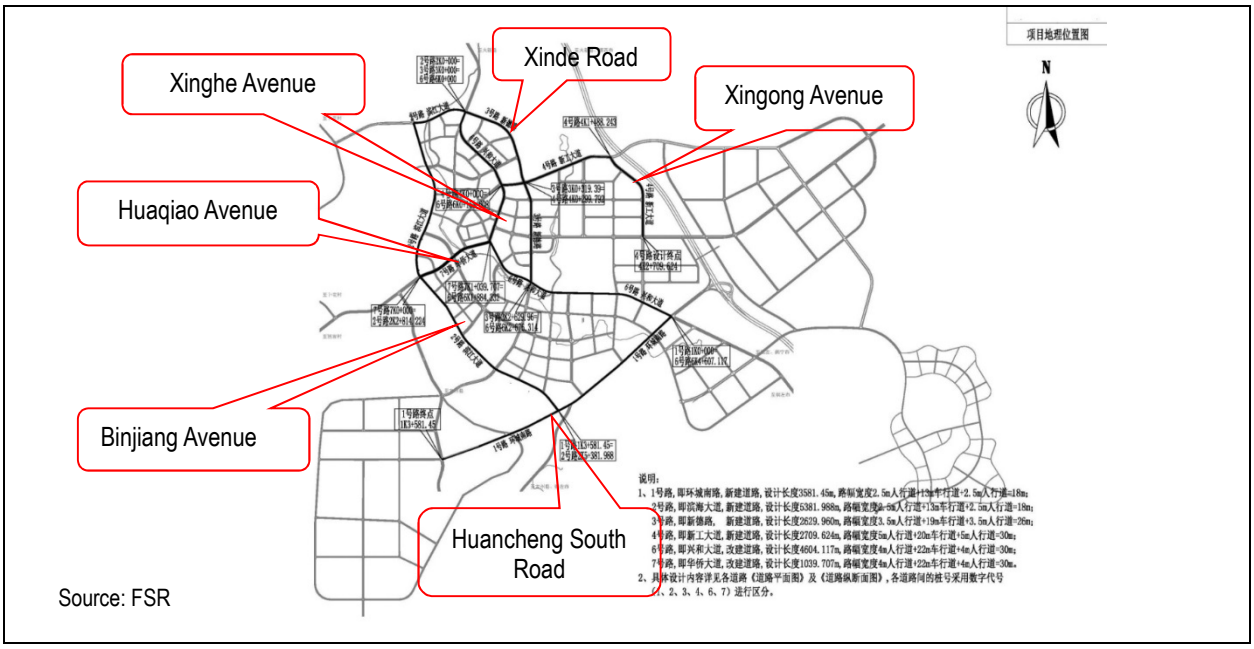
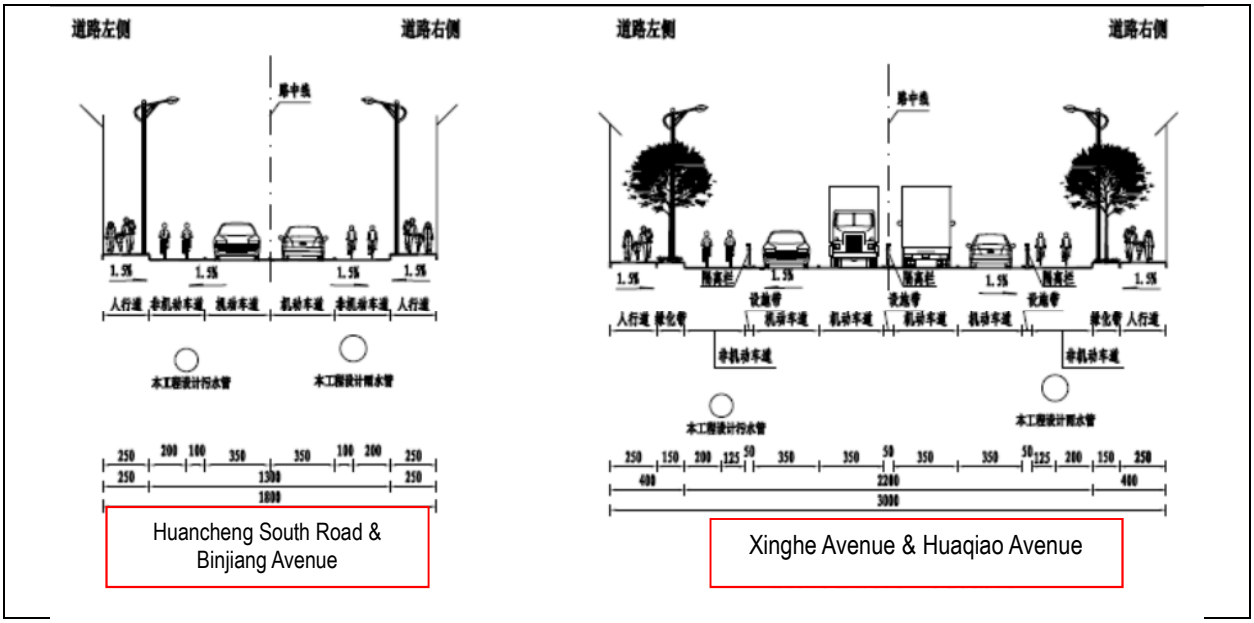
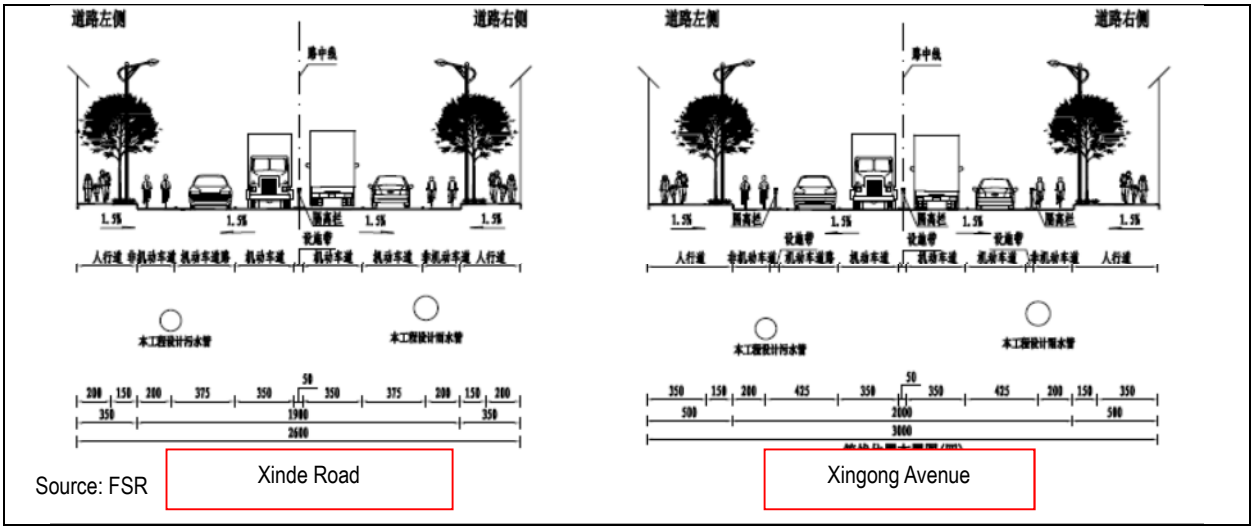


Figure 2: Locations of subproject roads within the Chongzuo Sino-Vietnam Border Economic Cooperation Zone in Xinhe Town





Source: FSR

Figure 3: Cross-sectional views of roads in subproject 1

Table 16: Traffic flow forecast for the proposed roads in subproject 1

Road	Daily Traffic Flow (vehicles/day) in Year		
	2023	2025	2033
Xinde Road	9210	11755	15002
Xingong Avenue	7358	9389	11985
Xinghe Avenue	7072	9023	11518
Huaqiao Avenue	7286	9299	11870
Huancheng South Road	4136	5155	6423
Binjiang Avenue	4088	5094	6350

Notes:
Composition of vehicle types:
(i) Small passenger cars: 46.09%
(ii) Mid-size passenger cars: 21.93%
(iii) Small trucks: 13.90%
(iv) Mid-size trucks: 9.13%
(v) Large trucks: 4.69%
(vi) Container trucks: 4.26%
Peak hour flow = 6.63% of daily flow
Day:night traffic flow ratio = 75%:25% of daily traffic flow

Source: FSR

81. **Wastewater collection and treatment.** .Figure 4 shows the locations of the proposed WWTP and the wastewater collection pipeline alignments within the Chongzuo Sino-Vietnam BECZ in Xinhe town. High density polyethylene (HDPE) pipes ranging from 400 mm to 1200 mm in diameter will be installed by open and cut method for wastewater collection. The wastewater treatment plant will adopt the dynamic membrane bioreactor (DMBR) process, which combines the technologies in membrane bioreactor, bio-membrane and anerobic-anoxic-oxic process. Figure 5 shows the treatment process. Disinfection will be by ultraviolet (UV) irradiation. Sludge dewatering will be by belt press.

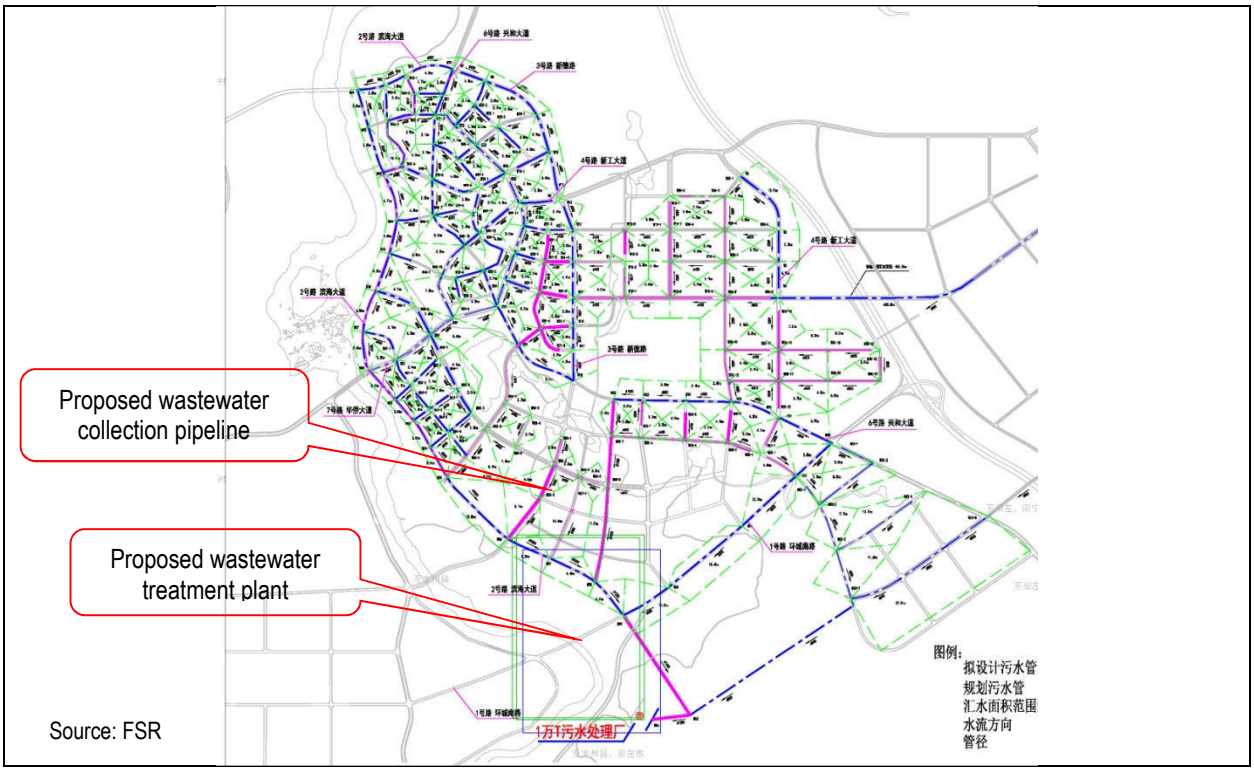
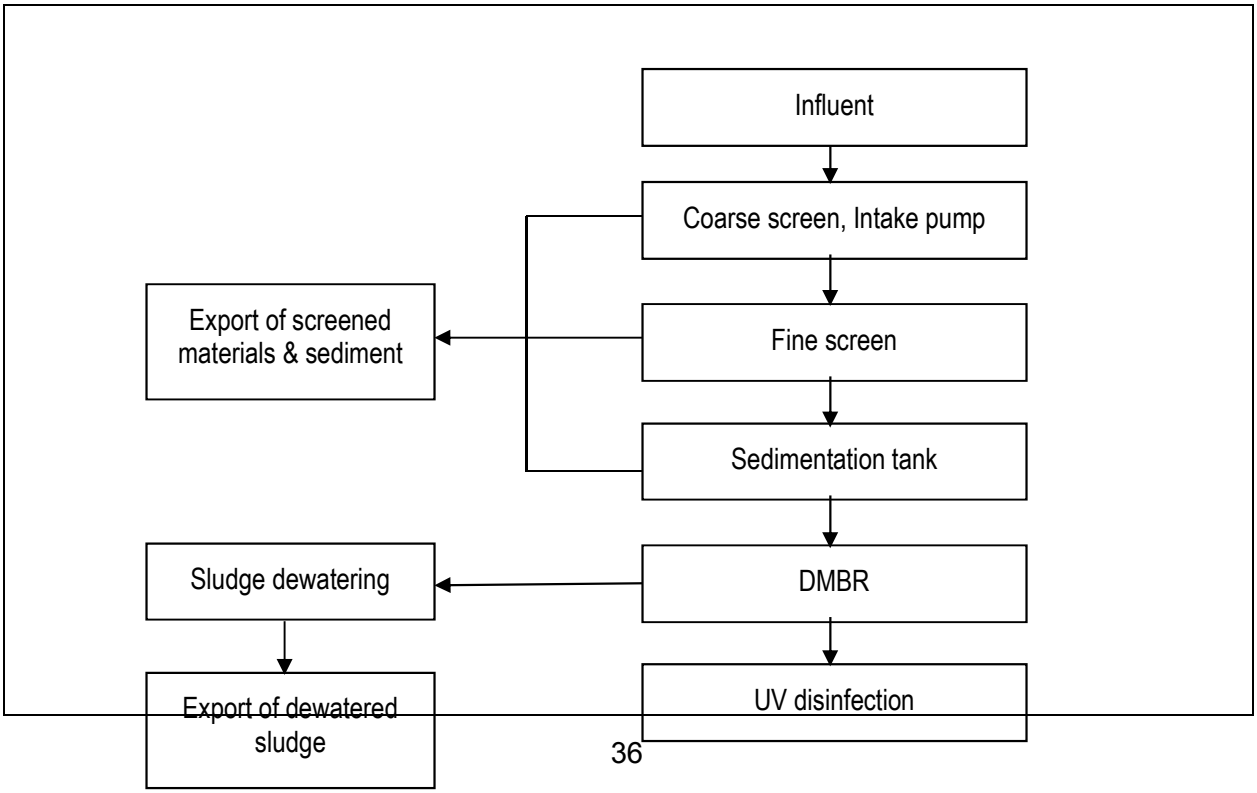
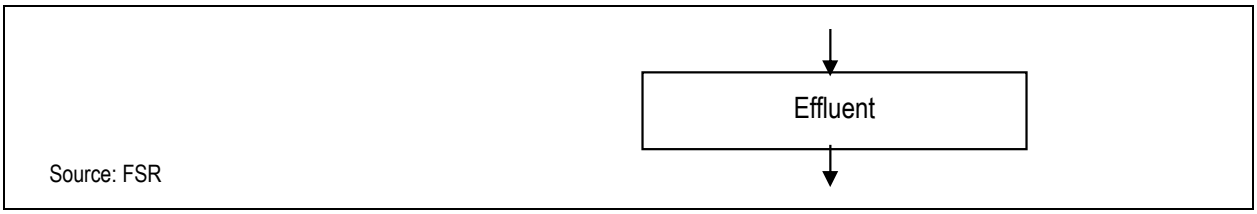


Figure 4: Locations of wastewater treatment plant and wastewater collection pipelines within the Chongzuo Sino-Vietnam Border Economic Cooperation Zone in Xinhe Town





Source: FSR

Figure 5: Wastewater treatment process flow diagram

82. The WWTP will treat both pretreated (by industrial enterprises mostly sugar cane processing industries in the BECZ) industrial wastewater and municipal wastewater from the BECZ. For discharging industrial wastewater into public sewer, the industrial wastewater must be pretreated to meet Class 3 standard prescribed in PRC's *Integrated wastewater discharge standard* (GB 8978-1996) (item #109 in Table 2). Table 17 presents the influent and effluent qualities. The effluent will be treated to Class 1B standard prescribed in the *Discharge standard of pollutants for municipal wastewater treatment plant* (GB 18918-2002) (item #124 in Table 2). The treated effluent will be discharged into the Heishui River which has category III water quality.

Table 17: Influent and effluent qualities for the wastewater treatment plant

Item	Concentration of Parameters in mg/L				
	COD	BOD_5	NH_3-N	SS	TP
Influent quality	≤ 500	≤ 300	≤ 40	≤ 400	≤ 4.0
Effluent quality (Class 1B standard)	≤ 60	≤ 20	≤ 15	≤ 20	≤ 1
Removal rate	≥88%	≥93.3%	≥62.5%	≥95%	≥75%

Source: FSR

D. Subproject 2: Dongxing Changhu Road (east section) construction project

83. This subproject is located in Dongxing (see Figure 1) involving the construction of the new east section of the Changhu Road and ancillary works for utility provisions along the alignment such as the installation of water supply and wastewater collection pipelines, and conduits for electricity (from the national grid) and communication cables. This road section will be 3,706 m long and 62 m wide, with the western end approximately 200 m east of the Luofu River. It will be a primary trunk road with dual-3 lanes and design speed of 60 km/h. Road pavement will be by cement concrete. Traffic flow forecast estimates 13,123 vehicles/day in 2022 and 23,718 vehicles/day in 2030. This subproject is in accordance with the *Dongxing Urban Master Plan (2013-2030)*.

84. Total permanent land take would be 25.2 ha. Temporary land take would be about 11.7 ha, which would include 0.2 ha for the construction camp and staging area, and 11.5 ha for temporary storage of excavated spoil (which will all be re-used on other road projects in Dongxing). The road would cross the upstream sections of the Dagoulong Reservoir (for irrigation) and the Xiangche Creek drainage ditch. Culverts will be constructed for the passage of these water bodies underneath the road. Figure 6 shows the alignment of the proposed road and nearby environ. Figure 7 presents a cross-sectional view of the dual-3 lane road.

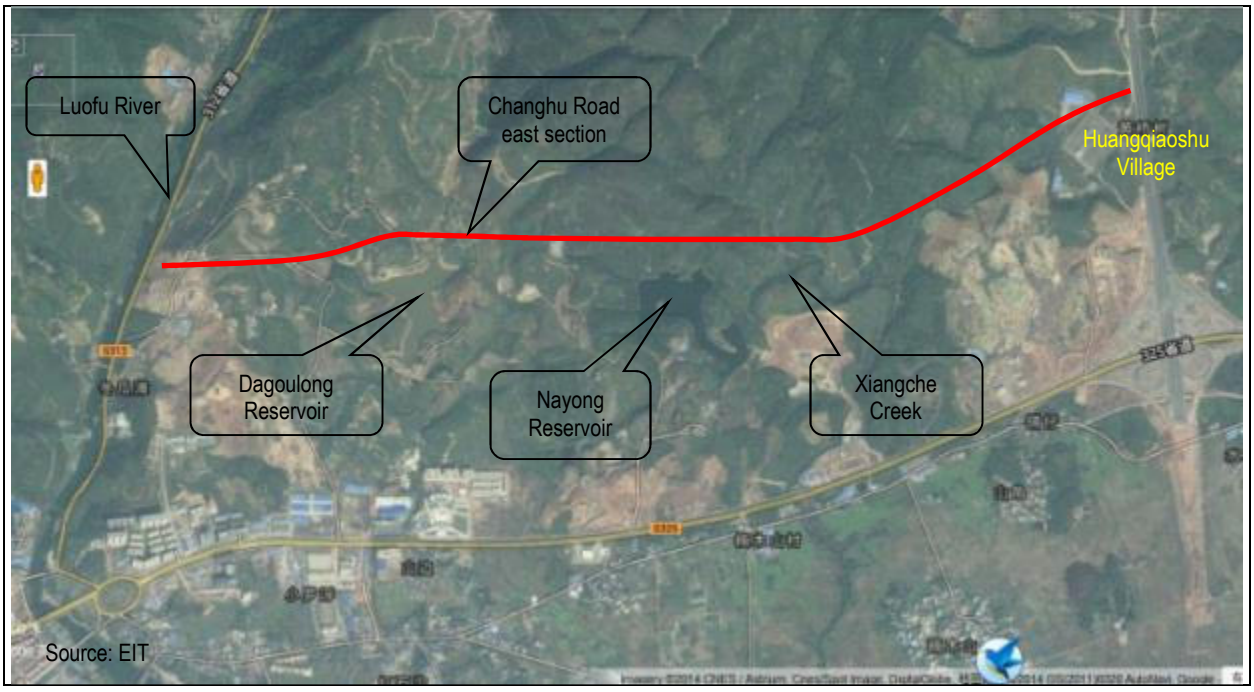


Figure 6: Aerial photograph showing the proposed alignment of Changhu Road east section and nearby environ

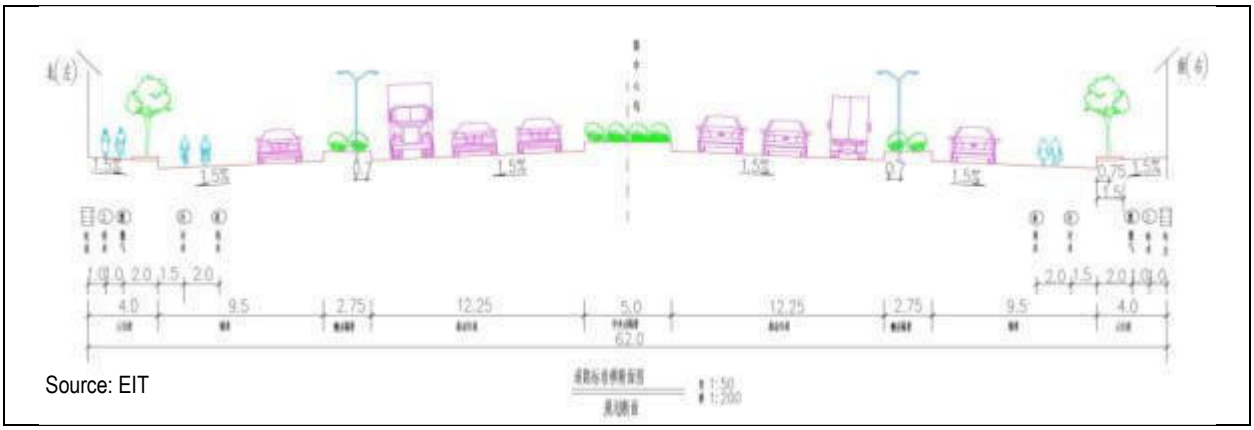


Figure 7: Cross-sectional view of Changhu Road east section

E. Subproject 3: Infrastructure development for Longzhou Border Economic Cooperation Zone

85. This subproject is located in the Poverty Alleviation Industrial Park within the Longzhou BECZ in Longzhou (see Figure 1). It is in accordance with the *Longzhou County Urban Master Plan*, the *Longzhou County Shuikou Town Master Plan* and the *Longzhou County Shuikou Border Trade Poverty Alleviation Industrial Park Master Plan*. The Poverty Alleviation Industrial Park occupies

an area of 305 ha with the purpose of attracting dry fruit processing enterprises in particular processing of nuts (such as cashew nuts and pistachio nuts) imported from Viet Nam, providing local employment and contributing to poverty alleviation. Longzhou accounts for approximately 70% of the national cashew nut import total, which in 2016 reached 198,000 t. A plan environmental impact report (EIR)[20] for the BECZ was prepared in 2015, indicating adequate municipal infrastructure such as water supply (Longzhou County Water Treatment plant with 22,000 m^3/d capacity), and wastewater treatment (Longzhou County Wastewater Treatment Plant with 20,000 m^3/d capacity). The plan EIR suggested measures to mitigate potential environmental impacts and indicated that potential environmental impacts would be acceptable if the management committee implements these measures. The subproject involves the construction of five roads totaling 9.729 km and ancillary works for utility provisions such as installation of drainage and water supply pipelines. Total land take has been estimated to be 30.81 ha, which accounts for approximately 10% of the size of the Poverty Alleviation Industrial Park. Four are new roads and one is an existing road for upgrading. Road pavement for all roads will be asphalt concrete. Table 18 describes the scope of this subproject. Table 19 presents the traffic flow forecast, indicating more than 11,000 vehicles/day would travel on each of the five roads in year 2033, and Yuanbian Road would have the highest traffic flow with more than 19,000 vehicles/day. Figure 8 shows the locations of the proposed subproject roads within the BECZ and Figure 9 shows the typical cross-sectional views of these roads.

Table 18: Description of the subproject roads

Name of Road		Description
1	Hengsi Road	2.182 km long, 40 m wide, new dual-2 lane primary trunk road with 40 km/h design speed
2	Zong'er Road	0.590 km long, 30 m wide, new dual-2 lane primary trunk road with 30 km/h design speed
3	Yuanbian Road	2.261 km long, upgrade existing to 40 m wide dual-3 lane primary trunk road with 50 km/h design speed
4	Heng'er Road	2.158 km long, 20 m wide, new dual-1 lane secondary trunk road with 30 km/h design speed
5	Hengsan Road	2.538 km long, 20 m wide, new dual-1 lane secondary trunk road with 30 km/h design speed
TOTAL LENGTH:		**9.729 km**
TOTAL LAND TAKE:		**30.81 ha**

Source: FSR

Table 19: Traffic flow forecast for the proposed roads in subproject 3

Road	Daily Traffic Flow (vehicles/day) in Year		
	2023	2025	2033
Hengsi Road	7518	9368	11674
Zong'er Road	7444	9276	11563
Yuanbian Road	12482	15556	19386
Heng'er Road	7557	9417	11734
Hengsan Road	7794	9712	12104

Notes:
Composition of vehicle types:
(i) Small passenger cars: 54.22%
(ii) Mid-size passenger cars: 19.90%

[20] Dongfang Huanyu Environmental Protection Technology Development Co. Ltd. 2015. Plan environmental impact report for the Longzhou Border Economic Cooperation Zone master plan (2015-2030). Prepared for the Longzhou Shuikou Port Economic Zone Management Committee.

Road	Daily Traffic Flow (vehicles/day) in Year		
	2023	2025	2033
(iii) Small trucks: 12.03% (iv) Mid-size trucks: 7.42% (v) Large trucks: 3.31% (vi) Container trucks: 3.12% Peak hour flow = 6.60% of daily flow Day:night traffic flow ratio = 75%:25% of daily traffic flow			

Source: FSR

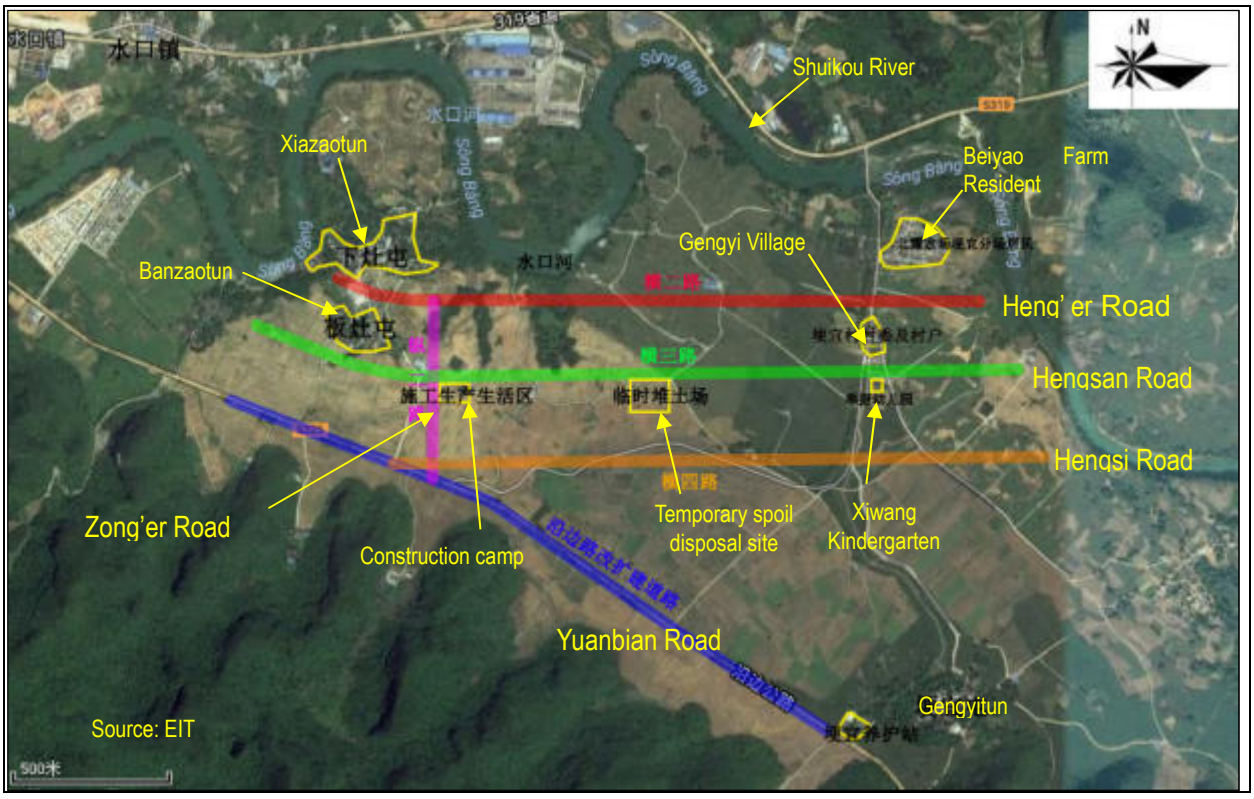
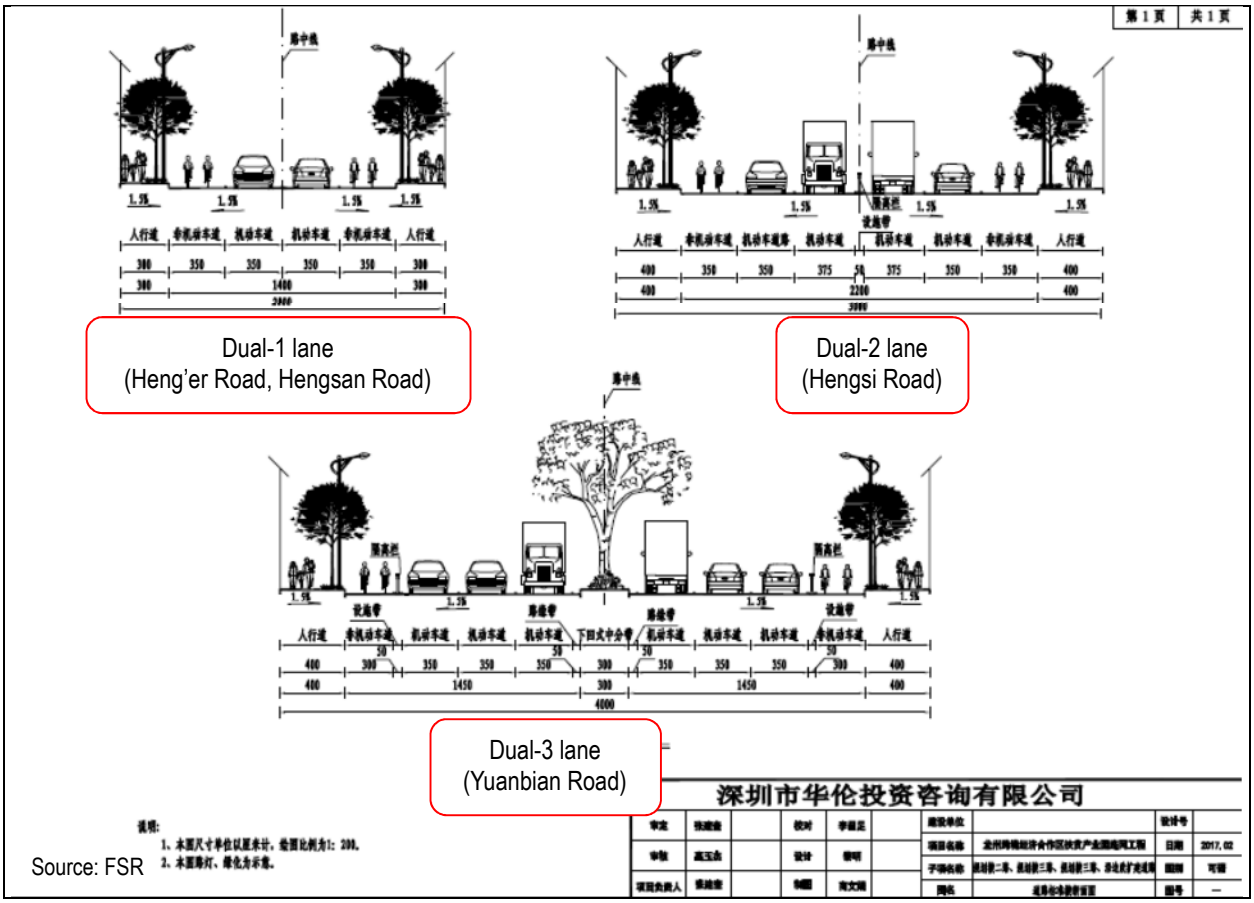


Figure 8: Aerial photograph showing the locations of subproject 3 roads and nearby environ in the Longzhou BECZ



Source: FSR

Figure 9: Typical cross-sectional views of subproject roads within the Longzhou Border Economic Cooperation Zone

F. Subproject 4: Road connectivity in Pingxiang-Viet Nam cross-border (phase 1)

86. This subproject is located in Pingxiang (see Figure 1) involving the construction of one road along mountainous terrain linking the towns of Kafeng and Nonghuai near the border with Viet Nam. It is in accordance with the *Pingxiang Urban Master Plan (2010-2030)*. The road section in this subproject does not link directly to a border control point. The road will be a new dual-2 lane class II road that is 2.668 km in length and 16 m in width with design speed of 40 km/h, with one gorge crossing bridge that is 106 m in length. Road pavement will be cement concrete. The road will run next to the existing road which is a class IV road that will be over-capacity soon and will be abandoned after this new road is completed. Some sections of the new road would utilize the old road alignment. Total land take would be 10.11 ha. Traffic flow forecast presented in Table 20 shows an annual growth rate of 6% from 2020 to 2029, reaching over 14,000 vehicles per day by year 2035. Figure 10 shows location of the proposed alignment and nearby environ. Figure 11 shows a cross-sectional view of the sub-grade along mountainous terrain.

Table 20: Traffic flow forecast for the proposed road in subproject 4

Item	Year		
	2020	2029	2035
No. vehicles/day (converted to small passenger cars)	8,394	12,954	14,433
Annual growth rate		6.03%	2.10%
Composition of vehicle types:			
(i) Small truck	8.09%	8.45%	8.75%
(ii) Mid-size truck	7.04%	8.31%	9.16%
(iii) Large trunk	3.66%	4.41%	4.96%
(iv) Container trunk	1.83%	2.41%	2.80%
(v) Small passenger car	28.21%	32.08%	34.35%
(vi) Large passenger car	6.76%	6.89%	7.13%
(vii) Tractor	5.78%	4.47%	2.72%
(viii) Motorcycle	38.64%	32.98%	30.12%

Source: FSR

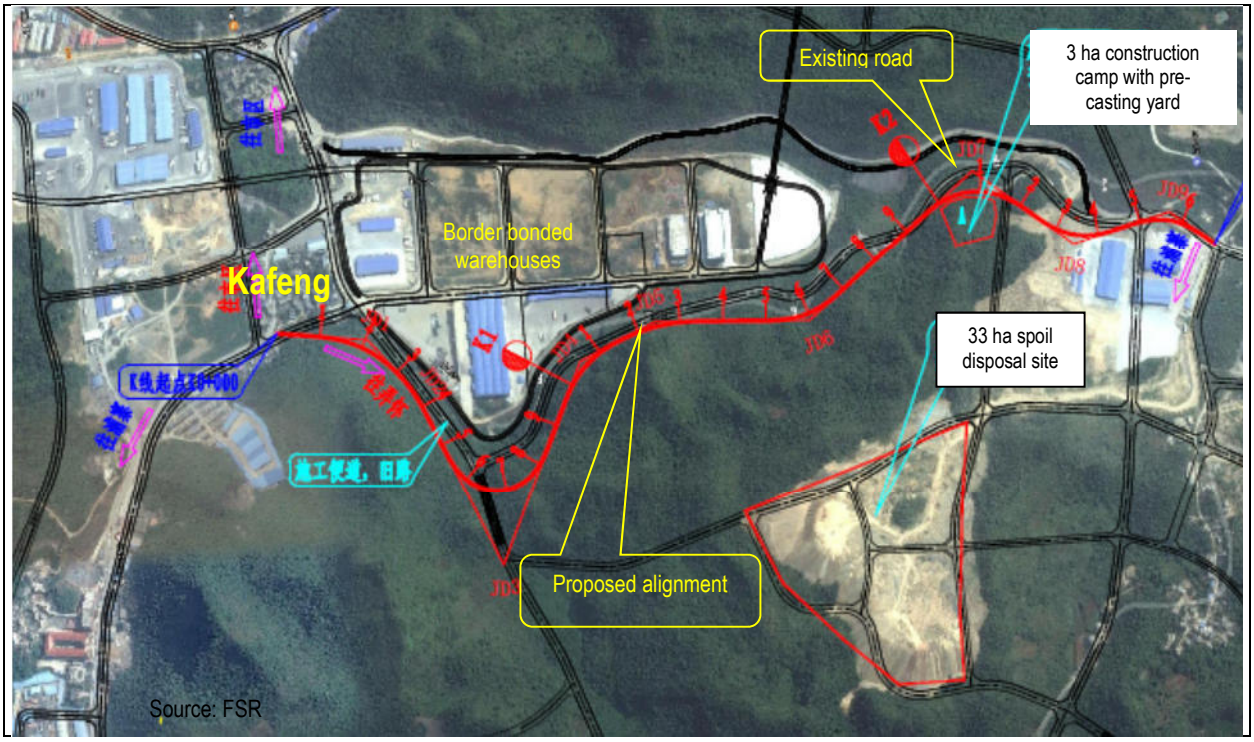


Figure 10: Aerial photograph showing the proposed Kafeng to Nonghuai alignment and nearby environ

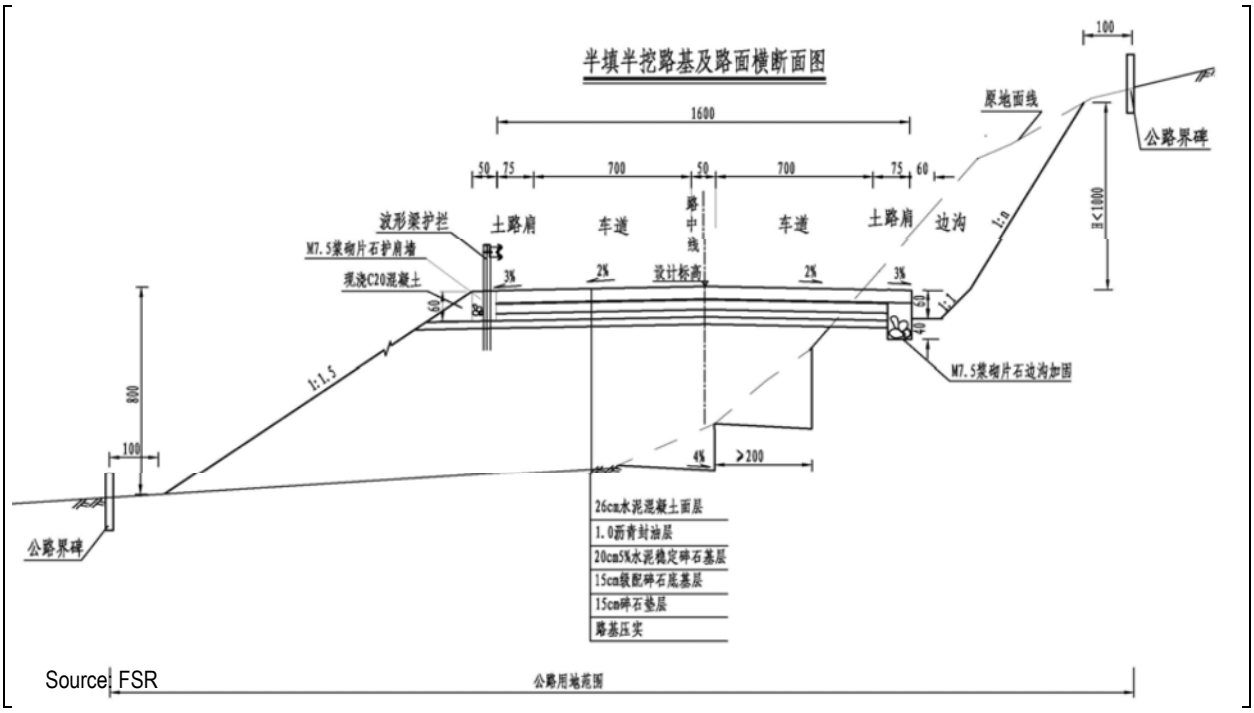


Figure 11: Cross-sectional view of sub-grade of the proposed road from Kafeng to Nonghuai along mountainous terrain

G. Subproject 5: Qinzhou cross-border trade e-commerce industrial park project

87. This subproject is located in Qinzhou (see Figure 1). It is in accordance with the *Qinzhou Bonded Port Zone Master Plan* and the *Guangxi Qinzhou Bonded Port Zone Cross-Border E-commerce Business Development Plan*. The site has an area of 5.67 ha in the Qinzhou Bonded Port Zone which occupies an area of 10 km^2 (1,000 ha) on land that was reclaimed from the sea. Reclamation for the construction of the Qinzhou Port started in August 1992 with the first two berths commissioned for operation in January 1994. In May 2008, the State Council approved the establishment of the Qinzhou Bonded Port Zone for logistics, port and navigation services, processing industries and international trade, etc. A plan EIR for the Qinzhou Bonded Port Zone was prepared in 2014[21]. The plan EIR indicates adequate municipal infrastructure to support the operation of the Qinzhou Bonded Port Zone, such as water supply (by the Qinzhou Port Water Treatment Plant and the Dalanping Water Treatment Plant), wastewater treatment (by the Dalanping Wastewater Treatment Plant),industrial solid waste (by the Qinzhou Industrial Solid Waste Treatment Center) and municipal solid waste (by the Qinzhou MSW Sanitary Landfill). The plan EIR has suggested measures for the environmental management of the Qinzhou Bonded Port Zone by its management committee, indicating that potential environmental impacts would be acceptable if such measures are implemented. These measures include establishment and implementation of an environmental management system for the Bonded Port Zone, criteria for selection of tenants, and environmental assessment process for all industrial enterprises prior to

[21] Guangxi Zhuang Autonomous Region Environmental Protection Science Research Institute. 2014. Environmental impact report for the Guangxi Qinzhou Bonded Port Zone Master Plan. Prepared for the Guangxi Qinzhou Bonded Port Zone Management Committee.

their establishment within the Bonded Port Zone. This subproject involves the construction of five buildings with total floor area of 50,000 m^2 providing offices, bonded warehouses, e-commerce supervision platform and merchandize exhibition and sales center to facilitate e-commerce and cross-border trade (Table 21). Based on historical import data, items for e-commerce trade and bonded warehousing are consumer products dominated by electronics, clothing and accessories, outdoor goods and health and cosmetic products. The total land take of 1.54 ha is approximately 0.15% of the size of the Qinzhou Bonded Port Zone. Figure 12 shows the location of the subproject site and nearby environ, dominated by port facilities and oil tank farms for industrial uses. Figure 13 shows the layout of the buildings and facilities on the site. The PIE has no authority over the inspection of imports and exports. All customs inspection and procedures will be in accordance with PRC laws and regulations.

Table 21: Description of Buildings and Facilities for subproject 5

Buildings and Facilities		Floor Area (m2)
1	Cross-border merchandize exhibition & sales center	10,000
2	Commercial office building	10,000
3	E-commerce supervision platform	10,000
4	Commercial ancillary facilities	10,000
5	E-commerce bonded warehouses	10,000
	Total floor area:	**50,000**
	Total land take area by buildings & facilities:	**15,361.31**

Source: FSR

Figure 12: Aerial photograph showing the location of subproject 5 site and nearby environ

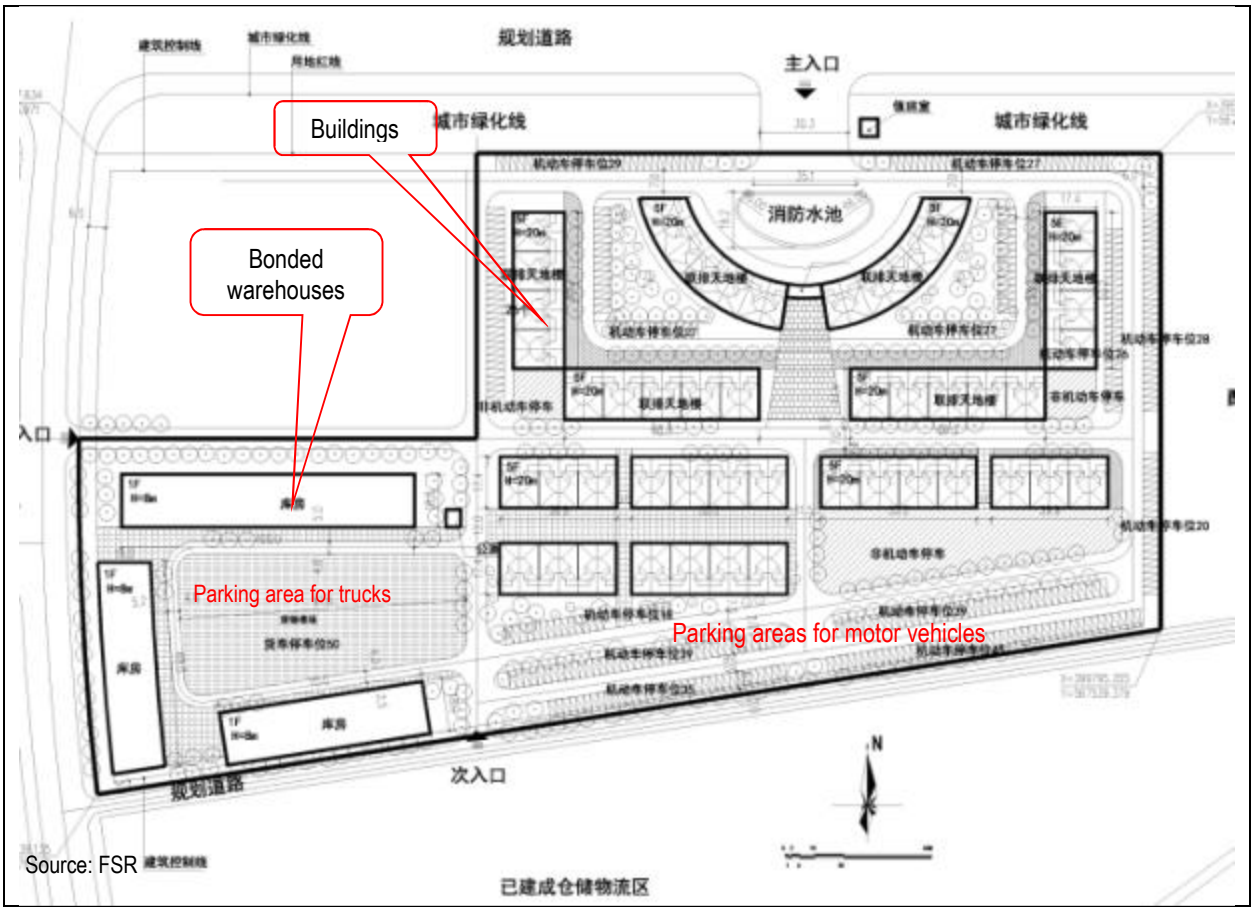


Figure 13: Layout of buildings and facilities on the subproject 5 site

88. Building design will include features to accommodate those with disabilities in accordance with GB50763-2012 *Codes for Accessibility Design*《无障碍设计规范》as well as energy saving and water conservation features. Water usage has been estimated to be 883 m^3/d, to be supplied by the existing Qinzhou Bonded Port Water Treatment Plant. The drainage system will separate rain water and wastewater. Rainwater will be collected by the rain water collection pipelines and discharged into nearby drainage ditches. Domestic wastewater, estimated to be approximately 707 m^3/d, will be pretreated on site with septic tanks, then conveyed to an existing underground wastewater treatment facility servicing the bonded port area, using an anaerobic-oxic biochemical treatment process.

89. ADB's project preparation environment specialists suggested that the PIE should pursue LEED (Leadership in Energy and Environmental Design) certification, an international green building certification scheme developed by the United States GBC, for at least one of the buildings. Since this subproject will involve cross-border trade, a LEED certified building such as the cross-border merchandize exhibition and sales center would have demonstration effect on enterprises involving cross-border trade.

