Guangxi Chongzuo Border Connectivity Improvement Project

Environmental and Social Impact Assessment

Report

Employer: Guangxi Chongzuo City Construction Investment Development Group Co., Ltd.

Prepared by: Guangxi Communications Design Group Co., Ltd.

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List of Preparation Personnel for Report on Environmental and Social Impact Assessment of Guangxi Chongzuo Border Connectivity Improvement Project

S/N	Name	Title	Discipline	Education	Technical Qualification
I	**Social Impact Assessment**				
1	**Jian Hui**	Senior engineer	Civil works	Bachelor’s Degree	Registered Consulting Engineer
2	Ou Youhua	Senior engineer	Road and Bridge Engineering	Bachelor’s Degree	Registered Consulting Engineer
II	Environmental Impact Assessment				
1	Liao Huiqiong	Engineer	Environmental Science	Bachelor’s Degree	Engineer (Environment impact assessment)
2	Huang Wei	Engineer	Environmental Engineering	Bachelor’s Degree	Engineer (Environment impact assessment)
3	Liang Xianxian	Engineer	Environmental Engineering	Master's Degree	Engineer (Environment impact assessment)

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Project Background

ASEAN is an important part of China's in-depth cooperation with its neighboring countries. Guangxi is the most convenient gateway to the sea connecting the inland in the southwest and mid-south of China with ASEAN countries in the Indochina Peninsula, and has advantages in serving the open development of the region. As an important fulcrum of China-ASEAN cooperation, Vietnam plays a bridge role in promoting the development of China and ASEAN. Relevant parties in China and Vietnam are accelerating the construction of cross-border economic cooperation zones, which designate specific areas in the border areas between the two countries. Special policies such as goods trade, technology trade, and open-up in investment are given, and special cross-border customs supervision is implemented in the region to attract people flow, materials flow, capital flow and other production factors to gather. By integrating the surrounding resources, we can realize the full interaction and make use of complementary advantages of the border areas between the two countries to promote the rapid economic development of the region, and then radiate and drive the surrounding areas.

The construction of the China-Vietnam Cross-border Economic Cooperation Zone has made positive progress. Taking infrastructure construction as an example, within the planning scope of Dongxing-Mong Cai Cross-border Economic Cooperation Zone, it has started the construction of the Beilun River Second Bridge connecting China and Vietnam on April 1st of this year, and it is planned to be completed and opened to traffic in 2017; within the planning scope of Dong Dang-Pingxiang Cross-border Economic Cooperation Zone, Pingxiang Comprehensive Bonded Port Area, as a priority project of cross-border cooperation, was closed and operated in 2011. Shenzhen-Nanning-Pingxiang-Hanoi logistics line has been opened, realizing cross-border traffic of transport vehicles and official vehicles between the two countries, and the preliminary work of Pingxiang-Hanoi Expressway is progressing smoothly.

Border ports are important channels for China's foreign exchanges and foreign trade. In recent years, Guangxi has accelerated the construction of transportation facilities at border ports. Expressways have been opened at five Category-1 border ports, namely Longbang, Shuikou, Pingxiang, Youyiguan and Dongxing. Expressways at border ports such as Pingmeng, Shuolong, Aidian, Ningming and Dongzhong are under planning and construction. Class II roads are opened at Category-2 ports such as Kejia, Longzhou and Pingerguan, Pingxiang. The “overland ASEAN” strategy has been be actively implemented, and the level of facility connectivity has been improved. The port corridor has been taken as the focus, 12 international highway interfaces leading to Vietnam have been planned, and expressways have been planned for those interfaces for connectivity.