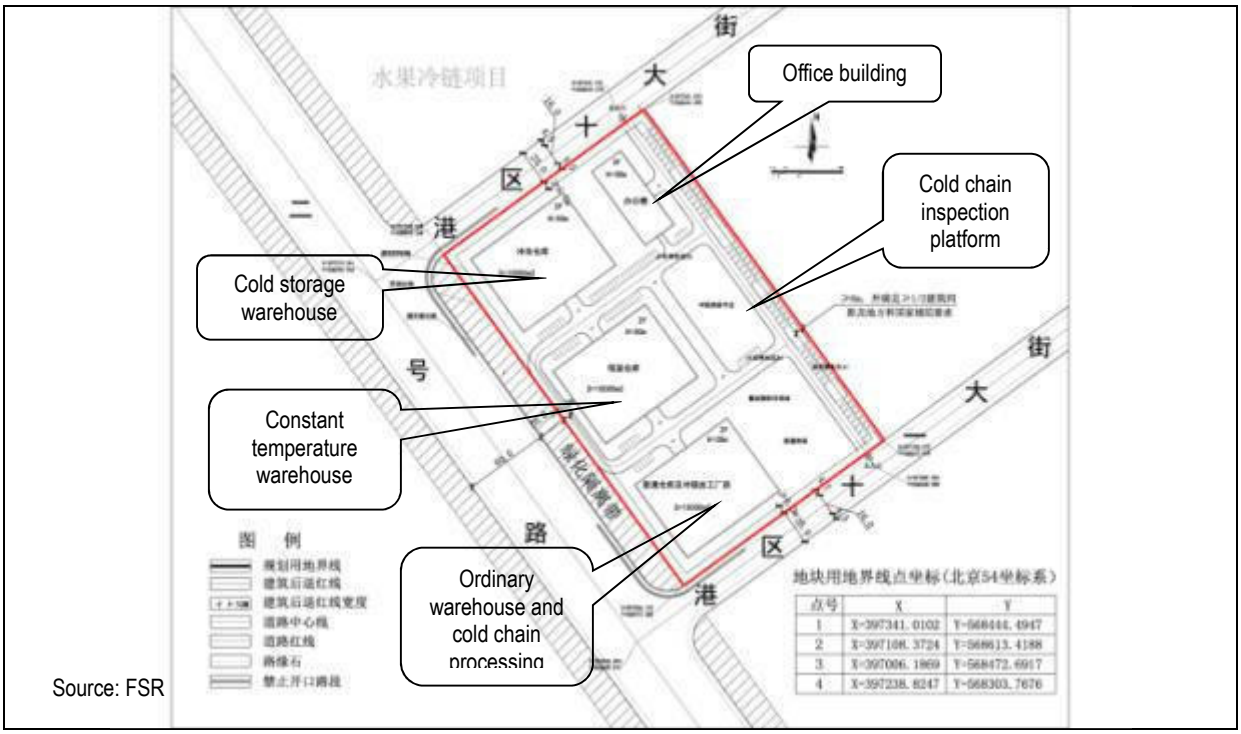
H. Subproject 6: Qinzhou international cold-chain logistic demonstration project

90. This subproject is located in Qinzhou (see Figure 1). It is in accordance with the *Qinzhou Bonded Port Zone Master Plan* and the *Qinzhou Bonded Port Zone 13th Five Year Development Plan*. The site occupies an area of 5 ha in the Qinzhou Bonded Port Zone on land that was reclaimed from the sea. Discussions on the subproject 5 site is also applicable to this subproject. This subproject involves the construction of 5 buildings and facilities with a total floor area of 45,000 m^2 for cold storage and constant temperature warehouses and offices for cold chain logistics of fresh agricultural products such as meat, poultry, seafood, vegetables, fruits and eggs, etc (Table 22). The total land take area of 2.75 ha is approximately 0.28% of the size of the Qinzhou Bonded Port Zone. Figure 14 shows the layout of the buildings and facilities on the site. Figure 15 shows the location of the subproject site and nearby environ, dominated by container port facilities. The PIE has no authority over the inspection of imports and exports. All customs inspection and procedures will be in accordance with PRC laws and regulations.

Table 22: Buildings and facilities for subproject 6

Buildings & Facilities		Floor Area (m^2)	Description
1	Cold storage warehouse	10,000	Building height of 30 m with 2 storeys
2	Constant temperature warehouse	10,000	Building height of 30 m with 2 storeys
3	Ordinary warehouse & cold chain processing	10,000	Building height of 30 m with 2 storeys
4	Office building	5,000	Building height of 30 m with 2 storeys
5	Cold chain inspection platform	10,000	For detention and inspection of containers
	Total floor area:	**45,000**	
	Total land take area:	**27,500**	

Source: FSR



Source: FSR

Figure 14: Layout of buildings and facilities on the subproject 6 site

Figure 15: Aerial photograph showing the location of subproject 6 site and nearby environ

91. Water supply will be through the municipal network. Municipal wastewater generated by the workers will be pretreated by septic tank on site then discharged to municipal sewer for treatment at the Dalanping WWTP. The cold storage warehouse will use R404A as the refrigerant. R404A is a common commercial hydrofluorocarbon (HFC) refrigerant consisting of a mixture of 1,1,1,2,2-Pentafluoroethane (C_2HF_5); 1,1,2-Tetrafluoroethane ($C_2H_2F_4$); and 1,1,1-Trifluoroethane ($C_2H_3F_3$).

I. Subproject 7: China-ASEAN small and medium enterprises (SMEs) synergy innovative development project

92. This subproject is located in Guilin (see Figure 1). It is in accordance with the Guangxi Zhuang Autonomous Region Short to Medium Term Education Reform and Development Planning Outline (2010-2010), Guangxi Zhuang Autonomous Region Short to Medium Term Human Resource Development Planning Outline (2010-2020), Guilin Urban Master Plan (2010-2010) and the Guilin University of Aerospace Technology Development Positioning Plan (2014-2020). The subproject involves the construction of three buildings as part of the expansion of the south campus of the Guilin University of Aerospace Technology (GUAT). Currently GUAT has on average 300 international students annually. With this expansion, the goal is to have 700 international students and 18,000 domestic full time students by year 2020. Table 23 shows that the three buildings would have a total floor area of 125,268 m^2 and a total land take of 26,132 m^2 accounting for 6.5% of the expansion area (400,993 m^2). Figure 16 shows an aerial photograph of the site and nearby establishments. Figure 17 shows the locations and layouts of the three buildings in the south campus expansion area.

Table 23: Description of buildings for subproject 7

Building		Land Take (m^2)	Floor Area (m^2)	Description
1	SME business development service information center	7,734.59	35,575.57	Building height of 23.60 m with 6 storeys, consisting of libraries and offices for SME business development promotion and information services, digital data centers and training workshops.
2	Aerospace and aeronautic industries training center	10,155.64	44,760.62	Building height of 23.30 m with 6 storeys, consisting of offices, workshops and laboratories for training of Chinese and ASEAN workers from aerospace and aeronautic industries on modern manufacturing technologies, airplane installation and maintenance, virtual reality and industrial robotics, etc.
3	ASEAN vocational education building	8,241.41	44932.06	Building height of 23.17 m with 6 storeys, consisting of classrooms and offices for vocational training of Chinese and ASEAN workers.
	Total:	26,131.64	125,268.25	

Source: FSR

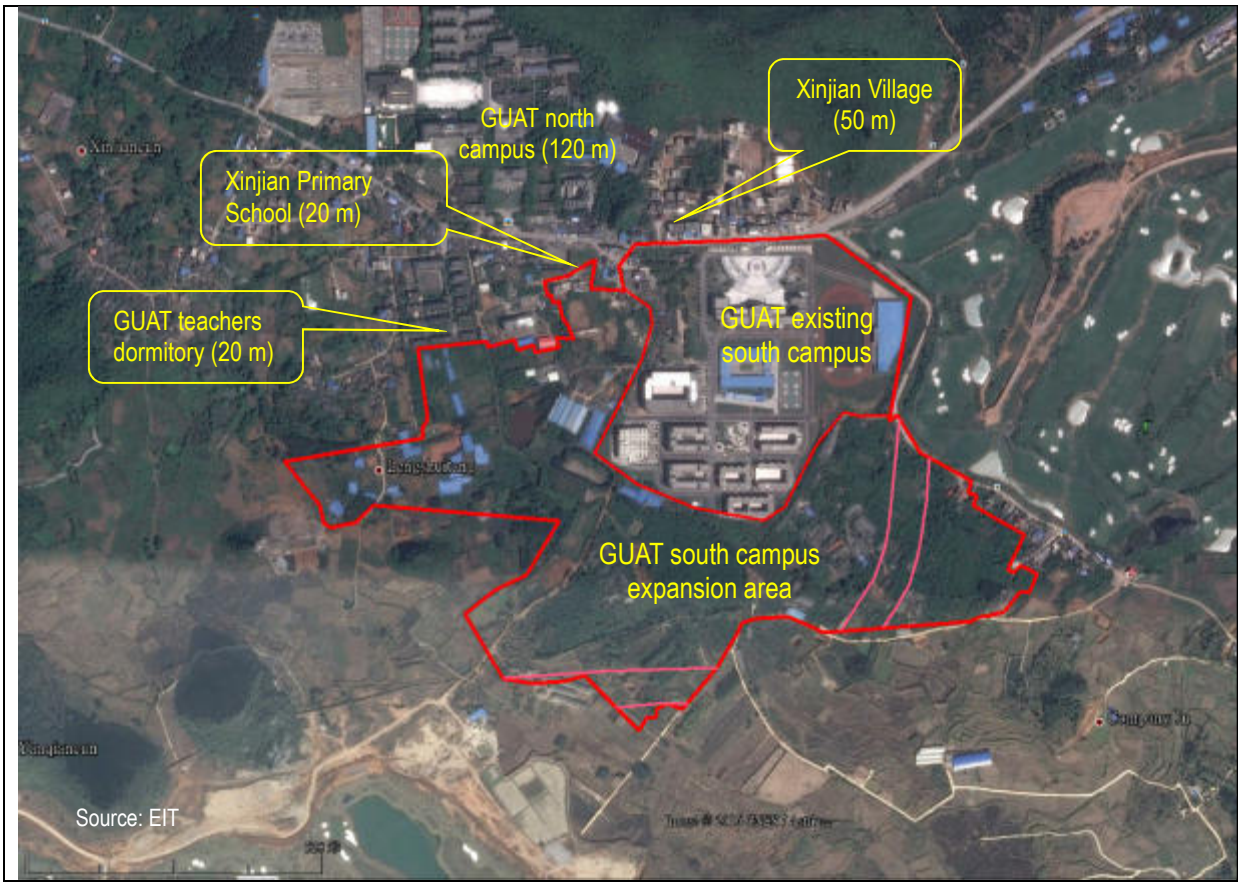


Figure 16: Aerial photograph showing the Guilin University of Aerospace Technology campuses and nearby environ

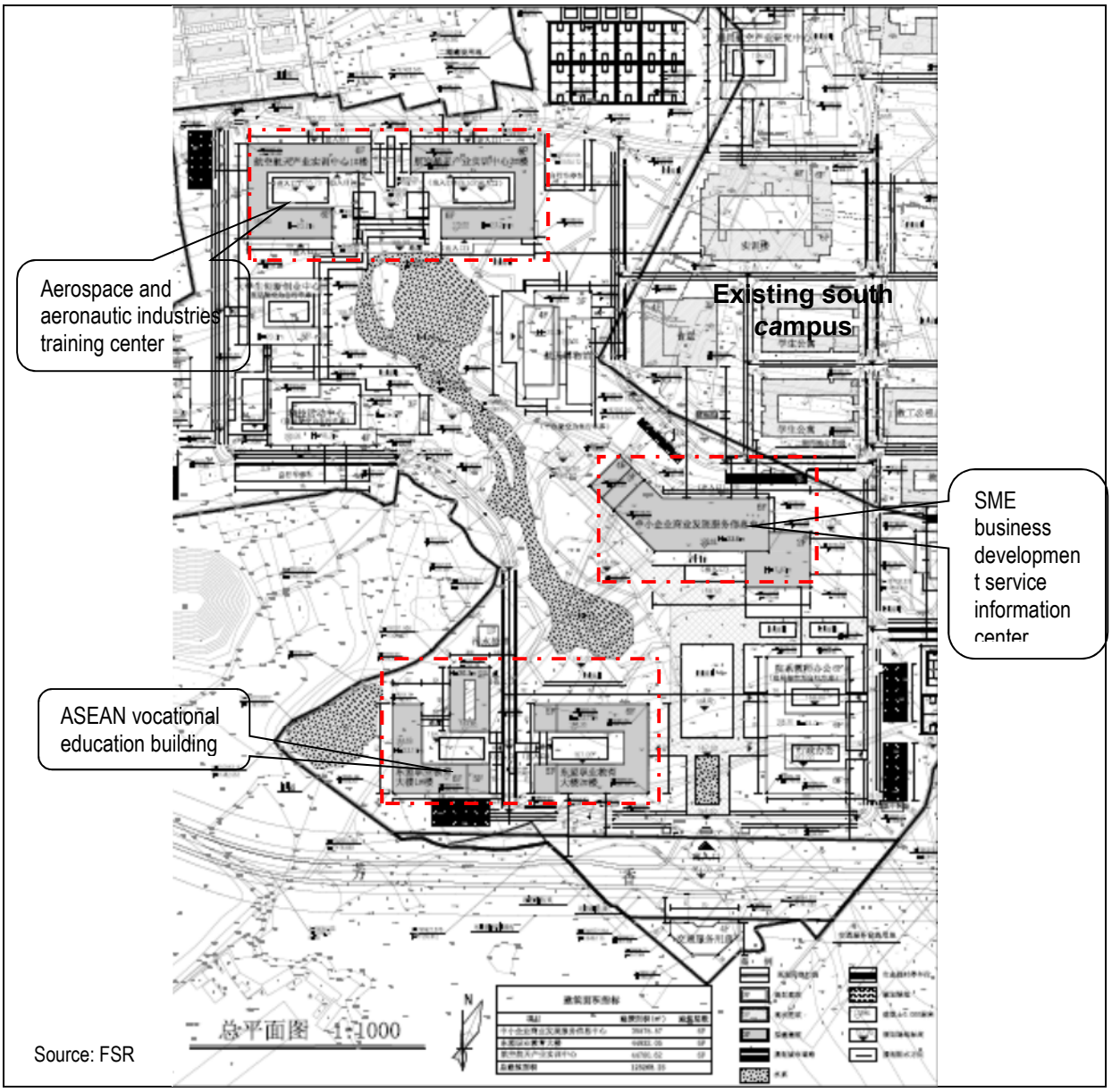


Figure 17: Locations of subproject buildings on the south campus expansion area of the Guilin University of Aerospace Technology

93. Building design will include features to accommodate those with disabilities in accordance with GB50763-2012 *Codes for Accessibility Design*《无障碍设计规范》as well as energy saving and water conservation features. Water will be supplied by the municipal water supply network. The drainage system will separate rain water and wastewater. Rainwater will be collected by the rain water collection pipelines and discharged into nearby drainage ditches. Wastewater generated by the three buildings will be collected by pipelines on campus for discharging into the public sewer network along Fangxiang East Road to the Qilidian Municipal Wastewater Treatment Plant for treatment. This subproject also features green building design, taking into account the requirements in PRC's *Assessment standard for green building* (GB/T 50378-2014, see item #134

in Table 2). The aim is to obtain a "one-star"[22] green building rating for the campus. ADB's project preparation environment specialists suggested that the PIE should pursue LEED (Leadership in Energy and Environmental Design) certification, an international green building certification scheme developed by the United States Green Building Council, for at least one of the three buildings. Since GUAT has close cooperation and partnership with education institutions and enterprises in ASEAN countries, having one or more LEED certified buildings for providing vocational training or SME business development services for students from these countries will have substantial demonstration effects to its ASEAN partners.

J. Subproject 8: China- ASEAN educational medicare cooperation project (phase I)

94. This subproject is located in Baise (see Figure 1). It is in accordance with the Baise Urban Master Plan (2010-2030), Baise Baidong New District Conceptual Plan and the Youjiang Medical College of Nationalities Infrastructure Development Positioning Plan (2013-2020). The subproject involves the phase 1[23] construction of the new Baidong campus of the Youjiang Medical College for Nationalities (YMCN). The College provides education, training and research for the medical profession. Currently YMCN has approximately 12,600 full time students, including 400 international students from 21 countries (with 30% from ASEAN countries). The goal is to have 15,000 students on the campus, including 800 international students. Phase 1 has been planned for a student intake of 5,000 upon completion. The whole campus will occupy approximately 88.50 ha, with 433,300 m^2 total floor area. Phase 1 will occupy 33.34 ha (38% of total campus area). The floor area to be constructed in phase 1 would be 182,210 m^2 (42% of total campus floor area) with a land take of 45,110 m^2, consisting of facilities listed in Table 24. Figure 18 shows an aerial photograph of the Baidong campus site and nearby establishments. Figure 19 shows the layouts of the buildings and facilities within the phase 1 area.

Table 24: Description of buildings and facilities for subproject 8

	Building / Facility	Floor Area (m^2)	Description
1	Public teaching building #1	19.750	Building height of 23.70 m with 5 storeys consisting of mostly classrooms.
2	Faculty laboratory #1	18,870	Building height of 21.0 m with 5 storeys
3	Faculty laboratory #2	23,600	Building height of 21.0 m with 5 storeys
4	Administration building	14,370	Building height of 20.85 m with 5 storeys. The 1st floor is for public services and the other floors are for offices.
5	Building #1 for research institutes	5,620	Building height of 20.40 m with 5 storeys consisting of mostly offices
6	Library	24,500	Building height of 40.5 m with 9 storeys including one underground storey.
7	Auditorium	10,480	It consists of a 1-storey education exchange center with a building height of 13.5 m and a 2-storey conference center with a building height of 13.5 m.
8	Student canteen #1	8,770	Building height of 10.35 m with 2-storeys
9	Student dormitory #1	54,980	Building height of 22.05 m with 6 storeys.
10	North gate	950	

[22] PRC has a three-star green building ranking system, from the lowest one-star, the middle two-star to the highest three-star.

[23] The new Baidong campus has been planned to be developed in three phases taking up to six years.

Building / Facility		Floor Area (m^2)	Description
12	Offices for logistical support	320	
13	Sports ground and ancillary facilities		Consist of track & field grounds, basket ball courts and underground wastewater treatment facility for pre-treatment of wastewater from laboratories.
Total floor area:		**182,210**	
Total land take area by buildings:		**45,110**	

Source: FSR

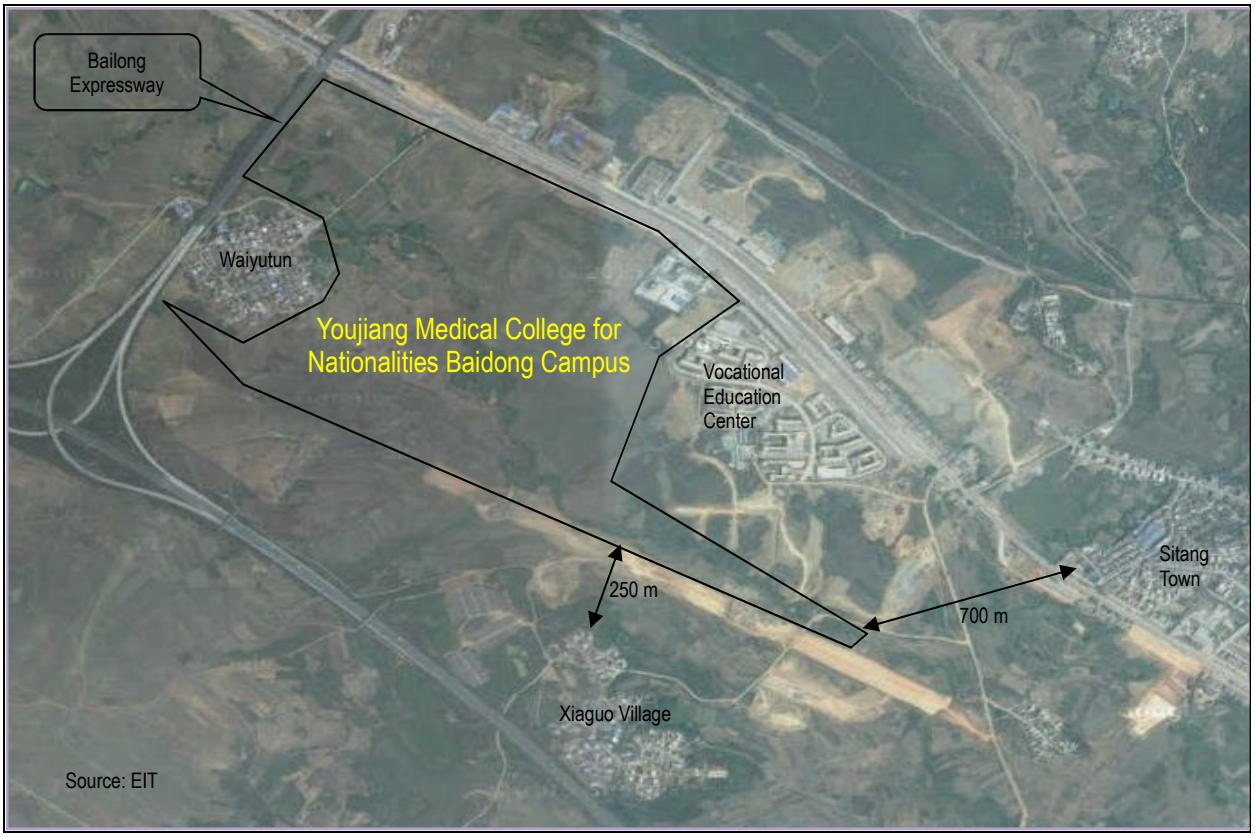


Figure 18: Aerial photograph showing the location of the new Youjiang Medical College for Nationalities Baidong Campus an nearby environ

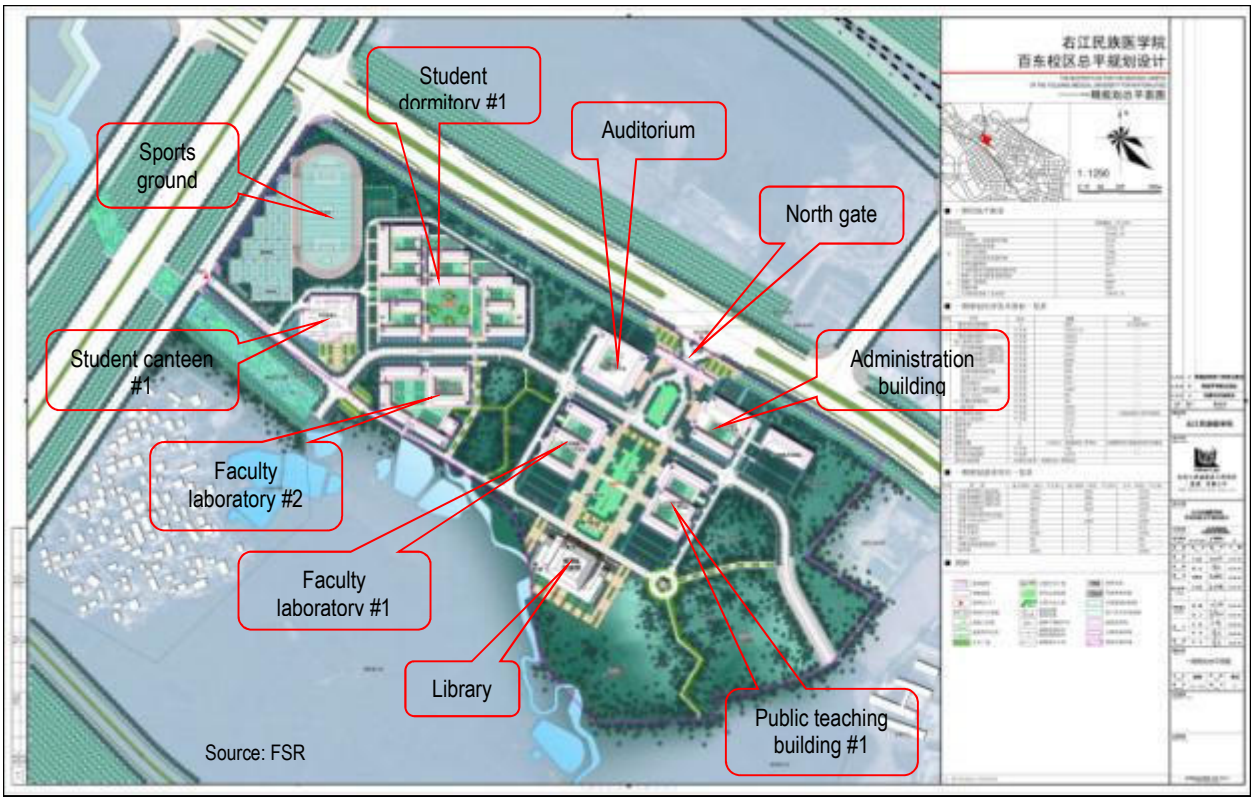


Figure 19: Layout of subproject buildings and facilities in the phase 1 development area of the new Youjiang Medical College for Nationalities Baidong Campus

95. Building design will include features to accommodate those with disabilities in accordance with GB50763-2012 *Codes for Accessibility Design*《无障碍设计规范》as well as energy saving and water conservation features. Water will be supplied by the Chengdong Water Treatment Plant via municipal network. Water consumption average has been estimated to be 4,823 m^3/d for phase 1. Wastewater volume generated during phase 1 operation has been estimated to be 3,411 m^3/d. Two wastewater treatment systems will be installed on campus: a cyclic activated sludge system (CASS) for treating municipal wastewater from students and staff and wastewater from canteens, with effluent to be reused as scenic water on campus; and an underground biochemical system for treating wastewater from the laboratories, landscaping and facilities cleaning. The pre-treated effluent will be conveyed via municipal sewer to the Xinghu Wastewater Treatment Plant in the Baidong New Development Area. When the Damei Wastewater Treatment Plant is commissioned (presently still in the design stage), pretreated wastewater from the Baidong campus will be diverted to this WWTP for treatment.

96. This subproject also features green building design in terms of energy and water conservation, building materials and indoor environmental conditions. ADB's project preparation environment specialists suggested that the PIE should pursue LEED (Leadership in Energy and Environmental Design) certification, an international green building certification scheme developed by the United States Green Building Council, for at least one of the buildings in phase 1. Since the College has close cooperation and partnership with education and research institutions in ASEAN countries, having one or more LEED certified buildings for providing professional training for medical students from these countries will have substantial demonstration effects to its ASEAN partners.

K. Climate Change Adaptation Considerations

97. Climate risk and vulnerability assessment for the subprojects has been conducted (Appendix 2). The subproject areas are characterized by hot summers, warm winter and plenty of rainfall, as well as complex geology. Potential climate change impact would include increased intensities and frequencies of precipitation, heat waves and sea level rise in Beibu Gulf. Heavy rainfall induced flood is a major natural hazard. Complex geology has resulted in geological hazards such as landslide. Projected average change in annual maximum daily rainfall would increase by 5.71% (in Guilin) to 6.94% (in Longzhou) in the 2050 mid-scenario and by 10.94% (in Guilin) to 13.52% (in Longzhou) in the 2100 mid-scenario. Heat waves would occur at least once every year in the subproject cities by 2100 under the mid-scenario, with the longest duration lasting more than 30 days in Guilin and Baise. According to the mid-scenario projection, th sea level in Beibu Gulf is likely to increase by about 25 cm by 2050 and 4 cm by 2100, which is a substantial rise. Adaptation considerations include increase in the drainage design of subprojects by up to 11% and slope stability particularly for subprojects 2 and 4 where the proposed roads are in hilly terrain. Additional cost for provision of drainage adaptation for the subprojects has been estimated to be approximately $1.07 million, which is approximately 7% of the original drainage cost for these subprojects. These measures have been included in the EMP. According to the FSRs, building designs have already considered ventilation and air-conditioning.

L. Associated Facilities

98. Based on SPS (2009) definition of associated facilities, Tranche 2 subprojects do not have facilities that are not funded by the project but (i) whose viability and existence depend exclusively on the project and (ii) whose goods and services are essential for successful operation of the project.

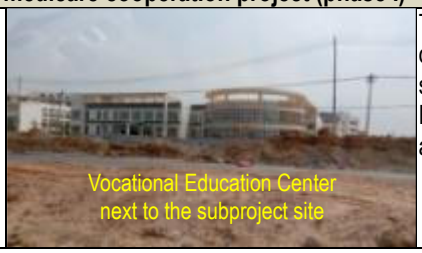
IV. DESCRIPTION OF THE ENVIRONMENT

A. General

99. The description of the pre-project environment (biophysical and socio-economic) establishes (i) the environmental setting within which the project will be implemented, and therefore needs to be designed to suit, and (ii) the environmental values which will be changed (either negatively or positively) by the project. Both these roles are encompassed by the concept of the “baseline” environment. The baseline environmental surveys undertaken for the subprojects were determined by the kinds of components proposed and the environmental parameters which were relevant to their impact assessment. The existing environmental settings of the subproject sites are illustrated and summarized in Table 25. Table 26 summarizes the air and noise sensitive receptors within the assessment area of 200 m from the subproject sites.

Table 25: Summary of environmental settings of subproject sites

Subproject 1: Chongzuo Sino-Vietnam Border Economic Cooperation Zone demonstration project (phase I)		
		Site is located in the BECZ with mainly industrial use mixed with some residential developments. Part of the BECZ has been cleared of vegetation. Remaining vegetation within the BECZ is dominated by shrubs and grasses with scattered wooded areas with trees. The WWTP site is dominated by planted species.
		
Subproject 2: Dongxing Changhu Road (east section) construction project		
		The proposed road is on hilly terrain with no vehicular access at present. The Dagoulong Reservoir is used for irrigation. There are scattered houses in Huangqiaoshu Village near the eastern end of the alignment and many are vacant.
Subproject 3: Infrastructure development for Longzhou Border Economic Cooperation Zone		
		The subproject roads are within the BECZ. Extensive site formation work within the BECZ is ongoing with vegetation removed. Vegetated areas are dominated by shrubs, grassland and planted species.
Subproject 4: Road connectivity in Pingxiang-Viet Nam cross-border (phase 1)		
		The proposed road would run on the hillward side next to the existing road. Vegetation is dominated by shrubs, weeds and planted species.

Subproject 5: Qinzhou cross-border trade e-commerce industrial park project		
		The site is located in the Qinzhou Bonded Port Zone just outside the fenced area, on land that was reclaimed from the sea. The employee dormitory is located next to the site with non-sensitive façade facing the site.
Subproject 6: Qinzhou international cold-chain logistic demonstration project		
		The site is located within the fenced area of the Qinzhou Bonded Port Zone on land that was reclaimed from the sea with scarce vegetation cover. No residential housing is permitted within the fenced area.
Subproject 7: China-ASEAN small and medium enterprises (SMEs) synergy innovative development project		
		The site is on vacant land with vegetation dominated by shrubs and weed.
Subproject 8: China- ASEAN educational medicare cooperation project (phase I)		
		The site is on vacant land with vegetation dominated by shrubs, weed and planted species. Waiyutun and the Vocational Education Center are located approximately 10 m from the site.

Source: PPTA, EIT

Table 26: Air and noise sensitive receptors for the subprojects

Subproject	Sensitive Receptor Name	Description
S1: Chongzuo Sino-Vietnam Border Economic Cooperation Zone demonstration project (phase I)	Nongben 农本	34 m from Binjiang Ave, 60 households
	Tanzha 潭榨	28 m from Huancheng South Road, 43 households
	Tuobu 驮咘	140 m from Huancheng South Road, 95 households
	Qinghe Village 庆合村	25 m from Huancheng South Road, 47

Subproject	Sensitive Receptor Name	Description
		households
	Mami 马密	30 m from Huancheng South Road, 32 households
	Jiupaitou 旧排头	137 m from the WWTP site, 358 population
S2: Dongxing Changhu Road (east section) construction project	Huangqiaoshu Village	70 m from the western end of Changhu Road east section,
S3: Infrastructure development for Longzhou Border Economic Cooperation Zone	Banzaotun 板灶屯	10 m south of Heng'er Road
	Xiazaotun 下灶屯	12 m north of Heng'er Road
	Xiwang Kindergarten 希望幼儿园	10 m south of Hengsan Road
	Gengyi Village 埂宜村村委及村户	40 m north of Hengsi Road
	Gengyitun 埂宜屯	Near the southern end of Yuanbian Road
	Beiyao Farm Resident 北耀农场埂宜分场	105 m north of Heng'er Road
S4: Road connectivity in Pingxiang-Viet Nam cross-border (phase 1)	Kafeng Town 卡凤镇	5 m from where the road starts with 30 households within the assessment area
S5: Qinzhou cross-border trade e-commerce industrial park project	Employee dormitory	Adjacent to the subproject site
S6: Qinzhou international cold-chain logistic demonstration project	---	No sensitive receptor
S7: China-ASEAN small and medium enterprises (SMEs) synergy innovative development project	GUAT teachers' dormitory 航院教师宿舍	20 m
	Xinjian Primary School 新建小学	20 m
	Xinjian Village 新建村	50 m but most houses are blocked by the existing south campus buildings
	Classrooms on existing south campus	Note: the north campus is 120 m from the site but blocked by other buildings and terrain.
S8: China- ASEAN educational medicare cooperation project (phase I)	Vocational Education Center 职教中心	10 m
	Waiyutun 外域屯	10 m

Source: EIRs and EITs

100. **Protected area**. According to site surveys and the domestic EIRs and EITs, no historical and cultural protection areas, nature reserves, scenic spot, drinking water source and other protection areas or species with international, national or provincial protection status have been identified within the subproject assessment areas of influence. No ecological sensitive receptors have been identified within the subproject areas of influence. The subproject sites are not located in critical or natural habitats.

B. Physical Setting

101. **Geography and topography**. Guangxi is a mountainous region. The Nanling Mountain range is located near the northeast border, with the Yuecheng Mountain and Haiyang Mountain being its shorter branching ridges. Nearer to the center of the region are the Dayao Mountain and the Daming Mountain. In the north are the Duyao Mountain and the Fenghuang Mountain. Near the southeast border is the Yunkai Mountain. The highest point is Mount Mao'er located at the Yuecheng Mountain, at 2,141 m. Many river cut valleys run through the mountains. Most of these rivers form the tributary watershed of the West River. Guangxi has a short coastline on the Gulf

of Tonkin. Important seaports include Beihai, Qinzhou and Fangchenggang.

102. Tranche 2 subproject sites are located in Guilin, Baise, Qinzhou, Chongzuo, Dongxing Longzhou and Pingxiang. Their geography has been illustrated in Figure 1. The topography of these locations is summarized in Table 27.

Table 27: Summary of the topography of subproject sites

Location	Description of Topography
Guilin	Guilin is located to the southwest of the Nanling Mountain range. The terrain is generally higher to the north and lower to the south, surrounded by karst mountains to the north, east and west, and plain and valley in the middle and to the south. Guilin city is located in Karst Basin, with a typical subtropical karst landform. The Lijiang River valley runs through the urban area formed with accumulation terrace landform, at an elevation of approximately 150 m.
Baise	Baise is in a mountainous area located in the transition belt between the Yun-Gui Plateau and the Guangxi hills. Mountainous areas account for 95.4% of the terrain (with 65.4% stone mountains and 30% earth mountains), with hills and plains accounting for the remaining 4.6%. Baise's terrain and topography could be classified into the following three types: i. Earth mountains in the north at elevations of 500-1,500 m ii. Stone mountains of karst landform in the south at elevations of 500-800 m. The area of stone mountains accounts for 21.31% of the total area of Baise Municipality. iii. Youjiang Basin in the middle at elevations of 100-300 m. It has an area of 2,628 km^2, with 120 km in length and 5-20 km in width. Youjiang flows from west to east.
Qingzhou	Qinzhou Port is composed of low mountains, micro-oblique plain and flooded plains, which is typical Liman type landform. Qionzhou Port is 35, 48, 135 and 133 nautical miles away from Fangchenggang Port, Beihai Port, Vietnamese coastal harbor and Hongji Port respectively. Qinzhou Port is located in the southern part of the Qinzhou inclined area according to the regional geology, and there is no large active rupture passes nearby. The subproject sites are on land that was reclaimed from the sea.
Chongzuo	The topography in Chongzuo slopes from north to south, with more mountainous areas and less flat land and the limestone formations are widely distributed. There are mountains, river valley and plain distributed in the urban area.
Dongxin	There are mountains, hills, coastal shoals, including river valley and coastal plains distributed in Dongxing City. The northwest is high with mountainous area and the southeast is low with coastal gentle slope. The terrain in the urban area is higher in the northwest and lower in the east, sloping from the northwest to the southeast. The urban peak is the Chongman Mountain in the north at an elevation of 260 m. The present landform in the subproject area is dominated by mountains and hills.
Longshou	The local terrain is the Longzhou Basin, at an average elevation of approximately 200 meters, with the peak of Daqing Mountain at an elevation of 1,046 m. The topography of Longzhou County is higher in the southeast, lower in the north and the west. The mountains, hills and Mingjiang Valley are distributed in the south, middle area and the north respectively.
Pingxiang	Pingxiang city is located in the territory of the Daqing Mountain area. From the west to the east is divided into western mountains, central mountains, and the northeast mountains. The peak of the Daqing Mountain is rounded, with small basins and valleys scattered within this mountainous area. The other mountains are all with sharp peaks, rocks bare, bluff and deep valley. The propose road is located in southern Pingxiang City, and the alignment passes through the mountainous area, where the terrain fluctuates substantially and the geological conditions are complicated. The bare geological condition is characterized by broken strong weathered rocks and partially expansive soils. On both sides of the existing road are mainly mountainous terrain and thickets.

Source: EIRs and EITs

103. **Climate**. Guangxi has a subtropical climate. Summers are generally long and hot. Average annual temperature is 17 ^oC to 23 ^oC, while average annual precipitation is 1,250 to

1,750 mm. Table 28 summarizes the weather conditions of the subproject locations.

Table 28: Summary of weather conditions for the subproject locations

Location	Description of Topography
Guilin	Guilin has subtropical monsoon climate, with long summer and short winter, and four distinct seasons. Rainy season occurs in winter and spring, with frequent storm weather during summer, and dry and cool weather in autumn. With an annual average temperature above 22 ℃, the duration of summer is up to 145 days. The coldest month is January with an average temperature of 7.9 ℃. July is the hottest month with an average temperature of 28.3 ℃. Rainfall is concentrated in May-July, accounting for about 47% of the annual rainfall.
Baise	Baise has subtropical seasonal monsoon climate, with long summer and short winter. Mild climate occurs in the mountainous regions to the north and south, while hot and dry in the Youjiang Basin. Rainy season occurs from May to October, with frequent storm weather from June to September. Dry season occurs from November to April. Severe weather includes drought, flood, wind storm, extreme cold and hail. Of these, droughts and colds are more frequent; especially spring droughts whose frequency reaches 70-90%.
Qingzhou	Qinzhou is located in the south subtropical maritime climate area, with more sun radiation, longer sunshine time, mild climate and abundant rainfall. According to monitoring data from the Longmen weather station, the annual average temperature in Qinzhou Port area is 21.9 ℃. The extreme high and low temperature are 37.5 ℃ and 1.1 ℃ respectively. The monthly highest and lowest average temperatures are 28.3 ℃ and 3.4 ℃ respectively. Annually, the lowest temperature occurs in January, and the highest temperature in July.
Chongzuo	Chongzuo has subtropical humid monsoon climate. The city's weather is characterized by mild climate and abundant rainfall. The annual sunshine hours are more than 1,600 hours, and annual average temperature is 20.8 ℃ ~22.4 ℃. The average temperature in January and July are 13.8 ℃ and 28.1 ℃ respectively. The annual frost-free period is more than 340 days, and the annual rainfall is above 1,200 mm. The climate provides suitable conditions for cultivation of subtropical cash crops.
Dongxin	Dongxing is located to the south of the Tropic of Cancer, in the south subtropical monsoon climate zone. Influenced by the sea in Beibu Gulf and the mountains around, there is plenty of sunshine, abundant rainfall and pleasant weather. The multi-year annual average temperature is 22.4 ℃. The maximum temperature occurs from June to September, with the highest temperature at 38.4 ℃ (August 1990), and lowest temperature at 0.9 ℃ (January 1955). According to the annual temperature statistics, the maximum temperature occurs in July with monthly average temperature of 31.2 ℃, and the lowest is in January with monthly average temperature of 12 ℃.
Longshou	Longzhou is located south of the Tropic of Cancer, has south subtropical monsoon climate, with abundant rainfall and sunlight. It is slightly colder in winter and spring, rainy in summer, warm and cool in autumn. There is clear demarcation for dry and wet seasons, and the annual frost-free period is 350 days. Due to the influence of local topography, there is more rainfall in the mountainous area than in the hilly and valley areas, and the rainfall distribution decreases from northwest to southeast. Rainfall in the summer accounts for more than half of the annual amount. Dry season occurs in winter and spring. Rainy season starts in late April with fluctuating weather.
Pingxiang	Pingxiang city belongs to the subtropical monsoon climate area. The annual average temperature is 21~23 ° C, annual rainfall between 1062~1772 mm, and the highest daily rainfall is 206.5mm. The annual frost-free period is 344 days, and sunshine duration is 1614 hours. The year-round wind direction is mainly from the east and south in summer, and from the northeast wind in winter, with the annual average wind speed of 5~17 m/s. Dry season occurs from October to March the following year, which is the suitable season for construction. The winter season is the best time for sub-grade earthwork and bridge foundation construction.

Source: EIRs and EITs

104. **Seismicity.** According to the *China seismic ground motion parameters zoning map* (GB 18306-2001) Amendment 1, the subproject areas have a seismic intensity scale of VI. The PRC classifies seismic intensity into 12 scales under the *China seismic intensity table* (GB/T 17742-2008), from Scale I to Scale XII based on increasing severity of “shaking” of the earth surface and

the extent of potential effect on senses of people on the ground and buildings. Scale VI is intermediate in severity with most people unable to stand still and furniture falling. Project design has taken the seismic intensity into consideration.

105. **Air quality**. The PRC ranks air quality into two classes according to air quality standards stated in GB 3095-2012: *Ambient air quality standard*, with Class 1 being having the best air quality. Baseline monitoring of ambient air quality at the subproject sites or at sensitive receptors in the vicinity of the subproject sites was collected or carried out by the environmental institutes who conducted the domestic EIRs or EITs. Typically, ambient air quality baseline monitoring consists of measuring the daily average concentration levels of $PM_{2.5}$, PM_{10} (also known as respirable suspended particulates, RSP), total suspended particulates (TSP), Sulfur dioxide (SO_2), nitrogen dioxide (NO_2) and carbon monoxide (CO) on seven consecutive days. The ambient air quality in all subproject areas has been assigned the ranking of Class 2 in accordance with GB 3095-2012, meaning that the baseline data should meet Class 2 standards.

106. Ambient air quality baseline data are summarized in Table 29. For each parameter, the range of concentration level measured in the seven days for each subproject is presented. GB 3095-2012 Class 2 standards are included in the table for compliance checking. Data in Table 28 shows that the daily average concentrations of TSP and PM_{10} at Kafeng Village in Pingxiang (Subproject 4) exceeded the Class 2 limit values of GB 3095-2012, due to dust emission caused by construction vehicles without dust suppression measures travelling along the existing road near Kafeng Village. All other monitoring data complied with GB 3095-2012 Class 2 standards.

Table 29: Ambient air quality monitoring results

Subproject	Monitoring Data Source	Daily average Concentration of Ambient Air Quality Parameter in mg/m³					
		$PM_{2.5}$	PM_{10}	TSP	SO_2	NO_2	CO
S1: Chongzuo Sino-Vietnam Border Economic Cooperation Zone demonstration project (phase I)	Monitoring data from the *Jiangzhou Economy Industrial Park Environmental Impact Report*	<0.075	<0.15	<0.30	<0.15	<0.08	<4
S2: Dongxing Changhu Road (east section) construction project	Dongxing Environmental Air Quality Annual Reports in 2015	<0.075	<0.15	<0.30	<0.15	<0.08	---
S3: Infrastructure development for Longzhou Border Economic Cooperation Zone	Monitoring data from the *Longzhou Shuikou Dongmeng Avenue Environmental Impact Report*	---	0.045~ 0.057	0.07~0.09	---	0.007~ 0.014	0.4~0.8
S4: Road connectivity in Pingxiang-Viet Nam cross-border (phase 1)	Continuous air quality monitoring during 13-19 June 2016 at 2 locations along the proposed road	---	0.142~ 0.167	0.306~ 0.344	---	0.012~ 0.123	0.6~1.0
S5: Qinzhou cross-border trade e-commerce industrial park project	Qinzhou Environmental Air Quality Annual Reports in 2015	---	<0.15	---	<0.05	<0.08	<4
S6: Qinzhou international cold-chain logistic demonstration project	Continuous air quality monitoring during 23-30 March 2016 at 11 locations in the Qinzhou Bonded Port Zone	---	0.021~ 0.070	0.041~ 0.165	0.004~ 0.011	0.005~ 0.027	---
S7: China-ASEAN small and medium enterprises	Guilin Environmental Air Quality Weekly Report from June 2 to	<0.075	<0.15	<0.30	<0.15	<0.08	---

Subproject	Monitoring Data Source	Daily average Concentration of Ambient Air Quality Parameter in mg/m^3					
		$PM_{2.5}$	PM_{10}	TSP	SO_2	NO_2	CO
(SMEs) synergy innovative development project	June 8 2016 published on Guilin Environmental Protection Website						
S8: China- ASEAN educational medicare cooperation project (phase I)	Environmental Air Quality Weekly Reports for Baise Urban Area from January to June 2015 published by the Baise Environmental Protection Bureau	<0.075	<0.15	<0.30	<0.15	<0.08	---
Ambient air quality standard (GB 3095-2012) Class 2 daily average		**0.075**	**0.15**	**0.30**	**0.15**	**0.08**	**4**
Note: ☐ exceed GB 3095-2012 Class 2 standard; "---" = no measurement was taken							

Source: EIRs & EITs

107. **Noise**. GB 3096–2008 *Environmental quality standard for noise* 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 environment and therefore has 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 centers. 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 railways, and is subdivided into 4a and 4b with the former applicable to major road (road class 2 and above) and marine traffic noise, and the latter applicable to rail noise.

108. The subproject sites consist of Categories 1, 2, 3 and 4a functional regions, but predominated by the Category 2 functional region. Baseline noise monitoring was carried out by the environmental institutes conducting the EIRs/EITs, typically on two consecutive days with noise measurements during the day time and the night time on each day. Table 30 summarizes the baseline noise monitoring results, showing the highest noise levels measured during day time and night time at each monitoring location, as well as respective functional groups for the subprojects and the noise limits under GB 3096-2008 for compliance checking. Monitoring results show that all noise levels complied with GB 3096-2008 standards for their relevant noise functional categories at the time of monitoring, except at the first row of buildings adjacent to the existing road in Kafeng Village in Pingxiang (subproject 4) where day time noise level barely exceeded the limit due to heavy road traffic.

Table 30: Baseline noise monitoring results

Subproject	Sensitive Receptor	Noise Level in L_{Aeq} [dB(A)]		Noise Functional Category
		Day Time	Night Time	
S1: Chongzuo Sino-Vietnam Border Economic Cooperation Zone demonstration project (phase I)	Nongben (34 m from Binjiang Ave)	56.3	49.2	4a
	Tanzha (28 m from Huancheng South Road)	56.3	49.2	4a

Subproject	Sensitive Receptor	Noise Level in L_{Aeq} [dB(A)]		Noise Functional Category
		Day Time	Night Time	
	Tuobu (140 m from Huancheng South Road)	56.3	49.2	2
	Qinghe Village (25 m from Huancheng South Road)	58.7	48.3	4a
	Mami (30 m from Huancheng South Road)	58.7	48.3	4a
S2: Dongxing Changhu Road (east section) construction project	10 m distance from the boundary of East Luofujiang Road	58	51	4a
	40 m distance from the boundary of East Luofujiang Road	53	45	2
	60 m distance from the boundary of East Luofujiang Road	50	42	
	10 m distance from the boundary of Gongye Avenue	58	53	4a
	40 m distance from the boundary of Gongye Avenue	53	47	2
	60 m distance from the boundary of Gongye Avenue	51	44	
	Huangqiaoshu Village	47	43	
S3: Infrastructure development for Longzhou Border Economic Cooperation Zone	Banzaotun (10 m S of Heng'er Road)	50.9	44.7	2
	Xiazaotun (12 m N of Heng'er Road)	49.0	45.4	
	Xiwang Kindergarten (10 m S of Hengsan Road)	52.6	45.8	
	Gengyi Village (40 m N of Hengsi Road)	51.4	45.5	
	Beiyao Farm Resident (105 m N of Heng'er Road)	50.6	45.1	
S4: Road connectivity in Pingxiang-Viet Nam cross-border (phase 1)	Kafeng Village (The first row of buildings adjacent to the road)	70.6	54	4a
	Kafeng Village (The second row of buildings adjacent to the road)	59.5	47.3	2
S5: Qinzhou cross-border trade e-commerce industrial park project	East boundary of construction site	<65	<55	3
	South boundary of construction site	<65	<55	
	West boundary of construction site	<65	<55	
	North boundary adjacent to Diba street	<70	<55	4a
S6: Qinzhou international cold-chain logistic demonstration project	Boundary of construction site	<65	<55	3
	Area 35 m distance from both sides of Dishi Street, Dishiyi Street and Erhao Road	<70	<55	4a
S7: China-ASEAN small and medium enterprises (SMEs) synergy innovative development project	East boundary of construction site	52.1	44.7	2
	South boundary of construction site	54.9	45.8	
	West boundary of construction site	54.8	45.7	
	North boundary of construction site	58.2	47.2	
S8: China- ASEAN educational medicare cooperation project (phase	East boundary of construction site	53.4	47.6	2
	South boundary of construction site	52.5	45.4	

Subproject	Sensitive Receptor	Noise Level in L_{Aeq} [dB(A)]		Noise Functional Category
		Day Time	Night Time	
I)	West boundary of construction site	57.9	48.7	
	North boundary of construction site	58.7	49.1	
		60	**50**	**2**
***Environmental quality standard for noise* (GB 3096-2008)**		**65**	**55**	**3**
		70	**55**	**4a**
Note: exceed GB 3096-2008 standard				

Source: EIRs & EITs

109. **Surface water quality**. Water quality status of the surface water bodies in the vicinities of the subproject sites was collected from the local environmental conditions bulletin by the environmental institutes conducting the EIRs/EITs. Table 31 summarizes the surface water quality condition of each subproject and the applicable standards in *Environmental quality standards for surface water* (GB 3838-2002). For subproject 1, the provision of WWTP would contribute to achieving the water quality target of Heishui River in 2020.

Table 31: Surface water conditions in the vicinities of the subproject sites

Subproject	Surface Water Quality Condition	Applicable Standard
S1: Chongzuo Sino-Vietnam Border Economic Cooperation Zone demonstration project (phase I)	Heishui River, which is for scenic and irrigation uses with Category IV water quality targeting for Category III water quality by 2020.	Category III of GB 3838-2002 (water quality target in 2020)
S2: Dongxing Changhu Road (east section) construction project	The surface water bodies closed to the road alignment consists of the Luofu River, Dagoulong Reservoir, and Xiangche Creek, and the water quality is good. Luofu River is 200 m distance from the west of the project area and is mainly used for landscape and irrigation. Dagoulong and Xiangche Creek is mainly for irrigation water.	Category III of GB 3838-2002
S3: Infrastructure development for Longzhou Border Economic Cooperation Zone	The shortest distance from Shuikou River is 70 m to Heng'er Road. There is a national water quality monitoring station at the Shuikou River Bajiao Power Station which is located approximately 350 m from Heng'er Road chainage K1+840. Monitoring data from March 2017 showed compliance with GB 3838-2002 Category III water quality standard	Category III of GB 3838-2002
S4: Road connectivity in Pingxiang-Viet Nam cross-border (phase 1)	No water body in the vicinity	Not applicable
S5: Qinzhou cross-border trade e-commerce industrial park project	The water body closed to the project area is the coastal sea area in Qinzhou Port. According to the Qinzhou Pollution Source Monitoring Information Disclosure for Sea Area with Municipal Discharge in Quarter 4 2014, all the parameters can meet the Class IV requirement of *Sea Water Quality Standard (GB3097-1997)*.	Class IV of Sea Water Quality Standard (GB 3097-1997).
S6: Qinzhou international cold-chain logistic demonstration project		
S7: China-ASEAN small and medium enterprises (SMEs) synergy innovative development project	The nearest surface water body in the project city is Li River at the west side of 6km. According to the "Guilin Water Quality Monthly Report in Key Watershed in May 2016", the water quality of the river section can meet the Class II standard of GB 3838-2002. According to the Guilin Environmental	Category III of GB 3838-2002

Subproject	Surface Water Quality Condition	Applicable Standard
	State Bulletin in 2015, the standard achieved rate of all parameters was 100%.	
S8: China- ASEAN educational medicare cooperation project (phase I)	The main water body in the project city is You River. The level of water source exploration and utilization is low. According to the survey by LDI conducting the EIT, the surface water quality comply with the Class III~IV requirement of GB3838.	Category III of GB 3838-2002 (water quality target in 2020)

Source: EIRs & EITs

C. Biological Resources, Ecology and Biodiversity

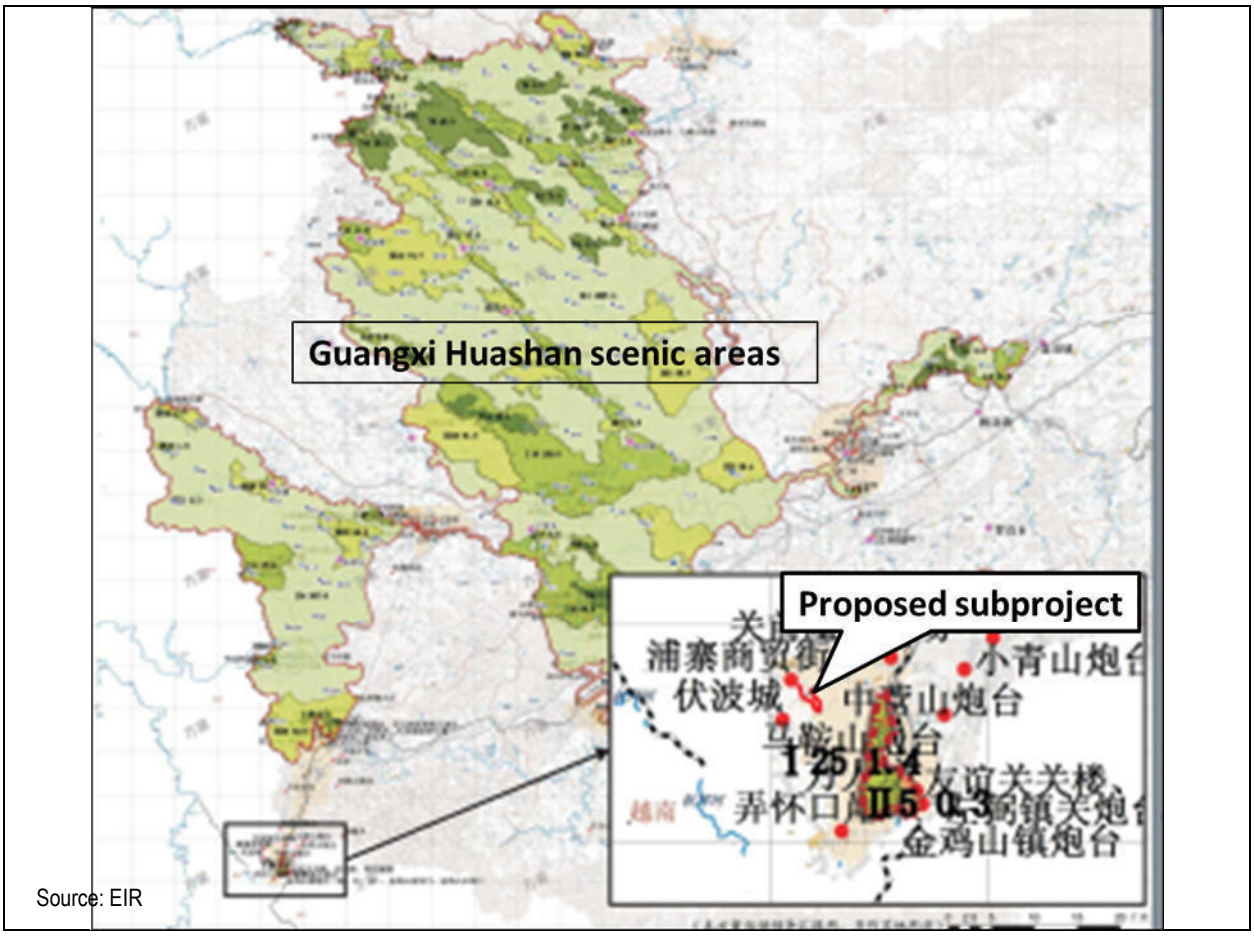
110. Field surveys and literature review undertaken during EIR/EIT preparation for the eight subprojects revealed the absence of species that are under the national and/or international protection status within 1 km of the subproject EIA sites. All the subproject sites have been influenced and disturbed by human activities, with the absence of natural woodland and critical habitat. None of the subproject sites impinges onto any conservation area such as nature reserve and scenic area. Table 32 summarizes the biological resources within the areas of influence (assessment area) of the eight subprojects. The habitats at these locations have also been illustrated in the photographs in Table 25 above, with most of the sites within BECZs already undergoing site formation works.

Table 32: Summary of biological resources within the assessment areas of the subproject sites

Subproject	Description of Biological Resources
S1: Chongzuo Sino-Vietnam Border Economic Cooperation Zone demonstration project (phase I)	Plants include *Dracaena, Camellia, Lonicera japonica, Herba lysimachiae, Gynostemma, Hematoxylin* and *Millettia extensa*. Crops include rice, corn, sugarcane, cassava, peanuts, yellow beans, red melon seed, longan, litchi, mandarin orange, banana and passion flower. Site has been influenced and disturbed by human activities and there is no natural habitat on site.
S2: Dongxing Changhu Road (east section) construction project	The vegetation is dominated by seasonal vegetables and weeds. Dominant fauna includes Muroidea*, Vespertilio, Lanius schach, Parus major, Passer, Acridotheres cristatellus, Hirundo rustica, Scolopendra subspinipes, Dendroaspis polylepis,* Bees, Dragonfies*, Rhopalocera, Cyprinus carpio, Oreochromis* spp*, Hypophthalmichthys molitrix,* Cobitidae*,* and Naticidae.
S3: Infrastructure development for Longzhou Border Economic Cooperation Zone	The area has been highly disturbed by human and agricultural activities. There is no natural habitat on site. Planted species include fruits such as *Citrus maxima*, pumpkin sprout, banana, water melon and various vegetables. Dominant shrubs and grass include Bambusa pervariabilis, *Miscanthus* spp., and *Bidens pilosa*.
S4: Road connectivity in Pingxiang-Viet Nam cross-border (phase 1)	The area of influence for this subproject site has been highly disturbed by human activities from heavy traffic travelling on the existing road. The area surrounding the subproject site is dominated by hilly terrain. The vegetation on the hills mainly consists of *Litchi chinensis, Dimocarpus longan, Eucalyptus urophylla, Miscanthus sinensis, Neyraudia reynaudiana, Imperata cylindrical, Bidens pilosa, Ageratum conyzoides, Rhus chinensis, Ficus hirta,* and *Alangium chinense*. The subproject is located outside the Huashan scenic areas (see Figure 19).
S5: Qinzhou cross-border trade e-commerce industrial park project	These subprojects are located in the Qinzhou Bonded Port Zone on land reclaimed from the sea. The vegetation in the port area are dominated by eucalyptus trees and shrubs and weed. Fauna mainly includes Muroidea*, Vespertilio, Lanius schach, Parus major, Scolopendra subspinipes, Dendroaspis polylepis,* Bees, Dragonflies*, Rhopalocera*.
S6: Qinzhou international cold-chain logistic demonstration project	

Subproject	Description of Biological Resources
S7: China-ASEAN small and medium enterprises (SMEs) synergy innovative development project	The site is on vacant land that has been disturbed by human activities with vegetation dominated by planted species, shrubs and weeds.
S8: China- ASEAN educational medicare cooperation project (phase I)	The vegetation on site is dominated by grassland, shrubs and planted Mango trees.

Source: EIRs & EITs



Source: EIR

Figure 19: Location of the Huashan scenic areas relative to subproject 4 in Pingxiang

111. **Wildlife trafficking.** ADB commissioned Wildlife Conservation Society to undertake an assessment of potential illegal wildlife trafficking and trade in border areas in the program area. Wildlife enforcement data, consultations and site visits indicate shows that Guangxi is a major wildlife trafficking trade center between Viet Nam and PRC. Based on historical records, Pingxiang and Dongxing would have the highest risk of trafficking in protected and controlled wildlife and timber species among the subproject cities, while Qinzhou and Longzhou could face increasing risk in parallel with increasing cross-border trade. Illegal items that have been confiscated included ivory, python skins, bear gallbladders, pangolins, civet casts, leopard cats

and rosewood. Many CITES appendix II species were found in the market without CITES permits. A detailed report has been prepared and will be included as an appendix to the IEE.

D. Socio-economic Conditions

112. Table 33 presents the 2015 socio-economic statistics of the prefecture level cities of the eight subprojects. Data show that per capita GDP in Guilin and Fangchenggang were higher than the GZAR average while the other three were below the average. Per capita rural net income and urban disposable income in Guilin, Fangchenggang and Qinzhou were higher than the GZAR average while the other two were below average.

Table 33: Main socio-economic indicators by prefecture (2015)

Items	GZAR	Guilin	Fangchenggang	Qinzhou	Baise	Chongzuo
		Subproject 7	Subproject 2	Subprojects 5, 6	Subproject 8	Subprojects 1, 3, 4
Administrative Land Area (km^2)	236,700	27,809	6,238	10,895	36,201	17,332
Per Capita GDP (CNY)	35,190	39,327	67,971	29,560	27,365	33,355
Total Population (million persons)	55.18	5.2897	0.9561	4.0410	4.1319	2.488
Female (%)	47.24	48.06	45.79	45.32	47.91	47.19
Total Households (million households)	15.75	1.6267	0.2491	0.9816	1.1088	0.7088
Rural Households (10,000 households)	N/A	107.22	17.58	85.18	82.48	54.70
Natural Growth (‰)	7.9	6.88	9.78	9.19		6.65
Urban Registered Unemployment Rate (%)	2.92	3.57	1.68	2.68	2.90	2.63
Average Wages of Employed Persons in Urban Units (CNY/year)	N/A	51,642	51,230	46,070	49,809	47,630
Rural Net Income per capita (CNY)	9,467	10,365	10,429	9,710	6,766	8,308
Per Capita Urban Disposable Income (CNY)	26,416	28,768	28,433	27,281	24,958	24,668

Source: PPTA

E. Physical Cultural Resources

113. The subproject EIRs and EITs have reviewed the status of cultural heritage within the subprojects' area of influence and concluded that no physical cultural resource exist within the subproject areas of influence. This was also confirmed by local cultural bureaus. Should buried artifacts of archaeological significance be uncovered during the construction stage within the subproject areas, construction will be stopped and immediately reported to the local Cultural Bureaus in accordance with the PRC's *Cultural Relics Protection Law* (2002) and *Cultural Relics*

Protection Law Implementation Ordinance (2003).

F. Greenhouse Gas Emissions

114. Mitigating climate change through energy saving and sound management to reduce GHG emissions is a priority in Guangxi. In view of climate change risks to the province, Guangxi established a Provincial Climate Change Adaptation Office within the Guangxi Development and Reform Commission in August 2011 with 15 staff. This office assigns binding CO_2 reduction targets (per unit GDP) to cities in the province, which becomes a binding target for the Five Year Plans (FYP).

V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

A. Positive Impacts and Environmental Benefits

115. **Training of skilled labor from the PRC and ASEAN countries**. The project will provide the training of highly skilled labor in aerospace, aeronautic and health professions from the PRC and ASEAN countries. Under subproject 7, the GUAT who presently trains on average 300 students annually from ASEAN countries especially Thailand and Viet Nam, aims to enroll 18,700 students by year 2020 including 800 international students in aerospace and aeronautic professions. Under subproject 8, the YMCN aims to increase its student enrollment to 15,000 by 2020, including 800 international students to narrow the gap in labor shortage on grass-root health professionals in GZAR, which in 2015 the medical school graduates of less than 5,000 met less than 40% of the demand in GZAR.

116. **Strengthening of business development services for SMEs**. The project will improve the provision of SME business development services in Guilin (subproject 7) by providing a conduit for communication and development platform between the SME's in GZAR and ASEAN countries.

117. **Development of new technologies such as e-commerce to facilitate cross-border trading and access to markets**. The project will help establish and/or improve logistics service platforms to remove bottlenecks at cross-border check points (subproject 5), which have impeded the cross-border e-commerce operation. It will also implement measures to improve customs and sanitary and phytosanitary services as they are related to e-commerce. The Qinzhou Bonded Port has been designated by the national government to be the import port for meat and fruit products. An e-commerce cross-border logistics service platform will be put in place in the Qinzhou Bonded Port Zone (subproject 5) with real-time trade-logistics data exchange and trade process optimization. It will improve the effectiveness and efficiency in truck inspection, customs inspection and clearance, sanitary and phytosanitary services, supply chain management services, and cross-border order management. A cold-chain logistics facility will also be established (subproject 6) in the Qinzhou Bonded Port Zone for the import and export of fresh agricultural products such as meat, poultry, seafood, vegetables, fruits and egg. At present, cold chain logistics is still in its infancy in GZAR with only 10% of fresh agricultural products are under cold delivery, resulting in approximately 25% of such products becoming rotten. Subproject 6 therefore will improve the cold chain logistics infrastructure for fresh agricultural products.

118. **Improved border trade transport infrastructure**. Tranche 2 will improve transport

infrastructure by improving the road networks within the border economic cooperation zones in Chongzuo (subproject 1) and Longzhou (subproject 3). Connectivity with Viet Nam will be improved thus facilitating cross border trade in Pingxiang through the construction of a class II road from Kafeng to Nonghuai (subproject 4); and in Dongxing through the construction of the Changhu Road east section connecting the Viet Nam border via Dongxing to Fangchenggang which is the largest seaport in GZAR. Changhu Road will also divert the cross border traffic between Viet Nam and Fangchenggang away from the urban area of Dongxing, thereby reducing traffic congestion in the urban area.

119. **Improved industrial and municipal wastewater treatment**. Subproject 1 will provide a wastewater treatment plant with a 10,000 m^3/d treatment capacity for treating industrial (pre-treated by industrial enterprises) and municipal wastewater from the BECZ in Xinhe Town in Chongzuo. The WWTP would remove approximately 1,600 t/a COD, 1,020 t/a BOD_5, 91 t/a NH_3-N and 10 t/a TP from discharging into the Heishui River.

120. **Adoption of green building design**. Both subprojects 7 and 8 indicated the adoption of green building design in the FSRs. This would result in energy savings and water conservation throughout the life cycle of these buildings. During the PPTA stage site visits, the PIEs for the four subprojects (5, 6, 7 and 8) with buildings were advised of the LEED certification scheme under the United States GBC, and were encouraged to adopt green building design and construction features listed in the scheme and to apply for LEED certification for at least one of their buildings. Since these subprojects will involve cross-border trade with and training of labor and students from the ASEAN countries, a LEED certified building used for these purposes will have important demonstration effect to their ASEAN partners and SMEs.

B. Impacts Associated with Project Location, Planning and Design

121. The eight tranche 2 subprojects will involve permanent land take of 134.21 ha (see Chapter III: Description of the Project) for the construction of buildings, roads and wastewater treatment plant, which is an irreversible impact from permanent change of land use and landscape. Environmental settings of these subproject sites have been illustrated and described in Table 25.

C. Measures during Detailed Design and Pre-Construction

122. **Measures during detailed design**. The FSRs for subprojects 5, 6, 7 and 8 have included the requirement for designing barrier-free universal access to the buildings and facilities. Detailed design of the buildings and facilities for these four subprojects should also include energy saving features identified in the FSRs, which include materials for the outer wall, windows and roofs; electrical system and automation; air conditioning and ventilation; and light fixtures, etc.

123. Climate change risk assessment indicates that all subproject sites would be affected by intensified heavy rainfall due to climate change resulting in potential flooding. For the roads in Drainage design for all subprojects shall therefore take into consideration climate change impact, especially subprojects 2 and 4 where the road alignments would cross hilly areas with steep slopes. The student dormitories in subproject 8 would be exposed to traffic noise from the Bailong Expressway, the layout and design of the façade of dormitory buildings with direct line of sight of the expressway shall incorporate noise mitigation features.

124. The following environmental measures shall be included in the detailed design of the

subprojects:

(i) Technical design of buildings and facilities shall include barrier-free universal access
(ii) Technical design of buildings and facilities shall include energy saving features in terms of building envelope/roofing materials, electrical system and automation, water heating, air conditioning and ventilation, and lighting, etc. as recommended in the FSRs
(iii) Technical design of buildings and facilities shall consider other "green building" features besides energy saving, such as the use of recycled building materials, rainwater capture and reuse, green roofs, etc.
(iv) Technical design of building and road drainage for the following subprojects shall take into consideration climate change impacts from intensified heavy rainfall, and shall increase the drainage design standards under GB 50014200 by the following percentages.
    a) Subproject 1: 11%
    b) Subproject 3: 11%
    c) Subproject 4: 11%
    d) Subproject 5: 10%
    e) Subproject 6: 10%
    f) Subproject 7: 5%
    g) Subproject 8: 8%
(v) A high design standard shall be adopted in the stabilizing slope design for all slopes on subproject 2 and 4.
(vi) In subproject 8, technical design of the façade of student dormitory #1 with a direct line of sight of the Bailong Expressway shall adopt noise reduction measures, and if necessary shall include noise insulated windows in accordance with GB 50118-2010 *Design Specifications for Noise Insulation of Buildings for Civil Use* 《民用建筑隔声设计规范》

125. **Measures during pre-Construction.** A number of environmental management measures shall be implemented in the pre-construction phase for the three subprojects to ensure environment management readiness. These include:

(i) The GPMO, as the executing agency, shall complete the following prior to construction commencement:
    (a) Integrate the grievance redress mechanism (GRM) for Tranche 2 into the GRM for Tranche 1.
    (b) Appoint qualified staff as the environmental coordinator to oversee EMP implementation.
    (c) Appoint the project management consultant (PMC). The PMC shall have an environmental specialist on the team to undertake the role of external (third-party) environmental monitor (EEM) during loan implementation.
    (d) Include specifications for environmental protection in all civil works tender documents and contracts.
    (e) If necessary, update the EMP to reflect changes made (such as changes in construction methods and building layout, etc.) during the detailed design.
(ii) Each project implementation entity (PIE), as the implementing entity for the respective subprojects, shall complete the following prior to construction commencement:
    (a) Appoint a qualified staff as the environmental coordinator responsible for EMP implementation.
    (b) Appoint an environmental supervision engineer (ESE,环境监理) responsible for the environmental supervision of contractors and environmental audit of construction sites for the subproject.

(c) Appoint an environmental monitoring station (EMS, 环境监测站) to undertake environmental monitoring according to the EMP during construction and operation of the subproject.

D. Impacts and Mitigation Measures during the Construction Stage

126. **Impact screening.** Construction activities will include site formation (except for subprojects 5, 6 7 and 8 where site formation is not part of these subprojects) and construction of buildings, roads, wastewater treatment plant, wastewater collection pipelines and ancillary facilities such as drainage system and landscaping etc. Potential environmental impacts arising from such activities would include air quality, noise, water quality, ecology, solid waste, and occupational health and safety.

127. Potential air quality impacts could occur due to fugitive dust generated on the construction site during earth works, from stockpiles of uncovered earth materials, exhaust from construction equipment and vehicles, and asphalt fumes during road paving. The use of powered mechanical equipment (PME) during construction activities will generate noise. Construction activities will generate process wastewater and construction workers will produce wastewater. Permanent and temporary land take might result in loss of vegetation. Construction activities will produce construction wastes and construction workers will generate refuse. Workers will face occupational health and safety issues working on construction sites, such as during road paving when workers are exposed to asphalt fumes, above ground construction works, and exposure to volatile organic compound (VOC) from paints and other organic solvents during interior fit-out of buildings. These potential impacts are assessed and addressed below. Land contamination would not be an issue in this project since there has been no industrial activity within the construction footprint of the subprojects.

1. Impacts and Mitigation Measures on Physical Resources

128. **Air quality.** Main air pollutants during the construction stage in this project include (i) fugitive emissions of dust during earth works and from uncovered stockpiles, (ii) fumes and exhaust from construction vehicles and machinery as well as during road paving, and (iii) fugitive emissions of VOC from paints and organic solvents during interior fit-out of buildings and facilities.

129. The EIRs and EITs estimated that the impact area of fugitive dust from construction sites, depending on the prevailing wind speed, would be confined to within 150 m downwind from the boundary of the construction site if no mitigation measure is adopted, and ambient air quality Class II standard would be achieved beyond 150 m. Therefore most of the sensitive receptors listed in Table 26 would be adversely affected if no mitigation measure is adopted. Fugitive dust during earth works, on haul roads and from uncovered stockpiles was estimated to affect a downwind distance of up to 50 m. Watering and vehicle speed control (at ≤ 8 km/h) are effective means of suppressing fugitive dust emissions from unpaved construction sites and haul roads. The EIRs and EITs estimated that watering of unpaved areas could reduce fugitive dust emissions by 80%.

130. For exhaust from construction vehicles and machinery, the EIRs and EIT estimated that the NO_2 emitted from these sources would comply with the *Ambient air quality standards* (GB 3095-2012) Class 2 standard at a distance of 50 m from the source. Asphalt paving produces fumes containing small quantities of toxic and hazardous chemicals such as volatile organic compounds (VOC) and poly-aromatic hydrocarbons (PAH). Concrete batching will produce TSP.

Air pollutant integrated emission standard (GB 16297-1996) controls the emission of air pollutants from these activities. Asphalt fumes generated during road paving would be considerably less than fumes generated during mixing, and once the paved asphalt is cooled to <82^{o} C, asphalt fumes would be reduced substantially and then totally when the asphalt is solidified. The impact from asphalt fumes during road paving is therefore of short duration. Based on monitoring of α-benzopyrene, a constituent of asphalt fume, on similar road projects, the EIRs indicated that its concentration would meet GB 3095-2012 Class 2 standard at a distance of 100 m downwind of the asphalt mixing station. However, asphalt fumes could affect construction workers doing the road paving and personal protective equipment (PPE) is needed for their occupational health and safety.

131. For installation of wastewater collection pipelines in subproject 1, households along the pipeline route would be affected since the purpose of such installation is to connect to the households. Road construction and wastewater pipeline installation are linear activities. Once a section of road or pipeline works near a sensitive receptor is completed, the works activities move on and away from the sensitive receptor. Potential impacts from these activities are therefore of short duration, from a few weeks for pipeline works to a few months for road construction.

132. Fugitive emission of VOC from paints and organic solvents during interior fit-out of buildings would mainly affect the construction workers on site and is thus an occupational health issue. Mitigation measures would include the provision of PPE to the workers and good ventilation in the work place.

133. The Contractor shall include all necessary mitigation measures to reduce air pollution that would impact public and occupational health, by implementing the following air quality control measures. Some of these measures are generic measures that are applicable to all construction sites and construction activities. Yet these are effective measures and are also described in WBG's EHS guidelines.

(i) Spray water at least twice each day on unpaved areas and exposed dust-prone stockpiles except on rainy days.
(ii) Store dust-prone materials in areas with shelters on four sides and on top. If such materials have to be stored in open area, cover with strong tarpaulin.
(iii) Control vehicle speed to ≤ 8 km/h in unpaved areas. Post the speed limit sign in these areas.
(iv) Pave construction site exits with gravel or asphalt.
(v) Install wheel washing equipment or conduct wheel washing manually at each construction site exit to prevent trucks from carrying muddy or dusty substance onto public roads.
(vi) Vehicles with an open load-carrying case, which transport potentially dust-producing materials, shall have proper fitting sides and tail boards. Dust-prone materials shall not be loaded to a level higher than the side and tail boards, and shall always be covered with a strong tarpaulin.
(vii) For road construction, site asphalt / concrete mixing stations at least 300 m downwind of the nearest household (plant noise is the limiting factor) and equip asphalt, hot mix and batching plants with fabric filters and/or wet scrubbers to reduce the level of dust emissions.
(viii) Provide personal protective equipment (PPE) such as goggles, gloves and respirators to construction workers doing asphalt concrete and cement concrete road paving and doing interior fit-out of buildings to minimize skin exposure to chemicals and inhalation of VOC.
(ix) Regularly maintain construction vehicles and machinery to minimize exhaust emissions from these sources.
(x) Unauthorized burning of construction and demolition waste material and refuse shall be

subject to penalties for the Contractor, and withholding of payment.

134. These measures are defined in the EMP. Contractors are required to ensure compliance with relevant PRC emission standards. Air quality monitoring will be carried out by a licensed environmental monitoring entity (external) during the construction period. Potential air quality impacts during the construction stage would be of short duration and localized. With the above mitigation measures in place, potential air quality impacts during the construction stage would be reduced to acceptable levels.

135. **Noise**. Noise is emitted by PME used during construction and construction vehicles travelling to and from the construction sites. For road construction, sub-grade works would be the noisiest activity. The EIRs and EITs estimated that noise from road construction would meet the day time [70 dB(A)] and night time [55 dB(A)] noise limits in *Emission Standard of Environmental Noise for Boundary of Construction Site* (GB12523 -2011) at distances of 100 m and 300 m respectively beyond the boundary of the construction site without noise mitigation. Most noisy activities during building construction would include piling works and during the use of excavators, electric saws, breakers and external elevators (for transporting materials and workers to upper floors) with cumulative sound power level reaching 105 dB(A). The EITs estimated that building construction would meet the day time [70 dB(A)] and night time [55 dB(A)] noise limits in *Emission Standard of Environmental Noise for Boundary of Construction Site* (GB12523 -2011) at distances of 50 m and 200 m respectively beyond the boundary of the construction site without noise mitigation. Therefore, all the sensitive receptors listed in Table 26 would be affected if no mitigation measure is adopted.

136. Road construction in subproject 4 in Pingxiang would require blasting at some road sections. The EIR estimated that noise level at the blast site would reach 130 dB(A), affecting a distance of up to 300 m from the blast site. Kafeng Village is located more than 300 m from the nearest blast site and there is no other sensitive receptor within 300 m of any blast site. No blasting impact is anticipated.

137. Contractors shall be required to implement the following mitigation measures for construction activities to meet PRC construction site and WBG recommended noise limits and to protect sensitive receptors. Some measures are generic and are applicable to all construction sites and activities. Yet they are effective measures and are also in line with WBG's EHS guidelines. The use of temporary noise barriers or hoardings to shield off construction noise is particularly relevant as many noise sensitive receptors listed in Table 26 would be very close to the work sites. Noisy construction activities shall also be avoided during examination periods such as the Xinjian Primary School and the south campus of GUAT in subproject 7; and the Vocational Education Center in subproject 8. The EIT also suggested that for protecting the acoustic environment of Huangqiaoshu Village in subproject 2, noisy machinery such as concrete batching and asphalt mixing equipment, generators, etc. should be positioned at least 150 m from the village and preferably in low lying areas with the direct line of sight to the village blocked by terrain, and that a 100-m long 2-m high hoarding should be erected as a temporary noise barrier for the village during construction.

(i) No construction works shall be conducted between 22:00 to 06:00 hours and piling works shall also be prohibited between 12:00 to 14:30 hours within 300 m of a noise sensitive receptor (such as residential household, school, health clinic, hospital).
(ii) During construction, the contractor shall:
    (a) ensure regular equipment repair and maintenance to keep them in good working condition to minimize noise

(b) deploy low noise machinery or the equipment with sound insulation
(c) erect temporary noise barriers or hoardings around noisy equipment to shield the noise from equipment
(d) provide the construction workers with suitable hearing protection (ear muffs) when working near noisy machinery such as during piling
(e) forbid the use of horns unless absolutely necessary, minimize the use of whistles

(iii) For subproject 2, noisy machinery such as concrete batching and asphalt mixing equipment, generators, etc. should be positioned at least 150 m from the Huangqiaoshu Village and preferably in low lying areas with the direct line of sight to the village blocked by terrain. As a recommendation from the domestic EIT, a 100-m long 2-m high hoarding shall be erected at Huangqiaoshu Village as a temporary noise barrier during road construction.

138. 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) Plan 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) Use noise control devices, such as temporary noise barriers and deflectors for impact and blasting activities, and exhaust muffling devices for combustion engines.
(iii) Avoid or minimize project transport through community areas.

139. Noise impacts during construction would be of short duration. Potential sensitive receptors will be exposed to short term, temporary and localized impacts. With the above mitigation measures in place, potential noise impacts during construction would be reduced to acceptable levels.

140. **Water quality.** Uncontrolled wastewater and muddy runoff from construction sites could potentially pollute nearby water bodies and clog up drains. Discharge of domestic wastewater generated by the construction workers could also pollute nearby water bodies if not treated. The EIRs and EITs estimated that process wastewater for the subprojects would contain approximately 250 mg/L suspended solids (SS) and 20 mg/L total petroleum hydrocarbon (TPH). Suspended solid (SS) concentration in the process wastewater of asphalt/concrete mixing stations could be as high as 5,000 mg/L. Process wastewater would be treated by oil-water separation then sedimentation on the construction sites. The process wastewater after treatment would be used for dust suppression on site resulting in no discharge of process wastewater from the construction sites.

141. Domestic wastewater generated by the construction workers has been estimated by the EIRs and EITs to range from 6 m^3/d to 24 m^3/d for the subprojects depending on the number of construction workers on site at any given time. Major pollutants are chemical oxygen demand (COD), biochemical oxygen demand (BOD_5), suspended solids (SS) and ammonia nitrogen (NH_3-N). Approximate concentrations are 400 mg/L, 200 mg/L, 200 mg/L and 25 mg/L respectively. These will be treated by septic tanks installed on site.

142. All subproject sites do not cross any water body except the Changhu Road east section in subproject 2 where the road alignment would cross the upstream sections of the Dagoulong Reservoir (for irrigation) and Xiangche Creek (drainage ditch). Culverts would be constructed for the passing of these water bodies underneath the road. If necessary these streams should be

temporarily diverted so that culvert and road construction could be conducted in the dry, or sandbags or berms should be placed downstream of the works area to contain the downstream dispersion of suspended solids.

143. The contractors shall implement the following mitigation measures to prevent water pollution:

(i) Collect runoff from construction sites with drainage ditches to prevent runoff containing muddy water from polluting nearby roads, land and water bodies.
(ii) Install and operate oily-water separators and sedimentation tanks on construction sites and asphalt/concrete mixing stations to treat process water and muddy runoff with high concentrations of total petroleum hydrocarbon and suspended solids. If necessary, use flocculants such as polyacryl amide (PAM) to facilitate sedimentation.
(iii) Provide portable toilets and small package wastewater treatment plants and/or septic tanks on construction sites for the workers. If there are nearby public sewers, install interim storage tanks and pipelines to convey wastewater to public sewers.
(iv) Store fuels, oil, and other hazardous materials on construction sites within secured areas on impermeable surfaces protected by bunds and provided with cleanup kits.
(v) Clean up any chemical spills into drains and water bodies within 24 hours of the occurrence, with contaminated soils and water treated according to HJ 25.4-2014 *Technical Guidelines for Site Soil Remediation*. Records must be handed over without delay to the GPMO and local EPB.
(vi) For subproject 2, deploy mitigation measures such as temporary diversion of stream flow or placement of sandbags or berms around the works area to prevent downstream dispersion of suspended solids during culvert and road construction crossing the upstream sections of the Dagoulong Reservoir and Xiangche Creek. Unless the road construction across these water bodies are done in the dry by first diverting these streams, mitigation of water quality impact during stream crossing road construction shall be based on water quality monitoring results. At each stream crossing road construction location, upstream and downstream monitoring stations will be set up and SS levels monitored. When the SS levels at the downstream impact station is 130% higher than the SS levels at the upstream control station, the contractor shall adopt alternative construction methods or additional mitigation measures until the downstream SS level is less than 130% above the upstream SS level.

144. With the above measures in place, potential water quality impact should be mitigated to acceptable levels.

145. **Solid waste**. Solid waste generated during construction will include refuse [municipal solid waste (MSW)] generated by construction workers on construction sites and construction waste generated during site formation and construction of buildings, roads and the WWTP. The EIRs and EITs estimated that the quantities of refuse generated by construction workers on the construction sites of the subprojects would range from 15 kg/d to 100 kg/d depending on the number of construction workers on site at the time. MSW from construction sites will be collected regularly by local sanitation bureaus for disposal and local landfills.

146. Since site formation is not part of the subprojects involving building construction (subprojects 5, 6 7 and 8), solid waste generated on construction sites, other than refuse from the construction workers, would mainly consists of construction waste. The EITs for these subprojects estimated that the quantities of construction waste generated from building construction would range from approximately 900 t in subproject 6 to 3,650 t in subproject 8. Construction waste generated on these construction sites will be transported to construction waste storage sites

designated by the local municipal administration bureaus.

147. Subprojects 1, 2, 3 and 4 would involve substantial earth cut and fill during the construction of roads and the WWTP, especially road construction in hilly terrain in subprojects 2 and 4. Table 34 presents the earth cut and fill balances and disposal means.

Table 34: Earth cut and fill balances for subprojects 1, 2, 3 and 4.

Subproject	Earth Cut (m^3)	Earth Fill (m^3)	Disposal (m^3)	Description
S1: Chongzuo Sino-Vietnam Border Economic Cooperation Zone demonstration project (phase I)	582,926	656,112	0	The quantities include construction of roads and the WWTP. Five road-side temporary sites totaling 4.46 ha within the BECZ will be established for storage of spoil. Those that cannot be reused for the subproject will be used for formation of other sites within the BECZ.
S2: Dongxing Changhu Road (east section) construction project	649,800	261,700	388,100	Spoil will be temporarily stored near the alignment on vacant land. All will be used for other infrastructure projects in Dongxing resulting in no permanent disposal.
S3: Infrastructure development for Longzhou Border Economic Cooperation Zone	679,067	320,038	358,029	Excess spoil will be temporarily stored (see Figure 8 on location) for use as site formation and backfill materials for other projects within the BECZ, resulting in no permanent disposal.
S4: Road connectivity in Pingxiang-Viet Nam cross-border (phase 1)	912,090	310,672	601,448	Spoil will be disposed of at an existing 33-ha disposal site (see Figure 10).

Source: EIRs and EITs

148. The contractors shall implement the following mitigation measures to manage construction waste and refuse generated during construction:

(i) Maximize the re-use of construction wastes on the project.
(ii) Store all refuse and construction waste generated on construction sites in designated areas and remove them from these locations for disposal or reuse regularly.
(iii) Include all soil erosion prevention measures listed in the EIRs and EITs in the design of spoil disposal sites.
(iv) Rehabilitate and vegetate spent spoil disposal/storage sites, haul roads and other unpaved temporary land take areas within one month after closure to prevent soil erosion and dust generation.

149. With the above measures in place, solid waste generated during construction should have minimal environmental impact.

150. **Soil erosion**. Runoff from construction sites is one of the largest sources of sediment in urban areas under development. If uncontrolled, eroded sediment from construction sites creates adverse impacts on water quality, drainage and recreational activities. Soil erosion protection measures including engineering, planting and temporary measures as described in the EIRs and EITs are summarized in Table 35. The most effective erosion control will be interception drainage to protect disturbed surfaces from surface flows, and sedimentation ponds to remove silt and sand from construction site runoff. The EIRs and EITs also contain soil erosion monitoring programs for implementation during the construction stage. The EMP will not include the details on mitigation and monitoring of soil erosion, but will require that all the EIR and EIT requirements on

mitigation and monitoring of soil erosion be included in all tender documents and works contracts for the subprojects

Table 35: Soil erosion protection measures

Project Site	Engineering Measure	Planting Measure	Temporary Measure
Works areas	• Site leveling and surface press • Slope protection works where appropriate • Drainage ditches	• Spray grass seeding	• Spray water to suppress dust
Spoil disposal sites	• Perimeter berm or hoarding • Perimeter drainage/ interception ditch • Site leveling and surface compaction	• Spray grass seeding	• Spray water to suppress dust
Construction staging areas & haul roads	• Site surface press	• Spray grass seeding	• Spray water to suppress dust

Source: EIRs and EITs

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2. Impacts and Mitigation Measures on Biological Resources, Ecology and Biodiversity

151. Existing conditions and biological resources of the subproject sites have been illustrated and described in Tables 25 and 32 above. Subprojects 5 and 6 are located on reclaimed land covered with scattered shrubs and weeds. Subprojects 1 and 3 are located in BECZs that are already disturbed and influenced by human activities and dominated by common floral and faunal species. The subproject 7 site is on vacant land that has been disturbed by human activities with vegetation dominated by planted species, shrubs and weeds. The vegetation on subproject 8 site is dominated by grassland, shrubs and planted species such as Mango trees. The subproject 2 site is on hilly terrain with cultivated land dominated by the growing of seasonal vegetables and grassy areas dominated by scattered shrubs and weeds. The subproject 4 site is also on hilly terrain next to an existing road that has heavy traffic and has also been influenced and disturbed by human activities. Dominant vegetation includes common species of shrubs and weeds as well as planted fruit trees such as Litchee and Longan. Literature review and site surveys did not reveal the presence of natural and critical habitats as well as protected floral and faunal species within the area of influence of these subprojects. None of the subproject sites is located within protected areas such as nature reserves, scenic areas and drinking water protection zones. Potential impact on biological resources, ecology and biodiversity should be localized and minimal, and would not adversely affect the overall regional ecological setting. The contractors will implement the following mitigation measures during construction for protection of biological resources.

(i) Construction workers are prohibited from capturing any wildlife during construction.
(ii) Protect existing trees and grassland during construction; remove trees or shrubs only as the last resort if they impinge directly on the permanent works or necessary temporary works.
(iii) Re-vegetate the area after construction. Tree planting shall use local species with local provenance. Planting of exotic of invasive species shall be prohibited.

3. Impacts and Mitigation Measures on Socio-economic Resources

152. **Land acquisition and resettlement**. Subprojects 1, 5 and 6 are on state-owned land and no land acquisition will be required. Land acquisition for subprojects 2, 3 4, 7 and 8 would total 117.3 ha, with 64.4 ha for subprojects 3, 7 and 8 already acquired and 52.9 ha for subprojects 2 and 4 to be acquired. Land acquisition and resettlement will be in accordance with PRC and ADB policies.

153. **Physical cultural resources.** Assessment undertaken did not reveal the presence of physical cultural resources within the footprints of the proposed subproject sites. Should buried artifacts of archaeological significance be uncovered during the construction stage within these sites, construction shall be stopped and immediately reported to the local cultural bureaus in accordance with PRC's *Cultural Relics Protection Law* (2002) and the *Cultural Relics Protection Law Implementation Ordinance* (2003).

154. **Occupational health and safety.** Due to its nature the construction industry is considered to be one of the most hazardous industries where a number of potentially hazardous operations are carried out. The contractors shall implement the following measures and precautions to protect the health and safety of construction workers.

(i) Environment, health and safety officer: Each contractor shall appoint at least one environment, health and safety (EHS) officer to manage occupational health and safety risks on construction sites by applying the following measures.

(ii) Construction site sanitation: (i) Each contractor shall provide adequate and functional systems for sanitary conditions, toilet facilities, and waste management with waste separation; (ii) Effectively clean and disinfect the site. During site formation, spray with phenolated water for disinfection. Disinfect toilets and refuse bins and ensure timely removal of solid waste; (iii) Exterminate rodents on site at least once every 3 months, and exterminate mosquitoes and flies at least twice each year; (iv) Provide public toilets in accordance with the requirements of labor management and sanitation departments in the living areas, if any, on construction site, and appoint designated staff responsible for cleaning and disinfection; (v) Construction site domestic wastewater shall be discharged into the municipal sewer system or treated on-site using a portable system.

(iii) Occupational safety: (i) Provide personal protective equipment (safety hats and shoes, high visibility vests, and safety belt and harness for above ground works) to all construction workers and strictly enforce all workers to put on the PPE; (ii) Provide safety goggles, gloves and respiratory masks to workers doing building interior fit-out works; (iii) Provide ear plugs to workers operating and working near noisy PME.

(iv) Food safety: (i) Inspect and supervise food hygiene in canteens, if any, on site regularly. Canteen workers must have valid health permits. If food poisoning is discovered, implement effective control measures immediately to prevent it from spreading.

(v) Disease prevention, health services: The following disease prevention measures and health services shall be undertaken: (i) Construction workers must have physical examination before 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; (ii) 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; (iii) Provide induction and training by local health departments on prevention and management of communicable diseases.

(vi) Social conflict prevention: No major social risks and/or vulnerabilities are anticipated as a

result of the project. The project construction workers will be engaged locally. Civil works contracts shall stipulate priorities to (i) employ local people for works, (ii) ensure equal opportunities for women and men, (iii) pay equal wages for work of equal value, and to pay women's wages directly to them; and (iv) not employ child or forced labor.

155. **Community health and safety.** Temporary traffic diversions, continual generation of noise and dust on haulage routes, and general hindrance to local access and services are common impacts associated with construction works within or nearby local settlements. The potential impacts on community health and safety will be mitigated through a number of activities defined in the EMP. The contractors shall implement the following measures:

(i) Traffic management: A traffic control and operation plan shall be prepared together with the local traffic police prior to any construction. The plan shall include provisions for 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, controls and planning in advance.
(ii) Information disclosure: (i) Construction billboards, which include construction description, schedule, responsible person and complaint phone number, shall be erected at the entry to each construction site and construction staging area. (ii) Residents and businesses shall be informed in advance of noisy construction activities such as piling, given the dates and duration of expected disruption and made aware of the project GRM.(iii) Clear signs shall be placed at construction sites in view of the public, warning people of potential dangers such as moving vehicles, hazardous materials, excavations etc. and raising awareness on safety issues.
(iii) Construction sites: All sites shall be made secure, discouraging access by members of the public through appropriate fencing, signage and/or security personnel, as appropriate.

156. **Utilities provision interruption.** Construction may require relocation of municipal utilities such as power, water, communication cables. Temporary suspension of services (planned or accidental) can affect the economy, industries, businesses and residents' daily life. Mitigation of impacts on utilities provision shall be through a number of activities defined in the EMP, to be incorporated in the tender documents and construction contracts:

(i) Contractors shall assess construction locations in advance and identify potential for disruption to services and risks before starting construction. Any damage or hindrance/disadvantage to local businesses caused by the premature removal or insufficient replacement of public utilities is subject to full compensation, at the full liability of the contractor who caused the problem.
(ii) If temporary disruption is unavoidable the contractor shall, 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 affected persons.

E. Impacts and Mitigation Measures during the Operational Stage

157. **Impact screening**. Potential environmental impacts during operation of the subprojects would include air quality, noise, water quality and solid waste. Potential air quality impacts would come from emissions of air pollutants from motor vehicles travelling on the subproject roads (subprojects 1, 2, 3 and 4), odor from the WWTP (subproject 1), indoor air quality from interior fit-out and new furniture in the buildings (subprojects 5, 6, 7 and 8), cooking fume from the canteens (subproject 8), and ozone depletion and global warming potential from the use of refrigerant for

the cold storage (subproject 5). Potential noise impacts would arise from motor vehicles travelling on the subproject roads (subprojects 1, 2, 3 and 4) and the operational noise from the WWTP (subproject 1). Potential water quality impact would arise from the discharge of treated effluent from the WWTP to the Heishui River (subproject 1), and wastewater generated by people using the buildings and facilities (subprojects 5, 6, 7 and 8). Solid waste will include MSW generated by the people using the buildings and facilities (subproject 5, 6, 7 and 8), chemical and medical wastes from the training facilities and laboratories (subprojects 7 and 8), and sludge generated by the WWTP (subproject 1). These impacts and respective mitigation measures are described below.

1. Impacts and Mitigation on Air Quality

158. **Air pollutants from road traffic**. NO_2 and CO are the main air pollutants emitted by road traffic. Of this two, NO_2 is the indicator parameter, meaning that if NO_2 levels comply with applicable air quality standard, then CO should also comply. Based on acceptance inspection information on other road projects in the PRC, road side NO_2 levels from highways with 30,000 pcu/d or less complied with Class 2 standard in GB 3095-2012 *Ambient air quality standards*. None of the subproject roads would have traffic flow exceeding 30,000 pcu/d and road side NO_2 levels would not exceed the applicable standard. This was also confirmed by dispersion modeling conducted for subproject 1, indicating that the maximum NO_2 levels at the sensitive receptors for subproject 1 listed in Table 26 would range from hourly averages of 0.025 – 0.034 mg/m^3 (GB 3095-2012 standard is 0.200 mg/m^3) and daily averages of 0.013 – 0.015 mg/m^3 (GB 3095-2012 standard is 0.08 mg/m^3) in year 2032.

159. **Greenhouse gas emission**. Besides NO_2 and CO, road traffic also emits carbon dioxide (CO_2) which is a greenhouse gas (GHG). All the subproject roads are short with no road longer than 6 km. Carbon emissions for the subproject roads in 2033 (based on a 15-year design horizon, 2033 being the 15th operation year) have been calculated using the methodology described in IPCC (2006),[24] based on fuel consumption from traveling distances of various vehicle types on the subproject roads. Assumptions and conversion factors shown in Table 36 were used in calculating CO_2 equivalent (CO_{2eq}) emissions. Table 37 shows that the carbon dioxide emissions from the subproject roads in 2033 would total less than 43,000 t. Carbon dioxide emission from the subproject roads would not exceed the ADB threshold of 100,000 t/a in the 15th design year.

Table 36: Assumptions and factors used in carbon emission calculations

Factors & Assumptions	Fuel Type	
	Gasoline (#93)	Diesel (#0)
Fuel consumption (L/100 km)		
Small vehicle	8.7	---
Mid-size vehicle	18.0	---
Large vehicle	---	26.0
Fuel density (kg/m^3)	725	860
CO_2 emission factor (gm/kg fuel)	2925	3096

Source: PPTA

[24] IPCC. 2006. 2006 IPCC guidelines for national greenhouse gas inventories. This is based on the current PRC fuel standards, more stringent standards in the future or more advanced fuel technologies may reduce GHG emissions further. This represents the worst case.

Table 37: Carbon dioxide emissions from motor vehicles travelling on the subproject roads

Subproject	Name of Road	CO_{2eq} Emission (t/a)	
		Each Road	Total
S1: Chongzuo Sino-Vietnam Border Economic Cooperation Zone demonstration project (phase I)	Xinde Road	4,194	20,602
	Xingong Avenue	3,452	
	Xinghe Avenue	5,637	
	Huaqiao Avenue	1,311	
	Huancheng South Road	2,376	
	Binjiang Avenue	3,632	
S2: Dongxing Changhu Road (east section) construction project	Changhu Road east section	6,511	6,511
S3: Infrastructure development for Longzhou Border Economic Cooperation Zone	Hengsi Road	2,520	13,075
	Zong'er Road	675	
	Yuanbian Road	4,336	
	Heng'er Road	2,505	
	Hengsan Road	3,039	
S4: Road connectivity in Pingxiang-Viet Nam cross-border (phase 1)	Kafeng – Nonghuai	2,593	2,593
		Total:	**42,781**
		ADB threshold:	**100,000**

Source: PPTA

160. **Indoor air quality**. Indoor air quality in new buildings could be affected by the emission of VOCs such as benzene and formaldehyde from newly fit-out rooms and furniture. The use of environmentally friendly building materials and furniture such as water-based paint would alleviate indoor air pollution during early occupancy of new buildings. The EITs estimated that formaldehyde levels in new buildings could reach 0.272 mg/m^3 in the first three months after completion of interior fit-out, decreasing to 0.078 mg/m^3 after 7 months (the indoor air quality standard for formaldehyde prescribed in GB/T 18883-2002 is 0.10 mg/m^3); and benzene levels could reach 1.087 mg/m^3 in the first month decreasing to 0.052 mg/m^3 in the third month (the indoor air quality standard for benzene is 0.11 mg/m^3). The EITs recommended that the classrooms and dormitories in subprojects 7 and 8 should be ventilated for one to two months until the indoor air quality complies with the *Code for indoor environmental pollution control of civil building engineering* (GB 50325-2001) (item #133 in Table 2) before occupancy. The EMP specifies indoor air quality monitoring in subproject buildings.