Although great progress has been made in the construction of border port traffic facilities for Guangxi, the requirements of opening up and development along the border have not been met yet; Therefore, many bottleneck problems such as the single road network restricting the hinterland transportation shall be solved. The proportion of high-grade highways in border counties and cities is generally low, and most highways are of Class III or below, which is difficult for large vehicles to pass through. And there is a lack of cross-border bridge facilities, which limits the passage of people and goods. The structure of the regional road network is simple, and main trunk lines have low grades and an overly concentrated layout, which limit the interconnection between ports and the hinterland, and restrict the open development of border trade economy and society.

Therefore, to speed up the development of Guangxi border ports, we must take Xi Jinping's Thought on Socialism with Chinese Characteristics for a New Era as the guide, transformation and upgrading as the main line, reform and innovation as the driving force and major projects as the carrier, fill up the shortcomings of infrastructure, improve the efficiency of customs clearance services, and effectively let the border ports to play the leading role in the development of border opening. Class-I highways shall be built at ports near urban areas and ports with large cargo flow, and Class-II highways or above should be built at other ports and trade points. Border highways shall be upgraded and constructed as per the standards for Class-II highways, promoting and strengthening infrastructure connectivity. Meanwhile, we must speed up the construction of cross-border tourism cooperation zones between China and Vietnam, such as Detian–Ban Gioc, Dongxing–Moncay, Friendship Pass–Youyi, and

Jingxi–Longbang tourism cooperation zones, and jointly promote cooperation in the entry-exit facilitation, infrastructure construction, public service system construction, cross-border self-driving tour development, and tourism safety management, so as to create a new high ground and demonstration zone for international cross-border tourism cooperation.

The Project is located in Chongzuo City, southwest of Guangxi, and in the middle of the Zuojiang River Basin. Chongzuo borders Nanning to the northeast, Baise to the north, and Fangchenggang to the southeast. Four counties of Chongzuo, including Pingxiang, Ningming, Longzhou, and Daxin, share boundaries with Vietnam in the west and south. Chongzuo City is along the border and expressways, adjacent to the capital and ASEAN, and close to the gulf, contributing to its location advantages in terms of transportation. The Nanning-Youyiguan Expressway, Chongzuo-Qinzhou Expressway and Chongzuo-Jingxi Expressway have been completed and open to traffic, and the Hunan-Guangxi Railway and national highways G322, G358, G359 and G219 run through the city from north to south. It is one of the few land port cities on China's southern border where railways, highways, and major domestic transport networks are connected. The borderline of Chongzuo is 533 km in length, accounting for 52% of the total length of the land border between Guangxi and Vietnam. It has the longest borderline among prefecture-level cities in Guangxi. There are five Category-1 ports, namely Pingxiang (Railway) Port, Youyiguan Port, Shuikou Port, Aidian Port and Shuolong Port. There are two Category-2 ports, namely Pinger and Kejia. The 14 cross-border trade points are convenient international passageways for connecting Guangxi to Vietnam and other ASEAN countries, and are the windows and frontiers for Guangxi’s opening-up.

At present, the border ports in Chongzuo are mainly connected by the border highway G219, a national highway stretching 387 km within Chongzuo. Chongzuo section of Highway G219 is mainly constructed as per the standards for Class-III highways in mountainous and hilly areas. It was built many years ago and was limited by the harsh terrain conditions and complicated geological and hydrological conditions along the route. On the one hand, the technical standards are low, so that local sections cannot meet the technical standards for Class-III highways, full of detours and steep slopes on the narrow road, with imperfect security facilities and many potential safety hazards. On the other hand, it is difficult for road maintenance and repair. Over the years, it has suffered from washouts and geological disasters many times, resulting in pavement desertification, unevenness, and poor traffic capacity, and even local road sections were interrupted by geological disasters. The current highways are unable to meet the requirements of economic development and people's life in border areas, and restrict the development of border ports.