161. **Cooking fumes from canteens**. Subproject 8 would include the operation of student canteens. Cooking fumes from the canteens would be collected by flue gas collection hoods for emission through chimneys above the roof of the building. Cooking fume removal efficiency and emission levels shall be in accordance with the requirements set forth in the *Emission standard of cooking fume* (on trial) (GB18483-2001) (item #119 in Table 2). Technical design of the canteen will include suitable equipment for controlling the emission of cooking fumes.

162. **Odor from the wastewater treatment plant**. The WWTP in subproject 1 would emit odor mainly consists of ammonia (NH_3) and hydrogen sulfide (H_2S) during operation. The EIR estimated that the highest ground level concentration of NH_3 and H_2S emitted from point sources during WWTP operation would be 0.003 mg/m^3 and 0.00006 mg/m^3 respectively, at a distance of

775 m from the WWTP. Both concentrations would be considerably less than the highest permissible concentrations of 0.20 mg/m^3 for NH_3 and 0.01 mg/m^3 for H_2S in residential areas prescribed in *Sanitary standards for industrial enterprise design* (TJ 36-79). The highest ground level concentrations of NH_3 and H_2S from fugitive emissions during WWTP operation would be 0.0036 mg/m^3 and 0.000075 mg/m^3 respectively, at a distance of 303 m from the WWTP, which are also substantially less than the standards prescribed in TJ 36-79. The EIR recommends a sanitary buffer distance of 100 m from the nearest sensitive receptor. The proposed WWTP site has no existing environmental sensitive receptor within 100 m from the boundary of the site (see Table 26).

163. **Refrigerant used in Cold Storage Warehouse**. Subproject 6 involves the operation of cold storage warehouse using R404A as the refrigerant. R404A is a commonly used and commercially available HFC refrigerant consisting of 1,1,1,2,2-Pentafluoroethane (C_2HF_5), 1,1,1,2-Tetrafluoroethane ($C_2H_2F_4$), and 1,1,1-Trifluoroethane ($C_2H_3F_3$). According to information from the EIT, it has zero ozone depletion potential (ODP) and a global warming potential (GWP) of 3,850. It is a non-flammable, non-explosive, non-toxic, non-corrosive, colorless and odorless chemical and is in gaseous state under room temperature. It complies with the A1 safety standard, the highest safety standard of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). It also complies with the Significant New Alternative Policy, an US EPA program to evaluate and regulate substitutes for the ozone-depleting chemicals that are being phased out under the stratospheric ozone protection provisions of the *Clean Air Act*, as well as the Underwriters Laboratory standard. The EIT estimates that the total usage by the cold storage warehouse would be 1000 kg, in an enclosed re-circulating system. It is also estimated that approximately 20 kg of R404A will be purchased once annually for replenishment, with no storage of R404A cylinders on site. Environmental risk to workers on site is expected to be low.

2. Impacts and Mitigation on Noise.

164. Noise impacts during operation would include road traffic noise from vehicles travelling on the subproject roads, and the plant noise from WWTP operation.

165. **Traffic noise**. For subproject 1 roads in the Chongzuo Sino-Vietnam BECZ, noise levels in the medium term (year 2024) were assessed to exceed the applicable night time noise standards by 1.1 – 2.3 dB(A) at Tanzha, Tuobu, Qinghe Village and Mami from Huancheng South Road. Detail design of Huancheng South Road will provide mitigation to these locations looking into the practicalities and effectiveness of providing road side walls as noise barriers or double glazed windows at affected households.

166. For subproject 2, road traffic during the operation of Changhu Road east section would cause night time noise exceedance in the medium term by 2.2 dB(A) at Huangqiaoshu Village, affecting five households. The following mitigation measure as recommended by the EIT shall be implemented in view of the small exceedance.

(i) Installation of noise insulation strips on the window frames for five households at Huangqiaoshu Village.

167. For subproject 3 roads in the Longzhou BECZ Poverty Alleviation Industrial Park, noise level at the Xiwang Kindergarten in the medium term were assessed to exceed the applicable night time noise standard by 0.8 dB(A). Since the kindergarten has no overnight occupancy and also has a boundary wall providing barrier effect to road noise from Hengsan Road, no mitigation is needed.

168. For subproject 4, road traffic during operation of the road from Kafeng to Nonghuai would cause night time noise exceedance in the medium term of 5 dB(A) on the first row of buildings affecting 20 households and 0.9 dB(A) on the second row of buildings affecting 10 households. The following mitigation measure for the 20 households on the first row of buildings as recommended by the EIR shall be implemented. Noise exceedance on the second row is less than 1 dB(A) and no mitigation is proposed.

(i) Installation of double-glazed windows for the 20 households on the first row of buildings in Kafeng.

169. **Plant noise**. Operational noise from the WWTP would come from plant equipment, especially the pumps, blowers and the belt press for sludge dewatering, with noise levels reaching 85 to 100 dB(A). The equipment would be housed in buildings that would provide noise shielding effect. As a result, operational noise levels at the boundaries of the WWTP have been assessed to range from 16 – 32 dB(A) during both day time and night time, in compliance with the *Emission standard for industrial enterprises noise at boundary* (GB 12348-2008) [60 dB(a) day time and 50 dB(A) night time]. No adverse operational noise impact from the WWTP is anticipated.

3. Impacts and Mitigation on Water Quality

170. Potential water quality impacts would come from the discharge of treated effluent from the WWTP in subproject 1; the discharge of wastewater from the users of the building facilities in subprojects 5, 6, 7 and 8; and the discharge of wastewater from the canteens in subprojects 7 and 8. The WWTP in subproject 1 will result in pollutant removal benefitting the water quality in Heishui River. Wastewater from the other subprojects would be pre-treated on site for discharging to and treated by municipal WWTPs. Adverse water quality impact due to operation of these subprojects is not anticipated.

171. **Treated effluent from WWTP in subproject 1**. The wastewater will be treated to Class 1B standard by the WWTP for discharge into the Heishui River which has a water quality function of Category III. Table 17 above shows the influent and effluent qualities, indicating that the WWTP would result in environmental benefit by removing approximately 1,600 t/a COD, 1,020 t/a BOD_5, 91 t/a NH_3-N and 10 t/a TP from discharging into the Heishui River.

172. **Wastewater from subprojects 5 and 6**. The EITs estimate that approximately 707 m^3/d and 2.8 m^3/d of municipal wastewater would be generated from people using the building facilities in subprojects 5 and 6 respectively. Wastewater will be treated by septic tanks on these sites then discharged to municipal sewer for treatment at the WWTP in the Bonded Port Zone for subproject 5 and at the existing Dalanping WWTP for subproject 6. The Dalanping WWTP has a treatment capacity of 50,000 m^3/d and has available capacity to treat the small quantities of municipal wastewater generated on these sites.

173. **Wastewater from subproject 7**. Operation of subproject 7 would generate wastewater from the staff and students, from the canteens and small quantities from the laboratories, amounting to approximately 2,053 m^3/d. Wastewater from the canteens will be pre-treated with oil-water separators, together with wastewater from the staff, students and laboratories will be discharged to the municipal sewer along Fangxiang East Road for conveyance to the existing Qilidian WWTP for treatment. The Qilidian WWTP has a treatment capacity of 160,000 m3/d and has available capacity to treatment the wastewater from the GUAT south campus.

174. **Wastewater from subproject 8**. Operation of subproject 8 would generate wastewater from the staff and students, canteens, laboratories and other uses such as landscaping and

cleaning, amounting to approximately 3,411 m^3/d. Wastewater from the canteen will be pre-treated with oil-water separator, together with the municipal wastewater from the students and staff, will be treated by a treatment system on campus using the CASS process. The treated effluent will be reused as scenic water on campus resulting in zero discharge externally. Wastewater from the laboratories, landscaping and facilities cleaning, amounting to approximately 1,020 m^3/d will be treated by an underground biochemical treatment system on campus using the anerobic-oxic process. The pre-treated effluent will be conveyed via municipal sewer to the Xinghu Wastewater Treatment Plant in the Baidong New Development Area. The Xinghu WWTP will have a design treatment capacity of 10,000 m^3/d, with phase 1 treatment capacity of 3,000 m^3/d for commissioning at the end of 2019, before student intake by YMCN. When the Damei Wastewater Treatment Plant (treatment capacity 50,000 m^3/d) is commissioned (presently still in the design stage), pretreated wastewater from the Baidong campus will be diverted to this WWTP for treatment.

4. Impacts and Mitigation on Solid Waste

175. Solid waste generated during the operation of subprojects 1 (WWTP), 5, 6, 7 and 8 would include municipal solid waste (MSW), kitchen waste, chemical and medical waste, and sludge from wastewater treatment. Their quantities, where available, are summarized in Table 38.

Table 38: Solid waste generated from operations of subprojects 1, 5, 6, 7 and 8

Subproject	Solid Waste Type and Quantity				
	Municipal Solid Waste	Sludge	Chemical Waste	Medical Waste	Kitchen Waste
S1: Chongzuo Sino-Vietnam Border Economic Cooperation Zone demonstration project (phase I) - [WWTP]	1.28 t/a	1,450 t/a (75% moisture content)	Spent UV lamp (contains Hg)	none	none
S5: Qinzhou cross-border trade e-commerce industrial park project	1,658 t/a	none	none	none	none
S6: Qinzhou international cold-chain logistic demonstration project	7.5 t/a (also 10t/a packaging waste for recycling)	none	none	none	None
S7: China-ASEAN small and medium enterprises (SMEs) synergy innovative development project	1,863 t/a	none	no data, small quantity	0.1 t/a	900 t/a
S8: China- ASEAN educational medicare cooperation project (phase I)	4,500 t/a	367 m^3/a (from CASS, <3% moisture content	3.5 t/a	no data, small quantity	no data

Source: EIR & EITs

176. MSW will be regularly collected by local sanitation bureaus for disposal at local sanitary landfills. Small quantities of chemical and medical wastes from subprojects 7 and 8 will be collected by approved companies for proper treatment and disposal. Spent UV lamps from the WWTP will be transported to the Guangxi Solid Waste (Dangerous Waste) Treatment Center in Nanning for treatment, which has a capacity of 65,200 t/a. Kitchen waste, according to the EIT, will also be collected by approved entity. The sludge from the CASS process on the YMCN campus has a moisture content of <3% and therefore could be disposed of at the Baise MSW Landfill. The sludge from subproject 1, however,

has a moisture content of 75% and therefore exceeds the requirement of <60% moisture content for MSW landfill disposal stated in the *Standard for pollution control on the landfill site of municipal solid waste* (GB 16889-2008). The EIR describes various reuse options for the sludge such as land improvement and agricultural use etc. Such reuses of wastewater sludge must comply with requirements prescribed in PRC's CJ/T 289-2008 (for making brick), CJ/T 291-2008 (for land improvement), and CJ/T 309-2009 (for agricultural use).The WWTP operator will conduct relevant analysis of the sludge quality before deciding on the suitable reuse option in compliance with the above requirements.

177. The EMP specifies the following for treatment and disposal of chemical and medical wastes.

(i) Chemical and medical wastes generated from subprojects 1, 7 and 8 shall be collected by companies approved to collect and treat chemical and medical wastes.

F. Cumulative Impacts

178. Cumulative impacts could arise from other projects in the vicinity particularly other buildings or infrastructure being constructed concurrently with the construction stage of the subprojects. Subprojects 1 and 3 are located in BECZs where other nearby developments could be ongoing concurrently with these subprojects. The same applies to subprojects 5 and 6 located in the Qinzhou Bonded Port Zone where other nearby developments could also be ongoing concurrently with these subprojects. These industrial zones are mostly occupied by industrial enterprises with few or no environmental sensitive receptors nearby. For subproject 3, construction of the high speed railway line and station running next to and parallel to the Changhu Road east section will likely overlap with the road construction. There is no existing sensitive receptor along the road and railway alignment except Huangqiaoshu Village. Potential cumulative impact from these subprojects would be minimal. Cumulative impact within the same subproject may also occur from multiple construction activities and deployment of multiple equipment concurrently on the construction site. The domestic EIRs/EITs and this IEE have already taken such scenarios into consideration and have provided effective measures to mitigate potential cumulative impacts within a subproject. The subprojects could also induce increased industrial activities in the Chongzuo and Longzhou BECZs from improvement of the road infrastructure. This could result in cumulative environmental impacts from the combined emissions and discharges from the industrial enterprises. The plan EIR for these industrial areas have described the use of "total quantity control" on pollutants by the management committees of these industrial zones, thus providing a cap on potential cumulative environmental impacts.

179. Construction related cumulative impacts would be effectively minimized by adopting proper mitigation measures, including: (i) coordination between all project components and other projects in the area of influence in terms of construction schedule, possible access road and borrow/disposal sites and spoil sharing; (ii) contractors will develop material transport plan with consultation of local road management authority and local community; (iii) enforcement of good construction management to minimize dust, noise and waste generation; (iv) education of construction workers to minimize social disturbance and cultural conflict; (vi) provision of temporary access to local traffic to minimize construction traffic interruption; (vii) proper maintenance of the access roads and timely restoration/strengthening upon completion. With effective implementation of good construction management measures, these common construction-related cumulative impacts can be adequately mitigated to acceptable levels.

G. Indirect and Induced Impacts

180. Tranche 2 subprojects would induce growth in cross-border trade with Viet Nam and other ASEAN countries. This could induce an increase in wildlife trafficking. This issue has been addressed in the wildlife trafficking assessment report (see Appendix 3) and described above. The report identifies that the government agencies with a role in wildlife trade management include Customs, the State Forestry Administration, the Bureau of Fisheries (under the Ministry of Agriculture), the Ministry of Commerce, the Administration of Industry and Commerce, and Ministry of Police, and suggests that these agencies need to work together in an integrated role and emphasizes the need to strengthen the wildlife enforcement capacities of these agencies in these cities and also in the region. The project would also induce increase in industrial activities from improved transport infrastructure in the Chongzuo BECZ, the and the Longzhou Poverty Alleviation Industrial Park. As described earlier, all industrial enterprises to be established in these industrial parks would have to go through the domestic environmental impact assessment process, which would provide a safeguard system against potential increases in pollution from induced increasing industrial activities.

VI. ANALYSIS OF ALTERNATIVES

A. No Project Alternative

181. The project has five outputs to improve regional cooperation and integration opportunities in border areas in Guangxi linking PRC and Viet Nam. Without the project, the border areas in Guangxi will continue to have difficulties in attracting investments for SMEs due to lack of infrastructure and services in the border economic zones, lack of new technologies such as e-commerce for accessing markets at and beyond the borders, inefficient cross-border financial transactions and settlement, and inability in customs inspection and clearance to handle the fast growing cross-border trade.

B. Alternatives Considered

182. **Wastewater treatment process.** Four treatment processes were compared for the proposed WWTP in subproject 1: the oxidation ditch process, aerobic/anaerobic/oxic process, the cyclic activated sludge technology process and the dynamic membrane bioreactor (DMBR). Table 39 compares the pros and cons of these treatment processes. The DMBR process was recommended because of better effluent quality, minimum floor area and high degree of automation.

Table 39: Comparison of wastewater treatment processes

Criterion	Oxidation Ditch	Aerobic/Anaerobic/ Oxic	Cyclic Activated Sludge Technology	Dynamic Membrane Bioreactor
Structural complexity	Medium	Medium	Low	Low
Process characteristics	It has various forms, with good impact resistance and stable outflow quality for BOD_5 and SS removal. Both nitrification and	Biological nutrient removal composed of anaerobic, anoxic and aerobic units. Biological phosphorus removal can be completed	Operation flexible and can be regulated according to the water quality. Aeration /mixture ratio can be regulated flexibly by	It is the combination of membrane bioreactor, bio-membrane, and reversed aerobic/anaerobic/oxic process for nutrient

Criterion	Oxidation Ditch	Aerobic/Anaerobic/ Oxic	Cyclic Activated Sludge Technology	Dynamic Membrane Bioreactor
	denitrification can also be fulfilled with nitrogen removal rete of more than 80%.	during the anaerobic process. The anoxic and aerobic units are used for NO_3-N and NH_3-N removal respectively.	the sequencing batch segment to ensure the BOD_5 and TN removal. Phosphorus removal can be fulfilled in a separately front anaerobic unit.	removal, with less waste sludge produced. It has advantage of being used for more strict discharge standard or low-concentration wastewater treatment.
Supporting unit	Secondary sedimentation tank should be installed.	Blower house and secondary sedimentation tank should be installed.	Blower house should be installed.	---
Operational management	Equipment and structures are minimal, management is simple	Process and operational management is simple	Good automaton, lower labor. Complex operation and higher operator ability.	Good automaton, lower labor.
Energy use	Lower oxygenate efficiency, higher cost for power consumption	Lower power consumption	Higher cost for power consumption	50% energy consumption compare to conventional process.

183. **WWTP sludge treatment process.** For the proposed WWTP in subproject 1, alternative concentrating and dewatering methods were considered for the sludge treatment process, including the mechanical concentrating and mechanical dewatering process, and gravity concentrating and mechanical dewatering process. The mechanical concentrating and mechanical dewatering process has the advantage of good dewatering effect, high sludge reduction rate, little phosphorus release from the sludge, better odor control, continuous and easy operation, etc, which is adopted for this subproject. There is no open structure for mechanical concentrating and mechanical dewatering process, so less environmental impact from sludge treatment process to the surrounding area in terms of noise and odor. The initial cost would also be less because of lower civil works and construction cost.

184. **Wastewater disinfection method.** In subproject 1, for the wastewater disinfection after the DMBR treatment, the ultraviolet irradiation process, liquid chlorine disinfection process and chlorinated compounds process were compared. The recommended ultraviolet irradiation method has higher disinfection efficiency and shorter reaction time, and the environmental advantage of smaller risk and no secondary pollution (such as the formation of chlorination byproducts), although both the initial and operation costs are higher.

185. **Alternative pavement scheme.** For the road construction in subprojects 1, 2, 3 and 4, comparisons were made between cement concrete and asphalt concrete surface pavement. Asphalt concrete pavement was recommended because it is relatively easy to apply and repair, in spite of the higher initial cost. In addition, it has the environmental advantage of reducing road traffic noise and dust in comparison with rigid cement concrete pavement. Cement stabilized crushed stone base is adopted for the road base courses after the comparison with the two-ash-macadam road base because its intensity is adequate in meeting the projected traffic loading and with successful experience in construction. Cement stabilized crushed stone also has the advantage of better water-resistant property, which is more applicable to use in rainy region to

decrease the surface flooding impact in extreme weather conditions.

186. **Alignment of the Kafeng-Nonghuai Road in Pingxiang.** Two alternative alignments for the Kafeng-Nonghuai Road in subproject 4 were compared regarding the aspects of traffic impact, consistent with the planning, and engineering cost. The two alignments are shown in Figure 20 (Line A: blue one; Line K: red one). Line K is selected because of in accordance with the city planning, low traffic impact to Nonghuai Border Zone, and in concert with the local economic development. The cost of Line K construction is higher, however the social environmental impact result from resettlement would be less compared to Line A option.

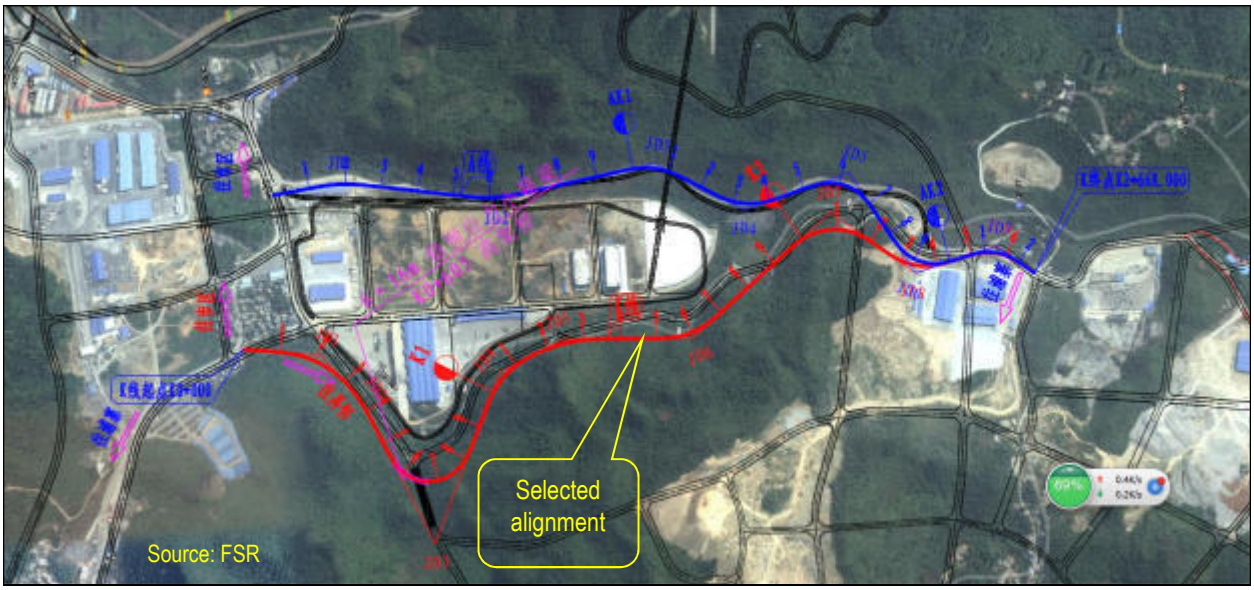

Figure 20: Kafeng-Puzhai Road – Alignment Options

VII. INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION

A. Legislative Framework for Consultation, Participation and Information Disclosure

187. Meaningful participation and consultation during project planning, feasibility study, design and implementation is an important environment safeguards requirement. It can directly reflect the public's perceptions of environmental quality in the project's area of influence. Public participation and environmental information disclosure provisions are among the most significant changes introduced in the amended *Environmental Protection Law* (2014). The legislative framework also includes decrees on the preparation of EIA summaries for the purpose of public disclosure (see Table 2, item #42), information disclosure on construction project EIAs by government (Table 2, item #48), measures for public participation in environmental protection (Table 2, item #53), and technical guidelines (for comment) for public participation in EIAs (Table 2, item #95).

188. ADB Safeguard Policy Statement (2009) requires meaningful participation, consultation and information disclosure. ADB Public Communications Policy: Disclosure and Exchange of

Information (2011) requires that the borrower shall provide safeguard information to affected people in a timely manner, in an accessible place, and in a form and language(s) understandable to them.

B. Information Disclosure

189. Information disclosure on the eight subprojects was conducted during public consultation for these subprojects. Information disclosed included the scope of these subprojects, potential environmental impacts and mitigation measures during construction and operation. ADB's environmental safeguard requirements with emphasis on the implementation of EMP and GRM during subproject implementation. The project environmental information will also be disclosed by ADB as follows: (i) this IEE is available at www.adb.org; (ii) copies of the domestic EIRs and EITs (in Chinese) for the subprojects are available on request from the GPMO; and, (iii) environment progress will be reported in the quarterly project progress reports and the annual environmental monitoring reports which will be disclosed on ADB's project website (www.adb.org).

C. Consultation and Participation during Project Preparation

190. Public consultations for the subprojects were conducted between June 2016 and July 2017. Public consultations were conducted by the PPTA environmental team from 12 – 15 April 2017 in Dongxing (for subproject 2), Qinzhou (for subprojects 5 and 6), Guilin (for subproject 7) and Baise (for subproject 8) , and during 3-5 July in Chongzuo (for subproject 1), Longzhou (for subproject 3) and Pingxiang (for subproject 4) after the completion of domestic EITs for these subprojects. They were conducted in form of a public forum in each subproject city. These public forums were by invitation and 268 people consisting of local residents, government officials, village representatives and community representatives participated. The forums were chaired by the subproject PIEs and supported by the PPTA environmental team and some of the domestic environmental institutes. The purpose of the forum is to report the EIA findings and to obtain feedback from the participants. Figure 21 shows some photos taken during the public forums.

Subproject 1: Chongzuo

Subproject 2: Dongxing

Subproject 3: Longzhou

Subproject 4: Pingxiang

Subprojects 5 & 6: Qinzhou

Subproject 7: Guilin

Subproject 8: Baise

Figure 21: Photographs showing public consultation forums

Source: PPTA

191. The subproject scopes, ADB SPS (2009) policy, EIA process, status of the surrounding

environment, potential pollutants and control measures, and ADB requirement on EIA and EMP during the construction and operation stage were explained to the participants in the forums. The PPTA environment consultant also introduced the proposed environmental mitigation measures. All participants expressed support for the subprojects and there was no objection. The main issues raised by the participants and the responses from local PIE and PPTA team are shown in Table 40. Basically, the concerns are related to noise, dust, public safety, GRM implementation, soil erosion, construction arrangement during the construction period, as well as potential flooding impact on their village during the road operation in Dongxing.

Table 40: Issues and responses during public forums

Subproject		Issues Raised	Response
No.	Title		
1	Chongzuo Sino-Vietnam Border Economic Cooperation Zone Demonstration Project (Phase I)	Noise impact to the nearby villages during the road construction.	Noise impact to the residents during the construction stage is short-term impact, and it will be mitigated by a serious of noise control measures, such as temporary noise barriers, construction machinery with low noise, construction time supervision, construction vehicles management, etc.
		Start the road construction as soon as possible, to benefit the villages from the road connection.	The project will be implemented according to both ADB and domestic procedures. The road construction will be started when the ADB procedures are completed.
2	Dongxing Changhu Road (east section) construction project	Soil erosion caused by road construction.	The soil erosion protection plan from the soil and water conservation report will be implemented during road construction. Mitigation measures, such as vegetation of slopes and drainage provisions will be implemented.
		Flooding impact to nearby villages during the rainy season after the road is constructed.	The alignment and elevation of the road will be verified to avoid flooding issues. The historical local flooding records and data will also be considered during road design.
3	Infrastructure Development for Longzhou Border economic cooperation zone	Noise and dusty impact to the nearby villages during the construction period.	Environment management will be implemented during the road construction according to the EMP, in which the detailed mitigation measures for noise and dust impact are specified.
		Impact caused by the construction vehicles for waste earth transportation.	The transport route for waste earth transportation will be arranged reasonably by the contractor. And temporary traffic management for construction vehicles will be conducted by the local transportation department.
		Reasonable construction schedule to decrease the environmental impact.	The contractors will be responsible for the reasonable construction schedule arrangement according to construction management regulations. It will also be supervised by both supervision company and the local EPB. Construction during nighttime (22:00-6:00) will be forbidden.
4	Road Connectivity in Pingxiang-Viet Nam Cross-Border	Traffic safety impact to nearby villagers during road construction.	The construction period will be arranged reasonably by the PIE, and the traffic management will be conducted to ensure the traffic safety for the nearby village.
		Noise and vibration impact during	The blasting work for the road construction in mountain

Subproject		Issues Raised	Response
No.	Title		
		road construction.	area will be designed and carried out by experienced explosives expert. The PIE also suggested to adopt static blasting technology to decrease the noise and vibration impact.
5&6	Qinzhou cross-border trade e-commerce industrial park project	Noise impact and management during the construction stage.	The mitigation measures in EMP for the noise impact management will be included in the bidding document of the contractor. Environment management and environmental training will also be provided to the contractor.
	Qinzhou international cold-chain logistic demonstration project	The GRM implementation during the project construction.	The project specific GRM and complaint channels, complaint center and complaint hotline were explained.
7	China-ASEAN small and medium enterprises (SMEs) synergy innovative development project	Noise and dusty impact to the nearby residents during the construction.	Mitigation measures for noise and dusty pollution will be implemented and strictly enforced during the construction stage to reduce the environment impact to the nearby teacher dormitory and the Xinjian Primary School
		The safety of the nearby villagers during the construction stage because of the construction truck impact to the existing narrow road.	The construction traffic management on the existing road during the construction period will be enhanced, to ensure the safety of the villagers.
8	China- ASEAN educational medicare cooperation project (phase I)	Dusty impact to the nearby villagers during the construction.	Noise impact on residents during construction period will be mitigated through the adoption of temporary noise barriers, construction machinery with low noise, construction time supervision, etc.
		Noise impact to the nearby villagers during the construction.	Dusty Control Office has been stablished in Baise. And the mitigation measure for dust impact management will be carried out during construction stage.

Source: PPTA

192. For subprojects 1, 3 and 4, the public consultations were also conducted by the domestic environmental institutes in the form of questionnaire surveys in a meeting format on 13 October 2016, 28-29 April 2017 and 28-30 June 2016 respectively. The questionnaires focused on public understanding of the project components, and local opinions on the potential environmental, social and economic impacts of the project. The results of questionnaire survey are in shown as below in Tables 41, 42 and 43.

Table 41: Subproject 1 questionnaire survey data

No.	Question	Choices	Response (N=20)	%
1	How did you know this project? (Single Choice)	A. Information disclosure for public consultation.	19	95
		B. Private information	0	0
		C. Other ways	1	5

No.	Question	Choices	Response (N=20)	%
2	What do you think of the environmental quality of the project area and the surroundings? (Single Choice)	A. Good	4	20
		B. Very good	6	30
		C. General	9	45
		D. Poor	0	0
		E. Very poor	1	5
3.	What is the major local environmental problem? (Multiple Choice)	A. Atmospheric pollution	13	65
		B. Water pollution	13	65
		C. Noise pollution	8	40
		D. Solid waste pollution	3	15
		E. Ecological destruction	2	10
4	What do you think is the main potential environmental issues caused by the project construction? (Multiple Choice)	A. Atmospheric pollution	7	35
		B. Water pollution	9	45
		C. Noise pollution	7	35
		D. Solid waste pollution	12	60
		E. Ecological destruction	4	20
5	What kind of pollution control should be enhanced during construction and operation stage for this project?	A. Air pollution control	15	75
		B. Water pollution control	17	85
		C. Noise pollution control	6	30
		D. Solid waste pollution control	8	40
		E. Ecological protection	4	20
6	Does this project impact your life or work after the project construction? (Single Choice)	A. Impact	5	25
		B. Less impact	4	20
		C. Little impact	1	5
		D. Unknown	10	50
7	What impact will this project have on the local economic development and social development?	A. Advantage	8	40
		B. Disadvantage	0	0
		C. Unknown	12	60
8	Do you think if the project location selection is appropriate?	A. Appropriate	20	100
		B. Inappropriate	0	0
9	What is your attitude for the project construction?	A. Support	20	100
		B. Objective	0	0

Source: EIR

Table 42: Subproject 3 questionnaire survey data

No.	Question	Choices	Response (N=33)	%
1	Did you know this project?	A. Well known	3	9
		B. Know	27	82

No.	Question	Choices	Response (N=33)	%
		C. Unknown	3	9
2	What do you think of the environmental quality of the project area?	A. Very good	16	49
		B. Good	8	24
		C. General	6	18
		D. Poor	3	9
3	What is the major environmental issue during the project construction stage?	A. Atmospheric pollution	22	67
		B. Water pollution	8	24
		C. Noise pollution	27	82
		D. Other issues	1	3
		E. Abandoned earth and stone	5	15
		F. Soil erosion	3	9
		E. Ecological and landscaping destruction	2	6
4	What kind of the mitigation measures do you suggested to be enhanced during the construction stage?	A. Dust control	16	49
		B. Wastewater treatment	4	12
		C. Solid waste disposal	6	18
		D. Noise control	28	85
		E. Water and soil conversation	2	6
		F. Ecological protection	2	6
		G. Other issues	1	3
5	What is the main environmental impact during the project operation?	A. Air pollution	25	76
		B. Water quality pollution	10	30
		C. Noise pollution	28	85
		D. Accident risk	1	3
		E. Others	4	12
6	What kind of the mitigation measures do you think to be used during operation stage for traffic noise control?	A. Greening improvement	28	85
		B. Noise barrier adoption	3	9
		C. Soundproof window installation	2	6
		D. Others	8	24
7	What kind of compensation do you like if your farmland will be requisition for the project construction?	A. One-time cash compensation	18	55
		B. Reconfigure	2	6
		C. Provide professional training and employment opportunity	6	18
		D. Others	7	21
8	Does this project benefit the local economy development?	A. Advantage	25	76
		B. More good than harm	7	21
		C. More harm than good	0	0
		D. Unknown	1	3.0
9	How do you think the extent of the local	A. Low impact and acceptable	20	61

No.	Question	Choices	Response (N=33)	%
	environmental impact by the project construction?	B. General impact and acceptable	13	39
		C. Unacceptable	0	0
10	What is your attitude for the project construction?	A. Support	33	100
		B. Objective	0	0

Source: EIT

Table 43: Subproject 4 questionnaire survey data

No.	Question	Choices	Response (N=44)	%
1	Did you know this project?	A. Unknown	33	75
		B. Know	11	25
		C. Well known	0	0
2	What is the major local environmental problem?	A. Atmospheric pollution	43	98
		B. Water pollution	2	5
		C. Noise pollution	32	73
		D. Ecological destruction	20	46
		E. Other issues	0	0
		F. Good environment	0	0
3.	What is the main environmental impact cause by the project construction?	A. Noise pollution	42	95
		B. Dust pollution	2	5
		C. Water quality pollution	22	50
		D. Ecological destruction	4	9
		E. Landscape impact	27	61
		F. Travel inconvenience caused by the construction	42	95
4	What kind of the mitigation measures do you suggested to be used?	A. Watering for dust control	44	100
		B. Sound insulation board	24	55
		C. Traffic organization enhancement	26	59
		D. Prohibiting all construction during rest time.	32	73
		E. Abandon earthwork collection in time	25	57
		F. Reasonable transportation way	21	48
5	What is the main environmental impact during the project operation?	A. Air pollution caused by vehicles	33	75
		B. Traffic noise pollution	24	55
		C. Water quality pollution	0	0.
		D. Ecological destruction	7	16
		E. Others	2	5
6	What kind of the mitigation measures do you suggested to be used during operation stage?	A. Watering for dust control	41	93
		B. Greening improvement	24	55

No.	Question	Choices	Response (N=44)	%
		C. Sound insulation window installation	2	5
		D. Drainage system improvement	21	48
		E. Solid waste collection and disposal	22	50
		F. Establish emergency plan	26	59
		G. Others	2	5
7	Do you agree with the resettlement?	A. Agree when it will be compensated according to government standard	44	100
		B. Disagree	0	0
		C. Unknown	0	0
8	How do you think the environmental impact caused by the project construction?	A. Positive effect	20	46
		B. Adverse effect by acceptable	23	52
		C. Unacceptable adverse effect by	0	0
		D. No impact	1	2
9	What is the main impact?	A. Improve traffic condition	44	100
		B. Improve environment quality	0	0
10	What is your attitude for the project construction?	A. Support	44	100
		B. Objective	0	0

193. The breakdown of participants is listed in Table 44. Of the 365 participants, females accounted for 36% with higher percentages in Qinzhou (45%) and Guilin (43%). The participants could be characterized as mostly in the 30-50 age group (55%), were mostly farmers (50%) with junior high school education (47%). Besides having the most females among all the locations, Qinzhou also had the highest educated (87% college or above) and the youngest age group (52% <30 years of age). In Pingxiang 98% of the participants were farmers.

Table 44: Breakdown of participants for public consultation

Subprojects		Participant Number and Profile											
			Gender		Education			Occupation			Age Group		
No.	Title	Total No	Male	Female	Junior High	Senior High	College or above	Farmer	Leader	Labor / Other	<30	30-50	>50
1	Chongzuo Sino-Vietnam Border Economic Cooperation Zone demonstration project (phase I)	79 (100%)	54 (68%)	25 (32%)	21 (27%)	10 (13%)	48 (60%)	23 (29%)	31 (39%)	25 (32%)	11 (14%)	44 (56%)	24 (30%)
2	Dongxing Changhu Road (east section) construction project	17 (100%)	12 (71%)	5 (29%)	8 (47%)	4 (24%)	5 (29%)	10 (59%)	5 (29%)	2 (12%)	3 (18%)	10 (59%)	4 (24%)

Subprojects		Participant Number and Profile											
			Gender		Education			Occupation			Age Group		
No.	Title	Total No	Male	Female	Junior High	Senior High	College or above	Farmer	Leader	Labor / Other	<30	30-50	>50
3	Infrastructure development for Longzhou Border Economic Cooperation Zone	72 (100%)	43 (60%)	29 (40%)	45 (63%)	12 (17%)	15 (20%)	50 (69%)	13 (18%)	9 (13%)	11 (15%)	40 (56%)	21 (29%)
4	Road connectivity in Pingxiang-Viet Nam cross-border (phase 1)	92 (100%)	64 (70%)	28 (30%)	50 (54%)	22 (24%)	20 (22%)	61 (66%)	15 (17%)	16 (17%)	17 (18%)	48 (52%)	27 (30%)
5&6	Qinzhou cross-border trade e-commerce industrial park project Qinzhou international cold-chain logistic demonstration project	31 (100%)	17 (55%)	14 (45%)	0 (0%)	4 (13%)	27 (87%)	0 (0%)	27 (87%)	4 (13%)	16 (52%)	14 (45%)	1 (3%)
7	China-ASEAN small and medium enterprises (SMEs) synergy innovative development project	46 (100%)	26 (57%)	20 (43%)	37 (80%)	5 (11%)	4 (9%)	32 (70%)	7 (15%)	7 (15%)	6 (13%)	24 (52%)	16 (35%)
8	China- ASEAN educational medicare cooperation project (phase I)	28 (100%)	17 (61%)	11 (39%)	9 (32%)	4 (14%)	15 (54%)	10 (36%)	3 (11%)	15 (53%)	2 (7%)	20 (72%)	6 (21%)
	Total:	**365 (100%)**	**233 (64%)**	**132 (36%)**	**170 (47%)**	**61 (17%)**	**134 (36%)**	**186 (50%)**	**101 (28%)**	**78 (22%)**	**66 (18%)**	**200 (55%)**	**99 (27%)**

Source: PPTA, EIRs and EITs

D. Future Plans for Public Participation

194. Since some participants raised their concerns on construction programs and impacts, it is important to maintain a dialogue with the stakeholders throughout the construction stage. Continued public participation will facilitate such dialogue so that the stakeholders' concerns are understood and dealt with in a timely manner. Meaningful consultation to safeguard the environment and local residents will continue before and throughout construction and operation phases consisting of information disclosure on project proponent and relevant government department web sites, posting of project information on community notice boards and discussion

forums. The GPMO and the PIEs will be responsible for organizing the public consultations, with the support of the External Environmental Monitor (EEM) on the project management consultant (PMC) team. The contractors will be required to communicate and consult with the communities in the project area of influence, especially those near the subproject sites. Clearly visible public notice boards will be set at each work site to provide information on the purpose of the subproject activity, the duration of disturbance, the responsible entities on-site (contractors, PIEs), and the project level Grievance Redress Mechanism (GRM). Contact information of all GRM entry points and the GPMO complaint center hotline will be disclosed on the construction site information boards. Consultation will focus on public nuisances from construction and operation activities, such as noise, dust, traffic disturbance, as well as public concerns about the environment and resettlement.

195. Future consultation and participation will also include (i) involvement of affected people in discussion forums during inspection and monitoring of EMP implementation during construction and operation phases; (ii) participatory evaluation on the environmental and social-economic benefits and impacts in these forums; and (iii) consultation with the public after the project completion. The EMP provides plans for future public participation. The EMP for this project is included in Appendix 1 of this report

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VIII. GRIEVANCE REDRESS MECHANISM

196. Public consultation undertaken for the tranche 2 subprojects have discussed and addressed major community concerns. Continued public participation and consultation have been emphasized as a key component of successful program implementation. As a result of this public participation and safeguard assessment, major issues of grievance are not expected. However, unforeseen issues may occur. To settle such issues effectively, a transparent grievance redress mechanism (GRM) for lodging complaints and grievances has been defined for environment related issues.

197. 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 Tranche 2 subprojects; (ii) prevent and mitigate any adverse environmental impacts on communities caused by construction and operation of the Tranche 2 subprojects; (iii) improve mutual trust and respect and promote productive relationships with local communities; and (iv) build community acceptance of the program.

198. The GPMO should have established a complaints center with a hotline for receiving both environmental and resettlement grievances for tranche 1. The GRM for tranche 2 could be integrated into the tranche 1 GRM so that there won't be two different GRMs for two tranches. The details of the GRM are described in the EMP (Appendix 1), and were also explained to various stakeholders during discussion forums for the tranche 2 subprojects. The GRM should already be in operation under tranche 1 prior to tranche 2 works commencing.

199. In addition to the program GRM, ADB's overall accountability mechanism (2012) applies.[25] This 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

[25] The revised accountability mechanism became effective on 24 May 2012.

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.

IX. ENVIRONMENTAL MANAGEMENT PLAN

A. Objectives

200. An environmental management plan (EMP) has been prepared for tranche 2 of the program. It will provide the mechanism to implement mitigation measures and monitoring programs. The full EMP is presented in Appendix 1. It will also be included as an Appendix to the Project Administration Manual (PAM) for the program. 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 tranche 2 subprojects in order to prevent, reduce, or mitigate adverse impacts. The EMP draws on the domestic EIRs and EITs, this IEE, and the PPTA 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, and will further be revised during implementation if determined that measures need to be amended or new measures are needed. The updated EMP will be disclosed on ADB's project website.

B. Organizational Structure for Environmental Management

201. **Executing agency (EA)**. As EA, the Guangxi Foreign Loans Project Management Office (GPMO) will be responsible for the overall implementation and compliance with loan assurances and the EMP (including Environmental Monitoring Plan). The GPMO will have the overall responsibility to manage day-to-day activities and to supervise the implementation of environment mitigation and monitoring measures, coordinate the project GRM and report to ADB. GPMO shall (i) appoint at least one staff as the environmental coordinator to coordinate and manage EMP implementation[26], (iii) engage the project management consultant (PMC) services, and (iii) undertake the procurement process for all tranche 2 subprojects. GPMO shall ensure that the environmental specification clauses listed in the EMP are incorporated into all bidding documents and works contracts for tranche 2 subprojects. The GPMO environmental coordinator shall (i) supervise contractors and their compliance with the EMP; (ii) conduct regular site inspections; (iii) act as local entry point for the project GRM; and (iv) submit environmental quality monitoring results provided by the IAs to the GPMO for verification. GPMO shall prepare quarterly project progress reports and annual environment monitoring reports (EMR) and submit them to ADB.

202. **Implementing agencies** (IA) for the subprojects will consist of seven project implementation entities (PIE) as shown in Table 1. They will implement subproject components,

[26] GPMO has already appointed two staff members as environment coordinators for tranche 1 to supervise the effective implementation of the EMP and to coordinate the project level GRM. These individuals will act as the environmental coordinators for Tranche 2 and if needed, more staff will be appointed for Tranche 2.

administer and monitor contractors and suppliers, and be responsible for construction supervision and quality control. Each PIE shall (i) contract the local Environmental Monitoring Station (EMS) to conduct environmental impact monitoring during the construction stage, and (ii) contract an external Environmental Supervision Engineer (ESE) to conduct independent verification of EMP implementation and environmental impact monitoring results. Each PIE shall have one staff as the environmental coordinator to (i) supervise contractors and their compliance with the EMP, (ii) conduct regular site inspections, and (iii) submit environmental monitoring results provided by the EMS to the GPMO, ESE and local Environmental Protection Bureaus (EPB) for verification and confirmation.

203. Under the PMC services contracted by the GPMO, an **external environmental monitor** (EEM) who is an environmental specialist will be included to support the project. Terms of reference for this EEM are provided in the Project Administration Manual. The EEM shall:

(i) assess the project components' environmental readiness prior to implementation based on the readiness indicators defined in the EMP;

(ii) support GPMO in updating the EMP including environmental monitoring plan 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);

(iii) if required, update the IEE and EMP reports for changes in the project during detailed design or project implementation (for example if there is a minor or major scope change) that would result in adverse environmental impacts not within the scope of the approved IEE/EMP;

(iv) assist GPMO to integrate the tranche 2 GRM with tranche 1 GRM (therefore forming a program GRM;

(v) conduct regular EMP compliance assessments, undertake site visits as required, identify any environment-related implementation issues, and propose and oversee implementation of necessary corrective actions;

(vi) assist GPMO to prepare quarterly project progress reports and annual EMRs for ADB;

(vii) provide training to GPMO, PIEs 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 GPMO and PIEs in conducting consultation meetings with relevant stakeholders as required, informing them of imminent construction works, updating them on the latest project development activities and GRM.

204. Each PIE shall contract an independent **Environmental Supervision Engineer** (ESE) to verify environmental performance during construction and whether the implementation of EMP items complies with the plan. The ESE shall review EMP implementation, monitoring activities and results, assess EMP implementation performance, visit the project sites and consult potentially affected people, discuss assessment with GPMO and the respective PIE; and suggest corrective actions. The ESE shall prepare monthly reports for submission to the PIE which shall be submitted to and reviewed by GPMO during the preparation of the quarterly project progress reports for ADB and by the EEM during the preparation of the annual EMRs for ADB.

205. Construction **contractors** shall be responsible for implementing the mitigation measures during construction under the supervision of the PIEs (through the ESE) and GPMO. In their bids, contractors shall be required to respond to the environmental specifications in the bidding documents. Each contractor shall be required to assign a person responsible for environment, health and safety.

C. Inspection, Monitoring and Reporting

206. **Internal environmental monitoring**[27] will include monitoring of air quality, noise, water quality and other parameters described in the EMP during construction and operation of tranche 2 subprojects. These shall be conducted by the local Environmental Monitoring Stations (EMS) contracted by the PIEs. The monitoring results shall be submitted to the PIEs and GPMO, and shall be reported in the quarterly project progress reports and the annual EMRs prepared by GPMO and submitted to ADB.

207. **External environmental inspection** 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.

208. **External compliance monitoring/auditing.** Independent evaluation (also known as compliance monitoring or compliance auditing) of EMP implementation shall be undertaken by the ESE and EEM. GPMO shall report the EEM's independent evaluation to ADB on the program's adherence to the EMP, information on tranche 2 subproject implementation, environmental performance of the contractors, and environmental compliance through quarterly project progress reports and annual EMRs. The EEM shall support GPMO in developing the annual EMRs. The reports should confirm the tranche 2 subprojects' compliance with the EMP and local legislation (including the PRC's EIA requirements), the results of independent evaluation (both contractor compliance with the EMP and the results of environmental monitoring by EMS), identify any environment related implementation issues and necessary corrective actions, and reflect these in a corrective action plan. Operation and performance of the program GRM, environmental institutional strengthening and training, and compliance with all covenants under the program will be included in the EMR.

209. Within 3 months after each tranche 2 subproject completion, or no later than 1 year with permission of the local EPBs, environmental acceptance monitoring and audit reports of each subproject completion shall be: (i) prepared by a licensed environmental monitoring station in accordance with the *Management Measures for Inspection and Acceptance of Environmental Protection at Construction Project Completion* (MEP Decree [2001] No. 13 and 2010 Amendment) (see Table 2, item #26) and *Management Measures for the Supervision, Inspection and Environmental Acceptance of Construction Projects under the "Three Simultaneities"* (on trial) (MEP Announcement [2009] No. 150) (see Table 2, item #33); (ii) reviewed for approval by environmental authorities prior to the official commencement of tranche 2 subproject operation, and (iii) finally reported to ADB. The environmental acceptance reports for completed tranche 2 subprojects shall indicate the timing, extent, effectiveness of completed mitigation and of maintenance, and the needs for additional mitigation measures and monitoring during operation.

[27] In this report, "environmental monitoring" refers to the activity of collecting environmental data either through *in-situ* measurements or through sampling followed by laboratory testing of samples.

These environmental acceptance reports shall be provided to the EEM who is responsible for preparing an environmental completion report and inputs for the Project Completion Report (PCR) for ADB.

X. CONCLUSION AND RECOMMENDATION

A. Expected Project Benefits

210. The project will have positive benefits in achieving better regional cooperation and investment between the PRC and Viet Nam by improving the skills of Chinese and Vietnamese workers and SMEs, improving the hardware and software for cross-border trade and commerce, improve transport infrastructure for cross-border trade, strengthening the support on SME development in the border areas of GZAR, and providing wastewater treatment to industries and residents of border economic cooperation zone.

B. Adverse Impacts and Mitigation Measures

211. During the construction stage, potential impacts would include dust, noise, wastewater and solid waste generated on the construction sites and by the construction workers. This IEE has identified appropriate mitigation measures to reduce such potential impacts to acceptable levels. These measures have been included in the EMP for implementation during the construction stage.

212. Land take for the eight subprojects would total approximately 134 ha. Subprojects 1, 3, 5 and 6 are within industrial areas with the later two on land that was reclaimed from the sea. All sites have been influenced and disturbed by human activities and development with vegetation dominated by shrubs, weeds and planted species. The sites do not impinge on protected areas, natural or critical habitats and no protected flora and fauna has been recorded on these sites. Ecological value of the subproject sites is deemed to be low.

213. Wastewater generated during operation of these facilities will be pretreated by wastewater treatment systems on site then conveyed to wastewater treatment plants for treatment. Solid waste generated during operation will be collected by local sanitation bureaus for proper disposal. Small quantities of chemical and medical wastes generated by subprojects 7 and 8 will be collected by licensed companies for treatment and disposal. Traffic noise have been assessed for the operation of roads in subprojects 1, 2, 3 and 4 and appropriate mitigation measures have been identified and will be provided to those noise sensitive receptors that would experience night time noise exceedance in the medium term.

214. Energy conservation, water saving and green building features for the facilities have been recommended in the FSRs. These will be adopted during detailed design. Based on climate risk and vulnerability assessment, increased drainage design and slope stabilization standards would increase climate resilience in the event of more extreme rainfall events. The PIEs have been encouraged to pursue LEED certification for at least one of their buildings in subprojects 5, 6, 7 and 8, which will have demonstration effect to the SMEs and their ASEAN partners.

215. Based on information gathered and assessments performed by the domestic environmental design institutes, it is concluded that environmental impacts during the construction and operational stages of the tranche 2 subprojects would be acceptable and in compliance with PRC regulations and standards and ADB's SPS (2009) if the EMP is implemented and monitored

effectively. The EMP defines mitigation measures and monitoring requirements for the design, construction, and operational stages of the subprojects. Appropriate environmental safeguards for the planned works are proposed and form part of a comprehensive set of project management documents. The EMP also includes a list of environmental contract clauses for inclusion into all tender documents and works contracts, thus binding the contractors legally in the implementation of environmental mitigation measures during construction.

216. An environmental assessment and review framework (EARF) has also been prepared as a guidance document for the Guangxi Zhuang Autonomous Region (GZAR) government to prepare relevant environmental safeguard documents to meet Asian Development Bank's (ADB) environmental safeguard requirements for subprojects in subsequent tranches.

C. Risks and Assurances

217. The project has no unusual technical risks and conventional engineering designs with proven reliability and performance will be adopted for all the subprojects. From an environment safeguards point of view, the main risk relates to the failure of GPMO and PIEs to monitor environmental impacts and implement the EMP during construction and operational stages. This risk will be mitigated by (i) providing training in environmental management under the project; (ii) appointing qualified project management consultant, (iii) following appropriate project implementation monitoring and mitigation arrangements, (iv) ADB conducting regular project review missions; and (v) through compliance with project assurances covenanted in the loan and project agreement with ADB.

218. General and specific environmental 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 project agreement. The EMP also includes a list of environmental contract clauses for inclusion into all tender documents and works contracts, binding contractors legally to implementation of environmental mitigation and monitoring measures during construction.

219. **General environmental assurances**. The Guangxi Foreign Loans Project Management Office (GPMO) as the EA will ensure and cause the PIEs and relevant government agencies to ensure that the preparation, design, construction, implementation, operation, maintenance, monitoring and decommissioning of the project and project facilities comply with (i) all applicable laws and regulations of the Government on environment, health, and safety; (ii) the environmental safeguards (i.e. principles and requirements set forth in ADB's Safeguard Policy Statement (2009); and (iii) all measures and requirements set forth in the domestic environmental impact reports (EIR), environmental impact tables (EIT), this IEE and environmental management plan (EMP) for the project; and any corrective or preventive actions (a) set forth in a safeguards monitoring report, or (b) which are subsequently agreed between ADB and GPMO will cause the PIEs to prepare, at the outset of component implementation, detailed internal monitoring programs to be implemented by the contractors during construction and operation phases, and to incorporate such mitigation and monitoring measures into the design of components, relevant bidding documents and construction contracts. Throughout project implementation, GPMO and the PIEs will review any changes to the project design that may potentially cause negative environmental impacts, and in consultation with ADB, update IEE and EMP by revising mitigation measures as necessary to assure full environmental compliance.

220. GPMO and the PIEs will appoint environmental coordinators for monitoring EMP implementation and making appropriate use of external independent entities for environmental monitoring and compliance monitoring. GZAR Government will ensure that the PIEs are obliged

to provide annual environmental monitoring reports throughout the construction period to GPMO, which will in turn prepare and submit to ADB annual environmental monitoring reports in a format acceptable to ADB.

221. **Specific environmental assurances**. GPMO will ensure that within 60 days from the loan effectiveness, GPMO 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: (a) review and document eligible complaints of project stakeholders; (b) proactively address grievances; (c) agree with the complainants the chosen mechanism for redress; and (d) prepare periodic reports to summarize 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.

222. GPMO will ensure that the PIEs will adopt applicable green building design codes, specifications and guidelines for the facilities in the Qinzhou cross-border trade e-commerce industrial park project (subproject 5), the Qinzhou international cold-chain logistics demonstration project (subproject 6), the China-ASEAN small and medium enterprise synergy innovative development project (subproject 7) and the China- ASEAN educational medicare cooperation project (phase I) (subproject 8).

223. GPMO will ensure that the PIEs for the Dongxing Changhu Road (east section) construction project (subproject 2) and the Road connectivity in Pingxiang-Viet Nam cross-border (phase 1) will implement the noise mitigation measures for traffic noise at the sensitive receptors as specified in the respective approved EIR and EIT, and also stated in the EMP.

224. GPMO will ensure that the PIEs for the China-ASEAN small and medium enterprises (SMEs) synergy innovative development project (subproject 7) and the China- ASEAN educational medicare cooperation project (phase I) (subproject 8) will commission licensed companies for the collection and treatment of chemical and medical wastes generated by the operation of these subprojects.

D. Overall Conclusion

225. The domestic EIRs, EITs and this IEE conclude that all identified environmental impacts can be mitigated to acceptable levels if the measures defined in the EMP and assurances are carefully implemented and monitored. The project is feasible from an environmental safeguards point of view and will contribute to improving regional cooperation and investment between the PRC and Viet Nam.

Appendix 1 to Initial Environmental Examination (IEE)

ENVIRONMENTAL MANAGEMENT PLAN

May 2017

People's Republic of China: Guangxi Regional Cooperation and Integration Promotion Investment Program – Tranche 2

Prepared by the Guangxi Zhuang Autonomous Region Government for the Asian Development Bank

ABBREVIATIONS

ADB	-	Asian Development Bank
AP	-	affected person
BOD_5	-	5-day biochemical oxygen demand
CASS	-	cyclic activated sludge system
COD	-	chemical oxygen demand
EA	-	executing agency
EEM	-	external environmental monitor
EHS	-	environment, health and safety
EIA	-	environmental impact assessment
EIR	-	environmental impact report
EIT	-	environmental impact table
EMP	-	environmental management plan
EMR	-	environmental monitoring report
EMS	-	Environmental Monitoring Station
EPB	-	Environmental Protection Bureau
ESE	-	environmental supervision engineer
PAM	-	project administration manual
FSR	-	feasibility study report
GPMO	-	Guangxi Foreign Loans Project Management Office
GRM	-	grievance redress mechanism
GZAR	-	Guangxi Zhuang Autonomous Region
IA	-	implementation agency
IEE	-	initial environmental examination
L_{Aeq}	-	equivalent continuous A-weighted sound pressure level
LDI	-	local design institute
NH_3	-	ammonia
NH_3-N	-	Ammonia nitrogen
NO_2	-	nitrogen dioxide
PCR	-	project completion report
PIE	-	project implementation entity
PMC	-	project management consultant
PME	-	powered mechanical equipment
PPE	-	personal protective equipment
PPTA	-	project preparation technical assistance
PRC	-	People's Republic of China
SPS	-	safeguard policy statement
SS	-	suspended solid
TP	-	total phosphorus
TSP	-	total suspended particulate
WWTP	-	wastewater treatment plant

A. Introduction

1. This Environmental Management Plan (EMP) is developed for Tranche 2 of the Guangxi Regional Cooperation and Integration Promotion Investment Program Multitranche Financing Facility (MFF) (the project). It identifies the potential environmental impacts and defines mitigation measures and monitoring requirements for the design, construction, and operational stages of the eight subprojects. It also defines the institutional arrangements and mechanisms, the roles and responsibilities of different institutions, procedures and budgets for implementation of the EMP. The EMP seeks to ensure environmental protection activities during preconstruction, construction, and operation stages are implemented effectively in order to prevent, reduce, or mitigate adverse environmental impacts and risks. The EMP draws on the findings of the project initial environmental examination (IEE) report; the domestic feasibility study reports (FSR), environmental impact reports (EIR) and environmental impact tables (EIT) for the subprojects; the project preparation technical assistance (PPTA) reports, and discussions and agreements with relevant government agencies and the Asian Development Bank (ADB).

2. This EMP is based on proposed subproproject designs described in the FSRs as of May 2017. Detailed engineering designs are yet to be finalized and may require subsequent impact assessment and/or revisions to this EMP if design changes result in changes in the extent of impact and impact locations. The Guangxi Zhuang Autonomous Region (GZAR) Government will provide the detailed designs to ADB for review to determine if the EMP requires revision. The final EMP will be disclosed on the ADB public website (www.adb.org) and included in the project administration manual (PAM). The final EMP will also be included as a separate annex in all bidding and contract documents. The contractors will be informed of their obligations to implement the EMP, and to include EMP implementation costs in their bids for subproject works.

3. This EMP consists of six components: (i) institutional arrangements and environmental responsibility, (ii) environmental mitigation measures, (iii) environmental monitoring, (iv) institutional strengthening and training, (v) public consultation, and (vi) grievance redress mechanism (GRM). Environmental monitoring consists of two types of monitoring: (i) environmental monitoring in terms of environmental data collection and analyses for assessing the extent and severity of impact and (ii) compliance monitoring (or audit) by independent entities for verifying EMP implementation. The last section of this EMP contains a list of environmental contract clauses for inclusion into all bidding documents and works contracts for environmental protection during construction.

B. Institutional Arrangements and Responsibilities for EMP Implementation

4. **Executing agency**. The **GZAR** will be the executing agency (EA) responsible for overall implementation and compliance with loan assurances and the EMP.

5. **Project management office**. The EA has established the **Guangxi Foreign Loans Project Management Office** (广西国外贷款项目管理办公室) (GPMO)**,** who shall be responsible, on behalf of the EA, for the day-to-day management of the project. The GPMO shall have the overall responsibility to supervise the implementation of environment mitigation and monitoring measures, coordinate the project GRM and report to ADB. GPMO shall (i) appoint one person on its staff roster as the **environmental coordinator** to coordinate and manage EMP implementation, (iii) engage the project management consultant (PMC) services, and (iii) supervise the procurement process. The GPMO environmental coordinator shall (i) supervise contractors and their compliance with the EMP; (ii) conduct regular site inspections; (iii) act as local entry point for the project GRM; and (iv) submit environmental monitoring data provided by

the IAs to the GPMO for verification. GPMO shall prepare quarterly project progress reports and annual environment monitoring reports (EMR) and submit them to ADB.

6. **Implementing agency.** Implementing Agencies (IA) for the eight subprojects will consist of seven **project implementation entities** (PIE) as shown in Table EMP-1. The PIEs shall implement subproject components, administer and monitor contractors and suppliers, and be responsible for construction supervision and quality control. To ensure that the contractors comply with the EMP provisions, the PIEs with the help and technical support of a Tendering Agent and the External Environmental Monitor (EEM) under the PMC services, shall prepare and provide the following specification clauses 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) major items in the IEE, and the full EMP. Each PIE shall (i) contract the local Environmental Monitoring Station (EMS) to conduct environmental quality monitoring during the construction stage, and (ii) contract an external Environmental Supervision Engineer (ESE) to conduct independent compliance audit and verification of EMP implementation during the construction stage of the subproject. Each PIE shall appoint one person on its staff as environmental coordinator to (i) supervise contractors and their compliance with the EMP, (ii) conduct regular site inspections, and (iii) submit environmental quality monitoring data provided by the EMS to the GPMO and local Environmental Protection Bureau (EPB).

Table EMP-1: Tranche 2 subprojects and project implementation entities

Subproject		Summary of Subproject Content	Project Implementation Entity
No.	Title		
1	Chongzuo Sino-Vietnam Border Economic Cooperation Zone demonstration project (phase I) 崇左中越边境经济合作区示范项目（一期）	Construction of 4 new roads and upgrade of 2 existing roads totaling 19.841 km plus ancillary works, a new wastewater treatment plant with 10,000 m^3/d treatment capacity, and 21.91 km of wastewater collection pipelines in the Chongzuo Sino-Vietnam Border Economic Cooperation Zone.	Chongzuo City Xinghe Investment Development Co. Ltd. 崇左市兴合投资开发有限责任公司
2	Dongxing Changhu Road (east section) construction project 东兴市长湖路东段工程	Construction of the new 3.704 km long east section of the Changhu Road and ancillary works in Dongxing City.	Dongxing City Development Investment Co. Ltd. 东兴市开发投资有限责任公司
3	Infrastructure development for Longzhou Border Economic Cooperation Zone 龙州边境经济合作区基础设施项目	Construction of 4 new roads and upgrade of 1 existing road totaling 9.729 km plus ancillary works in the Poverty Alleviation Industrial Park, which is within the Longzhou Border Economic Cooperation Zone in Longzhou County	Guangxi Longzhou County Industry and Transportation Investment Co. Ltd. 广西龙州县工业交通投资有限公司
4	Road connectivity in Pingxiang-Viet Nam cross-border (phase 1) 凭祥中越跨境经济合作区互联互通一期工程项目	Construction of a 2.668 km new road in Pingxiang connecting Kafeng Town with Nonghuai Town at the border with Viet Nam.	Pingxiang City Urban Construction Investment Co. Ltd. 凭祥市城市建设投资有限责任公司
5	Qinzhou cross-border trade e-commerce industrial park project 钦州跨境贸易电子商务产业园项目	Construction of 5 buildings with total floor area of 50,000 m^2 next to the Qinzhou Bonded Port Zone for exhibition and sales of cross-border merchandize, business offices and ancillary commercial facilities, and e-commerce supervision platform and bonded warehouse.	Guangxi Qinbao Investment Group Co. Ltd. 广西钦保投资有限责任公司
6	Qinzhou international cold-chain logistic demonstration project 钦州国际冷链物流示范项目	Construction of 4 buildings with total floor area of 35,000 m^2 for cold storage and constant temperature warehouses, warehouse and cold chain processing, and offices and distribution areas in the Qinzhou Bonded Port Zone	

Subproject		Summary of Subproject Content	Project Implementation Entity
No.	Title		
7	China-ASEAN small and medium enterprises (SMEs) synergy innovative development project 中国—东盟中小企业协同创新发展项目	Expansion of the south campus of the Guilin University of Aerospace Technology involving the construction of 3 buildings and ancillary facilities with total floor area of 125,268.25 m^2 for small and medium enterprises (SME) business development, aeronautic and aerospace industrial training, and ASEAN vocational education.	Guilin University of Aerospace Technology 桂林航天工业学院
8	China- ASEAN educational medicare cooperation project (phase I) 中国—东盟教育医疗合作项目（一期）	Phase 1 construction of the new campus of the Youjiang Medical College for Nationalities in Baise involving the construction of buildings and ancillary facilities with total floor area of 182,210 m^2 for classrooms, laboratories, library, administration, offices, auditorium, student canteens and dormitories, and housing for support staff.	Youjiang Medical College for Nationalities 右江民族医学院

7. **Construction contractors** shall be responsible for implementing the mitigation measures during construction under the supervision of the PIEs (through the ESE) and GPMO. In their bids, contractors shall be required to respond to the environmental management and monitoring requirements defined in the EMP. Each contractor shall be required to assign a person responsible for environment, health and safety (EHS).

8. **External environmental monitor (EEM).** An EEM will be recruited to support the project. The EEM shall be an environment specialist on the project management consultant (PMC) team. Terms of reference for the EEM are provided in the PAM. The EEM shall:

- assess the project components' environmental readiness prior to implementation based on the readiness indicators defined in Table EMP-3 of this EMP;
- support GPMO in updating the EMP including environmental monitoring plan 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);
- if required, update the IEE and EMP reports for changes in the project during detailed design or project implementation (for example if there is a minor or major scope change) that would result in adverse environmental impacts not within the scope of the approved IEE/EMP;
- assist GPMO to integrate the tranche 2 GRM with tranche 1 GRM (therefore forming a program GRM;
- conduct regular EMP compliance assessments, undertake site visits as required, identify any environment-related implementation issues, and propose and oversee implementation of necessary corrective actions;
- assist GPMO to prepare quarterly project progress reports and annual EMRs for ADB;
- provide training to GPMO, PIEs 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

- assist GPMO and PIEs in conducting consultation meetings with relevant stakeholders as required, informing them of imminent construction works, updating them on the latest project development activities and GRM.

9. **Environmental supervision engineer (ESE)** 环境监理. Each PIE shall contract an independent ESE to verify environmental performance during construction and whether the implementation of EMP items complies with the plan. The ESE shall review EMP implementation and monitoring activities and results, assess EMP implementation performance, visit the project sites and consult potentially affected people, discuss assessment with the GPMO and the respective PIE; and suggest corrective actions. The ESE shall prepare monthly reports for submission to the PIE which will be submitted to and reviewed by GPMO during the preparation of the quarterly project progress reports for ADB and by the EEM during the preparation of the annual EMRs for ADB.

10. Table EMP-2 outlines the overall environmental responsibilities.

C. Summary of Potential Impacts and Mitigation Measures

11. Potential environmental issues and impacts during pre-construction, construction and operation phases, and corresponding mitigation measures, are summarized in Table EMP-3, separated into those that are common to all subprojects and those that are subproject specific. There are two types of mitigation measures:

- Measures that will permanently become part of the infrastructure such as engineering measures for energy efficiency, green building features, barrier-free accessibility, and odor control for the wastewater treatment plant etc. should be included within the main civil work contract costs, and are not double-counted as part of the EMP costs.
- Temporary measures during the construction stage (e.g. dust suppression by watering, use of quiet / low noise powered mechanical equipment (PME), flocculants used to facilitate sedimentation of suspended solids in construction site runoff, etc.) will need to be included in the tender documents to ensure that contractors budget these items in their bids.

Table EMP-2: Environmental responsibility

Responsible Entity	Project Stage and Environmental Responsibility				
	Project Preparation	**Engineering Detailed Design**	**Tendering & Pre-construction**	**Construction**	**Operation**
GZAR Government	The Executing Agency (**EA**) for the project responsible for overall implementation and compliance with loan assurances and the EMP.				
GPMO (Guangxi Foreign Loans Project Management Office) 广西国外贷款项目管理办公室	Established by the EA to be responsible for the day-to-day management of the project. Has overall responsibility delegated by the EA for supervising the implementation of environmental mitigation measures, coordinating the project level GRM and reporting to ADB				
	1. Engage LDIs to prepare FSR, EIR, EIT and RP	1. Engage LDIs 2. Update IEE/EMP if needed 3. Review updated EMP 4. Confirm that mitigation measures have been included in engineering detailed design	1. Appoint one environmental coordinator on staff 2. Incorporate IEE/EMP clauses in tender documents and contracts 3. Manage the procurement process 4. Establish the project complaint center with hot-line 5. Engage EEM as part of the PMC services	1. Supervise EMP implementation to ensure effectiveness 2. Operate the project complaint center and coordinate the project environment GRM records and reporting. 3. Prepare quarterly project progress reports and annual EMRs and submit them to ADB 4. Conduct information disclosure and public consultation 5. Inspect implementation of mitigation measures.	1. Instruct the PIEs on environmental management requirements 2. Prepare quarterly project progress reports and annual EMRs until a PCR is issued
1. Chongzuo City Xinghe Investment Development Co. Ltd. 崇左市兴合投资开发有限责任公司 2. Dongxing City Development Investment Co. Ltd. 东兴市开发投资有限责任公司 3. Guangxi Longzhou County Industry and Transportation Investment Co. Ltd. 广西龙州县工业交通投资有限公司 4. Pingxiang City Urban Construction Investment Co. Ltd. 凭祥市城市建设投资有限责任公司 5. Guangxi Qinbao Investment Group Co. Ltd. 广西钦保投资有限责任公司 6. Guilin University of Aerospace Technology 桂林航天	The Implementing Agency (**IA**) for the subprojects are the project implementation entities (**PIE**) who will implement subproject components, administer and monitor contractors and suppliers, and take responsibility for construction supervision and quality control. The PIEs shall ensure that the EMP is implemented proactively and shall respond to any adverse impact beyond those foreseen in the IEE and ensure that if there are any changes in scope the IEE/EMP shall be updated, as needed. The PIEs shall also attend to requests from relevant agencies and ADB regarding the mitigation measures and environmental monitoring program.				
			1. Incorporate IEE/EMP clauses in tender documents and contracts 2. Appoint an environmental coordinator on staff 3. Engage local EMS for environmental monitoring 4. Engage ESE for independent compliance audit and verification	1. Supervise contractors and ensure compliance with the EMP 2. Coordinate construction supervision and quality control 3. Coordinate environmental monitoring according to the environmental monitoring program in the EMP 4. Act as a local entry point for the project GRM, collate records and report monthly to GPMO on GRM 5. Submit monthly monitoring results to GPMO and local EPBs	1. Coordinate environmental monitoring according to the EMP until a PCR is issued 2. Ensure proper operation of subproject facilities according to design standards

Responsible Entity	Project Stage and Environmental Responsibility				
	Project Preparation	Engineering Detailed Design	Tendering & Pre-construction	Construction	Operation
工业学院 7. Youjiang Medical College for Nationalities 右江民族医学院					
Local design institutes (LDIs)	1. Prepare subproject FSRs, EIRs, EITs, RPs 2. Conduct public consultation	1. Incorporate mitigation measures defined in the approved EIRs and EITs and this EMP into engineering detailed designs 2. Update the EMP in cooperation with the EEM 3. Incorporate agreed climate adaptation measures into engineering detailed designs..			
Local EPBs	1. Review and approve the subproject EIRs and EITs			1. Review subproject environmental monitoring results 2. Conduct mandated inspection and monitoring 3. Conduct the "Three Simultaneity[1]" acceptance inspections on completion of the subprojects	
PPTA consultant	1. Provide technical assistance 2. Review EIRs, EITs and other relevant documents 3. Prepare IEE report and EMP				
EEM		1. Review updated EMP, confirm that mitigation measures have been included in engineering detailed design	1. Review bidding documents to ensure that the IEE/EMP clauses are incorporated 2. Confirm project's readiness in respect of environmental management.	1. Advise on mitigation measures 2. Provide technical support to GPMO, PIEs and contractors for environmental management 3. Conduct environmental training 4. Conduct EMP compliance audit 5. Support GPMO in preparing quarterly project progress reports and annual EMRs. 6. Review domestic environmental inspection acceptance reports 7. Provide environmental input to the PCR.	1. Conduct EMP compliance audit 2. Support GPMO in instructing PIEs on environmental management requirements 3. Support GPMO in preparing quarterly project progress reports and annual EMRs until a PCR is issued 4. Coordinate environmental monitoring until a PCR is issued

[1] The "Three Simultaneities" requires the design, construction, and operation of pollution control and treatment facilities to occur simultaneously with the project design, construction, and operation.

Responsible Entity	Project Stage and Environmental Responsibility				
	Project Preparation	**Engineering Detailed Design**	**Tendering & Pre-construction**	**Construction**	**Operation**
Contractors			1. Ensure sufficient funding and human resources for proper and timely implementation of required mitigation and monitoring measures in the EMP throughout the construction phase	1. Appoint an environment, health and safety (EHS) officer to oversee EMP implementation related to environment, occupational health and safety on construction site 2. Ensure health and safety 3. Implement mitigation measures 4. Act as a local entry point for the project GRM	
Local EMS 环境监测站				1. Undertake environmental monitoring according to the environmental monitoring program in the EMP (*contracted by PIEs*) 2. Report monitoring data to ESE, PIEs and GPMO	1. Undertake environmental quality monitoring until a PCR is issued (*contracted by PIEs*) 2. Submit monitoring results to the PIEs
ESE 环境监理				1. Conduct independent verification of subproject's environment performance and compliance with the EMP (*contracted by PIEs*) 2. Review monthly monitoring data submitted by EMS, and conduct compliance checking against applicable environmental standards and report to EEM. 3. Provide advice to contractors to resolve on-site environmental problems when monitoring data shows non-compliance and any environmental complaints raised. 4. Submit monthly compliance auditing results to GPMO and PIEs	
ADB	1. Review and clear the IEE and EMP and disclose on ADB website	1. Clear updated IEE/EMP if appropriate and disclose on ADB website	1. Review bidding documents 2. Review proposed candidates for EEM to ensure suitably qualified. 3. Confirm project's readiness	1. Review quarterly project progress reports, annual EMRs and PCR 2. Undertake review missions 3. Advise on compliance issues, as required 4. Review and disclose annual EMRs on ADB website.	1. Review and approve EMRs and disclose on ADB website 2. Undertake project completion review mission and prepare PCR for approval by Board and disclosure on ADB website.

Notes:

ADB = Asian Development Bank; **EA** = executing agency; **EEM** = external environmental monitor; **EHS** = environment, health & safety; **EIR** = environmental impact report; **EIT** = environmental impact table; **EMP** = environmental management plan; **EMR** = environmental monitoring report; **EMS** = Environmental Monitoring Station; **EPB** = Environmental Protection Bureau; **ESE** = environmental supervision engineer; **FSR** = feasibility study report; **GPMO** = Guangxi project management office; **GRM** = grievance redress mechanism; **GZAR** =Guangxi Zhuang Autonomous Region; **IA** = implementing agency; **IEE** = initial environmental examination **LDI** = local design institute; **PCR** = project completion report; **PIE** = project implementation agency; **PMC** = project management consultant; **PPTA** = project preparation technical assistance; **RP** = resettlement plan

Table EMP-3: Summary of potential impacts and mitigation measures

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Source of funds
A: Mitigation measures applicable to all subprojects						
A.1: Detailed design stage						
Green building design	Materials and fixtures, carbon emission	Efficient use of resources and energy	● Technical design of buildings and facilities shall include barrier-free universal access ● Technical design of buildings and facilities shall include energy saving features in terms of building envelope/roofing materials, electrical system and automation, water heating, air conditioning and ventilation, and lighting, etc. as recommended in the FSRs ● Technical design of buildings and facilities shall consider other "green building" features besides energy saving. Such as the use of recycled building materials, rainwater capture and reuse, green roofs, etc. ●	LDI	GPMO	Included in design contract
Drainage	Climate change	Extreme rainfall causing flooding	● Technical design of building and road drainage for all subprojects shall take into consideration climate change impacts from intensified heavy rainfall.	LDI	GPMO	Included in design contract
A.2: Pre-construction stage						
Institutional strengthening	--	Lack of environmental management capacities within GPMO and PIEs	● Appoint qualified staff as environmental coordinator to oversee EMP implementation.	GPMO, PIEs	ADB	GPMO, PIEs
			● Contract EEM within PMC services ● Conduct environment management training.	GPMO	ADB	GPMO
	--	Lack of environmental monitoring and supervision capability and qualification	● Contract local EMS (环境监测站) to conduct environmental quality monitoring during construction and operation. ● Appoint an environmental supervision engineer (ESE,环境监理) responsible for the environmental supervision of contractors and environmental audit of construction sites.	PIEs	GPMO	PIEs
Grievance redress mechanism	--	Establish a system for receiving and resolving complaints	● Integrate the grievance redress mechanism (GRM) for Tranche 2 into the GRM for Tranche 1. ● Brief and provide training to other GRM access points (PIEs, contractors).	GPMO	ADB	GPMO, PMC service
EMP Update	-	-	● Review mitigation measures defined in this EMP, update as required to reflect detailed design, disclose updated EMP on project website.	GPMO, EEM	ADB	GPMO, PMC
Tender and contract documents	-	Environmental contract clauses-	● Put the environmental contract clauses listed in Section J of this EMP into all civil works tender documents and contracts and ensure adequate cost provision.	GPMO, PIEs, Tendering Agent	EEM, ADB	Included in tendering agency contract
						Estimated cost for Design and Pre-construction stage: Included in detailed design and contract tender fees
A.3: Construction stage						
Construction site good practice	Air quality	Dust (TSP) during construction	● Spray water at least twice each day on unpaved areas and exposed dust-prone stockpiles except on rainy days. ● Store dust-prone materials in areas with shelters on four sides and on top. If such materials have to be stored in open area, cover with strong tarpaulin. ● Control vehicle speed to ≤ 8 km/h in unpaved areas. Post the speed limit sign in these areas. ● Pave construction site exits with gravel or asphalt. ● Install wheel washing equipment or conduct wheel washing manually at each construction site exit to prevent trucks from carrying muddy or dusty substance onto public roads. ● Vehicles with an open load-carrying case, which transport potentially dust-producing materials, shall have proper fitting sides and tail boards. Dust-prone materials shall not be loaded to a level higher than the side and tail boards, and shall always be covered with a strong tarpaulin. ● For road construction, site asphalt / concrete mixing stations at least 300 m downwind of the nearest household (plant noise is the limiting factor) and equip asphalt, hot mix and batching plants with fabric filters and/or wet scrubbers to reduce the level of dust emissions. ● Provide personal protective equipment (PPE) such as goggles, gloves and respirators to construction workers doing asphalt concrete and cement concrete road paving and doing interior fit-out of buildings to minimize skin exposure to chemicals and inhalation of VOC. ● Regularly maintain construction vehicles and machinery to minimize exhaust emissions from these sources. ● Unauthorized burning of construction and demolition waste material and refuse shall be subject to	Contractor	PIEs, ESE, EEM	$200,000 (contractor bid)

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Source of funds
			penalties for the Contractor, and withholding of payment			
	Noise and vibration	Noise from PME and vehicles	● No construction works shall be conducted between 22:00 to 06:00 hours and piling works shall also be prohibited between 12:00 to 14:30 hours within 300 m of a noise sensitive receptor (such as residential household, school, health clinic, hospital). ● During construction, the contractor shall: – ensure regular equipment repair and maintenance to keep them in good working condition to minimize noise – deploy low noise machinery or the equipment with sound insulation – erect temporary noise barriers or hoardings around noisy equipment to shield the noise from equipment – provide the construction workers with suitable hearing protection (ear muffs) when working near noisy machinery such as during piling – forbid the use of horns unless absolutely necessary, minimize the use of whistles ● Plan 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. ● Use noise control devices, such as temporary noise barriers and deflectors for impact and blasting activities, and exhaust muffling devices for combustion engines. ● Avoid or minimize project transport through community areas.	Contractor	PIEs, ESE, EEM	$350,000 (contractor bid)
	Water quality	Construction site runoff and wastewater discharge	● Collect runoff from construction sites with drainage ditches to prevent runoff containing muddy water from polluting nearby roads, land and water bodies. ● Install and operate oily-water separators and sedimentation tanks on construction sites to treat process water and muddy runoff with high concentrations of total petroleum hydrocarbon and suspended solids. If necessary, use flocculants such as polyacryl amide to facilitate sedimentation. ● Provide portable toilets and small package wastewater treatment plants and/or septic tanks on construction sites for the workers. If there are nearby public sewers, install interim storage tanks and pipelines to convey wastewater to public sewers. ● Store fuels, oil, and other hazardous materials on construction sites within secured areas on impermeable surfaces protected by bunds and provided with cleanup kits. ● Clean up any chemical spills into drains and water bodies within 24 hours of the occurrence, with contaminated soils and water treated according to HJ 25.4-2014 *Technical Guidelines for Site Soil Remediation*. Records must be handed over without delay to the GPMO and local EPB.	Contractor	PIEs, ESE, EEM	$320,000 (contractor bid)
	Solid waste	Construction site refuse and construction waste	● Maximize the re-use of construction wastes on the project. ● Store all refuse and construction waste generated on construction sites in designated areas and remove them from these locations for disposal or reuse regularly.	Contractor	PIEs, ESE, EEM	$95,000 (contractor bid)
	Soil erosion	Soil erosion caused by surface runoff over unpaved areas	● Include all soil erosion prevention measures listed in the EIRs and EITs in the design of spoil disposal sites. ● Rehabilitate and vegetate spent spoil disposal/storage sites, haul roads and other unpaved temporary land take areas within one month after closure to prevent soil erosion and dust generation.	Contractor	PIEs, ESE, EEM	Costs included in Soil and Water Conservation Plans (contractor bid)
	Ecology	Destruction of vegetation and wildlife	● Construction workers are prohibited from capturing any wildlife during construction. ● Where a tree has to be removed or an area of grassland disturbed, replant trees and re-vegetate the area after construction. ● Tree planting shall use local species with local provenance. Planting of exotic or invasive species shall be prohibited.	Contractor	PIEs, ESE, EEM	None
	Physical cultural resources	Destruction of buried cultural relics	● Comply with PRC's *Cultural Relics Protection Law* and *Cultural Relics Protection Law Implementation Ordinance* if such relics are discovered, stop work immediately and notify the local cultural authority, adopt measures to protect the site.	Contractor	PIEs, ESE, EEM	None

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Source of funds
	Overall disturbance to communities	Excessive disturbance to communities due to prolonged construction times	• Identify and adhere to strict schedule for completion of civil works and avoid prolonged construction and disturbance. • Keep communities informed of construction activities, in particular those that may result in disruption of access, noisy or dust-generating activities that are likely to result in significant disturbance. Ensure communities are aware of grievance redress mechanism entry points.	Contractor	PIEs, ESE, EEM	Covered in above costs
Health and Safety	Occupational health and safety	Environment, health & safety officer	• Appoint at least one environment, health and safety (EHS) officer to manage occupational health and safety risks on construction sites by applying the following measures.	Contractor	PIEs, ESE, EEM	(contractor staff)
		Construction site sanitation	• Provide adequate and functional systems for sanitary conditions, toilet facilities, waste management with waste separation, labor dormitories and cooking facilities. • Effectively clean and disinfect the site. During site formation, spray with phenolated water for disinfection. Disinfect toilets and refuse bins 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, and appoint designated staff responsible for cleaning and disinfection • Discharge construction site domestic wastewater into the municipal sewer system or treated on-site using a portable system.	Contractor	PIEs, ESE, EEM	Included in water quality above (contractor bid)
		Occupational safety	• Provide personal protective equipment (safety hats and shoes, high visibility vests and safety belt and harness for above ground works) to all construction workers and strictly enforce all workers to put on the PPE. • Provide safety goggles, gloves and respiratory masks to workers doing interior fit-out works. • Provide ear plugs to workers operating and working near noisy PME.	Contractor	PIEs, ESE, EEM	$160,000 (contractor bid)
		Food safety	• Inspect and supervise food hygiene in canteens on site regularly. Canteen workers must have valid health permits. • If food poisoning is discovered, implement effective control measures immediately to prevent it from spreading.	Contractor	PIEs, ESE, EEM	None
		Disease prevention and safety awareness	• Construction workers must have physical examination before starting work 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. • 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. • Provide induction and training by local health departments on prevention and management of communicable diseases.	Contractor	PIEs, ESE, EEM	$25,000 (contractor bid)
	Community health and safety	Temporary traffic management	• Prepare a traffic control and operation plan together with the local traffic police prior to any construction. The plan shall include provisions for 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, controls and planning in advance.	Contractor, local traffic police	PIEs, ESE, EEM	None
		Information disclosure	• Erect construction billboards, which include construction contents, schedule, responsible person and complaint phone number, at the entry to each construction site and construction staging area. • Inform residents and businesses in advance of the road improvement activities, given the dates and duration of expected disruption and make aware of the project GRM. • Place clear signs at construction sites in view of the public, warning people of potential dangers such as moving vehicles, hazardous materials, excavations etc. and raising awareness on safety issues.	Contractor	PIEs, ESE, EEM	None
		Access to construction sites	• Make all sites secure, and discourage access by members of the public through appropriate fencing, signage and/or security personnel, as appropriate.	Contractor	PIEs, ESE, EEM	None
		Utility services interruptions	• Assess construction locations in advance and identify potential for disruption to services and risks before starting construction. Any damage or hindrance/disadvantage to local businesses caused by the premature removal or insufficient replacement of public utilities is subject to full compensation, at the full liability of the contractor who caused the problem.	Contractor, local utility service providers	PIEs, ESE, EEM	None

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Source of funds
			• If temporary disruption is unavoidable, develop a plan in collaboration with relevant local authorities such as power company, water supply company and communication company to minimize the disruption and communicate the dates and duration in advance to affected persons.			
Grievance redress mechanism	Social & environmental	Handling and resolving complaints on contractors	• Appoint a GRM coordinator • Disclose GRM to affected people before construction begins at the main entrance to each construction site. • Maintain and update a Complaint Register to document all complaints.	Contractor, PIEs	PMO, EEM	Contractor and PIE budget
Zone						
B: Subproject 1: Chongzuo Sino-Vietnam Border Economic Cooperation Zone demonstration project (phase I)						
B.1: Detailed design stage						
Noise	Traffic noise	Traffic noise from Huancheng South Road in the medium term	Design road side walls as noise barrier or noise insulated windows for affected households at Tanzha, Tuobu, Qinghe Village and Mami	LDI	GPMO, PIE	Included in design contract
Drainage	Climate change	Extreme rainfall	Increase design standard in GB 50014-2006 by 11%			
C: Subproject 2: Dongxing Changhu Road (east section) construction project						
C.1: Detailed design stage						
Slope stability	Climate change	Extreme rainfall	A high design standard shall be adopted in the stabilizing slope design for all slopes	LDI	GPMO, PIE	Included in design contract
C.2: Construction stage						
Construction site good practice	Noise	Noise from PME affecting Huangqiaoshu village	• Noisy machinery such as concrete batching and asphalt mixing equipment, generators, etc. should be positioned at least 150 m from the Huangqiaoshu Village and preferably in low lying areas with the direct line of sight to the village blocked by terrain. • A 100-m long 2-m wide hoarding shall be erected at Huangqiaoshu Village as a temporary noise barrier during road construction as recommended in the EIT	Contractor	PIE	$10,000 (contractor bid)
	Water quality	Road crossing upstream of Dagoulong Reservoir and Xiangche Creek	Deploy mitigation measures such as temporary diversion of stream flow or placement of sandbags or berms around the works area to prevent downstream dispersion of suspended solids during culvert and road construction crossing the upstream sections of the Dagoulong Reservoir and Xiangche Creek. Unless the road construction across these water bodies are done in the dry by first diverting these streams, mitigation of water quality impact during stream crossing road construction shall be based on water quality monitoring results. At each stream crossing road construction location, upstream and downstream monitoring stations will be set up and SS levels monitored. When the SS levels at the downstream impact station is 130% higher than the SS levels at the upstream control station, the contractor shall adopt alternative construction methods or additional mitigation measures until the downstream SS level is less than 130% above the upstream SS level.	Contractor	PIE	River diversion if adopted would be included in civil works bid by contractor. Water quality monitoring cost included in Table EMP-5
C.3: Operation stage						
Noise	Traffic noise	Traffic noise affecting Huangqiaoshu Village	Install noise insulation strips on the window frames for five households at Huangqiaoshu Village as recommended by the EIT.	PIE	GPMO	$800
D: Subproject 3: Infrastructure development for Longzhou Border Economic Cooperation Zone						
D1: Detailed design stage						
Drainage	Climate change	Extreme rainfall	Increase design standard in GB 50014-2006 by 11%	LDI	GPMO, PIE	Included in design contract
E: Subproject 4: Road connectivity in Pingxiang-Viet Nam cross-border (phase 1)						
E.1: Detailed design stage						
Drainage	Climate change	Extreme rainfall	Increase design standard in GB 50014-2006 by 11%	LDI	GPMO, PIE	Included in design contract
Slope stability	Climate change	Extreme rainfall	A high design standard shall be adopted in the stabilizing slope design for all slopes			
E2: Operation stage						
Noise	Traffic noise	Traffic noise affecting Kafeng	Install ventilated double-glazed windows for the 20 households on the first row of buildings in Kafeng as	PIE	GPMO	$65,000

Item	Impact Factor	Potential Impact and/or Issues	Mitigation Measures	Implementing Entity	Supervising Entity	Source of funds
		Town	recommended by the EIR			
F: Subproject 5: Qinzhou cross-border trade e-commerce industrial park project						
F.1: Detailed design stage						
Drainage	Climate change	Extreme rainfall	Increase design standard in GB 50014-2006 by 10%	LDI	GPMO, PIE	Included in design contract
G: Subproject 6: Qinzhou international cold-chain logistic demonstration project						
G.1: Detailed design stage						
Drainage	Climate change	Extreme rainfall	Increase design standard in GB 50014-2006 by 10%	LDI	GPMO, PIE	Included in design contract
H: Subproject 7: China-ASEAN small and medium enterprises (SMEs) synergy innovative development project						
H1: Detailed design stage						
Drainage	Climate change	Extreme rainfall	Increase design standard in GB 50014-2006 by 5%	LDI	GPMO, PIE	Included in design contract
H2: Operation stage						
Wastewater	Canteen wastewater	Oil and grease in canteen wastewater	Regular maintenance of the oil-water separator.	PIE	GPMO	PIE's operating cost
Solid waste	Chemical and medical wastes	Chemical and medical wastes generated from the training center, laboratories and infirmary	Chemical and medical wastes generated shall be collected by companies approved to collect and treat chemical and medical wastes.	PIE	GPMO	PIE's operating cost
I: Subproject 8: China- ASEAN educational medicare cooperation project (phase I)						
I.1: Detailed design stage						
Noise	Traffic noise	Student dormitory affected by traffic noise from Bailong Expressway	Technical design of the façade of student dormitory #1 with a direct line of sight of the Bailong Expressway shall adopt noise reduction measures, and if necessary shall include noise insulated windows in accordance with GB 50118-2010 *Design Specifications for Noise Insulation of Buildings for Civil Use* 《民用建筑隔声设计规范》	LDI	GPMO, PIE	Included in design contract
Drainage	Climate change	Extreme rainfall	Increase design standard in GB 50014-2006 by 8%			
I.2: Operation Stage						
Solid waste	Chemical and medical wastes	Chemical and medical wastes generated from the laboratories	Chemical and medical wastes generated shall be collected by companies approved to collect and treat chemical and medical wastes.	PIE	GPMO	PIE's operating cost
Wastewater	Wastewater quality	Improper maintenance of the CASS treatment system	Regularly maintain the CASS wastewater treatment system on campus	PIE	GPMO	PIE's operating cost
						Estimated cost for mitigation measures: $1,225,800

Key: **ADB** = Asian Development Bank; **CASS** = cyclic activated sludge system; **EEM** = external environmental monitor; **EHS** = environment, health & safety; **EIR** = environmental impact report 环境影响报告书; **EIT** = environmental impact table 环境影响报告表; **EMP** = environmental management plan; **EMS** = Environmental Monitoring Station 环境监测站; **EPB** = Environmental Protection Bureau; **ESE** = Environmental supervision engineer 环境监理; **FSR** = feasibility study report; **GPMO** = Guangxi project management office; **GRM** = grievance redress mechanism; **IA** = implementing agency; **IEE** = initial environmental examination; **LDI** = local design institute; **PIE** = project implementation entity; **PMC** = project management consultant; **PME** = powered mechanical equipment; **PPE** = personal protective equipment; **PRC** = :People's Republic of China; **SS** = suspended solid; **TSP** = total suspended particulates; **VOC** = volatile organic compound

12. The mitigation measures defined in the EMP shall be (i) checked and where necessary updated by the design institutes and the EMP subsequently updated; (ii) incorporated into tender documents (where appropriate), construction contracts, and operational management plans; and (iii) implemented by contractors and PIEs under supervision of GPMO. The effectiveness of these measures shall be evaluated based on the results of the environmental monitoring conducted by local EMS, and through EMP compliance audits conducted by the ESE and EEM.

D. Monitoring and Reporting

13. Three types of project monitoring shall be conducted under the EMP. [2]

i. **Project readiness monitoring**. To be conducted by the EEM or GPMO environmental focal point (under the support of EEM).

ii. **Environmental quality monitoring**. To be conducted by local EMS (contracted by the PIEs) involving the collection and analyses of air quality, noise and water quality data at designated monitoring locations to assess compliance with applicable environmental quality and emission standards during construction.

iii. **Compliance monitoring or auditing**. To be conducted by the ESE (contracted by the PIEs) and EEM to verify EMP compliance during project implementation. The EEM will function as an external monitor/auditor for ADB.

14. ADB will oversee project compliance on the basis of the quarterly project progress reports and annual environmental monitoring reports provided by GPMO and site visits (generally 1-2 times/year). Monitoring and reporting arrangements are described below.

15. **Project readiness monitoring.** Before construction, the EEM shall assess the subprojects' readiness on environmental management based on a set of indicators (Table EMP-4) and report it to ADB and GPMO. 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 EMP-4: Project Readiness Assessment Indicators

Indicator	Criteria	Assessment
EMP update	• EMP was updated after technical detail design & approved by ADB	Yes No
Compliance with loan covenants	• The borrower complies with loan covenants related to project design and environmental management planning	Yes No
Public involvement effectiveness	• Meaningful consultation completed • GRM established with entry points	Yes No Yes No
Environmental supervision and monitoring in place	• External Environmental Monitor (EEM) is in place • Staff environmental coordinators appointed by GPMO and PIEs • Environmental supervision engineers (ESE) contracted by PIEs	Yes No Yes No Yes No

[2] In addition to project-specific monitoring, local EPBs will conduct independent ambient and/or enforcement monitoring as per national requirements. This is separate to, and not funded by, the project.

Indicator	Criteria	Assessment
	• Environment monitoring stations (EMS) contracted by PISs	Yes No
Bidding documents and contracts with environmental safeguards	• Bidding documents and contracts incorporating the environmental activities and safeguards listed as loan assurances	Yes No
	• Bidding documents and contracts incorporating the environmental contract clauses listed in Section J of the EMP	Yes No
EMP financial support	• The required funds, if applicable, have been set aside for EMP implementation	Yes No

16. **Environmental monitoring.** Table EMP-5 shows the environmental monitoring program designed for the three subprojects, defining the scope, location, parameter, duration and frequency, and responsible agencies, for monitoring during the construction. Environmental monitoring will include monitoring of air quality, noise and water quality during construction. These will be conducted by local EMSs (contracted by the PIEs). The selection of monitoring locations is based on distances from the subproject sites, number of households and populations affected, and the extent of sensitivity to air and noise impacts (e.g. residential household, school).

17. For subproject 2, unless the road construction across the upstream sections of the Dagoulong Reservoir and the Xiangche Creek are done in the dry by first diverting these streams, mitigation of water quality impact during stream crossing road construction shall be based on water quality monitoring results. At each stream crossing road construction location, upstream and downstream monitoring stations will be set up and SS levels monitored. When the SS levels at the downstream impact station is >130% of the SS levels at the upstream control station, the contractor shall adopt alternative construction methods or additional mitigation measures until the downstream SS level is less than 130% of the upstream SS level.

18. The monitoring results shall be compared with relevant PRC performance standards (Table EMP-6). Non-compliance with these standards shall be highlighted in the EMRs. Monitoring results shall be submitted by the EMSs to the PIEs, ESE and local EPBs on a monthly basis. In turn, the PIEs shall submit the data to GPMO and EEM also on a monthly basis. GPMO shall then submit to ADB in the annual EMRs (prepared with the support of the EEM–Table EMP-7).