To enhance the all-round opening-up capacity of transportation, strengthen the construction of passages for connecting expressways leading to areas beyond the province, the border and the sea, promote connectivity with neighboring regions and countries, and further strengthen the development of border ports, according to the *Expressway Network Planning of Guangxi (2018-2030)* approved by the Guangxi People's Government in 2018, it is planned to connect major border ports as important traffic hub nodes with expressways to ensure that each major port has access to expressways. Component A of the Project is a section of Wuzhou (Longyanzui) - Shuolong Expressway, which is the planned 7th horizontal line. The construction of the Project has opened up the "last kilometer" of Guangxi's interconnection with Vietnam through the Shuolong port and features short construction mileage and remarkable construction benefit. It will open up a convenient passage from Guangdong-Hong Kong-Macau Greater Bay Area to Vietnam and ASEAN countries via Nanning, improve the regional highway network, promote the effective development and utilization of tourism resources and mineral resources along the line and promote the local economic and social development.

In view of these factors, it is proposed to seek support from the Asian Infrastructure Investment Bank for the construction of the Guangxi Chongzuo Border Connectivity Improvement Project, which is of great significance to speed up the fight against poverty in border areas, improve the road network of border ports, promote interconnection with neighboring regions and countries, develop the economy of the Shuolong Port, and accelerate the development of China-ASEAN Free Trade Area.

Guangxi Chongzuo Border Connectivity Improvement Project consists of Component A: Wuzhou (Longyanzui) - Shuolong Highway (Chongzuo - Jingxi Expressway to Shuolong Port Section), Component B: Detian - Shuolong Highway, and Component C: Shuolong Port (Shuolong Main Gate) (Phase II) under Shuolong Port Infrastructure (Upgrading) Project in

Daxin County. The about 355m long road of the Detian (Daxin)–Huashan (Ningming) Highway (Shuolong–Tianxi Section)(Phase II) is associated to the Project.

Component A - Wuzhou (Longyanzui) - Shuolong Highway (Chongzuo - Jingxi Expressway to Shuolong Port Section) is "west-east road 7" among the "1 ring road, 12 west-east roads, 13 north-south roads, and 25 connecting lines" as planned in the *Expressway Network Planning of Guangxi* (2018-2030). The road consists of two parts: the main line and the Shuolong Connecting Line. The main line starts from the vicinity of Neitun, Liliang Village, Fuxin Town, Tiandeng County, connects Long'an-Shuolong Expressway under construction, extends southwestwards via Bulitun of Xuanjie Village and Longrun and Baidou of Yining Village, Shuolong Town, Daxin County, crosses the Xialei River at Bangtun of Yixian Village, and finally reaches the end point. Shuolong Connecting Line connects the end point of the main line and extends southwards to the vicinity of Rentun of Shuolong Community in the southeast corner of Shuolong Town via Guitun and Mengtun of Yixian Village. Then, it crosses Detian (Daxin)-Huashan (Ningming) Highway (Shuolong to Tianxi Section) at the same level, and finally reaches the end point of the Project. Component A is an important part of the inter-provincial channel "West-East Road 7"—Wuzhou (Longyanzui)–Shuolong Highway (Guangdong Yunfu–Cenxi–Guiping–Guigang–Qintang–Binyang–Wuming–Long'an–Shuolong) in the planning layout of the highway network. The construction of the Project is of great significance for building a convenient international channel from Guangxi to Vietnam and other ASEAN countries, and further strengthening the connection between Guangxi and Gaoping, Vietnam; The Project will facilitate the economic development of ethnic minority areas involved, help win the battle against poverty, promote the integration of all ethnic groups, drive forward cross-border labor cooperation of China and Vietnam, provide employment opportunities for women, boost the circulation of goods among ASEAN countries, speed up the development of China-Vietnam port trade. Therefore, it is necessary to construct the Project in order to build a sea-land corridor connecting ASEAN countries, enhance cooperation in the Pan-Pearl River Delta Area, forge ahead with the development of China-ASEAN Free Trade Area, improve China-Vietnam cooperation in infrastructure connectivity, achieve mutual benefit and win-win results, support the economic and social development of contiguous poor areas and ethnic minority and border areas, implement the *Expressway Network Planning of Guangxi* (2018-2030), improve the regional highway network, upgrade the International Corridor of Shuolong Port, implement the national strategy of western development, drive forward the revitalization and development of the

Zuojiang River and Youjiang River Former Revolutionary Base Areas, push ahead with the construction of Sino–Vietnamese Detian–Ban Gioc Waterfalls International Tourism Cooperation Zone, and turn Detian Waterfalls into a world waterfalls park.