Table EMP-5: Environmental Monitoring Program

Monitoring Location	Item	Monitoring Parameter	Monitoring Frequency & Duration	Implementing Entity	Supervising Entity
Subproject 1: Chongzuo Sino-Vietnam Border Economic Cooperation Zone demonstration project (phase I)					***Estimated cost: $22,000***
Construction stage					
1. Nongben 农本 2. Tanzha 潭榨 3. Tuobu 驮呖 4. Qinghe Village 庆合村 5. Mami 马密 6. Jiupaitou 旧排头	Air quality	TSP	2 consecutive days (24-hr) per month until a PCR is issued	Local EMS	PIE, ESE
	Noise	L_{Aeq}	2 consecutive days per month until a PCR is issued (day time only if no night time construction)		
Operation stage					
1. Nongben 农本 2. Tanzha 潭榨 3. Tuobu 驮呖 4. Qinghe Village 庆合村 5. Mami 马密 6. Jiupaitou 旧排头	Air quality	NO_2 (24-hr average)	2 consecutive days per month until a PCR is issued	Local EMS	PIE
1 station at 10 m upwind of the WWTP and 2 stations at 10 m and 50 m downwind of the WWTP	Odor	H_2S, NH_3	2 consecutive days per month until a PCR is issued	Local EMS	PIE
1. WWTP north boundary 污水处理厂北边厂界 2. WWTP east boundary 污水处理厂东边厂界 3. WWTP south boundary 污水处理厂南边厂界 4. WWTP west boundary 污水处理厂西边厂界	Noise	L_{Aeq}	2 consecutive days per month until a PCR is issued (day time only if no night time construction)	Local EMS	PIE
1. Influent 2. Effluent	Influent & effluent quality	pH, COD, NH_3-N, TP	Online monitoring daily until a PCR is issued.	WWTP operator	PIE
Sludge dewatering room	Dewatered sludge	Moisture content and parameters in GB 4284-84	Once every 3 months until a PCR is issued	Local EMS	PIE
Subproject 2: Dongxing Changhu Road (east section) construction project					***Estimated Cost: $24,000***
Construction stage					
1. Huangqiaoshu Village 黄桥树 when construction occurs within 300 m from the village	Air quality	TSP	2 consecutive days (24-hr) per month until a PCR is issued	Local EMS	PIE, ESE
	Noise	L_{Aeq}	2 consecutive days per month until a PCR is issued (day time only if no night time construction)		
Road crossing upstream of Dagoulong Reservoir 1. Control station at 50 m upstream of road crossing 2. Impact station at 50 m downstream of road crossing Road crossing upstream of Xiangche Creek	Water quality	SS (if SS level at the downstream impact station is >130% of SS	2 consecutive days per month during road construction crossing these streams.	Local EMS	PIE, ESE

Monitoring Location	Item	Monitoring Parameter	Monitoring Frequency & Duration	Implementing Entity	Supervising Entity
3. Control station at 50 m upstream of road crossing 4. Impact station at 50 m upstream of road crossing		level at upstream control station, mitigation by contractor is required)			
Subproject 3: Infrastructure development for Longzhou Border Economic Cooperation Zone					***Estimated cost : $22,000***
Construction stage					
1. Banzaotun 板灶屯 2. Xiazaotun 下灶屯 3. Xiwang Kindergarten 希望幼儿园 4. Gengyi Village 埂宜村村委及村户 5. Gengyitun 埂宜屯 6. Beiyao Farm Resident 北耀农场埂宜分场	Air quality	TSP	2 consecutive days (24-hr) per month until a PCR is issued	Local EMS	PIE, ESE
	Noise	L_{Aeq}	2 consecutive days per month until a PCR is issued (day time only if no night time construction)		
Operation stage					
1. Xiwang Kindergarten 希望幼儿园	Air quality	NO_2 (24-hr average)	2 consecutive days per month until a PCR is issued	Local EMS	PIE
Subproject 4: Road connectivity in Pingxiang-Viet Nam cross-border (phase 1)					***Estimated cost : $37,000***
Construction stage					
1. Kafeng Town 卡凤镇 when construction occurs within 300 m from the nearest household	Air quality	TSP	2 consecutive days (24-hr) per month until a PCR is issued	Local EMS	PIE, ESE
	Noise	L_{Aeq}	2 consecutive days per month until a PCR is issued (day time only if no night time construction)		
Operation stage					
1. Kafeng Town 卡凤镇	Air quality	NO_2 (24-hr average)	2 consecutive days per month until a PCR is issued	Local EMS	PIE
Subproject 5: Qinzhou cross-border trade e-commerce industrial park project					***Estimated cost : $32,000***
Construction stage					
1. Employee dormitory next to the site 场地旁的员工宿舍	Air quality	TSP	2 consecutive days (24-hr) per month until a PCR is issued	Local EMS	PIE, ESE
	Noise	L_{Aeq}	2 consecutive days per month until a PCR is issued (day time only if no night time construction)		
Operation stage					
1. Commercial office building 商务办公区 2. Cross-border merchandize exhibition & sales center 跨境产品展销中心	Indoor air quality	Hourly average of formaldehyde and benzene; daily average of TVOC	2 consecutive days per month until a PCR is issued	Local EMS	PIE

Monitoring Location	Item	Monitoring Parameter	Monitoring Frequency & Duration	Implementing Entity	Supervising Entity
Subproject 6: Qinzhou international cold-chain logistic demonstration project					***Estimated cost : $37,000***
Construction stage					
1. North boundary of the site 场地北边边界 2. East boundary of the site 场地东边边界 3. South boundary of the site 场地南边边界 4. West boundary of the site 场地东边边界	Air quality	TSP	2 consecutive days (24-hr) per month until a PCR is issued	Local EMS	PIE, ESE
	Noise	L_{Aeq}	2 consecutive days per month until a PCR is issued (day time only if no night time construction)		
Operation stage					
1. Office building 办公及配送区	Indoor air quality	Hourly average of formaldehyde and benzene; daily average of TVOC	2 consecutive days per month until a PCR is issued	Local EMS	PIE
2. Cold storage warehouse	Temperature	^oC	Daily until a PCR is issued	Cold storage warehouse operator	PIE
Subproject 7: China-ASEAN small and medium enterprises (SMEs) synergy innovative development project					***Estimated cost : $37,000***
Construction stage					
1. GUAT teachers' dormitory 航院教师宿舍 2. Xinjian Primary School 新建小学 3. Xinjian Village 新建村 4. Student canteen in the existing south campus 现有校舍内的学生食堂	Air quality	TSP	2 consecutive days (24-hr) per month until a PCR is issued	Local EMS	PIE, ESE
	Noise	L_{Aeq}	2 consecutive days per month until a PCR is issued (day time only if no night time construction)		
Operation stage					
1. SME business development service information center 中小企信息中心 2. Aerospace and aeronautic industries training center 实训中心 3. ASEAN vocational education building 教育大楼	Indoor air quality	Hourly average of formaldehyde and benzene; daily average of TVOC	2 consecutive days per month until a PCR is issued	Local EMS	PIE
Subproject 8: China- ASEAN educational medicare cooperation project (phase I)					***Estimated cost : $44,000***
Construction stage					
1. Vocational Education Center 职教中心 2. Waiyutun 外域屯	Air quality	TSP	2 consecutive days (24-hr) per month until a PCR is issued	Local EMS	PIE, ESE
	Noise	L_{Aeq}	2 consecutive days per month until a PCR is issued (day time only if no night time construction)		
Operation stage					
1. Public teaching building #1 公共教学楼#1 2. Administration building 行政办公楼 3. Library 图书馆	Indoor air quality	Hourly average of formaldehyde and benzene;	2 consecutive days per month until a PCR is issued	Local EMS	PIE

Monitoring Location	Item	Monitoring Parameter	Monitoring Frequency & Duration	Implementing Entity	Supervising Entity
4. Auditorium 会堂 5. Student dormitory #1 学生公寓#1		daily average of TVOC			
1. Student dormitory #1 学生公寓#1 at the façade nearest to Bailong Expressway	Noise	L_{Aeq}	2 consecutive days (day time and night time on each day) per month until a PCR is issued	Local EMS	PIE
At the discharge point of the wastewater secondary treatment system on campus for treatment of laboratory and medical wastewater	Effluent quality	pH, COD, BOD_5	2 consecutive days per month until a PCR is issued	Local EMS	PIE
Total estimated cost for environmental monitoring: $255,000					

Notes: **BOD_5** = 5-day biochemical oxygen demand; **COD** = chemical oxygen demand; **EMS** = Environmental Monitoring Station 环境监测站; **ESE** = environmental supervision engineer 环境监理; **H_2S** = hydrogen sulfide; **L_{Aeq}** = A-weight equivalent sound pressure level； ; **GPMO** = Guangxi project management office; **NH_3** = ammonia; **NH_3-N** = ammonia nitrogen; **NO_2** = nitrogen dioxide; **PCR** = project completion report; **PIE** = project implementation entity; **SS** = suspended solid; **TP** = total phosphorus; **TSP** = total suspended particulates; **TVOC** = total volatile organic compound.

Table EMP-6: Monitoring Indicators and Applicable PRC Standards[3]

Phase	Indicator	Standard
Construction	TSP	Class II *Ambient Air Quality Standard* (GB 3095-2012)
	Noise limits of PME at boundary of construction site	*Emission Standard of Environmental Noise for Boundary of Construction Site* (GB 12523-2011)
Note: **PME** = powered mechanical equipment		

19. **Independent compliance monitoring.** Independent evaluation of EMP implementation will be undertaken by the ESE and EEM. The budget for the ESEs is estimated at $615,000. The EEM will be recruited as an individual consultant ($100,000). GPMO shall report the EEM's independent evaluation to ADB on the subprojects' adherence to the EMP, information on subproject implementation, environmental performance of the contractors, and environmental compliance through quarterly project progress reports and annual EMRs (Table EMP-6). The EEM shall visit the subproject sites twice a year and support GPMO in developing the annual EMRs. The reports should confirm the subprojects' compliance with the EMP and local legislation (including the PRC's environmental assessment and implementation requirements), the results of independent evaluation (both contractor compliance with the EMP and the results of environmental monitoring by local EMSs), identify any environment related implementation issues and necessary corrective actions, and reflect these in a corrective action plan. Operation and performance of the project GRM, environmental institutional strengthening and training, public consultation, compliance with all covenants under the project and site photographs will also be included in the report. A template for the Environmental Monitoring Report is included in the Project Administration Manual.

20. **Monitoring by ADB.** Besides reviewing the annual EMRs from GPMO and the verification reports from the EEM, 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) environmental monitoring data; (ii) the implementation status of subproject performance indicators specified in the loan documents for the environment, environmental compliance, implementation of the EMP, and environmental institutional strengthening and training; (iii) the environmental performance of contractors, EEM, PIEs and GPMO; and (iv) operation and performance of the project GRM and ongoing information disclosure and public consultation. The performance of the contractors in respect of environmental compliance will be recorded and will be considered in the next bid evaluations. ADB also prepares the final Project Completion Report (PCR).

21. **Environmental acceptance monitoring and reporting.** Following the PRC's *Management Measures for Inspection and Acceptance of Environmental Protection at Construction Project Completion* (MEP Decree [2001] No. 13 and 2010 amendment), within three months after the completion of each subproject, an environmental acceptance monitoring and audit report for the subproject shall be prepared by a licensed environmental monitoring institute. The report shall be reviewed and approved by the local EPB, and then reported to ADB (Table EMP-7). The environmental acceptance reports for the completed subprojects shall indicate the timing, extent, effectiveness of completed mitigation and maintenance, and the needs for additional mitigation measures and monitoring during operation. The GPMO with support of the EEM shall prepare a draft Project Completion Report which includes an environment chapter. GPMO shall be responsible for the costs of environmental acceptance monitoring and reporting.

[3] The project applies PRC standards. A comparison of PRC standards with internationally accepted standards (as defined in the World Bank's Environment Health and Safety Guidelines) was conducted for the IEE. The comparison confirmed that PRC standards are either internationally accepted, or have comparable standard limits with most of the international standards.

Table EMP-7: Reporting plan

Reports		From	To	Frequency
Construction Phase				
Internal progress reports by contractors	Internal project progress report by construction contractors, including monitoring results	Contractors	GPMO, PIEs	Monthly
Environmental monitoring and compliance monitoring reports	Environmental monitoring report	EMSs	Local EPBs, PIEs, GPMO, ESE, EEM	Monthly
	Environment monitoring reports (EMR)	GPMO (with EEM support)	ADB	Annually
Acceptance report	Environmental acceptance monitoring and audit report	Licensed institute	Local EPBs	Once; within 3 months of completion of physical works
Operational Phase				
Environmental monitoring	Quarterly project progress reports (until a PCR is issued	Local EMSs	Local EPBs, PIEs, GPMO, EEM	Quarterly
	Environment monitoring reports (until a PCR is issued)	GPMO (with EEM support)	ADB	Annually
Project completion report	Draft project completion report including environmental chapter	GPMO (with EEM support)	ADB	On completion
	Final project completion report	ADB	ADB	On completion

Notes: **ADB** = Asian Development Bank; **EEM** = external environmental monitor; **EMR** = environmental monitoring report; **EMS** = Environmental Monitoring Station; **EPB** = Environmental Protection Bureau; **ESE** = environmental supervision engineer; **GPMO** = Guangxi project management office; **PCR** = project completion report; **PIE** = project implementation entity

E. Institutional Capacity Building and Training

22. The capacity of GPMO, PIEs 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 capacity and expertise in environmental management through (i) institutional capacity building, and (ii) training.

23. **Institutional strengthening**. The capacities of GPMO and PIEs to coordinate environmental management will be strengthened through a set of measures:

(i) The appointment of qualified staff within the GPMO and each PIE as environmental focal points in charge of EMP coordination, implementation and site inspections including GRM.
(ii) The commissioning of an independent ESE by each PIE to provide independent monitoring and verification of EMP implementation.
(iii) The appointment of EEM (an independent consultant) under the PMC service to guide GPMO and PIEs in implementing the EMP and ensuring compliance with ADB's Safeguard Policy Statement (SPS 2009).

24. **Training**. GPMO, PIEs and contractors will receive training in EMP implementation, supervision, and reporting, and on the GRM (Table EMP-8). Training will be facilitated by the EEM with support of experts under the PMC services, as needed.

Table EMP-8: Training program

Training	Attendees	Contents	Times	Period (days)	No. of persons	Cost ($/person /day)	Total Cost
EMP adjustment and implementation	GPMO, PIEs, contractors	Development and adjustment of the EMP, roles and responsibilities, monitoring, supervision and reporting procedures, review of experience (after 12 months)	Twice - Once prior to, and once after the first year of subproject implementation	2	20	100	$8,000
Grievance Redress Mechanism	GPMO, PIEs, contractors, local EPBs	Roles and responsibilities, procedures, review of experience (after 12 months)	Twice - Once prior to, and once after the first year of subproject implementation	1	15	100	$3,000
Environmental protection	GPMO, PIEs, contractors	Pollution control on construction sites (air, noise, wastewater, solid waste), use of PPE during construction and operation, occupational health and safety	Once (during subproject implementation)	2	15	100	$3,000
Environmental monitoring	GPMO, PIEs, contractors	Monitoring methods, data collection and processing, reporting systems	Once (at beginning of subproject construction)	1	10	100	$1,000
						Total estimated cost:	**$15,000**

Notes: **EPB** = Environmental Protection Bureau; **GPMO** = Guangxi project management office; **PIE** = project implementation entity; PPE = personal protective equipment.

25. **Capacity building**. In addition to training for EMP implementation, the project will provide consulting services and training to assist and train the staff of GPMO and PIEs in project management, environmental management, land acquisition and resettlement, procurement, as well as external resettlement and environmental monitoring.

F. Consultation, Participation and Information Disclosure

26. **Consultation during project preparation**. Chapter VII of the IEE describes the public participation and consultation carried out during project preparation.

27. **Future public consultation plan**. Plans for public involvement during construction and operation stages were developed during project preparation. These 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 subproject is completed. These plans will include several types of public involvement, including site visits, interviews, workshops and investigation of specific issues (Table EMP-9).

Table EMP-9: Public consultation plan

Organizer	Format	No. of Times	Subject	Attendees	Budget
Construction Stage					
GPMO	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 timing and impact; truck routes; noisy construction activities; safety near construction sites; comments and suggestions	Residents adjacent to subprojects, representatives of local communities	$5,000
GPMO	Expert workshop / press conference	As needed based on public consultation	Comments / suggestions on mitigation measures, public opinions	Experts of various sectors, media	$2,000
Operational Stage					
GPMO, PIEs	Public consultation and site visits	Once in the first year	Effectiveness of mitigation measures, impacts of operation, comments and suggestions	Residents adjacent to subproject sites, social sectors	$1,500
GPMO, PIEs	Expert workshop or press conference	As needed based on public consultation	Comments and suggestions on operational impacts, public opinions	Experts of various sectors, media	$1,500
				Total budget:	**$10,000**
Notes: **GPMO** =Guangxi project management office; **PIE** = project implementation entity;					

G. Grievance Redress Mechanism

28. A Grievance Redress Mechanism (GRM) will be established as part of this EMP to receive and manage any public concerns or issues which may arise due to the subprojects. The GRM comprises: (i) a set of clear procedures developed by GPMO to receive, record, and address any concerns which are raised; (ii) specific contact details for individuals at the GPMO, PIEs and the contractors, and (iii) the local EPBs.

29. All contractors and work staff will be briefed by the GPMO on the GRM. Contractors and workers will be instructed to be courteous to local residents and, in the event they are approached by the general public with an issue, to immediately halt their work and report the issue to the foreman. The foreman will immediately report the issue to the PIEs or GPMO for action.

30. There are multiple entry points to the GRM, including face-to-face meetings, written complaints, hotline number and telephone conversations, anonymous drop-boxes for written comments, and/or e-mail. All concerns received will be treated confidentially and professionally. The identity of individuals will not be circulated among subproject agencies or staff and will only be shared with senior staff, and then only when there is clear justification. In the construction period and the initial operational period covered by loan covenants, GPMO will report on GRM to ADB, including complaints and their resolution in the quarterly project progress reports and annual environmental monitoring reports up to the project completion report.

31. Basic steps for resolving complaints are as follows and illustrated in Figure EMP-1.

Step 1: For environmental problems during the construction and operational stages, the affected person (AP) can register his/her complaint directly with the contractors or with the GPMO complaint center via its hotline. A joint hotline for resettlement and environment issues will be established within GPMO. Complaints related to land acquisition and resettlement issues will be directed to the GPMO and relevant agencies in accordance with the RP. 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, together with the hotline number of the GPMO complaint center. The contractors are required to maintain and update a Complaint Register to document all complaints. The contractors are also required to respond to the complainant in writing within 7 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, this can be recorded by the GPMO complaint center and follow-up should be carried out during a next project site visit by the EEM. The contractors are required to report complaints received, handled, resolved and unresolved to the GPMO complaint center immediately, and to the IAs and GPMO monthly (through progress reporting).

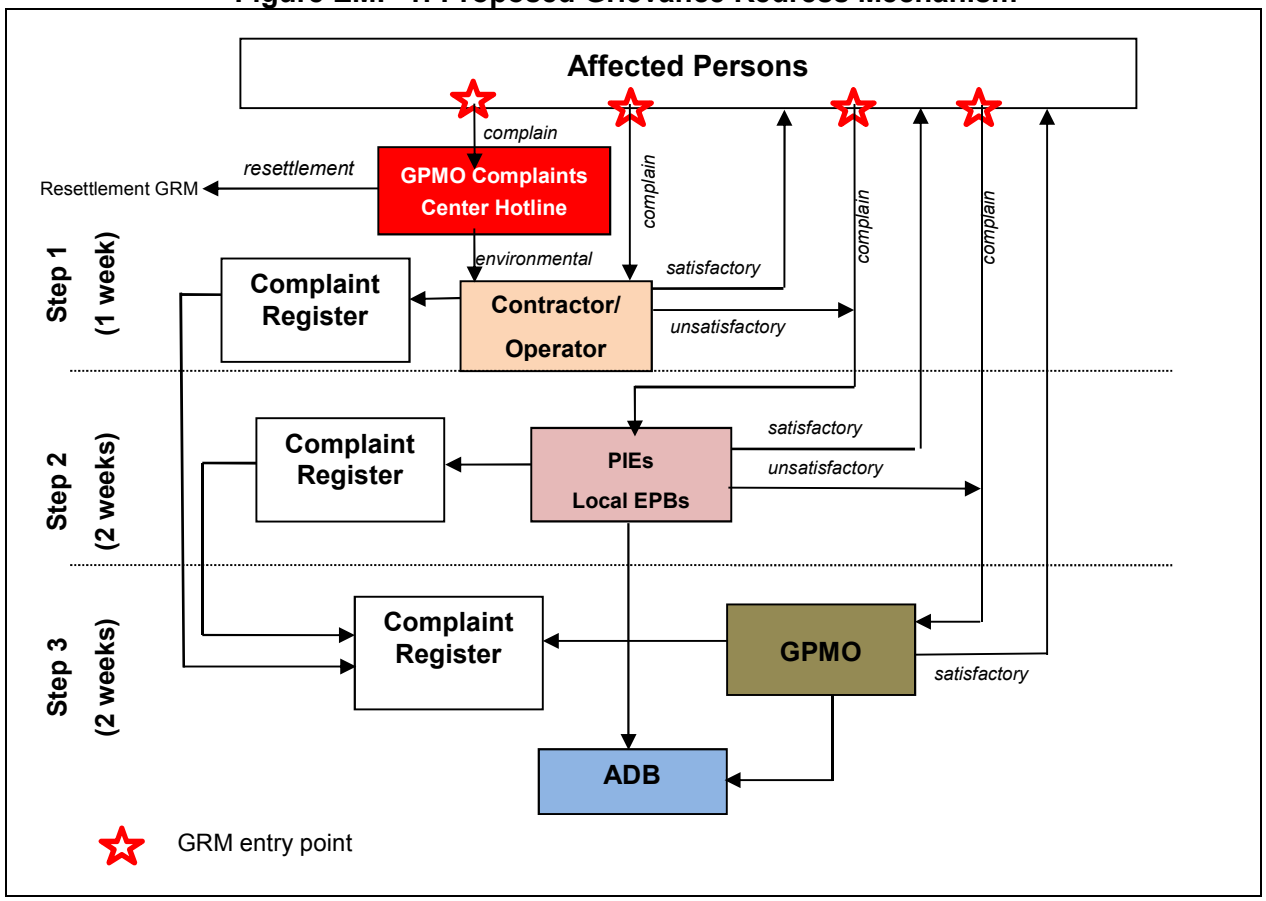
Step 2: If no appropriate solution can be found during step 1, the contractor has the obligation to forward the complaint to the GPMO complaint center, the PIEs and local EPBs. The PIEs and local EPBs shall immediately notify GPMO upon receiving the complaint. For an oral complaint, proper written records shall be made. Once a complaint is registered and put on file, the GPMO complaints center will immediately notify ADB and others concerned to discuss acceptable solutions. The GPMO complaint center will assess the eligibility of the complaint, identify the solution and provide a clear reply for the complainant within 14 calendar days. The EEM will assist the GPMO complaint center in addressing the complaint, and follow-up with the AP. The GPMO complaint center will also inform the ADB project team and submit all relevant documents. Meanwhile, the GPMO complaint center will convey the complaint/grievance and suggested solution to the contractors, PIEs, and/or facility operator in a timely manner. The contractors during construction and the facility operator during operation will implement the agreed redress solution and report the outcome to the GPMO complaint center within fifteen (15) working days.

Step 3: In case no solution can be identified by the GPMO complaint center, or the complainant is not satisfied with the proposed solution, the GPMO complaint center will organize, within 14 calendar days, a multi-stakeholder hearing (meeting) involving all relevant stakeholders (including the complainant, PIEs, contractors, facility operator, local EPB, and GPMO). The hearing shall identify a solution acceptable to all, and formulate an action plan.

32. The tracking and documenting of grievance resolutions by GPMO will include the following elements: (i) tracking forms and procedures for gathering information from project personnel and complainant(s); (ii) regular updating of the GRM database by the GPMO environmental focal point; (iii) processes for informing stakeholders about the status of a case; and (iv) procedures to retrieve data for reporting purposes, including the periodic reports to the ADB.

33. At any time, an AP may contact ADB (East Asia Department) directly, including the ADB Resident Mission in the PRC.

Figure EMP-1: Proposed Grievance Redress Mechanism



H. Cost Estimates

34. The total cost for EMP implementation comprises six items: (i) mitigation measures (Table EMP-3), (ii) environmental monitoring by local EMSs (Table EMP-5), (iii) external independent EMP compliance monitoring by ESE, (iv) public consultation (Table EMP-9), (v) training (Table EMP-8), and (vi) the EEM. The total cost, which is a budgetary estimate, is summarized in Table EMP-10 and is $3,760,800, which is about 0.8% of the total tranche 2 cost Of this total the mitigation cost of $1,225,800 should have been included in the civil works costs in the contractor bids for implementing environmental mitigation measures for air quality, noise, water quality, solid waste, etc. on construction sites.

35. The training cost of $15,000 and the external environmental monitor cost of $100,000 have been included in the ADB funded PMC budget. The public consultation cost of $10,000 has been included in the project management cost for GPMO. Environmental monitoring by local EMS for the subprojects at a cost of $255,000 and external compliance monitoring by Environmental Supervision Engineers at $2,155,000 have been included in the environmental monitoring and supervision costs for the PIEs.

Table EMP-10: Estimated Budget for Environmental Management Plan Implementation

EMP Item	Estimated Cost	
	EA or PIE Funded	ADB Funded
Training[1]	---	$15,000

EMP Item	Estimated Cost	
	EA or PIE Funded	ADB Funded
Mitigation measures[2]	1,225,800	------
Environmental monitoring by local EMS[3]	255,000	---
External compliance monitoring by ESE[4]	2,155,000	---
External compliance monitoring by EEM (5 months)[5]	---	100,000
Public consultation[6]	$10,000	---
Subtotal:	3,645,800	115,000
Total:	**3,760,800**	
Notes: ADB = Asian Development Bank; **EA** = executing agency; **EEM** = external environmental monitor; **EMP** = environmental management plan; **EMS** = Environmental Monitoring Station; **ESE** = environmental supervision engineer; **PIE** = project implementation entity		

[1] Included in PMC training budget
[2] Included in civil works contract - contractors' bids
[3] Included in environmental monitoring costs for PIEs
[4] Included in Environmental Supervision Engineer costs for PIEs
[5] Included in PMC budget
[6] Included in Project Management Cost for GPMO

36. Excluded from the budget are (i) infrastructure costs which relate to environment and public health but which are already included in the project direct costs and (ii) remuneration for the GPMO environment coordinator and consulting packages, (covered elsewhere in the project budget).

37. The PIEs will bear all environmental monitoring costs during the operational stage. 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 PIEs will bear the costs related to mitigation measures during operation (e.g. installation of double=glazed windows for noise mitigation in subprojects 2 and 4).

I. Mechanisms for Feedback and Adjustment

38. The EMP is a living 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, monitoring locations are no longer appropriate or mitigation measures are inadequate or ineffective. Based on environmental monitoring and reporting systems in place, GPMO (with the support of the EEM) shall assess whether further mitigation measures are required as corrective action, or improvement in environmental management practices are required. GPMO 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 ADB project website, if required.

J. Environmental Contract Clauses for Inclusion into Tender Documents and Civil Works Contracts

41. The following contract clauses for safeguarding the environment during construction shall be incorporated into all the tender documents and works contracts.

1. Construction time:

   1.1 No construction works shall be conducted between 22:00 to 06:00 hours and piling works shall also be prohibited between 12:00 to 14:30 hours within 300 m of a noise

sensitive receptor (such as residential household, school, health clinic, hospital).

2. Protection of air quality

2.1 Watering of unpaved areas and exposed dust-prone stockpiles shall be undertaken at least two times each day except on rainy days

2.2 Dust-prone materials shall be stored in areas with shelters on four sides and on top. If such materials have to be stored in open area, they shall be covered with strong tarpaulin.

2.3 Vehicle speed in unpaved areas shall be limited to ≤ 8 km/h. Speed limit sign shall be posted in these areas.

2.4 Construction site exits shall be paved with gravel or asphalt

2.5 Wheel washing equipment shall be installed or wheel washing shall be conducted manually at each exit of the works area and asphalt/concrete mixing station to prevent trucks from carrying muddy or dusty substance onto public roads.

2.6 Vehicles with an open load-carrying case, which transport potentially dust-producing materials, shall have proper fitting sides and tail boards. Dust-prone materials shall not be loaded to a level higher than the side and tail boards, and shall always be covered with a strong tarpaulin.

2.7 Asphalt / concrete mixing stations shall be sited at least 300 m downwind of the nearest household (plant noise is the limiting factor) and asphalt, hot mix and batching plants shall be equipped with fabric filters and/or wet scrubbers to reduce the level of dust emissions.

2.8 Personal protective equipment such as goggles, gloves and respirators shall be provided to construction workers doing asphalt concrete and cement concrete road paving and doing interior fit-out of buildings to minimize skin exposure to chemicals and inhalation of volatile organic compounds.

2.9 Construction vehicles and machinery shall be regularly maintained to minimize exhaust emissions from these sources.

2.10 Unauthorized burning of construction and demolition waste material and refuse shall be subject to penalties for the Contractor, and withholding of payment.

3. Protection of the acoustic environment

3.1 Machinery and equipment shall be maintained and repaired regularly and properly to keep them in good working condition and to minimize noise.

3.2 Low noise machinery or equipment with sound insulation shall be deployed.

3.3 Temporary noise barriers or hoardings shall be erected around the equipment to shield the noise from equipment.

3.4 Suitable hearing protection (such as ear muffs) shall be provided to construction workers when working near noisy machinery such as during piling.

3.5 The use of horns is forbidden unless absolutely necessary. The use of whistles shall be minimized.

3.6 Noisy activities affecting other site users such as students in training classes or taking

examinations shall be avoided and the deployment of low noise machinery and temporary noise barrier shall be adopted.

4. Protection of water quality

4.1 Runoff from construction sites shall be collected with drainage ditches to prevent runoff containing muddy water from polluting nearby roads, land and water bodies.

4.2 Oily-water separators and sedimentation tanks shall be installed and operated on construction sites to treat process water and muddy runoff with high concentrations of total petroleum hydrocarbon and suspended solids. If necessary, flocculants such as polyacryl amide (PAM) shall be used to facilitate sedimentation.

4.3 Portable toilets and small package wastewater treatment plants and/or septic tanks shall be provided on construction sites for the workers. If there are nearby public sewers, interim storage tanks and pipelines shall be installed to convey wastewater to public sewers.

4.4 Fuels, oil, and other hazardous materials on construction sites shall be stored within secured areas on impermeable surfaces protected by bunds and provided with cleanup kits.

4.5 Chemical spills into drains and water bodies shall be cleaned up within 24 hours of the occurrence, with contaminated soils and water treated according to HJ 25.4-2014 *Technical Guidelines for Site Soil Remediation*. Records must be handed over without delay to the GPMO and local EPB.

5 Protection of biological resources and wildlife

5.1 Construction workers are prohibited from capturing any wildlife during construction.

5.2 Where a tree has to be removed or an area of grassland disturbed, trees shall be replanted and the area revegetated after construction.

5.3 Tree planting shall use species of local provenance. Planting of exotic or invasive species shall be prohibited.

6. Solid waste management

6.1 The re-use of construction wastes on the project shall be maximized.

6.2 All refuse and construction waste generated on construction sites shall be stored in designated areas and regularly removed from these locations for disposal or reuse.

6.3 All soil erosion prevention measures listed in the soil and water conservation plan, the environmental impact reports or the environmental impact tables shall be included in the design of spoil disposal sites.

6.4 Spent spoil disposal/storage sites, haul roads and other unpaved temporary land take areas shall be rehabilitated and vegetated within one month after closure to prevent soil erosion and dust generation.

7. Construction site sanitation

7.1 Adequate and functional systems for sanitary conditions, toilet facilities, waste management, labor dormitories and cooking facilities shall be provided.

7.2 The site shall be effectively cleaned and disinfected. During site formation, the site shall be sprayed with phenolated water for disinfection. Toilets and refuse bins shall be disinfected and timely removal of solid waste shall be ensured.

7.3 Rodents on site shall be exterminated at least once every 3 months. Mosquitoes and flies shall be exterminated at least twice each year.

7.4 Public toilets shall be provided in accordance with the requirements of labor management and sanitation departments in the living areas on construction site, and designated staff responsible for cleaning and disinfection shall be appointed.

7.5 Construction site domestic wastewater shall be discharged into the municipal sewer system or treated on-site using portable systems or septic tanks.

8. Occupational safety

8.1 At least one environment, health and safety (EHS) officer shall be appointed to manage occupational health and safety risks on construction sites.

8.2 Personal protective equipment (PPE) (safety hats and shoes and high visibility vests) shall be provided to all construction workers, with strict enforcement on all workers wearing PPE. Personal protective equipment (PPE) such as goggles, gloves and respirators shall be provided to construction workers doing interior fit-out to minimize skin exposure to chemicals and inhalation of VOC.

8.3 Ear plugs for hearing protection shall be provided to workers operating and working near noisy power mechanical equipment.

9. Food safety

9.1 Food hygiene in canteens on site shall be inspected and supervised regularly. Canteen workers must have valid health permits.

9.2 If food poisoning is discovered, effective control measures shall be implemented immediately to prevent it from spreading.

10. Disease prevention and health services

10.1 All construction workers shall undergo a physical examination before starting work on site. If infectious disease is found, the patient must be isolated for treatment to prevent the disease from spreading. Physical examination shall be conducted on 20% of the workers every year from the second year onwards.

10.2 Health clinic shall be established at location where workers are concentrated, which shall be equipped with common medical supplies and medication for simple treatment and emergency treatment for accidents.

10.3 Induction and training by local health departments on prevention and management of communicable diseases shall be provided.

11. Social conflict prevention

11.1 The following shall be prioritized: (i) employ local people for works, (ii) ensure equal

opportunities for women and men, (iii) pay equal wages for work of equal value, and pay women's wages directly to them; and (iv) not employ child or forced labor.

13. Community health and safety

13.1 A traffic control and operation plan shall be prepared together with the local traffic police prior to any construction. The plan shall include provisions for 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, controls and planning in advance.

13.2 Construction billboards, which include construction description, schedule, responsible person and complaint phone number, shall be erected at the entry to each construction site and construction staging area.

13.3 Residents and businesses shall be informed in advance of noisy construction activities such as piling, given the dates and duration of expected disruption and made aware of the project grievance redress mechanism.

13.4 Clear signs shall be placed at construction sites in view of the public, warning people of potential dangers such as moving vehicles, hazardous materials, excavations, etc. and raising awareness on safety issues.

13.5 All construction sites shall be made secure and access by members of the public shall be discouraged through appropriate fencing, signage and/or security personnel, as appropriate.

14. Utility interruption

14.1 Contractors shall assess construction locations in advance and identify potential for disruption to services and risks before starting construction. Any damage or hindrance/disadvantage to local businesses caused by the premature removal or insufficient replacement of public utilities shall be subject to full compensation, at the full liability of the contractor who causes the problem.

14.2 If temporary disruption is unavoidable the contractor shall, 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 affected persons.

15. Grievance redress mechanism

15.1 The contractor's environment, health and safety (EHS) officer shall be responsible for manning the grievance redress mechanism (GRM) on site for receiving and handling complaints. In case of a complaint, the contractor shall notify the GPMO within one week and shall advise on the agreed solution.

15.2 The contractor shall disclose the GRM to affected persons before construction begins at the main entrance to each construction site.

15.3 The contractor shall maintain and update a Complaint Register to document all complaints.

Technical Assistance Consultant's Report

Contract No. 133990-SC 108746

PRC: Guangxi Regional Cooperation and Integration Promotion Investment Program – Tranche 2

Climate Risk and Vulnerability Assessment for Guangxi Regional Cooperation and Integration Promotion Investment Program, the People's Republic of China

DRAFT

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Asian Development Bank

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ACRONYMS AND ABBREVIATIONS

ADB	Asian Development Bank
AR5	The fifth assessment report of climate change of IPCC
ARI	annual recurrence interval
BEZ	border economic zone
CRVA	Climate Risk, Vulnerability and Adaptation Assessment
DI	Design Institute
FSR	The feasibility study report
GCM	General Circulation Model
GEV	generalized extreme value
GHGs	Greenhouse Gases
Guangxi	Guangxi Zhuang Autonomous Region
IA	Implementing Agency
IPCC	Intergovernmental Panel on Climate Change
masl	metres above sea level
MFF	Multitranche Financing Facility
PRC	the People's Republic of China
RCP	Representative Concentration Pathway (of Greenhouse gases)

A. Executive Summary

1. This study is a climate risk and vulnerability assessment of climate change impact on Tranche 2 subprojects of the Regional Cooperation and Integration Promotion Investment Program (RCI) at Guangxi Zhuang Autonomous Region (Guangxi) of the People's Republic of China (PRC). Tranche 2 subprojects cover five prefecture-level municipalities of Gulin, Qinzhou, Fangchenggang, Chongzuo and Baise and the counties or county-level cities under their respective jurisdictions. This climate change risk and vulnerability assessment (CRVA) is focused on the climate change impact on the infrastructure components of the subprojects including construction of school buildings, administration buildings, commercial market facilities and roads. The RCI program area has a southern monsoon Asian sub-tropical climate, which is characterized by hot summer with warm winter and distinctive rainy and dry season with plenty of rainfall. Qinzhou and Fangchenggang are among the Chinese cities that have the highest annual rainfall of over 2000 mm on average. Heavy rainfall induced flood is a major natural hazard in the area. In addition, the area is characterized by complex geology and has frequent geological disasters, such as landslide, debris flow, and karst collapse. The geological disasters have a high correlation with rainfall intensity. In addition, Qinzhou and Fangchenggang are coastal cities nearby the Beibu Gulf of China South Sea. Historically, high tide together with strong typhoon and tropical storm have caused backwater effects in the rivers or overtopped or destroyed the sea wall and lead to urban flooding in the cities, damaged inland infrastructure. In addition, the program area is situated in the south of the tropic of cancer. The heatwave from high temperature in the summer season has the potential to harm human health.

2. The climate change projections of 2050 and 2100 were generated for the program area based on the pattern scaling method. Different greenhouse gas concentration pathways (RCPs) published by IPCC were used in combination with different climate sensitivity to generate the uncertainty range of the global warming trend. The IPCC AR5 GCM model ensemble was used to produce the 'best guess' change scenarios for future climate, sea level and extreme rainfall.

3. It was found that climate change will likely have a profound impact on both temperature and precipitation in the program area. In comparison to climate change impact on the normal climate, climate change impact on climate variation such as heavy rainfall will likely be even more significant. Sea level likely continues to rise. The climate change trend indicates a more intensified and/or frequent flood and landslide risk in future. The daily maximum temperature change implies more severe heatwave events in future in terms both intensity and duration, with potential harmful effects to human health.

4. All the subprojects are under medium risk to climate change impact. Several adaptation options were identified for Tranche 2 infrastructure subprojects based on the completed feasibility study reports (FSRs), including adjustment of storm water drainage system design to increase capacity for additional rain water due to enhanced storm intensity; allocation of additional electricity supply for air conditioning system; provision of space for air conditioning system facilities. Other options that are out of the scope of RCI program were also provided as suggestions and recommendations: examination of the planned slope stabilization measures to ensure their functioning under enhanced surface flood; planning green space in the project area with native vegetation; and the awareness raising on the knowledge of heatwave and preparedness when heatwave strikes

B. Introduction

5. The RCI program will help the PRC to achieve its strategic objective of greater integration with the global economic system through improved connectivity and strengthening of regional economic cooperation and integration. The program is aiming to assist Guangxi in implementing its action plan for regional cooperation and integration with the members of the Association of the Southeast Asian Nations (ASEAN), particularly the Greater Mekong Subregion (GMS) countries. The program will stimulate economic corridor development between Guangxi and the northern border provinces of Viet Nam by: (i) promoting sustainable small and medium enterprise (SME) development and investment in the border areas; (ii) facilitating efficient cross-border financial transactions and investments; (iii) facilitating adoption of new technologies such as e-commerce to improve logistics and access to market information; (iv) upgrading cross-border transport linkages through improved physical connectivity and operational and policy coordination at key border crossing points; and (v) improving infrastructure, social- and trade-related services in border economic zones (BEZs).[1]

6. Guangxi's action plan includes a list of priority investment projects that are intended for financing over 2014–2022 by various national and regional funding sources, multilateral development banks such as ADB, and the private sector. The PRC government has requested ADB to provide a $450 million MFF loan to fund a portion of the long-term investment needed for implementing Guangxi's strategies and action plans for both the GMS and the Belt and Road Initiative.[2]

7. The RCI program includes a series of subproject components that are proposed to be implemented in 3 tranches, include infrastructure developments. As infrastructure is designed to provide long term service climate change could pose various threats. The long term climatic averages and extreme weather events are important factors which need to be considered in the planning, design, operation, maintenance and management of an infrastructure project. Climate change will likely alter both long term climatic averages and the frequency and severity of extreme weather events. For a sustainable infrastructure project development, it is thus important to make climate adaptation adjustments to engineering specifications, alignments, and master planning; incorporating associated environmental measures; and adjusting maintenance and contract scheduling (ADB 2010). Effective climate-proofing of an infrastructure project requires project specific climate risk and vulnerability assessment to identify, evaluate and implement feasible adaptation measures to strengthen project resilience to future climate change impacts. The objective of this study is to conduct climate change risk, vulnerability and adaptation assessment (CRVA) for Tranche 2 of the RCI program.

[1] The Asian Development Bank (ADB) provided project preparatory technical assistance for preparation of the Proposed Multi-tranche Financing Facility People's Republic of China Guangxi Regional Cooperation and Integration Promotion Investment Program (TA-9120 PRC).

[2] In 2015, the PRC announced plans to develop the so-called Silk Road Economic Belt and 21st Century Maritime Silk Road (the Belt and Road Initiative). he strategic initiative aims to promote connectivity and strengthen economic partnerships between and among Asian, European and African continents in the spirit of open regionalism. It cites five priorities for cooperation: (i) fostering economic and development policy coordination; (ii) strengthening connectivity by developing energy, transport and telecommunication infrastructure and harmonizing standards; (iii) promoting trade and investment through customs, sanitary and phyto-sanitary cooperation, implementation of World Trade Organization's Trade Facilitation Agreement, and development of economic zones and industry clusters; (iv) deepening financial cooperation and integration; and (v) promoting people-to-people exchanges. To implement the Belt and Road Initiative, Guangxi has developed its own action plan with special emphasis on strengthening cooperation with the members of the ASEAN, particularly the GMS countries.

C. Climate Hazards in the RCI program area

8. Guangxi is situated in the south of PRC, with the tropic of cancer traversing the region from the middle. Mountains are the dominant topography of the region, which occupy most area in the southwest, west and north. Guangxi adjoins the Beibu Gulf of the South China Sea in its south and the southeast area is mostly hills with patchy alluvial plains (Figure 1). Guangxi is strongly influenced by the south Asian monsoon, it has a warm climate with plenty of rainfall.

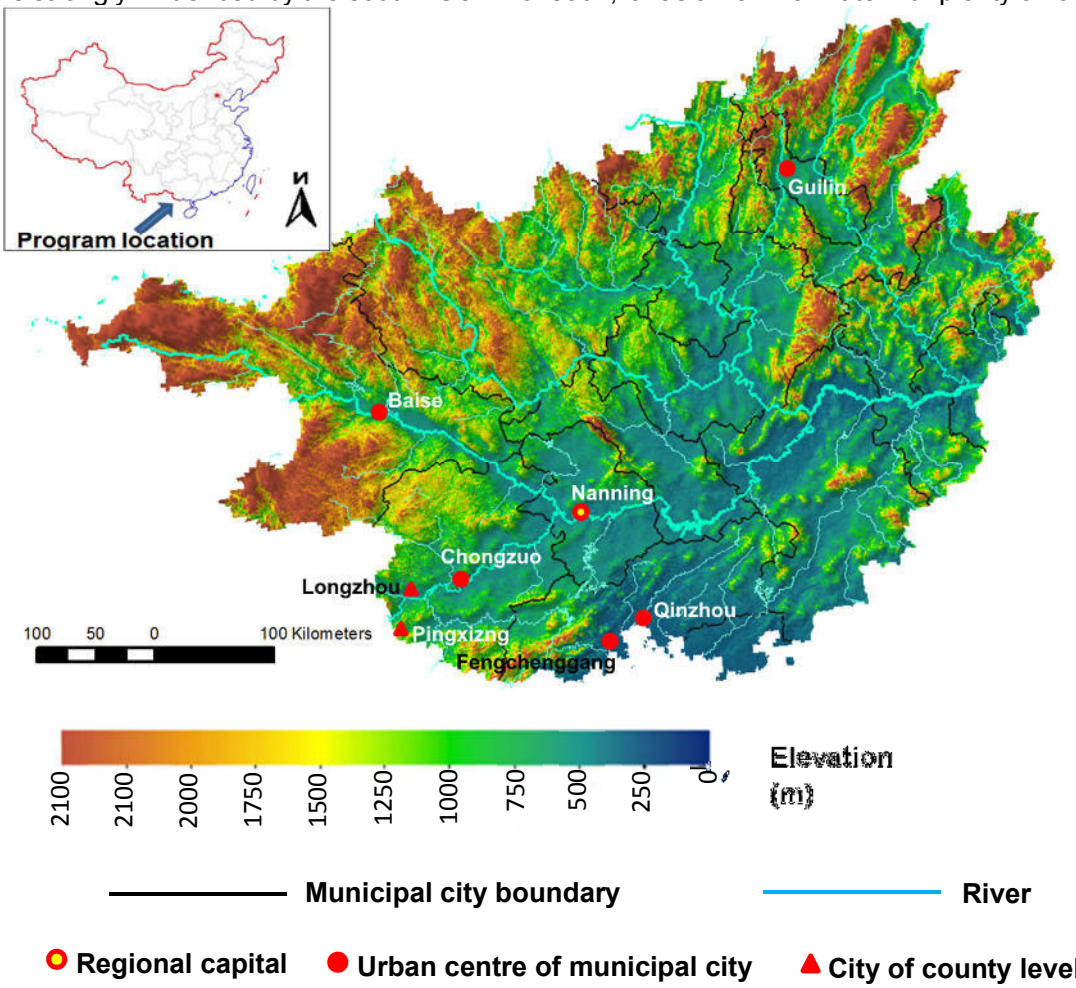

Figure 1: The program location with elevation and river network. Red spots are the location of subprojects.

9. Rainfall varies significantly between seasons. The half year rainy season (Apr. to Sept.) receives more than 70% of the annual rainfall, and heavy storm is frequent in the rainy season. Flood and drought are the major climate hazards in Guangxi. Other climate hazards include frost damage, strong wind, hails and tropical cyclones. Geologically, Guangxi has the largest karst topography in China[3] and is among the regions that has the most serious rocky desertification. Geological hazards, such as landslide, debris flow, and karst collapse, have occurred frequently in the region.

[3] Karst topography is a geological formation shaped by the dissolution of a layer or layers of soluble bedrock, usually carbonate rock such as limestone. Some of the karst landscapes in Guangxi are included in the South China Karst UNESCO World Heritage Site designation as having outstanding universal value http://whc.unesco.org/en/list/1248.

10. Economically Guangxi is one of the less developed regions (at provincial level) in China. The annual GDP per capita is ranked 27 among 32 provinces and provincial level regions (2013 data) (GDRC, 2013).

11. The proposed Tranche 2 of the RCI program will be implemented at five prefecture-level municipalities of Guilin, Qinzhou, Fangchenggang, Chongzuo and Baise and the counties or county-level cities under their respective jurisdictions. Of the five municipal urban cities under the RCI program, Baise and Chongzuo are situated at the southeast edge of the Yunnan-Guizhou Plateau. Mountains dominate the land area. The Baise urban area is surrounded by mountains and has typical basin topography. The heavy storm is the major climate hazard in Baise, which accounts for 76% of total climate hazards in history (Li, 2011), and has resulted in huge economic loss to Baise. Gulin is located in the northeast of Guangxi, and is famous for its unique karst geo-topography. Flood is also the major natural disaster in Guilin and has reported to become more frequent since 1990 (Ma et al., 2010). Both Fangchenggang and Qinzhou are coastal cities that adjoin Beibu Gulf in the south. The topography of these two cities is mainly small hills and alluvial plains. The rivers in these two cities are largely small rivers and discharge directly to the Beibu Gulf. The cities are of maritime climate condition and are also under strong influence from the south Asian monsoon.

12. All the cities have the highest annual rainfall in China, particularly Qinzhou and Fangchenggang. The urban drainage system is out-dated and lags behind urban development. Heavy storm has given rise to severe urban flooding. Furthermore, the sea tidal fluctuation of the Beibu Gulf exacerbates the flood hazard. High tide with storm or tropical cyclone causes backwater effects in the rivers, and/or overtops/damages sea embankment and consequently inundates the urban area. In August 2012, the typhoon Kai-tak flooded the cities. In Qinzhou, two thirds of the urban roads were inundated; the deepest area was more than 1.5 m under water (Huang et al. 2014). During summer of 2014, Typhoon Rammasun resulted in record breaking heavy storms that hit the cities successively, causing major damage to both cities. Direct economic losses were more than CNY5 billion for Qinzhou (Qinzhou government news, 2015) and more than CNY4 billion for Fangchenggang (Fangchenggang News, 2016).

13. Heatwave is another climate hazard that potentially may threaten human health in the future. Previous research suggests that extreme heatwaves are associated with heightened levels of human morbidity and mortality (Kunst et al. 1993; Hajat et al. 2002). Data from Shanghai for 1975–2004 shows that the urban heat island effect and extremely high temperatures are directly responsible for an increased summer mortality rate (Tan et al. 2010). A series of heatwaves occurred in Guangxi during the summer of 2010. The heat related morbidity rate increased significantly but the mortality is still relative low, only one heat related death observed in Nanning City (Qin and Li, 2011). Currently heatwave events are relatively rare in the program area and no research has been conducted specifically for the program locations.

14. Geological hazards are also natural threats to the urban cities in the RCI program area. Geological hazards have close correlation with climate, and are usually induced by storm. In the future, climate change will likely strengthen the rainfall intensity, and any potential sea level rise will also exacerbate potential tropical storm damage to coastal areas. It is important to take the future climate change scenarios into account in the planning and design of any infrastructure project, in order to ensure the long-term project service can be delivered as planned.

15. The extreme weather continue to show enhanced trend in terms of intensify and frequency in Guangxi. During 2016, The Super Typhoon ‘Sarika’ hit Guangxi in October. It is the strongest Typhoon landed in Guanxi since 1949. Typhoon ‘Nida’ hit Guangxi in August and circulated around for more than 15 hours. These 2 extreme weather events have led to more than RMB370 million damages to the local communities. The frequent strong storm

events during May to June have caused even more severe damages in many urban areas, which is as high as RMB625 million in total. In addition, there are 81 stations that have observed close to or above record highest temperature around Guangxi.

D. Purpose and scope of this study

16. This study aims to provide an assessment of potential risks posed by climate change to the RCI program. The focus is on the Tranche 2 subprojects based on the completed feasibility study reports (FSRs) and field work findings. The overall objective of this study is to identify and minimize future climate change risks to the Tranche 2 of RCI program through scientifically based impact assessment and adoption of feasible adaptation actions to improve resilience.

17. There are 8 subprojects in Tranche 2 which involve civil works for the construction of training and cross-border trade services facilities and road development as listed in Table 1. All subprojects have completed FSR but detailed design has not yet started.

18. The risk assessment will consider changes in temperature, rainfall and sea level based on outputs from the latest climate change research findings. Two future timeslices, i.e. 2050 and 2100 are analysed in this study to represent mid-term and long-term future conditions. Based on the findings, adaptation options have been recommended.

19. The main focus of this study is infrastructure components that are vulnerable to changes in temperature and rainfall and their variability; the required information to support this CRVA is historical observed temperature and rainfall at the appropriate spatial and temporal scale and future climate change projections based. Relevant daily rainfall and temperature data was collected for 4 meteorological stations in the area.

20. Section E describes the methodology for the CRVA. Details of the baseline and scenario datasets used for climate impacts assessment are provided in Section F. Given the generated climate change scenarios, Section G describes the detailed impact assessment for Tranche 1 subprojects and identifies implications of climate change vulnerability on the subproject design. Section H discusses the adaptation options based on the completed FSRs. The report concludes with main findings of this study, identifies constraints and limitations and future recommendations.

Table 1: List of subproject in Tranche 2

No.	**Location (Lat/Long)**	**Name**	**Contents**
1	Xinhe, Chongzuo (22.556°/ 107.222°)	Chongzuo Sino-Vietnam Border Economic Cooperation Zone Demonstration Project (Phase I)	Road Engineering: 7 roads total of 19846.85m, including new construction 14203.022m and rehabilitation 5643.824m; a sewage treatment plant.
2	Dongxin/ Fangcheng gang (21.583°/ 108.050°)	Dongxing Changhu Road (East Section) Construction Project	Construction of a 3703.616m of new trunk road.
3	Pingxiang/ Chongzuo (21.580° /106.430°)	Road Connectivity in Pingxiang (Guangxi)– Lang Son (Viet Nam) Cross-Border Project	Construction of a 2668m new road.
4	Qinzhou (21.683°/ 108.667°)	Qinzhou Cross-Border Trade E-Commerce Industrial Park Project	Construction of E-commerce facilities of area , including electronic business data center and cross-border trade exhibition center inside the Free Trade Zone of Qinzhou.
5	Qinzhou (21.683°/ 108.667°)	Qinzhou International Cold-Chain Logistic Demonstration Project (renamed)	Construction of cold storage, related inspection and detention facilities and surveillance facilities.
6	Gulin (25.283°/ 110.371°)	China-ASEAN Small and Medium Enterprises (SMEs) Synergy Innovative Development Project	Construction of: (i) SME Business development service information center; (ii) Aeronautic and Aerospace Industry Practice Base; (iii) ASEAN vocational education building
7	Baise (23.800°/ 106.733°)	China- ASEAN Educational Medicare Cooperation Project (Phase I)	Construction of: (i) Auditorium; (ii) Administration Office building; (iii) Public teaching building; (iv) Lab building; (v) research building; (vi) canteen

E. Methodology

21. A risk is the product of the magnitude of the hazards and the vulnerability of an object; while the vulnerability of an object is determined by its exposure, sensitivity and adaptive capacity to the hazard. In this study, hazard is used to denote the threat from climate variables such as precipitation, extremes and aftermath. Exposure is referred to the presence of assets or people that could be adversely affected when a hazard happens and which, thereby, are subject to potential harm, loss, or damage. Vulnerability is defined generally as the susceptibility to be adversely affected by climate hazards. Vulnerability can be either physical or socio-economic. Tranche 2 subprojects are vulnerable to potential rainfall induced flood damage and human health is vulnerable to heatwave. The vulnerability also derives from ecosystem degradation due to human activities in the area. This section describes the methodology of identifying climate variables that may become hazardous to the subprojects and their projected future change. The climate change projections focus on the relative changes between historical and future periods by applying an ensemble based pattern scaling approach.

E.1 Overall approach

22. The first step in CRVA is the construction of the future climate change scenarios. The construction of climate change scenarios involves the development of the baseline climate condition and the future climate change projections. Depending on the study objectives, spatial and/or site specific climate change scenarios are needed for impact assessment. In this study, the baseline spatial climatology for the RCI program areas was obtained from the WorldCLIM database (http://www.worldclim.org). The station based observed data collected was used for developing the site specific baseline climate condition.

23. The future climate projection is subject to considerable uncertainty. Uncertainty is a key element in most aspects of climate change. The decision on adaptation options must take careful account of the degree of uncertainty, the long time horizons and the range of possible outcomes. The lifespan of a project may set the best time horizon for CRVA. One important aspect is to comprehend such an uncertainty range in decision making and policy planning process. Within this context, any climate change scenario constructed on a single Greenhouse Gas (GHG) emission rate and/or individual GCM outputs is generally considered inappropriate for CRVA purposes, because it cannot provide information on the uncertainty that characterizes future climate for a given location and from all uncertainty sources. The first important uncertainty is the future atmospheric GHG concentration. The GHG concentration will vary depending on how the future world develops socio-economically. Global economic development driven mainly by fossil-fuels will cause higher GHG concentrations than more sustainable, lower emission global economic development. To reflect such uncertainties, different GHG Representative Concentration Pathways (RCPs) were used by IPCC AR5 to represent different trajectories of future GHG concentrations that would result in radically different radiative forcing by the year 2100. It should be borne in mind that each RCP itself is subject to additional uncertainties arising from incomplete understanding by the modelling communities as regard to the processes involved in converting GHG emissions into atmospheric concentrations and radiative forcing as reflected, for example, in the different results obtained from various carbon cycle models. The second important uncertainty results from limitations in the scientific understanding of the response of the climate systems to radiative forcing. Consequently, there remain large differences between GCMs in their projections of global-mean temperature change. These are due largely to the differences in the ways in which climate feedback is modelled. For example, cloud feedbacks, which can enhance or dampen rates of global warming. The metric “climate sensitivity”, broadly defined as the equilibrium global mean surface temperature change following a doubling of

atmospheric CO_2 concentration, captures these uncertainties. Thus a combination of different RCPs and climate sensitivities can be used to characterise future scenarios that reflect the major uncertainties at the global scale. The three RCPs used in this study, RCP4.5, RCP6.0, and RCP8.5, are named after a possible range of radiative forcing values in the year 2100 (of 4.5, 6.0, and 8.5 W/m^2, respectively). RCP6.0 with mid-climate sensitivity represents a middle range future global change scenario, which was used as an indicator of the mid-scenario projection of future global change, while RCP4.5 with low-climate sensitivity and RCP8.5 with high-climate sensitivity was used as indicators of the corresponding low and high bounds of the uncertainty range (Table 2). The third important uncertainty in climate change scenario generation is the difference between GCM simulations for given regions or locations. At the regional-to-local scale, the uncertainties expend in terms of the spatial patterns of climate change. As the current climate science still cannot identify any individual GCM that may be superior to others in simulating future climate change, it makes the CRVA a challenge because of the three key sources of uncertainties. To account for such an uncertainty in CRVA, a pattern scaling method (see Appendix 1 for detailed calculation process) was adopted and applied to a wide range of GCMs to build a model ensemble.

24. The advantage of pattern-scaling method is that the three key uncertainties – the future radiative forcing, the climate sensitivity and the GCM projected change – can be treated independently and combined flexibly and quickly to produce future climate scenarios (Wigley, 2003), while the key assumption underlining the pattern-scaling method is that, at first the RCPs can accurately represent the global responses of a GCM even when the response is non-linear (Raper et al, 2001); and secondly for a GCM, the change of its climatic variables are a linear function of its global annual mean temperature change at different spatial and/or temporal scales. This study made use of the GCM model results from phase 5 of the couple model intercomparsion project (CMIP5), which was the data supporting the IPCC AR5 (see Appendix 2 for the GCM included). All 40 GCMs with monthly data outputs were used in spatial GCM scenario generation. Of the 40 GCMs, the 20 GCMs that have daily GCM outputs were used in extreme rainfall scenario construction; and the 24 GCMs that have sea level outputs were used in sea level change scenario construction.

25. As pointed out by Reichler and Kim (2008), the average simulation from model ensemble for a climate variable is normally used to capture the middle conditions, because the average often agrees better with observed climate than any individual model estimates. However, it was found that, though all GCMs has reasonable agreement in climate simulation at global or continental scale, the difference of GCMs results could be significantly large for local areas or small regions, which indicates a huge uncertainty at such spatial scales. Furthermore, this uncertainty is not consistent spatially; hence it is difficult to identify and eliminate certain GCMs from model ensemble. The one or two 'outlier' GCM results could generate a very biased projection for the average value of the ensemble. In this study, the median of the model ensemble, instead of the average, was used in order to provide a "best estimate" scenario of future change. It is worthwhile to note that we only use the median value in this study, mainly due to the relative small ensemble size. Ideally top and bottom percentiles should also be used to determine the high and low uncertainty range bounds, but for practical purposes of guidance for policy and action this often tends to expend the scenarios to the point of being unmanageable and/or unusable. Again this is particularly true given the relative small size of ensemble.

Table 2: Three climate projections and their input conditions represent the uncertainty ranges

Climate projection	Representative Concentration Pathways	Climate sensitivity
Mid scenario	RCP6.0	Mid
Low scenario	RCP4.5	Low
High scenario	RCP8.5	High

E.2 Spatial climate change scenario

26. Annual and monthly climate change impact was assessed spatially over the RCI area. The baseline climatology was obtained from the WorldCLIM database with a spatial resolution of about 1 km (http://www.worldclim.org). In generating the climate change scenario for the RCI area, the simulation results from 40 GCMs that were assessed in the IPCC AR5 were used. All 40 models have their monthly simulation results available.

E.3 Site specific climate change scenario

27. Besides the spatial monthly change projections, site specific climate change scenarios with a more detailed temporal scale are usually required for impact assessment. The site specific climate change scenario was constructed by adjusting the station observed daily data using the normalised GCM pattern value from the GCM grid where the climate station is located. In this report, the baseline data was constructed from the observation data of the period 1986-2015. For site specific extreme value analysis, an intensity value such as maximum daily rainfall of 20 year annual recurrence interval (ARI) was chosen and then its normalised pattern value from the GCM gird where the site is located was selected. The value is then applied to the same rainfall intensity that was derived from the observed historical data to generate the future change scenarios.

28. In the following two sections, the method described above is adopted to generate the change projections for climate variables that may become hazardous to the proposed RCI subprojects. Rainfall and/or temperature data were collected for four stations around the RCI area. Table 3 lists the information for the stations. The locations of the stations are also shown in Figure 1.

Table 3: Information of the meteorological stations

Station Name	Longitude (°E)	Latitude (°N)	Altitude (masl)	Observation Period
Guilin	110.30	25.32	164.4	1951-2016
Qinzhou	108.62	21.95	4.5	1952-2015
Longzhou	106.85	22.33	128.8	1953-2015
Baise	106.60	23.90	173.5	1951-2015

F. Climate observations and change projections

F.1 Observational temperature data and their future projections

29. The temperature related climate variables that might have high risk potential is heatwave hazard and impacts on human health. Most of the RCI program area is in the south of the Tropic of Cancer, so has hot and humid summers. Figure 2 illustrates the spatial annual mean temperature of the baseline and 2050 and 2100 projections under a mid climate change scenario. Across Guangxi, the annual mean temperature is likely to increase between 1.1°C to 1.3°C by 2050 and 2.2°C to 2.5°C by 2100, according to the mid scenario projection. The northwest area has a slightly higher warming rate than the southern area.

30. Figure 3 shows the observed annual mean temperature of the 4 meteorological stations. As shown in Figure 3, a warming trend has already been observed for all stations. It is relatively weak for the northwest inland station of Baise, but is quite strong for other sites.

31. Figure 4 shows the monthly observed monthly normal mean temperature and its 2050, 2100 projections and uncertainty ranges for the 4 stations. The warming rate due to climate change impact on temperature is similar for each month for the mean temperature. The climate change impact on the maximum temperature is similar for the mean. The influence of heatwave on human health is closely related to the heatwave intensity, which is defined as the duration of continuous day of maximum temperature over a given threshold. The heatwave change scenarios are discussed in Section G.

F.2 Observational rainfall data and their future projections

Baseline:

32. Figure 5 shows the spatial annual rainfall distribution. There is a high spatial variation in rainfall over Guangxi. The northwest mountainous area has the lowest annual average rainfall between 1000 to 1100 mm, which is less than half received by the southeast coastal area that is over 2400 mm (baseline shown in Figure 5). The coastal area of Qinzhou receives heavy rainfall, because it is under the combined effects of a maritime climate and south Asian monsoon.

33. Figure 6 shows the observed annual rainfall for the 4 stations. The annual average rainfall is clearly over 2000 mm for the coastal city of Qinzhou, but it is merely above 1000 mm for the northwest inland city of Baise. The Coefficient of Variation (CV) is between 0.17 and 0.20, which indicates that the inter-annual variation of rainfall is not very strong (Table 4). Unlike the temperature, there is no consistent change trend in annual rainfall from the observations. While Qinzhou and Guilin demonstrates an upper trend, the Longzhou rainfall is slightly downward, and Baise does not show a clear trend.

34. In contrast to the inter-annual variation, the rainfall shows a very high seasonal variation. Figure 7 shows the observed monthly normal rainfall and its 2050, 2100 projections for the 4 stations. The average rainfall for four months from June to September accounts for more than half of the annual total. On average June is the wettest month for three stations except Qinzhou where July has the most rainfall. December is the driest month for all stations.

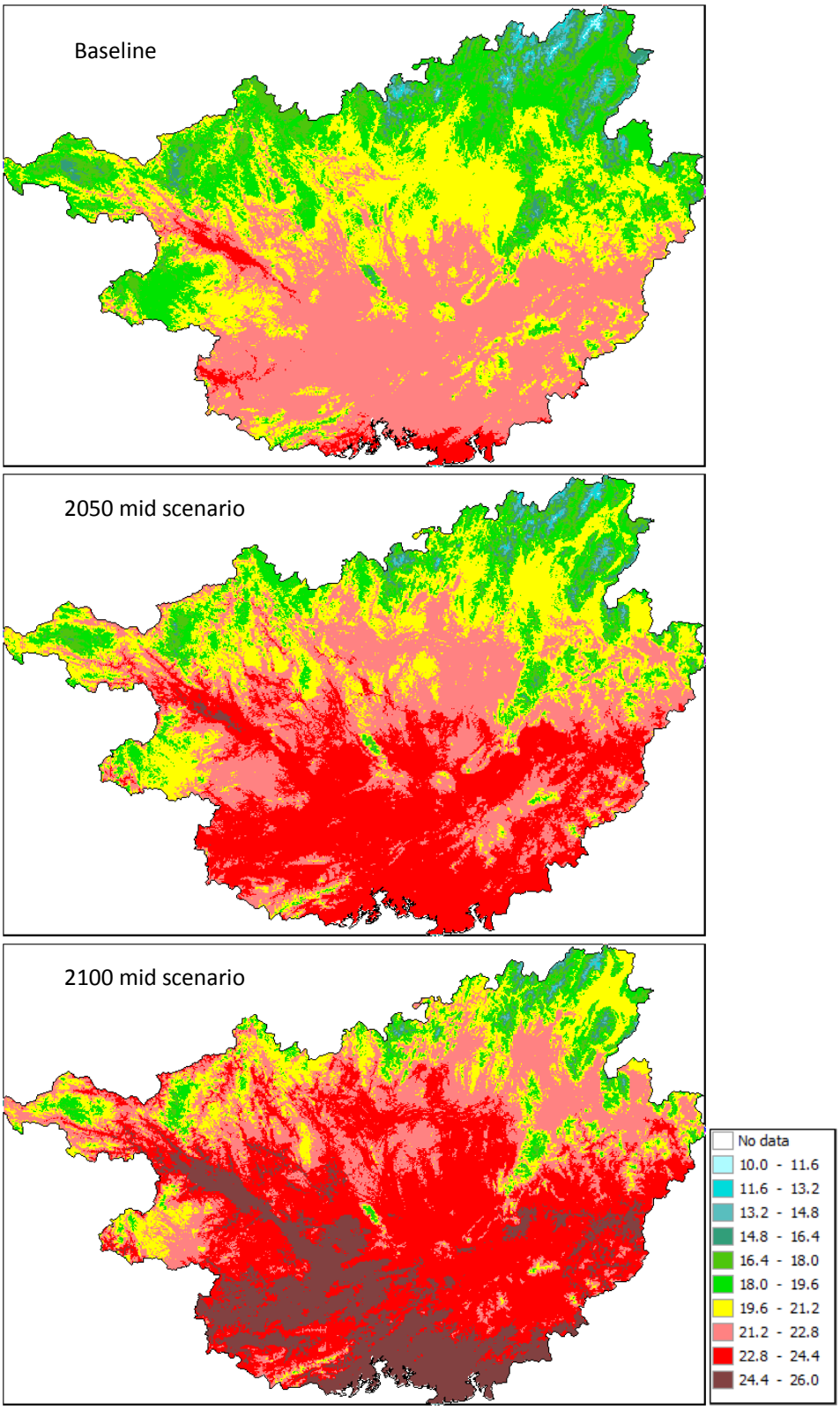

Figure 2: Baseline annual average mean temperature (°C) and 2050, 2100 projections based on the mid scenario projection

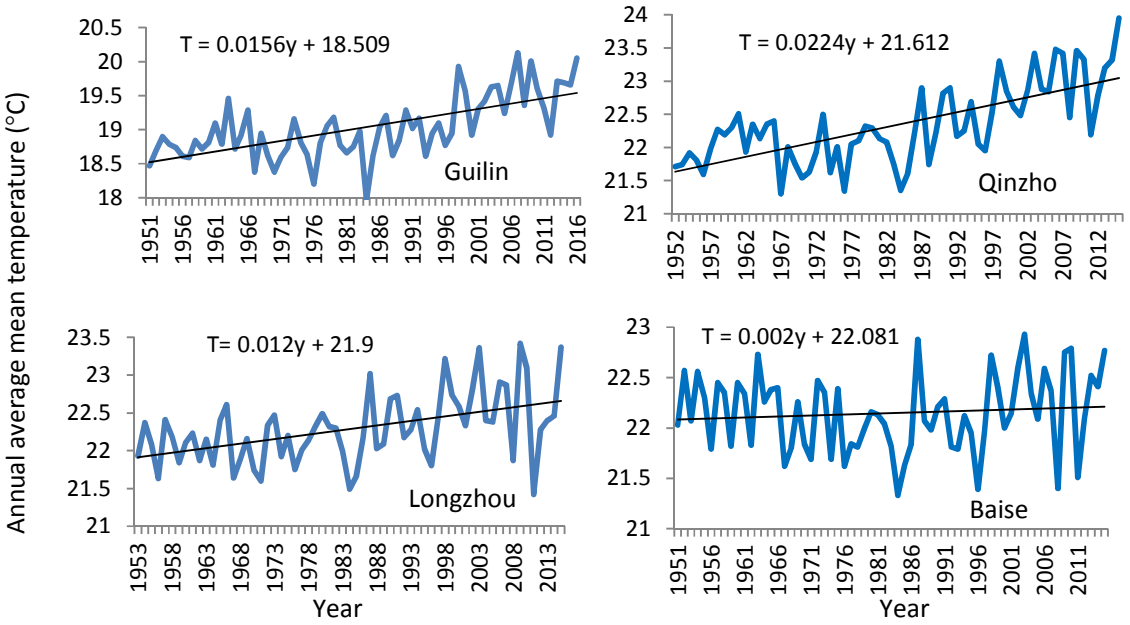

Figure 3: Observed annual average mean temperature (°C)

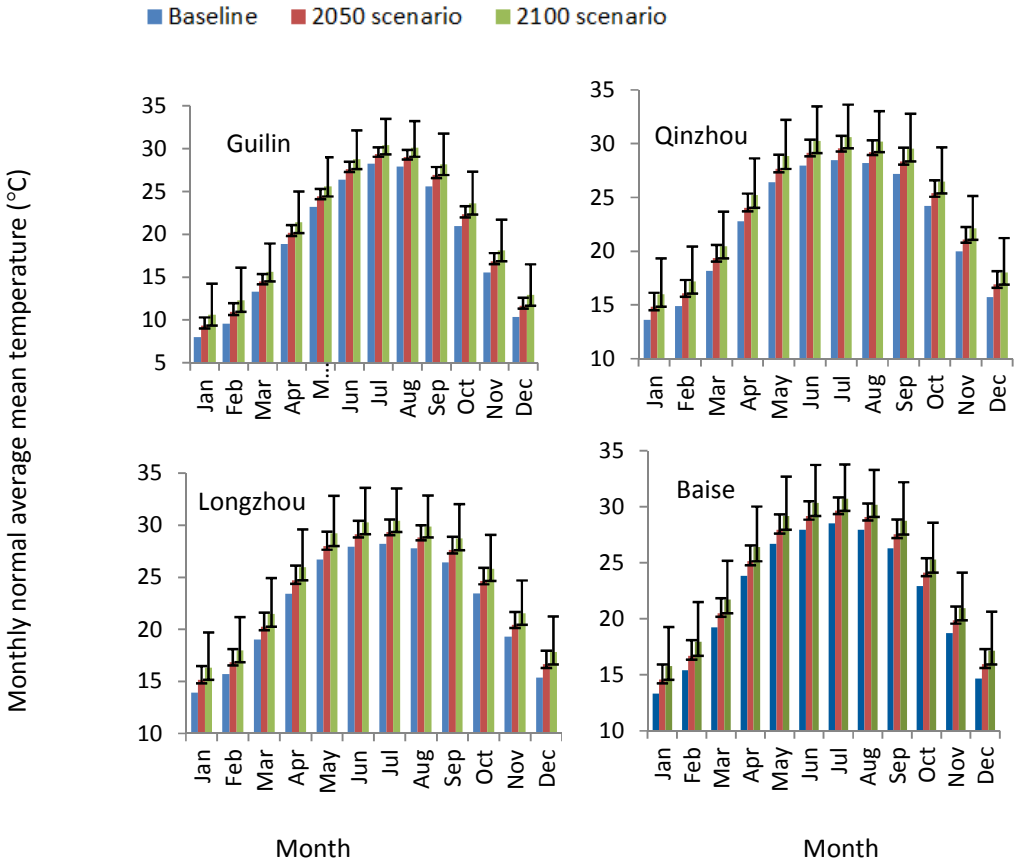

Figure 4: Baseline monthly normal mean temperature (°C), 2050 and 2100 projections. The bar indicates the uncertainty range of the climate change projection as defined in Table 2

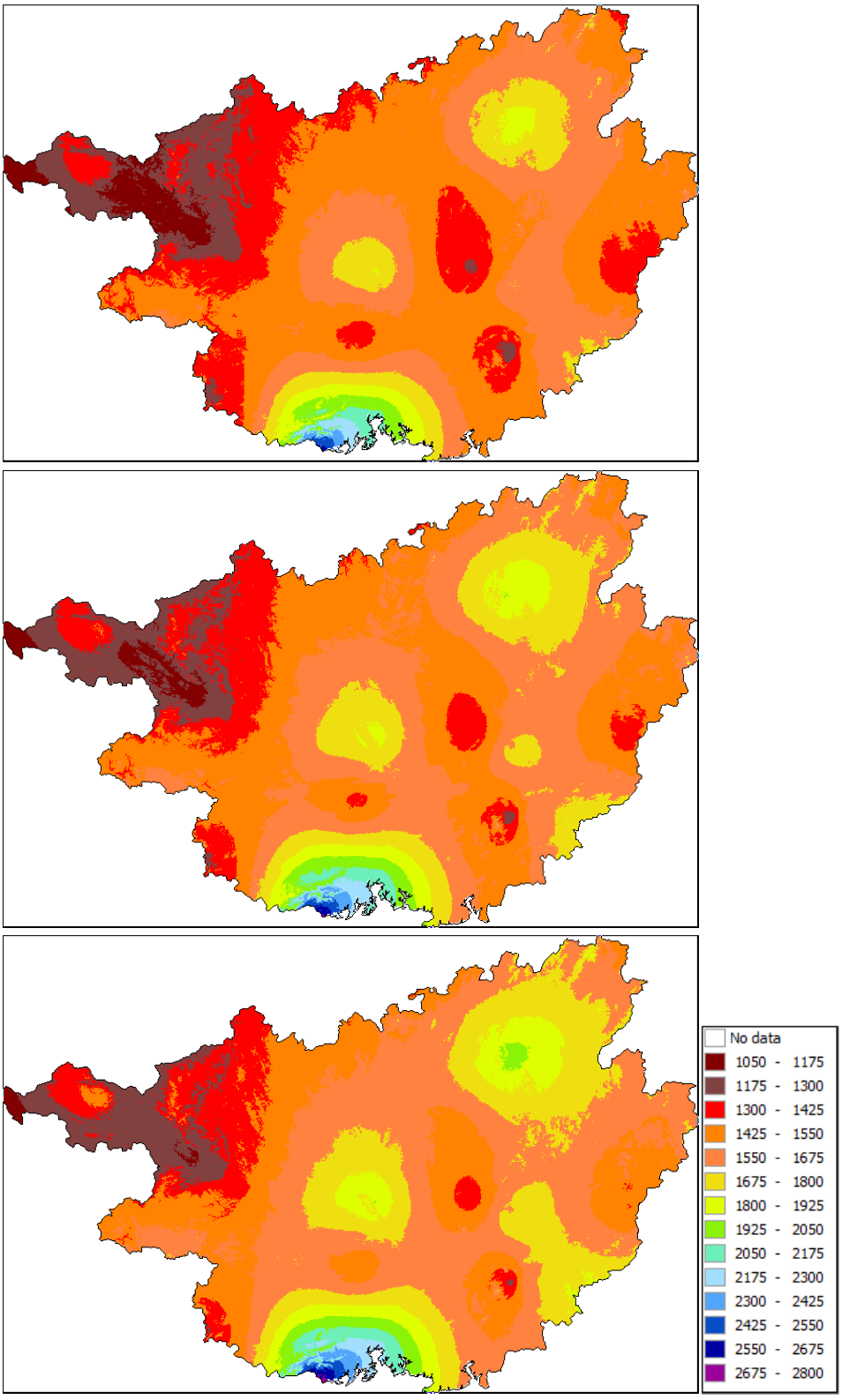

Figure 5: Baseline annual precipitation (mm) and 2050, 2100 projections based on the mid scenario projection

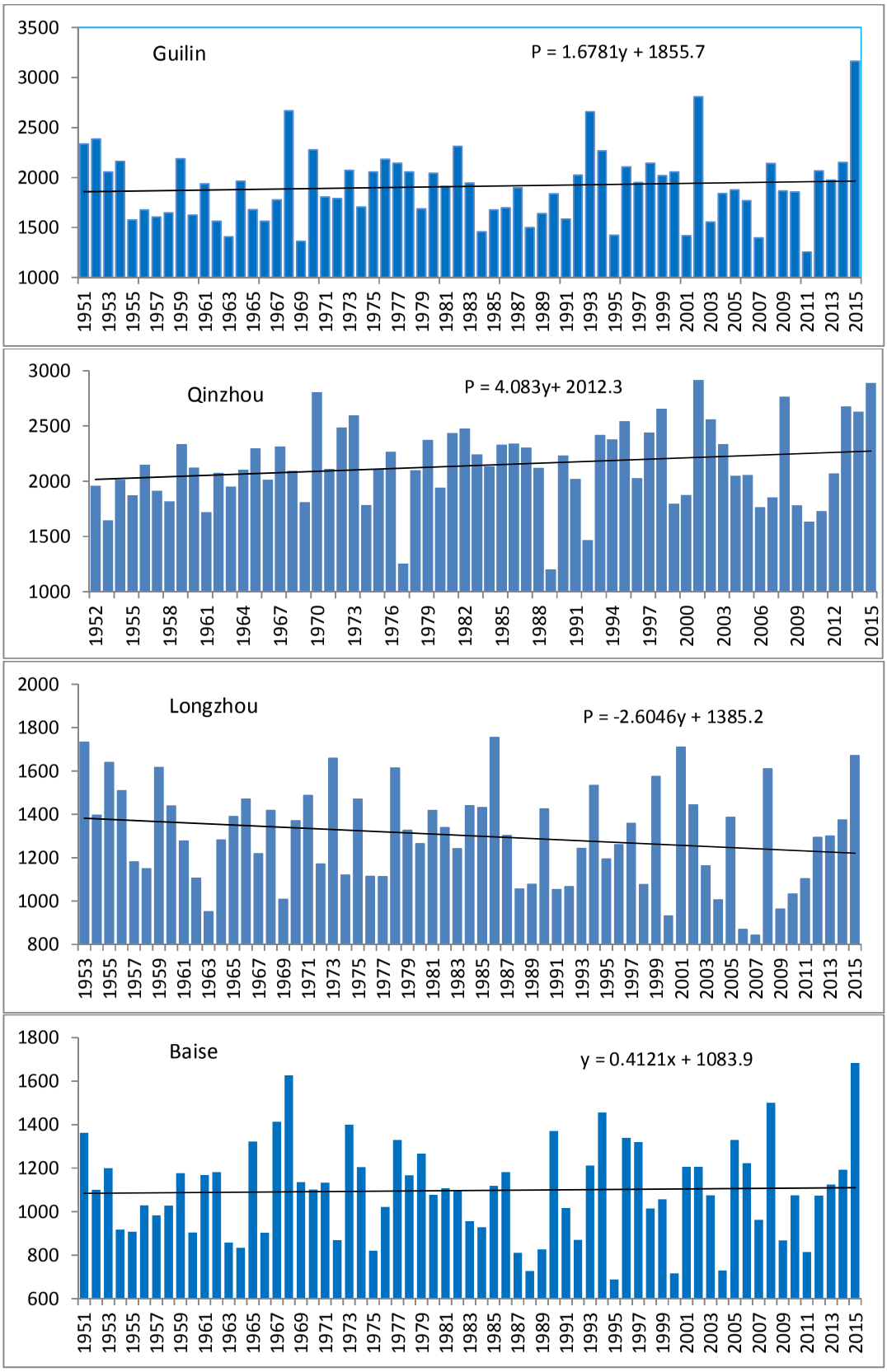

Figure 6: Observed annual rainfall of the 4 stations (mm)

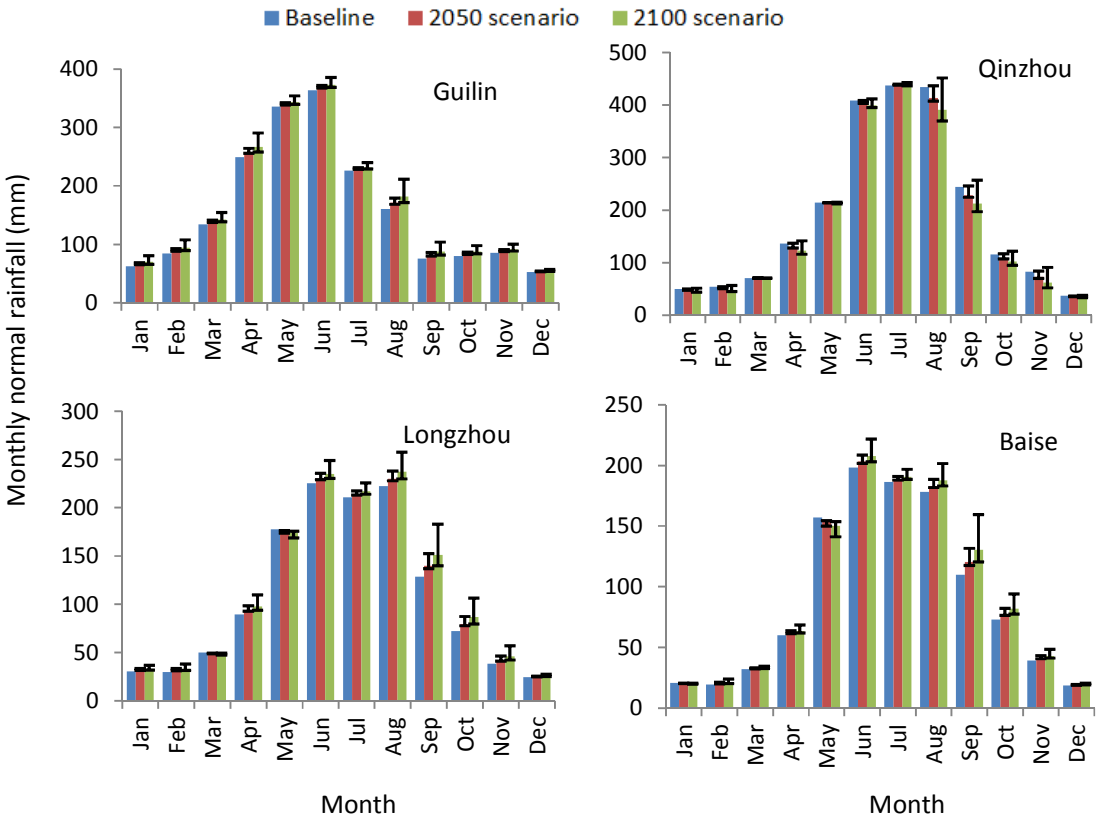

Figure 7: Monthly normal rainfall and climate change projection.The bar indicates the uncertainty range of the climate change projections as defined in Table 2

Table 4: General rainfall information of the four stations

Station name	Annual average precipitation (mm)	CV	Maximum annual precipitation (mm)	Minimum annual precipitation (mm)
Guilin	1911.03	0.19	3163.20	1254.30
Qinzhou	2145.04	0.17	2917.10	1204.60
Longzhou	1295.87	0.18	1755.00	841.80
Baise	1097.50	0.20	1683.30	688.80

Future projection

35. Applying the method of previous section to the RCI area, the mid scenario change projection indicates the annual rainfall change in the area will also likely be noticeable, with an average increase across the area of 2.5% in the northwest to 3.5% in the southeast by 2050 and 4.5 to 7.0% by 2100 across the area. The climate change projection indicates that the spatial variation of rainfall may become even larger in the future (2050 and 2100 projection in Figure 5), as the current wettest area likely receives even more rainfall than relative drier areas.

36. At a site specific scale, the projected rainfall increase is clear for the rainy season, but much less for the dry season. The dry period of January to March of Qinzhou even shows a slight decrease trend (Figure 7). Such a scenario projection implies an increased storm and flood risk for the area, particularly for the coastal area.

Table 5: The GEV results of annual maximum daily rainfall and its future projections

Station Name	ARI (years)	Baseline	2050 scenario			2100 scenario		
			Low	Mid	High	Low	Mid	High
Annual maximum daily rainfall projection (mm)								
Guilin	2	126.10	132.27	134.32	141.67	134.26	140.99	159.48
	5	171.23	177.36	179.59	188.25	179.52	187.41	209.31
	10	200.56	208.22	211.07	222.33	210.98	221.23	249.83
	20	228.30	238.61	242.45	257.67	242.33	256.17	295.51
Qinzhou	2	175.63	184.10	187.3	198.67	187.02	197.55	226.73
	5	229.95	239.06	242.42	255.64	242.31	254.34	288.57
	10	262.46	273.22	277.20	292.96	277.07	291.40	332.44
	20	291.28	304.41	309.26	328.46	309.10	326.56	376.85
Longzhou	2	92.46	98.07	100.10	107.94	100.03	107.17	127.13
	5	118.74	124.39	126.48	134.69	126.40	133.88	155.21
	10	135.98	142.27	144.60	153.80	144.52	152.89	176.85
	20	152.40	159.78	162.50	173.26	162.41	172.19	200.25
Baise	2	87.83	91.85	93.321	99.052	93.27	98.49	113.28
	5	113.96	119.06	120.93	128.34	120.88	127.61	146.78
	10	131.98	138.21	140.50	149.56	140.43	148.68	172.17
	20	149.83	157.48	160.30	171.42	160.21	170.33	199.23
Change in Annual maximum daily rainfall projection (%)								
Guilin	2	-	4.89	6.52	12.35	6.47	11.81	26.47
	5	-	3.58	4.88	9.95	4.84	9.45	22.24
	10	-	3.82	5.24	10.86	5.19	10.30	24.57
	20	-	4.52	6.20	12.87	6.15	12.21	29.44
	Average change		4.20	5.71	11.51	5.66	10.94	25.68
Qinzhou	2	-	4.83	6.55	13.12	6.49	12.49	29.10
	5	-	3.96	5.42	11.17	5.38	10.61	25.49
	10	-	4.10	5.62	11.62	5.57	11.03	26.67
	20	-	4.51	6.18	12.77	6.12	12.12	29.38
	Average change		**4.35**	**5.94**	**12.17**	**5.89**	**11.56**	**27.66**
Longzhou	2	-	6.07	8.26	16.74	8.19	15.92	37.50
	5	-	4.76	6.52	13.43	6.46	12.75	30.71
	10	-	4.63	6.34	13.10	6.28	12.44	30.06
	20	-	4.84	6.62	13.68	6.57	12.99	31.40
	Average change		**5.07**	**6.94**	**14.24**	**6.88**	**13.52**	**32.42**
Baise	2	-	4.58	6.25	12.78	6.20	12.14	28.98
	5	-	4.47	6.13	12.62	6.07	11.98	28.80
	10	-	4.72	6.46	13.33	6.40	12.65	30.45
	20	-	5.10	6.99	14.40	6.93	13.68	32.97
	Average change		4.72	6.46	13.28	6.40	12.61	30.30

Extreme rainfall and its projection

37. According to the extreme value theorem, the generalized extreme value (GEV) distribution, which combines type I, II and III extreme value distribution, is often used as an approximation to model the normalized maxima (minima) of a long (finite) sequence of

independent and identically distributed random variables such as annual daily maximum rainfall. In this study the GEV distribution was applied to the daily observation to investigate extreme rainfall and their future changes. A detailed method description and analysis process can be found in Ye and Li (2011). The annual maximum daily rainfall and its future projection were investigated in detail because the sub-daily rainfall data was not available. Figure 8 illustrates the GEV distribution of the annual maximum daily rainfall of Qinzhou and their 2050 and 2100 future projections. The right-shifting of the projected GEV distribution indicates an increment in daily rainfall intensity or frequency. Table 5 lists the assessment of climate change impact on the extreme daily rainfall for the 4 stations. As seen in Table 5, the baseline 5 year ARI of maximum daily rainfall of Qinzhou is 229.95 mm, as calculated from historical record. The climate change alters the climate regime, and the same ARI event will likely have 242.42 and 254.34 mm by 2050 and 2100 respectively, following the mid scenario projection.

F.3 Climate change impact on heatwave

38. The heatwave hazard is also projected to increase due to climate change. Heatwave is normally defined as a consecutive days of temperature above a given threshold. Human have developed different tolerance to heat from their long term living experience. Regional difference is a key feature in the relationship between heatwave and human. The impact of heatwave on human health should be determined based on effects to local people. Ye et al. (2013) studied the relationship of mortality and daily maximum temperature of the summer season for 753 stations over China, excluding the very cold area. Heatwave was defined as needing to satisfy 2 conditions: 1) the daily maximum temperature is higher than the 97th percentile of the local observed long term daily maximum temperature records; and 2) the duration is equal to or longer than the consecutive 6 days.

39. For the sites of Guliin, Qinzhou and Baise that have the building development, their baseline and future projections of the heatwave frequency and intensity was derived from their stations and the results are listed in Table 7. Currently, the heatwave is still rare in coastal city of Qinzhou, which is 3 times per 100 years on average. However, it is noticeable for inland cities of Gulin and Baise, which is 23.9 and 15.2 times per 100 years on average. Based on the mid-climate change scenario projection, by 2050 the heatwave frequency is likely to increase by almost 5 times from the baseline for Qinzhou, and almost 4 times for Guilin and more than 6 times for Qinzhou. Except under the low scenario projection for Qinzhou, the heatwave will likely become annual event by 2100 for all cities. The intensity also increases. The heat duration is more than doubled from their baseline for Guilin and Baise and changes from 7 days of baseline to 8 days for Qinzhou by 2050 under mid scenario projection.

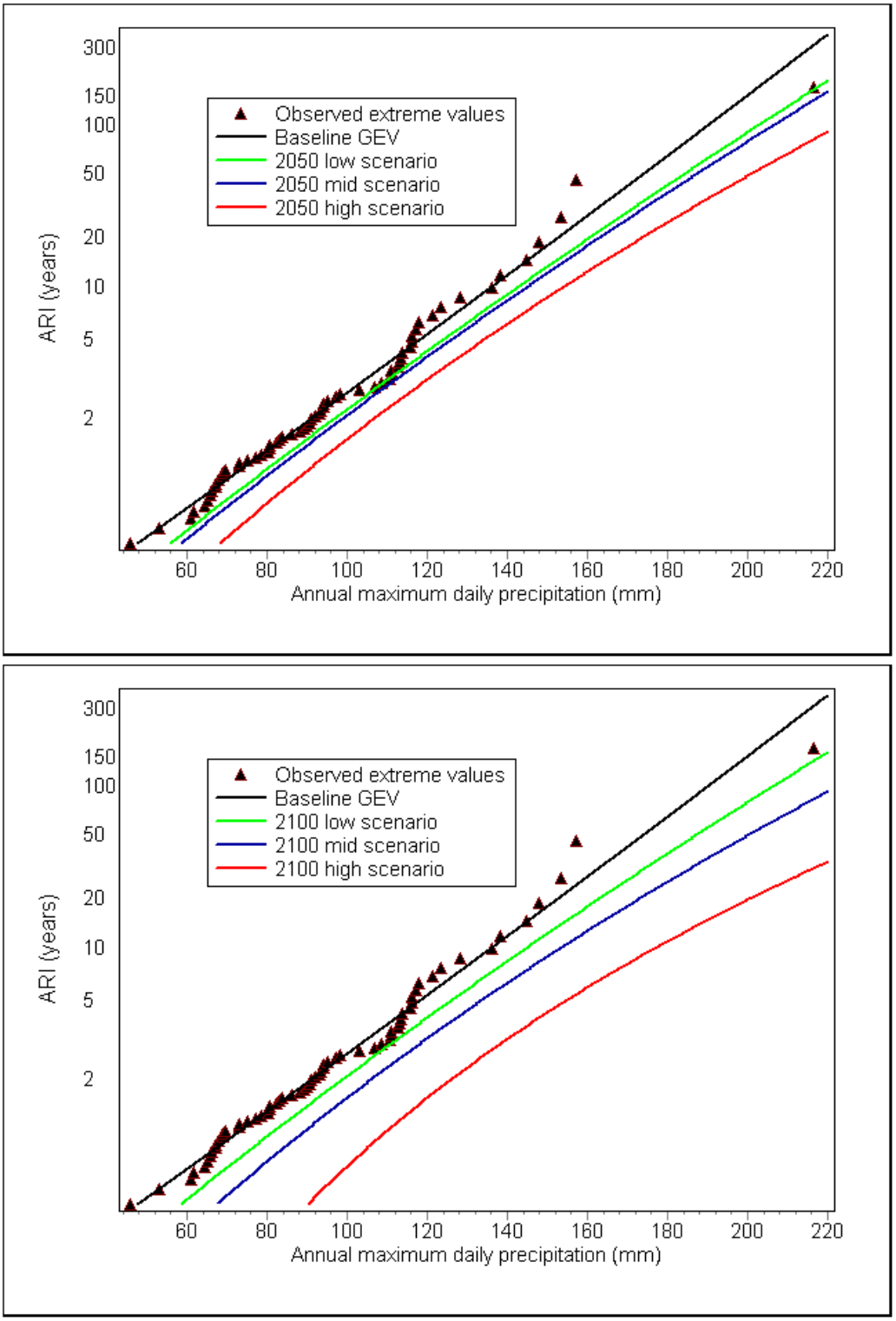

Figure 8: Climate change impact on Qinzhou annual maximum daily rainfall

Table 6: Heatwave: baseline and future projection

Station	Heat wave frequency (times/100years)						
	Baseline	2050 scenario			2100 scenario		
		Low	Mid	High	Low	Mid	High
Guilin	23.9	65.7	92.5	261.2	92.5	235.8	591.0
Qinzhou	3.0	7.6	13.6	122.7	13.6	101.5	809.1
Baise	15.2	62.1	93.9	242.4	93.9	206.1	853.0
	Heat intensity (the longest duration in days)						
Guilin	16	16	16	33	16	33	78
Qinzhou	7	8	8	15	8	15	52
Baise	15	16	18	31	18	31	56

F.4 Sea level change projections

40. The sea level change scenario was based on a model ensemble of 24 GCMs sea level simulations. The first step was to construct the normalised change pattern, as expressed as sea level change per 1 cm global sea level rise (unit: cm/cm). Again the median value from the model ensemble was used as the 'best guess' of the future sea level change for a given location. Figure 10 demonstrates the normalised pattern based on RCP6.0 for the South China Sea. The sea level rise rate of Beibu Gulf is 1.16 cm/cm that is lower than the coastal area of neighbouring Guangdong Province, perhaps due to the protection from the surrounding land mass, particularly the Hainan Island and Leizhou Peninsula in the south. Table 6 lists the projection and uncertainty range of the sea level change of Beibu Gulf. According to the mid scenario projection, the sea level of Beibu Gulf is likely to increase about 25 cm by 2050 and 64 cm by 2100, which is a substantial rise.

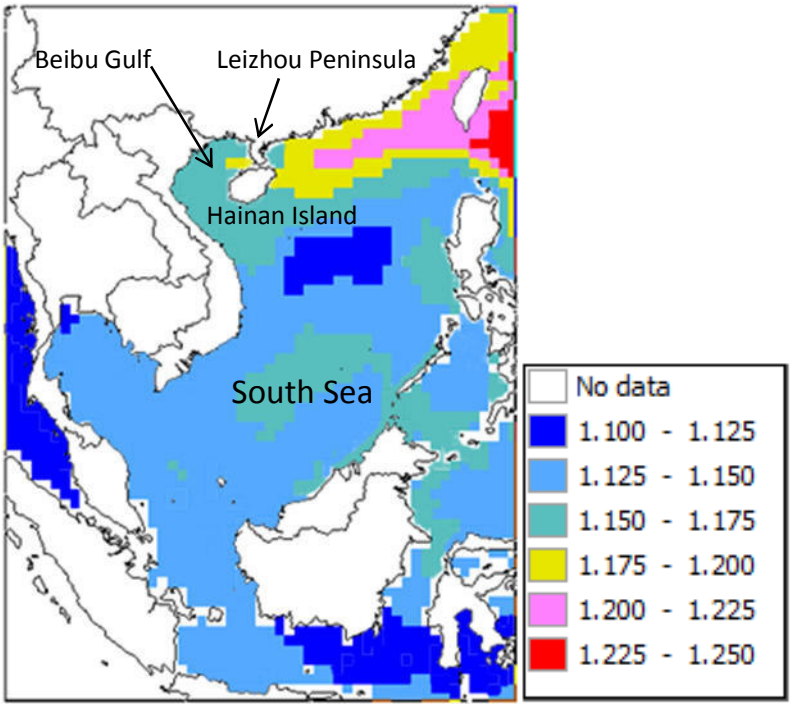

Figure 9: Normalised change pattern of sea level of South China Sea. (expressed as change per 1 cm global rise: cm/cm)

Table 7: Sea level change scenario of Beibu Gulf, South China Sea (cm)

	Climate sensitivity					
	Low	Mid	High	Low	Mid	High
	2050			2100		
RCP4.5	19.81	26.79	33.78	41.94	61.74	82.71
RCP6.0	18.64	25.63	32.62	44.27	64.07	85.04
RCP8.5	22.13	29.13	37.28	61.74	86.21	114.17

G. Climate change impact on Tranche 2 subprojects and the implications for subprojects design

41. Climate change information needs to be related to climate sensitive components of each subproject in order to determine the climate risk and how to address vulnerability. Feasibility studies have been completed for all subprojects so CRVA was conducted based on the FSR as well as information gathered from field visit. For all subprojects, one common climate risk is the outdoor surface flood. The local geological conditions are characterised by serious rocky desertification. The steep slope of the landscape and the strong summer storm, as well as the unique geological conditions demand a careful rain water drainage design in order to prevent flash surface floods and soil/rock erosion. According to Chinese national outdoor drainage design standard (GB50014-2006), the drainage capacity design is based on an empirical formula with the coefficients being determined from the historical annual maximum rainfall observations. Normally the maximum rainfall of 10 minute duration and 3 to 5 year ARI are used in drainage system design. However, no sub-daily data was available for this study. Only daily time series rainfall data was obtained. Hence the climate change impact assessment was conducted based on the daily rainfall data.

42. In general, the storm water was designed to drain to nearby water bodies, including nature river systems, navigation canals or urban storm drain systems. In this CRVA studies, we consider the climate change impact on the subproject drain system itself. The storm water drain capacity that the subprojects connect to is assumed sufficient. In addition, according to the local regulation, the storm drain system and sewage drain system are separated so no consideration was given to the climate change impact on sewage.

43. **Subproject 1: Chongzuo Sino-Vietnam Border Economic Cooperation Zone Demonstration Project (Phase I).** Subproject 1 is located at Xinhe, Jiangzhou District of Chongzuo. It includes construction and rehabilitation of 19846.85m roads and a construction of a sewage treatment plant in the border economic zone (BEZ). The main climate risk is the water damage from the surface flood for the road and surface and riverine flood for the sewage treatment plant. The sewage treatment plant is on the right bank of the Heishui River just above a reservoir. This section of Heishui River is highly controlled by a series of reservoirs along the river networks. It was found from the field works that no river flood has been observed in history since the reservoirs were built. Therefore, we only considered surface flood risk under climate change impact for this subproject.

44. In FSR, the storm drain system was estimated as:

$$q = \frac{3634.767 \times (1 + 0.633 LgP)}{(t + 14.613)^{0.791}} \qquad (1)$$

where, q is the designed rain water discharge capacity (L/(s·ha));
P is the design ARI (years); and
t is the rain duration (min).

45. According to the classification of the roads and the landuse conditions surrounding the subproject area, P and t were chosen as 2 years and 10 min respectively. No climate observation was obtained for Chingzuo, so the climate change impact assessment was conducted based on nearby station of Longzhou. As shown in Table 5, the current 2 year ARI daily storm of Longzhuo is 92.46mm, while under mid-scenario projection, it becomes 100.10mm by 2050 and 107.17mm by 2100, which represents a 8.3 and 15.9% storm intensity increase for the mid and long term respectively. The projected enhanced storm intensity indicates that the storm drain system designed may be insufficient under future climate. Surface flood may become more frequent and threat the road and sewage treatment plant operation.

46. **Subproject 2: Dongxing Changhu Road (East Section) Construction Project.**

47. The subproject includes a 3703.616m new trunk road construction. The location of Subproject 2 is in Dongxing, about 40km west of Fangchenggang. Dongxing is one of the storm centres in China. On average, there are 108 stormy days in a year with maximum of 133 days being recorded. The subproject is cross hilly landscape, with substantial slope cutting and refill earth-moving work being required. The subproject crosses two river systems: the Dalonggou Reservoir and Xiangchegou Stream. According to the feasibility study, it was proposed that culverts should be used for road crossing given the local environmental settings and flood water drain needs. The main climate sensitive component is the water damage caused by surface flood. The rain water discharge capacity is estimated based on historical storm intensity observation of Dongxing as following:

$$q = \frac{1217 \times \left(1 + 0.0685(LgP)^2\right)}{(t+5)^{0.439} P^{0.159}} \qquad (2)$$

where, q is the designed rain water discharge capacity (L/(s·ha));
P is the design ARI (years) (3 years); and
t is the rain duration (min) (10 mins).

48. According to regulation for trunk road drain system design, P and t were chosen as 2 years and 10 min respectively. No climate data was available for Dongxing. The climate change impact assessment was conducted based on the nearby station of Qinzhou. As shown in Table 5, the current 2 year ARI daily storm of Qinzhou is 126.10mm, while under mid-scenario projection, it becomes 134.32mm by 2050 and 140.99mm by 2100, which represents a 6.5 and 11.8% storm intensity increase for the mid and long term respectively. The projected enhanced storm intensity indicates that the storm drain system designed may be insufficient under future climate. Surface flood may lead to water damage to the road.

49. **Subproject 3: Road Connectivity in Pingxiang (Guangxi)–Lang Son (Viet Nam) Cross-border project.** Subproject 3 involves 2.668km class II new road development in the border area with Viet Nam. The subproject area is inside the subtropical climate zone characterised with abundant rainfall and frequent storm events during the summer rainy season, particularly between June and August. Therefore, sufficient road side and surface water drain system is required to prevent any damage to the road, including roadside ditch, blind drain, cut off drain, and bridges culverts etc. There is no river in the subproject area. However, the subproject was designed with 9 culvers of total length of 360m for the surface storm drain. In FSR, the rain water discharge capacity is estimated based on storm intensity observation of Chongzuo as Equation (1). However, the design ARI was selected as 3 years in FSR analysis. The baseline 3 year ARI storm is 104.93mm. A 7.1% and 13.9% intensity increase was estimated by 2050 and 2100 under mid scenario projection, which is 112.43mm 119.52mm.