Component B - Detian - Shuolong Highway is a special road planned for Detian Waterfall Scenic Area. The line starts from the entrance of Detian Waterfall Scenic Area, Detian Village, Shuolong Town, Daxin County, and connects the starting point of Detian-Renai Highway. It extends eastwards along the existing Detian-Shuolong Highway, passes through Liudeng of Detian Village, Wanlong of Aijiang Village, as well as Longhong and Gutun of Shuolong Community, ends at the vicinity of Rentun of Shuolong Community in the southeast corner of Shuolong Town. It crosses the Shuolong Connection Line of Component A at the same level. It is an important collector-distributor road connecting Shuolong Town and the Detian Scenic Area, and it is also an important tourism infrastructure road serving the Detian 5A Scenic Area. After it is upgraded, it will serve as the main transport line running through the entire Detian Scenic Area, and form a transport network for Shuolong Town together with Detian-Shuolong Highway and National Highway G359. The Project will be conducive to improving the highway network in the China-Vietnam border area and Daxin County of Guangxi Region, improving the reliability and traffic capacity of highway network, helping Daxin County accelerate the implementation of industrial and agricultural development plans, attracting goods and passengers from inter-provincial highways, and facilitating land development around the road. It will play a significant role in boosting the local industrialization and urbanization, achieving coordinated urban and rural development, and meeting the living needs and improving living standards of residents along the Project.

Component C is the Shuolong Port (Shuolong Gate) (Phase II) under Shuolong Port Infrastructure (Upgrading) Project in Daxin County. It functions as an integrated service area, mainly to provide customs clearance and passenger boarding and alighting services, parking of customs passing vehicles and the development of border port tourism services. The planning land area of Phase II is about 18,533.72 m2, with a total floor area of 11,668.03 m2, including the Port Service Center, service station, public restroom, ecological parking lot and ancillary road revegetation project, Guichun River revetment landscape park and basement. After completion, Component C will vigorously drive China-Vietnam trade and tourism cultural exchanges, to achieve mutual complementarity by advantages and mutual benefits in economic development, so that the people in the two countries can actually enjoy the benefits of economy and trade. The cross-border trade economy between China and Vietnam involves a wide variety of commodities, with complementary structures and resources. The trade covers northern Vietnam, Central China, Southwest China and Beibu Gulf Economic Zone, with huge market potential, which is conducive to promoting industrial upgrading and resource integration between the two countries, advancing bilateral cooperation in agricultural development, transportation, electricity, fertilizer, cement, and communication, and speeding up investment and construction between the two countries, and bringing more benefits to the Chinese and Vietnamese people.

Associated Project - Detian (Daxin)-Huashan (Ningming) Highway (Shuolong-Tianxi Section) is located in Daxin County, Longzhou County and Ningming County of Chongzuo City in southwest Guangxi. Running from north to south, the route starts near Bami, Shuolong Town and ends at Tianxi Interchange Exit of Nanning-Friendship Pass Expressway in Tingliang Township, Ningming County, with a total design length of 84.171 km. The Project will be constructed in three phases. Among them, Phase II is the Shuolong-Yanying Section, which starts near the Gate of Shuolong Port in the southeast of Shuolong Town, Daxin County and ends in Yanying, connecting to Phase I, with a total design length of 9.092 km. It adopts Class-I highway technical standard, with a design speed 60 km/h, and a subgrade width of 22.5 m. From the design starting point of Phase II Project to 105 m towards Shuolong Town, and from the starting point to about 250m towards the Yanying border region residents trade point, the road section of a total length of about 355 m connects Components C and A, which is necessary for the feasibility of the Project, thus being associated to the Project.