50. **Subproject 4: Qinzhou Cross-Border Trade E-Commerce Industrial Park Project.** Subproject 5 is the construction of E-commerce facilities, including electronic business data center and cross-border trade exhibition center inside the Free Trade Zone of Qinzhou. Qinzhou is a coastal city and the subproject is located on a reclaimed land from the South China Sea. The main climate sensitive component of the subproject is the outdoor storm water drain capacity and the risk of Typhoon. In FSR, the capacity of storm water drain system was estimated as:

$$q = \frac{1817 \times \left(1 + 0.5051 LgP\right)}{(t+5.7)^{0.58}} \qquad (3)$$

where, q is the designed rain water discharge capacity (L/(s·ha));
P is the design ARI (years); and
t is the rain duration (min).

51. In FSR, *P* and *t* were selected as 3 years and 10min. The baseline 3 year ARI daily storm of Qinzhou is 202.15mm, but becomes 213.71mm and 224.54mm by 2050 and 2100 respectively under mid scenario projection, which represents a 5.7% and 11.1% increase. To provide sufficient drain capacity for future intensified heavy rainfall, the drain system should be designed based on projected future storm intensity. The subproject is built on reclaimed land so the sea level rise scenario may also need to be considered in detailed project design. The sea level is projected to rise 25.63cm and 64.07cm by 2050 and 2100 respectively under mid scenario projection.

52. **Subproject 5: Qinzhou International Cold-Chain Logistic Demonstration Project.** Subproject 6 includes 50000m^2 refrigerated store developments on a 57014.27m^2 land at the same location as subproject 5, and it has the same climate risk as the subproject 5.

53. **Subproject 6: China-ASEAN Small and Medium Enterprises (SMEs) Synergy Innovative Development Project:** Subproject 7 involves 144600.51 m^2 building development inside the campus of Guilin University of Aerospace Technology. It is located at Qixing District of Guilin, and the main climate sensitive component of the subproject is the outdoor storm water drain capacity. In FSR, the capacity of storm water drain system was estimated as:

$$q = \frac{4230 \times (1 + 0.402 LgP)}{(t + 13.5)^{0.841}} \qquad (4)$$

where, *q* is the designed rain water discharge capacity (L/(s·ha));
P is the design ARI (years); and
t is the rain duration (min).

54. According to the design standard, the historical storm intensity of 5 year ARI of 10 min duration was used for FSR analysis. The baseline 5 year ARI of maximum daily rainfall of Guilin is 171.23mm, while it becomes 179.59 and 187.41mm by 2050 and 2100 according to the mid-scenario projection (Table 5). To provide sufficient drain capacity for future intensified heavy rainfall, the drain system should be designed based on projected future storm intensity.

55. Subproject 7 includes teaching building and student dormitory development. According to Table 6, the heatwave may become 4 times frequent by mid-term and even become annual event by the end of this century, so great attention should be paid in project design to provide facilities to alleviate the heatwave damage to the inhabitants of the buildings.

56. **Subproject 7: China- ASEAN Educational Medicare Cooperation Project (Phase I):** Subproject 8 is the new campus construction of Youjiang Medical College for Nationalities. The infrastructure development of subproject 8 includes teaching buildings, Lab buildings, administration building, student dormitory, a canteen and sports/leisure facilities. The total building area is 182210 m^2. It is located in the Baidong District of Baise, and the main climate sensitive component of the subproject is the outdoor storm water drain capacity.

$$q = \frac{2800 \times (1 + 0.547 LgP)}{(t + 9.5)^{0.747}} \qquad (6)$$

where, *q* is the designed rain water discharge capacity (L/(s·ha));
P is the design ARI (years); and
t is the rain duration (min).

57. *P* and *t* were selected as 3 years and 10 min respectively in the FSR analysis. The baseline 3 year ARI daily storm of Baise is 100.03mm, and 2050 mid scenario projection becomes 106.10mm, and 2100 projection is 111.88mm, which represents a 6.0% and 11.8% storm intensity increase.

58. The same as subproject 7, subproject 8 includes teaching building and student dormitory development. In order to mitigate heatwave damage to human health, good attention should be paid in building project design.

H. The adaptation options

59. Given the likely changing climate in the future, managing climate risks will require adoption of effective adaptation actions, in order to minimise future risks. Adaptation measures can reduce vulnerability and alleviate climate change impacts. This section discusses the adaptation options that have been identified based on literature review and field visit.

H.1 "Hard" options: engineering measures in project design and construction

60. As 'hard' adaptation, the adjusting of the design standard based on the climate change assessment would be the most effective and efficient option to mitigate the impact, because the investment at this stage is usually small but with the best outputs. For the subprojects included in this study, the adjusting of the design standard is mainly to increase the drain capacity to ensure that the standard will still be valid under future climate. Sufficient drainage capacity is critical to prevent surface flooding. According to the FSRs, the drainage system design followed the general method of adopting an empirical formula from analysis of the historical observed storm event. Clearly the adequacy of the design requires examination given the climate change impact on rainfall.

61. The construction of drain systems consist of laying underground pipes, which is usually difficult to rectify in the future. Therefore it may be worthwhile to adopt the climate change result from high climate change scenario projection to determine the adjusting value. As show in Table 5, for station Longzhou the 2 year ARI daily maximum rainfall is 92.46mm, which will become 107.17mm by 2100 under mid-climate change scenario projection, which is 15.9% increase. The projected event corresponds to a 3.25 year ARI according to the baseline GEV distribution. In other words, the current 3.25 year ARI event may become 2 year ARI event by 2100. Assuming the climate change impact on rainfall of Chongzuo is similar to Longzuo, the adjusted design rain water discharge capacity *q'* can be derived from equation (1) as:

$$\frac{q'}{q} = \frac{1 + 0.633LgP'}{1 + 0.633LgP} = \frac{1 + 0.633Lg(3.25)}{1 + 0.633Lg(2)} = 1.11$$

62. Therefore it is recommended that the outdoor drain system design should be examined against 11% increase current design standard, in order to ensure its sufficiency for future increased storm intensity due to climate change impact. Similar adjustment should also be considered for other subprojects, with the results summarised in Table 8.

63. As shown in Table 8, the drain system design standard requires different level of adjustment for different subproject. Subproject 2 requires the least adjustment of 1% increase, while subprojects 1, 3, and 4 require the highest adjustment of 11% increase. Subprojects 7, 8, 5, and 6 require 5 to 10% increase.

64. The heavy storm induced surface runoff is a major cause of soil erosion. If the frequency of heavy storm events increases there is also likely to be a higher risk of other geological hazards such as landslide. Both subprojects 2 and 4 are road construction on hilly locations, with substantial slope-land cutting and levelling. Engineering measures are usually required to stabilize the slopes. It is recommended that a higher design standard should be adopted for slope stabilisation.

Table 8: Storm water drain design standard adjustment for each subproject

Item	Location	Baseline Design *ARI* (Year)	2100 Mid Scenario Design at baseline *ARI* (Year)	Drain Design Standard Change Ratio (*q'/q*)
Subproject 1	Jiangzhou/ Chongzuo	2	3.25	1.11
Subproject 2	Dongxing/ Fangchenggang	3	4.50	1.01
Subproject 3	Pingxiang/ Chongzuo	3	5.15	1.11
Subproject 4	Qinzhou	3	4.50	1.10
Subproject 5	Qinzhou	3	4.50	1.10
Subproject 6	Guilin	5	7.28	1.05
Subproject 7	Baise	3	4.62	1.08

Table 9: Estimation of additional construction cost of adjusting drainage system design*

	Original cost (US$)	Additional cost (US$)	Additional cost to total cost ratio (%)
Subroject 1	6724000	460000	0.6
Subroject 2	5370150	370000	0.7
Subroject 3	1355300	100000	0.5
Subroject 4**	-	15000	0.05
Subroject 5**	-	12400	0.05
Subroject 6	433200	30000	0.03
Subroject 7	1230000	85000	0.09

*Original cost data obtained from Feasibility Reports (US$1=CNY6.78).
Additional adaptation cost ratio was based on Tranche 1 civil works impact assessment.
**Outdoor storm drain design was not considered for building subprojects 4 and 5 in their feasibility studies. A ratio of 0.05% of the total cost was adopted as a guideline for the detailed design.

65. The detailed design has not started for the subprojects in Tranche 2. Reference was made to the similar civil works in Tranche 1 projects in order to estimate the additional cost of adopting the 'hard' adaptation in design standard adjustment. During discussion with the Design Institutes for Tranche 1 civil work projects, it was found that approximately 10% additional cost was needed to provide 8% to 10% outdoor drainage capacity increase, as showing in Table 9. In general, the required additional adaptation cost is relative small compared to the total cost; with the road civil works requires the largest input (Subprojects 1, 2 and 3).

66. Heatwave will very likely become more frequent and long lasting in the future. Potentially, heatwave may become a big health threat for people living/working in the subprojects area. Through a comparison study of heatwaves of 1998 and 2003, Tan et al. (2007) conclude that mortality was strongly associated with the duration of the heatwave when it happens. However, the improvements in living conditions, such as increased use of air conditioning, larger living areas, and increased urban green space, along with higher levels of heat awareness and the implementation of a heat warning system, could significantly reduce

the heatwave risk. Clearly, air conditioning is the most effective engineering measure against heatwave risk. According to the FSRs, no centralized air conditioning system was designed for the 3 subprojects that involve building living and working environment for people (subproject 5, 7 and 8). Even though the air conditioning system may not be necessary for the current climate conditions, the need for air conditioning facility in the future should be considered and if necessary provisions included in the design, for example, adequate power supply and facility space so a system can be installed easily at a future time when it becomes necessary. Building design should incorporate natural ventilation options and could specify materials for roofs and building envelope that reflect solar radiation rather than absorb it. Covered walkways that provide cover from rain and sun could also be considered.

67. In addition to adjusting the outdoor drainage capacity design standard, the 'green building construction' and 'sponge city' concepts were included in the feasibility study for the two campus development subprojects. The implementation of these concepts could effectively alleviate the surface flooding impact and reduce the heat wave effects on human; hence are active 'hard' adaptation options. In Subprojects 6, additional CNY15,466,000 (US$2,281,121) is allocated for green building development; a CNY9,666,000 (US$1,425,664) is allocated for sponge city development. In Subprojects 7, the allocated fund for outdoor drainage system development construction sponge city development is CNY8,334,600 (US$1,229,292). Therefore, according to the FSRs, the total estimated adaptation cost, which includes the additional cost of adjusting the drain system design (US$1,072,400) and the green building/sponge city development (US$4,936,077), is approximately US$6,000,000.

H.2 "Soft" measures: ecological solutions, management options

68. Resilience can also be strengthened through non-engineering measures. Good vegetation cover has proven to be effective in preventing soil erosion and landslide hazard. More green space created by good vegetation cover is also an effective option to reduce the heatwave risk to human health, as found by Tan et al (2007). Heatwave risk can also be managed through awareness raising of staff, students and trainees to enable preparedness in the event of a heatwave.

69. Even generally in small scale, the subprojects of Tranche 2 also contribute to the climate change mitigation. Solar energy generation and solar water heating was adopted in the FSRs for building development of subprojects 6 and 7. The estimated mitigation investment required for installation of the solar energy and solar heating system is US$5,600,000. The solar energy will help reduce CO_2 emission. Based on the FSRs, the daily hot water consumption of subprojects Gulin and Baise is 56m^3 and 606m^3 respectively, or a total of 0.24 million ton annually. Assume the water is heated from 25 to 45°C, which approximately requires 0.7 million ton combustion of coal annually. Therefore, the annual CO_2 reduction due to the use of solar energy is approximately 2 million ton annually. The road development will help to save petrol. According to the FSRs, for the next 15 to 20 years the derived annual CO_2 reduction is equivalent to 25000 tons from the road development of subprojects 1 and 3 only.

I. Conclusion

70. The future changing climate will have important implications for Tranche 2 subprojects of Guangxi RCI program. The RCI area has already observed a warming trend and the temperature will likely continuously increase due to climate change impacts. According to the mid climate change scenario, the annual mean temperature was projected to increase about 1.2ºC and 2.3ºC by 2050 and 2100, respectively. Similar impacts are also expected for the maximum temperature, which is closely related to heatwave hazard. Climate change will also impact on future rainfall in the program area. For the northwest program area, the annual average rainfall was projected to increase about 2.0% and 4.0% by 2050 and 2100 respectively; and for the southeast, it is 3.8% and 7.4% by 2050 and 2100 respectively. Heavy storm events will likely be even more frequent and intense. For the coastal city of Qinzhou, the storm water amount is projected under a mid climate change scenario to increase almost 6% and 12% by 2050 and 2100, respectively. The impact effects are more pronounced for the inland city of Longzhou, which is 6.94% and 13.52%, by 2050 and 2100, respectively. The increased storm volume indicates an exacerbated risk of surface flood and landslide hazards. Finally, the mid sea level change scenario projects that the average sea level of Beibu Gulf increases between 25 cm and 64 cm, by 2050 and 2100, respectively.

71. Several 'hard' adaptation options were identified in order to alleviate the climate change impacts, with the most important action being adjusting the storm water drain system design standard according to the assessment findings. Detailed adjustment values are listed in Table 8. 'Hard' slope land stabilization measures such as retaining wall and soft measures such as vegetation planting are recommended to minimise risk of landslide damage. Heatwave has the potential to become a major climate hazard in the future. Air conditioning is the most effective engineering measure against the heatwave risk. It is recommended to have the buildings being 'heatwave ready' through providing sufficient power supply and preparing space for future air-conditioning facilities. Provision of natural ventilation opportunities, use of solar reflective non-absorbent material in roof and building exterior material specifications and provision of covered walkways on campus should also be considered.

72. 'Soft' adaptation options have also been proven to be effective in reducing impact risk. Landslide risk is closely related with soil erosion. It has been found that human induced soil erosion has become a serious issue in the program area. Ecological restoration by planting native vegetation to create more green space helps stop soil erosion; and it also helps reducing heatwave risks. Awareness raising about the knowledge of heatwave, its risk to human health and ways to manage risks should be considered for the future during high heatwave risk periods.

73. This study was constrained by a number of limitations and could be improved if more supporting data was accessible. The following are the lists of some of the major limitations:

- The drainage capacity assessment was conducted on the basis of available data. Because storm drainage system design commonly makes use of sub-daily rainfall data, it would be ideal that the assessment could be conducted based on data that has the same temporal scale.
- For data was not available for some subproject locations, the assessment is based on data close to the subproject sites.
- The adaptation recommendation is made on the 'best guess' assessment results, which are the mid scenario projection for 2100. Considering the uncertainty of the future change, the affordability of the adaptation cost, as well as the longevity of the subprojects, we did not use the high climate sensitivity scenario projection, but it was listed as a reference.

- The adaptation options discussed were presented as initial recommendations. No economic data was available to investigate the cost-benefit of implementing such adaptation options. However, we recommend selection of appropriate adaptations and/or their combination to be considered in subproject detailed design wherever feasible.

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Appendix 1: Climate change scenario generation

The uncertainties in climate change scenario generation

The future climate change projection includes uncertainties, particularly at the regional and local level. The major sources of uncertainties come from: 1) the difference of spatial change projections modelled by different GCMs; 2) the uncertainty in future atmospheric GHG concentration; and 3) the uncertainty results from limitations in the scientific understanding of the response of the climate systems to radiative forcing. Different GCM models have different parameterisation due to the unknown or not fully understood mechanism and feedbacks in the climate systems. Consequently, there remain large differences between GCMs in their projections of global-mean temperature change. A thoroughly studied uncertainty by the scientific community is the difference in GCM model parameterisation, or the climate sensitivity. The climate sensitivity is conventionally defined as the equilibrium change in global mean surface temperature following a doubling of the atmospheric (equivalent) CO_2 concentration simulated by a GCM. It has been found that the uncertainty range is between 2.0°C to 4.5°C (Solomon et al., 2007).

To reflect the uncertainty of future GHG emission rates, a new process has been used for future global climate change projection since IPCC AR5. In this process, GHG emissions and socioeconomic scenarios are developed in parallel, building on different trajectories of radiative forcing over time to construct ***pathways*** (trajectories over time) of radiative forcing levels (or CO_2-equivalent concentrations) that are both ***representative*** of the emissions scenario literature and span a wide space of resulting GHG ***concentrations*** that lead to clearly distinguishable climate futures. These radiative forcing trajectories were thus termed "Representative Concentration Pathways" (RCPs). A RCP was simulated in an Integrated Assessment model to provide one internally consistent plausible pathway of GHG emissions and land use change that leads to the specific radiative forcing target. The full set of RCPs spans the complete range of integrated assessment literature on emissions pathways and the radiative forcing targets are distinct enough to result in clearly different climate signals.

Thus a combination of different RCPs and climate sensitivities can be used to characterise future scenario that reflect the major uncertainties at the global scale. In this study, three RCPs are used to characterise the possible climate change scenario and uncertainty range, i.e., RCP4.5, RCP6.0 and RCP8.5, which are corresponding to a possible range of radiative forcing values in the year 2100 of 4.5, 6.0, and 8.5 W/m^2, respectively. RCP6.0 with mid-climate sensitivity represents a middle range future change scenario. Similarly, RCP4.5 with low-climate sensitivity and RCP8.5 with high-climate sensitivity represents the low and high bound of the uncertainty range of future global change scenarios.

The General Circulation Model (GCM) is the most reliable tool in generating the future climate change scenarios at large to global scale. The third important uncertainty in climate change scenario generation is the difference between GCM simulations for given regions or locations. At the regional-to-local scale, the uncertainties expend in terms of the spatial patterns of climate changes. Given the current state of scientific understanding and limitations of GCMs in simulating the complex climate system, for any given region in the world, it is still not possible to single out a GCM that outperforms all other GCMs in future climate change projection. Future climate change projection based on the analysis of a large ensemble of GCM outputs is more appropriate than using any individual GCM outputs (Wilby et al. 2009). This is particularly important if such a projection is used for impact assessments; a large ensemble of GCM simulations can provide a reliable specification of the spread of possible regional changes by including samples covering the widest possible range modelling uncertainties (Murphy et al. 2004, Sortberg and Kvamsto 2006, Murphy et al. 2007, Räisänen 2007). A single GCM projection of future climate made with even the most sophisticated GCM can be of limited use for impact assessment as it lacks the ability to provide information on the

range of uncertainties. Within an ensemble approach; provided the members of the ensemble are independent, a larger ensemble size could lead to a more reliable statistical result (Sterl et al. 2007). In this study, the 50 percentile value from the model ensemble sample was used in generating future climate change projections.

The pattern scaling method

The pattern-scaling method (Santer *et al*., 1990) is based on the theory that firstly, a simple climate model can accurately represent the global responses of a GCM, even when the response is non-linear (Raper et al. 2001), and secondly, a wide range of climatic variables represented by a GCM are a linear function of the global annual mean temperature change represented by the same GCM at different spatial and/or temporal scales (Mitchell, 2003, Whetton et al. 2005). Constructing climate change scenarios using the pattern-scaling method requires the following information:

a) regional patterns of changes in climate (e.g. for precipitation) by specified timeframe (e.g. month) from GCM results, which are normalized to give a spatial pattern of change per degree of global-mean temperature change;
b) time-dependent projections of global-mean temperature change projected by a selected RCP under a selected "climate sensitivities"
c) baseline climate variables derived from observational records.

In generating a "time-slice" scenario for a future year, the normalised pattern (a) is scaled by a time dependent projection of global-mean temperature change (b). The resultant scenario of climate change is then used to perturb the underlying observed spatial climatology (c) to give a "new" climate for the year in question. In this way, the three key uncertainties – the GCM spatial patterns of change, the future GHG emission rates and the climate sensitivity – can be treated independently and combined flexibly and quickly to produce future climate scenarios (as per Wigley, 2003).

The advantage of pattern-scaling method is that the three key uncertainties – the future radiative forcing, the climate sensitivity and the GCM projected change – can be treated independently and combined flexibly and quickly to produce future climate scenarios (Wigley, 2003), while the key assumption underline the pattern-scaling method is that, at first the RCPs can accurately represent the global responses of a GCM even when the response is non-linear (Raper et al, 2001); and secondly for a GCM, the change of its climatic variables are a linear function of its global annual mean temperature change at different spatial and/or temporal scales. The GCM models of the couple model intercomparsion project phase 5 (CMIP5) results, which was the data supporting the IPCC AR5, were included in in the model ensemble (see Appendix 2 for the GCM included). All 40 GCMs with monthly data outputs were used in spatial GCM scenario generation. The 20 GCMs that has daily GCM outputs were used in extreme rainfall value scenario construction. As pointed by Reichler and Kim (2008), the average of models' simulation of changes for a climate variable is normally used to capture the middle conditions, as that the average often agrees better with observed climate than any individual model estimates. However, it was found that, though all GCMs has reasonable agreement in climate simulation at global or large regional scale, the difference of GCMs results could be significantly large at local or small regional scale indicating a huge uncertainty at such spatial scales. Furthermore, such uncertainty is not consistent; hence it is difficult to identify and eliminate certain GCMs from model ensemble. The one or two 'outlier' GCM results could generate very biased projection for the average value of the ensemble. In this study, the median of the model ensemble, instead of the average, was used in order to provide a "best estimate" scenario of future change It is worthwhile to note that we only use the median value in this study, mainly due to the relative small ensemble size. Ideally top and bottom percentiles should also be used to determine the high and low uncertainty range bounds, but for practical purposes of guidance for policy and action this often tends to expend

the scenarios to the point of being unmanageable and/or unusable. Again this is particularly true given the relative small size of ensemble that is 40 monthly GCMs and 20 daily GCMs.

The pattern scaling method is also extended to analyse the climate change impact on climate variability, such as the extreme precipitation event. A general extreme value (GEV) function was applied to the daily precipitation data from historical observations and GCM outputs to derive precipitation intensity values. Similar to a normalised pattern for monthly precipitation, normalised patterns of a series of precipitation intensities, such as 20 year ARI maximum daily precipitation, are calculated for a GCM following the steps discussed previously. In generating the normalised patterns, the GCM simulated period of 1975 to 2005 was used as GCM baseline.

Out of the 40 GCMs 22 have their daily simulation outputs publically available (see Appendix 2). For the GCM with available daily data, a linear regression method was used to process them in order to derive the normalised pattern for the precipitation intensity series. A more detail discussion of the extreme precipitation change scenario generation can be found from Ye and Li (2011).

Appendix 2: IPCC AR5 GCMs used in this scenario generation and their horizontal and vertical resolutions. Models with daily data available are used for extreme rainfall event scenario generation, with sea level are used for sea level change scenario generation

Model label	Resolution (longitude°× latitude°)	Daily	Sea level	Institution
ACCESS1.0	1.875×1.25	No	No	Commonwealth Scientific and Industrial Research Organisation/Bureau of Meteorology (CSIRO-BOM) Australia
ACCESS1.3	1.875×1.25	Yes	No	Commonwealth Scientific and Industrial Research Organisation/Bureau of Meteorology (CSIRO-BOM) Australia
BCC-CSM1.1	2.8125×2.8125	No	Yes	Beijing Climate Center (BCC) China
BCC-CSM1.1(m)	2.8125×2.8125	No	Yes	Beijing Climate Center (BCC) China
BNU-ESM	2.8125×2.8125	No		Beijing Normal University (BNU) China
CanESM2	2.8125×2.8125	Yes	Yes	Canadian Centre for Climate Modelling and Analysis (CCCma) Canada
CCSM4	1.25×0.9375	Yes	Yes	National Center for Atmospheric Research (NCAR) USA
CESM1(BGC)	1.25×0.9375	Yes	No	National Center for Atmospheric Research (NCAR) USA
CESM1(CAM5)	1.25×0.9375	No	No	National Center for Atmospheric Research (NCAR) USA
CMCC-CM	0.75×0.75	Yes	Yes	Centro Euro-Mediterraneo sui Cambiamenti Climatici (CMCC) Italy
CMCC-CMS	1.875×1.875	Yes	Yes	Centro Euro-Mediterraneo sui Cambiamenti Climatici (CMCC) Italy
CNRM-CM5	1.4×1.4	Yes	Yes	Centre National de Recherches Météorologiques (CNRM-CERFACS) France
CSIRO-Mk3.6.0	1.875×1.875	Yes	Yes	Commonwealth Scientific and Industrial Research Organisation (CSIRO) Australia
EC-EARTH	1.125×1.125	No	No	EC-EARTH consortium published at Irish Centre for High-End Computing (ICHEC) Netherlands/Ireland
FGOALS-g2	2.81x1.66	No	No	Institute of Atmospheric Physics, Chinese Academy of Sciences(LSAG-CESS) China
FGOALS-s2	2.81x1.66	No	No	Institute of Atmospheric Physics, Chinese Academy of Sciences(LSAG-IAP) China
GFDL-CM3	2.5 × 2.0	No	Yes	Geophysical Fluid Dynamics Laboratory (GFDL) USA
GFDL-ESM2G	2.5x2.0	Yes	Yes	Geophysical Fluid Dynamics Laboratory (GFDL) USA
GFDL-ESM2M	2.5x2.0	Yes	Yes	Geophysical Fluid Dynamics Laboratory (GFDL) USA
GISS-E2-H	2.5×2×L40	No	Yes	NASA Goddard Institute for Space Studies (NASA-GISS) USA

GISS-E2-H-CC	2.5×2×L40	No	No	NASA Goddard Institute for Space Studies (NASA-GISS) USA
GISS-E2-R	2.5×2×L40	No	Yes	NASA Goddard Institute for Space Studies (NASA-GISS) USA
GISS-E2-R-CC	2.5x2×L40	No	Yes	NASA Goddard Institute for Space Studies (NASA-GISS) USA
HadCM3	3.75x2.5	No	No	Met Office Hadley Centre (MOHC) UK
HadGEM2-AO	1.875 × 1.2413	No	No	National Institute of Meteorological Research, Korea Meteorological Administration (NIMR-KMA) South Korea
HadGEM2-CC	1.875 × 1.2413	No	Yes	Met Office Hadley Centre (MOHC) UK
HadGEM2-AO	1.875 × 1.2413	No	No	National Institute of Meteorological Research, Korea Meteorological Administration (NIMR-KMA) South Korea
HadGEM2-CC	1.875 × 1.2413	No	No	Met Office Hadley Centre (MOHC) UK
HadGEM2-ES	1.875 × 1.2413	Yes	Yes	Met Office Hadley Centre (MOHC) UK
INM-CM4	2x1.5	Yes	Yes	Russian Academy of Sciences, Institute of Numerical Mathematics (INM) Russia
IPSL-CM5A-LR	3.75x1.875	Yes	No	Institut Pierre Simon Laplace (IPSL) France
IPSL-CM5A-MR	2.5x1.25874	Yes	No	Institut Pierre Simon Laplace (IPSL) France
IPSL-CM5B-LR	3.75x1.875	Yes	No	Institut Pierre Simon Laplace (IPSL) France
MIROC-ESM	2.8125x2.8125	Yes	Yes	Atmosphere and Ocean Research Institute (The University of Tokyo), National Institute for Environmental Studies, and Japan Agency for Marine-Earth Science and Technology (MIROC) Japan
MIROC-ESM-CHEM	2.8125x2.8125	Yes	Yes	Atmosphere and Ocean Research Institute (The University of Tokyo), National Institute for Environmental Studies, and Japan Agency for Marine-Earth Science and Technology (MIROC) Japan
MIROC4h	0.5625x0.5625	No	No	Atmosphere and Ocean Research Institute (The University of Tokyo), National Institute for Environmental Studies, and Japan Agency for Marine-Earth Science and Technology (MIROC) Japan
MIROC5	1.40625 × 1.40625	Yes	Yes	Atmosphere and Ocean Research Institute (The University of Tokyo), National Institute for Environmental Studies, and Japan Agency for Marine-Earth Science and Technology (MIROC) Japan
MPI-ESM-LR	1.875x1.875	Yes	Yes	Max Planck Institute for Meteorology (MPI-M) Germany
MPI-ESM-MR	1.875 × 1.875	Yes	Yes	Max Planck Institute for Meteorology (MPI-M) Germany
MRI-CGCM3	1.125x1.125	Yes	Yes	Meteorological Research Institute (MRI) Japan

NorESM1-M	2.5x1.875	Yes	Yes	Bjerknes Centre for Climate Research, Norwegian Meteorological Institute (NCC) Norway
NorESM1-ME	2x2	No	Yes	Bjerknes Centre for Climate Research, Norwegian Meteorological Institute (NCC) Norway

Wildlife Trafficking Report

Project Number: 50050-004
July 2017

PRC: Guangxi Regional Cooperation and Integration Promotion Investment Program – Tranche 2

Report on the trade and Wildlife Trafficking Assessment for the SC 108777 PRC: Guangxi Regional Cooperation and Integration Promotion Investment Program – Tranche 2

June 2017

1. ADB is preparing tranche 2 of the investment program to support the PRC's Guangxi Zhuang Autonomous Region (Guangxi) in developing the border areas, within the framework of the Greater Mekong Subregion (GMS) Program, with a particular focus on economic corridor development. The investment program will enhance cooperation between the PRC and Viet Nam, and is expected to have high spill-overs, benefitting both Guangxi and Viet Nam's northern border provinces including Quang Ninh, Lang Son, and Cao Bang.

2. The illegal smuggling of protected and controlled wildlife and timber species has been identified as a major issue in the program area with additional concerns on trading contaminated agricultural products (including contaminations by soils, waters, and banned fertilizers and pesticides). This may increase as a result of increased trade and activity associated with growth of border economic zones. In order to manage those risks, it is proposed that an assessment be undertaken to determine the potential impact of the proposed tranche 2 activities on trade and wildlife trafficking in the target areas, and identify mitigating measures to minimize risks.

3. As the trade and wildlife trafficking specialist, a site visit for the tranche 2 of the investment program were arranged during April 9th to 15th. The assessment will be engaged to support the government with cross-border dialogue on trade and wildlife trafficking issues, assessment, monitoring and reporting. To the extent possible, help the government develop initial trade and wildlife trafficking capacity building training programs to raise awareness and understanding of international and national trade and wildlife laws, specific trade and wildlife trafficking issues in the target area to build capacity for enforcement.

4. In Guangxi 8 counties share a border with Vietnam, with 12 border ports of entry, among which Dongxing, Pingxiang, Youyiguan, Shuikou and Longbang are national ports. Along the border with Vietnam, 25 border markets are connected by road to these ports and other trading points. Dongxing, Puzhai and Nongrao-Nonghai are the three most important border trade ports. Nanning, as the capital of Guangxi, is one of the largest international wildlife trading hubs in China, also acting as a market for trade in domestic wildlife resources illegally harvested from within the province and Yunnan. In this visit, the project team visited Pingxiang, Longzhou, Chongzuo, Qinzhou, Dongxing, Guilin and Baise.

5. Pingxiang, Longzhou and Dongxing visited during this trip were used to be key illegal wildlife trafficking ports in the province. Most of smuggled wildlife products from Vietnam through these ports were transported via Nanning or Beihai and finally traded to the illegal market destinations in Guangdong Province according to the previous studies in the region. Based on the confiscation data provided by Guangxi Forest Policy, ivory, rosewood, pangolin and turtles were popular wildlife products in seizures.

Assessment report for each applicant project

#1. Chongzuo Sino-Vietnam Border Economic Cooperation Zone Demonstration Project (Phase I). Location: Chongzuo

6. Construction and rehabilitation of roads in the border economic zone (BEZ).
The proposed roads construction project in the region would be benefit for improving the

transportation status of the sugar refinery, feed mill and organic fertilizer factory that already built in the Chongzuo city. The improvement of the traffic could also benefit for workers living in town to get to these factories. There is no significant link between the proposed roads with other cross border paths based on the design drawing provided by local construction unit. In this regard, the project does have immediate risk of increasing illegal wildlife trade in the region.
Facilities of the feed mill and fertilizer factory had been built to using sugarcane leaves to make fodder and green fertilizer. There is over 270,000 hectares sugarcane planted in Chongzuo annually since 2015. The local feed mill and fertilizer factory could fully use sugarcane leaves and bagasse those leftovers from sugar refining to make high value products such as greenfeed and green manure. All raw materials for the sugar refinery, feed mill and fertilizer factory are all local planted sugarcane, and there won't be any imported materials from Vietnam side for these factories. Therefore, as of now there is no concern on contaminated agricultural products traded going beyond the border (including contaminations by soils, waters, and banned fertilizers and pesticides).

#2. Dongxing Changhu Road (East Section) Construction Project. Location: Dongxing
Construction of the east section roads. This subproject will improve cross-border connectivity.

7. Beilun River is the most important smuggling route between China and Vietnam in Dongxing City, where is a boundary river between the cities of Dongxing of PRC and Moncay of Vietnam. The region along the Beilun River has become an important doorway for smuggling activities. Although the entire region of the Beilun River is surrounded by guardrails, where are still a few places which allow people to pass or climb over, and there are a lot of people (at least five people in 15 minutes were observed at the site) that traveled back and forth along the river by boat after climbing over the guardrails. Some people from Vietnam quickly ran away after going ashore, and then were picked up by someone else and left by a motorbike. Given the rampant smuggling activities during the day, it is believed that the condition would be worse at night.

8. In addition, along the Beilun River, there are many handicraft shops and redwood furniture stores. According to the previous survey in 2016 in Dongxing, it was found that there are 6 stores engaging in display and public sale of ivory products, and that they just display one or two products at the corner, but after asking the vendors, they can show you much more than those on display; besides, the prices of the ivory products here are generally slightly lower than those in the illegal markets of other cities in China. Besides, there are also water deer (*Rusa unicolor*, 2nd class national protected species/CITES Appendix I) heads, Tibetan antelope (*Pantholops hodgsonii*, 1st class national protected species/CITES Appendix I) horns sold in the market. Meanwhile, in the Dongxing International Trade Market, it was also found that some vendors selling live wild animals, most of them being wild birds (like Reded Feet *Amaurornis phoenicurus*, IUCN LC), Testudinates, frogs and snakes (like mud snakes, species unknown, IUCN LC). According to these vendors, Elongated tortoises (*Indotestudo elongate*, CITES Appendix II), golden head tortoises (*Cuora* spp, CITES Appendix II), forest tortoises (species unknown) and *chelydra serpentines* (IUCN, LC) were also found. During the recent assessment in the past April of 2017, there are more rosewood stores were found at the port of Dongxing. Stores along the street are mainly engaging in selling furniture made of redwood, which are a group of protected species including *Dalbergia cochinchinensisin* (Siam Rosewood), *Pterocarpus santalinus* (Red Sandalwood) and *Dalbergia odorifera* (Fragrant rosewood). Red sandalwood and Siamese rosewood are listed on CITES Appendix II, and Fragrant rosewood is a 2nd class national protected species. In term of quantity, the *Dalbergia odorifera* is so fewer that it is the most expensive one; the red sandalwood is seldom used to make large furniture, and is mainly used to make crafts and strings; at present, the relatively popular material is the Siamese rosewood imported from Vietnam. The numbers of rosewood stores are increasing comparison to the previous survey a year ago. It is indicated that the demand for rosewood in China side keeps increasing, and

the market price of the rosewood furniture has increased at 50 percent comparison to that found about a year ago.

9. The road construction project would improve the local transportation condition and benefit border trade business. However, it would also have potential opportunity for smugglers to take this advantage for the illegal wildlife trafficking in the area. Nanning Customs Office, CITES Nanning Branch Office, and together with Guangxi Forest Police had organized couple of wildlife law enforcement training courses in Dongxing together with Beijing Normal University since 2014. The collaboration among wildlife law enforcement agencies including Customs, Forest Police, Frontier Army and local market management bureau are still critically needed. The collaboration such as periodically joint anti-smuggling actions should be led by regional CITES branch office in partnership with all related port control agencies including Customs and Frontier Army at the port checking points; the local Market Management Bureau, Forest Police and CITES branch office also need to work together to check those rosewood furniture stores frequently, and see whether all CITES regulated species products have required permits.

#3. Infrastructure development for Longzhou Border Economic Cooperation Zone.

Location: Longzhou
Construction of roads for a new area of BEZ. The demand analysis of constructing the new area has to be strengthened.

10. Shuikou port at Longzhou used to be one of important checkpoint to combat wildlife smuggling in the region. Several illegal wildlife trafficking cases were confiscated by local Customs and Forest Police officers at Shuikou in 2014, and confiscation were including bear gallbladders, pangolins, civet casts and leopard cats etc. In recent two years, illegal wildlife trafficking cases were dropped significantly due to the strengthening of local wildlife law enforcement led by Shuikou Customs and Chongzuo Frontier Army under the leadership of CITES Nanning Branch Office and Guangxi Provincial Anti-smuggling Office. CITES Nanning Branch Office in partnership with Guangxi Provincial Anti-smuggling Office organized joint wildlife law enforcement training course at least once a year for local Customs officers, Forest Police officers and Frontier Army soldiers since 2015. Experts from Beijing Normal University, Wildlife Conservation Society, International Fund for Animal Welfare and Guangxi University gave lectures on species identification for wildlife in common trade, wildlife products identification, national wildlife enforcement laws, as well as related CITES regulations and appendix species identification etc. With the intensive trainings and more frequent joint wildlife enforcement actions, local wildlife law enforcement capacity got improved signification.

11. The proposal project aims to build new roads in the region to improve the transportation condition for Longzhou Border Economic Cooperation Zone, in which in the future food processing factories can be built to process cashew nuts and pistachio nuts imported from Vietnam even though there is no such factory as of now. Meanwhile, it was estimated by local officials that 5,000 to 10,000 Vietnamese workers would be hired by these factories in future. In short term, the improvement of the transportation status the region will lead to significant increase of the agriculture products trade from Vietnam into China. The local project applicant needs to provide how big amount of the agriculture products will be imported from Vietnam and its further impact and safeguard on food production environmental externalities such as water, land, chemicals and pesticides use, as well as food safety issues on the Vietnam side should also be assessed.

12. In addition, with a relevant big number of Vietnamese workers hired in near future after the opening of the factories, more foreign immigrants and workers may provide more opportunities for wildlife smugglers to use Shuikou as an easy route for illegal wildlife

trafficking. Therefor, it is suggested continuing to build the wildlife law enforcement capacity in the region. Besides providing CITES and related wildlife law enforcement training courses, local forest police and customs need to establish new on-site checkpoint after the complete of the road construction. Currently, the nearest local trade port on the border is a preliminary port without customs officers due to the limited transportation capacity.

#4. Road Connectivity in Pingxiang-Viet Nam Cross-Border. Location: Pingxiang

13. This proposed subproject is to improve the cross-border connectivity between Guangxi and Viet Nam, which is a key output of MFF. This proposed subproject will be included in the list of subprojects of tranche 2, subject to meeting the following conditions: (i) inform ADB regarding the confirmed implementing agency and the implementing entities, (ii) complete the revision of the feasibility study report by incorporating all requests from ADB, and submit the revised acceptable FSR to ADB by 31 March 2017, and (iii) prepare and submit the domestic resettlement plan to ADB by 15 April 2017.

14. Pingxiang is one of important port for both legal and illegal wildlife trade in Guangxi Province. According to the previous surveys, several cases of wildlife seizures including rosewood without CITES permits, endangered turtles and ivory were confiscated by Customs and Forest Police officers in 2011, 2013 and 2015. During the survey, more rosewood stores were found in this April along the road from the Pingxiang City to the port. Seizures of ivory, python skins, and tons of rosewood were most popular products confiscated by local Customs and Forest Police in Pingxiang City. The construction of the road will benefit for improving local transportation, meanwhile it may also become an easy path for smugglers to bring more wildlife products through land transportation from Vietnam into China. Therefore, it is strongly suggested that local law enforcement agencies need to collaborate together under the leadership of the Provincial Anti-smuggling Office in partnership with CITES Nanning Branch Office at the checkpoints to strengthen the enforcement actions more frequently and to combat illegal wildlife trafficking in the region. Pingxiang Customs and Forest Police officers, as well as Frontier Army soldiers were well trained in the past two years during different types of wildlife law enforcement training courses organized by CITES Nanning Branch Office and Beijing Normal University. However, Coordination and collaboration among all these law enforcement agencies at the checkpoints in the city could be coordinated by the Provincial Anti-smuggling Office. A permanent wildlife law enforcement coordination team could be formed with representatives from each party at the city level to share intelligence information and to organize joint enforcement actions at local level. CITES Nanning Office could provide technical support such as periodically trainings and species identification supports to the joint team. Meanwhile, CITES Nanning Office can also bridge the Chinese law enforcement officers with counterparts in Vietnam side. In recent two years, China and Vietnam had established national level wildlife law enforcement dialog meetings to improve the collaboration on CITES implementation in the region. The regional cooperation between local enforcement agencies from both countries could be pilot in Pingxiang with support of ADB or other funding agencies in future.

5. Qinzhou Cross-Border Trade E-Commerce Industrial Park Project. Location: Qinzhou

15. Construction of E-commerce facilities, including electronic business data center and cross-border trade exhibition center. The relevant management information system (MIS) ICT system will be also installed as counterpart financing. An advisory service will be provided for the planning and procurement of the relevant MIS ICT system.

16. According to previous wildlife trade surveys in 2008, 2014 and 2016, as well as the data from the provincial forest police and customs, few wildlife confiscations had accrued in Qinzhou in the past 10 years. It is believed that Qinzhou is not a city on the wildlife trafficking route and the port of Qinzhou is not a key trading port with Vietnam or other Southeast Asian

states currently. With the increasing of the trade between China and ASEAN states in Qinzhou city, although the project itself would not have any potential risk of increasing illegal wildlife trade, criminals may choose any port of law enforcement weakness, and the illegal wildlife trade may increase if the law enforcement capacity could not match the change of potential rapid increasing of the trade between China and Vietnam in the region. Therefore, it is important to train more skilled wildlife law enforcement officers to strengthen the control of the port trade and reduce the risk of increasing illegal wildlife trafficking in the area. The Provincial Anti-smuggling Office together with CITES Nanning Branch Office could organize the trainings with the potential increase of the wildlife law enforcement needs such as Qinzhuo City. Currently, CITES Nanning Office will organize as least two or three wildlife enforcement training courses a year in Guangxi in partnership with Beijing Normal University, Wildlife Conservation Society and International Fund for Animal Welfare. It is suggested that the CITES Nanning Office could provide at least two law enforcement trainings (each course could train about 30-40 law enforcement officers) a year for related agencies in Qinzhou. With the current situation, only four customs officers from Qinzhou City to participate the annual training held by Nanning CITES Office last year.

#6. Qinzhou International Cold-Chain Logistic Demonstration Project. Location: Qinzhou

17. Construction of cold storage, related inspection and detention facilities and surveillance facilities. This subproject will also cover trade facility components, such as unification of testing standard of SPS between PRC and Viet Nam. An advisory support will be provided for the trade facility components.

18. The ADB experts visited the site where is inside the Qinzhou tax-protected zone, in which has its own customs, and inspection and quarantine checkpoints inside. The proposed project will increase the capacity of the imported good storage and improve related surveillance facilities in the area. In the previous CITES wildlife law enforcement training courses hosted by CITES Nanning Office and Beijing Normal University, there had beenonly four participants from Qinzhou Customs and Forest Police to take the trainings. Considering the size and the cargo handling capacity of the port is Qinzhou tax-protected zone, it is expected to have 15 to 20 more customs officers got trained annually to meet the future increasing of the cargo handling capacity in next two years in the area.

#7. China-ASEAN Small and Medium Enterprises (SMEs) Synergy Innovative Development Project, Location: Guilin

19. The project contents the construction of SMEs business development service center, industry practice base, ASEAN vocational training facilities and other related facilities. The project could benefit students from ASEAN States as well as locals to take various business trainings by improving the training facilities of Guilin University of Aerospace Technology, where currently could train over 350 students from Thailand, Vietnam and other ASEAN states annually. The university aims to increase the capacity of 18,700 students in total with over 700 overseas students (mainly from ASEAN states) by 2020. And the ADB project will help the university to reach its goal in next three years. Meanwhile, Guilin is a tourism city in northern Guangxi, there were few wildlife confiscation reported in the past two years according to data provided by provincial customs and forest police, it's indicated that the city is on the wildlife trafficking route in the province. The project is not related to illegal wildlife trade and agriculture trade in the region.

#8. China- ASEAN Educational Medicare Cooperation Project (Phase I), Location: Baise

20. This project will support the relocation/expansion of the campus, which is necessary to meet the growing demands for the medical/health human resources in the regions, including China side and ASEAN countries. The high-demand areas both in China and ASEAN states

are (i) medical equipment, (ii) food pharmacy, (iii) healthcare, (iv) elderly care, (v) inspection & quarantine, (vi) public health management. Those areas are keys for strengthening 'safe' connectivity of people between China and ASEAN countries, by ensuring safety in the regional public health. Currently, the Youjiang Medical College For Nationalities has capacity of 12,590 students with 399 overseas students and 736 faculties. After the improvement of the educational facilities, the university aims to reach 15,000 students with over 700 overseas students and more than 930 teachers in near future. The project is not related to illegal wildlife trafficking nor agriculture trade in the region directly.

Suggestions and recommendations:

21. Government agencies with a role in wildlife trade management including Customs, the State Forestry Administration, the Bureau of Fisheries (under the Ministry of Agriculture), the Ministry of Commerce, the Administration of Industry and Commerce, and Ministry of Police need to work together on combating illegal wildlife trafficking in the region. Wildlife trafficking and smuggling is a kind of organized crime with huge benefit along its supply chains. Single enforcement agency could not completely cover all aspects of illegal wildlife trade issue.

i) Customs is responsible for inspecting imported and exported goods, managing and monitoring wildlife trade, overseeing wildlife smuggling cases, within the customs inspection area and the coastal area near customs, and confiscating wildlife during smuggling and illegal importation.

ii) State Forestry Administration. In terms of import and export control, the Forestry Bureau has the right to monitor the implementation of the Law of the People's Republic of China on the Protection of Wildlife and other related regulations. According to the "Specific Permit Law," the Forestry Bureau can authorize or submit import and export applications to higher level authorities for authorization, and the Bureau has the right to handle cases involving forging, cheating, or transferring import or export permits.

iii) The Convention on International Trade of Endangered Species of Flora and Fauna (CITES) is enforced by offices around the country under the management of the China National Management Authority (CNMA) and the Forestry Bureau. They are responsible for the monitoring of CITES implementation on wildlife trade, authorizing permits and certificates, assisting relevant law enforcement bodies in illegal importing or exporting cases, rescuing and resettling confiscated live wild animals, charging wildlife import & export management fees based on relevant regulations, and organizing the training or publicity on CITES and the related domestic laws. In recent years, CITES Nanning Branch Office coordinated with Beijing Normal University together with Wildlife Conservation Society, International Fund for Animal, The Nature Conservancy and TRAFFIC to provide wildlife law enforcement training course for customs and forest police officers, which are warmly welcomed by local law enforcement officers.

iv) Administration of Industry and Commerce. This Administration is responsible for the management of domestic markets, protection of wildlife species, monitoring the market selling of livestock, marine animals, flowers, medicine and wildlife, and jointly working with the Forestry Bureau to regulate the market. Confiscated wildlife or smuggling cases identified by this Administration are handed over to the Forest Police Bureau.

v) Bureau of Fisheries under the Ministry of Agriculture. The Bureau is responsible for the implementation of state laws and regulations on oceans and fishery management, as well as for related international conventions. This means they control the overall

management of China's river areas, including aquatic animal conservation, fishery industry administration, the fishery industry business permit system, and other fishing activities, such as processing and distribution.

22. Currently, these governmental agencies are not integrated well on illegal wildlife trafficking control in the region. In recent years, CITES Nanning Branch Office, Guangxi Forest Police and Nanning Customs are working closely on wildlife law enforcement capacity building in partnership with Beijing Normal University and related civil society. More governmental agencies with responsibility on market management, aquatic wildlife management, road transportation control and port check points should also get involved in future to strengthen the collaboration on wildlife trade control in the region, especially on information exchange, joint actions, wildlife related legislation trainings, as well as trade controlled endangered species identifications. The collaboration among these related governmental agencies includes intelligence information sharing among related agencies, and organizing joint law enforcement actions frequently in key regions in the province. A first step is to establish a meeting dialog meeting among these enforcement agencies, and a working group should be established with key officers from intelligence sections, and then a core leading group could be formed to direct joint actions in future.

23. Wildlife law enforcement authorities should be incorporated into the joint-agency checkpoints along the border between China and Vietnam to enable checking of wildlife products at the ports. Awareness of domestic (eg. China Wildlife Protected Law) and international (eg. CITES) wildlife laws and punishments should also be directed to related governmental agencies and private sectors in the project region. In recent years, civil society working on combating wildlife trafficking had developed various kind of training manuals and public education brochures. Under the coordination of CITES Nanning Branch Office, related government agencies could also distribute these materials at ports along the border between China and Vietnam in the region. With the coordination of CITES Nanning Branch Office, a public awareness and education billboard was established and displayed at Nanning International Airport since 2015.

24. China and Vietnam CITES offices started to their annual dialog meeting since 2015. However, national level meetings and dialogs are not enough to deal with the increasing needs at local level. Joint efforts between China and Vietnam, such as joint wildlife enforcement actions, monthly dialog meeting at key ports like Pingxiang, Dongxing and Longzhou, as well as frequent intelligence information sharing mechanism could be facilitated by ADB or other funding agencies working in Guangxi Province to promote the solid collaboration between China and Vietnam on combating illegal wildlife trade in the region.

25. ADB and local stakeholders in Guangxi Province could facilitate on-site wildlife enforcement training courses for Customs, Forest Police, Market Management Bureau and Frontier Army in the key areas where applying ADB fund but with potential risks of increasing illegal wildlife trafficking, such as Pingxiang, Dongxing, Longzhou and Qinzhou. CITES Nanning Office could coordinate this kind of wildlife law enforcement capacity building together with its partners. With experiences in the past two years working in the region through this project, a 2-day training course for 100 enforcement officers with experienced trainers from partner NGOs and universities could be less than $15,000 USD each. Since 2015, CITES organized two training courses and trained over 200 wildlife enforcement officers annually in partnership with Beijing Normal University, International Fund for Animal Welfare, Freeland Foundation and Wildlife Conservation Society. It may be expected to provide two more trainings each year for enforcement agencies in Guangxi to meet the capacity building needs with the rapid increase of the trade between China and ASEAN States in the region.