Detian (Daxin)-Huashan (Ningming) Highway (Shuolong-Tianxi Section) Phase II will be implemented under the responsibility of Guangxi Xingchong Infrastructure Investment Co., Ltd.

Executive Summary

I. Project Overview

The Guangxi Chongzuo Border Connectivity Improvement Project consists of three components, namely Component A: Wuzhou (Longyanzui)– Shuolong Highway (Chongzuo–Jingxi Expressway to Shuolong Port Section), Component B: Detian-Shuolong Highway and Component C: Shuolong Port (Phase II of Shuolong Gate). The Project is necessary for implementing the Expressway Network Planning of Guangxi (2018-2030), improving the regional highway network, enhancing the international corridor of Shuolong Port, implementing the national strategy of western development, driving forward the revitalization and development of the Zuojiang River and Youjiang River Former Revolutionary Base Areas, pushing ahead with the construction of Sino–Vietnamese Detian–Ban Gioc Waterfalls International Tourism Cooperation Zone, improving the highway networks in the China-Vietnam border area and Daxin County of Guangxi Region, promoting bilateral cooperation between China and Vietnam, promoting investment to the construction of two countries, and making the trade economy better benefit the people of China and Vietnam.

The Report is prepared based on the *Environmental and Social Framework* issued by AIIB, the *Environmental Protection Law of the People's Republic of China*, the *Environmental Impact Assessment Law of the People's Republic of China* and the *Regulations on Environmental Protection Management of Construction Projects* (Decree No.253 of the State Council), and by summarizing the results of the monographic studies related to the Project, experts' comments and public opinions.

Analyze the conformity between the Project and local road network planning, ecological protection red line, minimum environmental quality requirements, resource utilization limit and industrial access negative list to determine whether the Project is feasible; figure out the main environmental and social issues involved in the Project.

II. General of Environmental Impact

(1) Assessment Rating and Scope

The assessment rating of AIIB for Guangxi Chongzuo Border Connectivity Improvement Project is Class A.

The assessment rating for ambient air of Components A and B is Level III, and the assessment scope is within 200 m on both sides of the centerline of the highway; The assessment rating for surface water environment of Component A is Level II, that of Component B is Level III, and that of Component C is Level III. The assessment scope covers the surface water bodies within 200m on both sides of the centerline of the highway. When the route crosses a large surface water body, the assessment scope shall be extended to the water area within 500 m upstream to 3000 m downstream of the river-crossing bridge; the assessment rating for groundwater environment of Component A is simple demonstration, and the groundwater environment of Component B and Component C is not subject to groundwater environmental impact rating; the assessment rating for acoustic environmental of Components A and B is Level I, that of Component C is Level II, and the assessment scope is within 200 m on both sides of the centerline of the highway. Components A, B and C belong to Class IV construction projects, and soil environmental impact assessment is not carried out; the eco-environmental assessment rating of Component A is Level I, while that of Component B and Component C is Level III. The assessment scope is that the investigation and assessment scope of road sections crossing Xialei Autonomous Region Nature Reserve and Huashan National Scenic Area in Guangxi is extended to the whole special ecological sensitive area or important ecological sensitive area, while the assessment scope of other road sections is 300m on both sides of the centerline of the highway. The assessment scope of the temporary land occupation such as borrow yard and spoil ground and temporary stock yards, as well as auxiliary facilities along the Project are within 100m of land occupation area and surroundings. The environmental risk assessment rating of Components A and B is simple analysis.

(2) Environmental Protection Objectives

Acoustic environment: 12 objects within the evaluation scope of Component A (2 at schools and 6 at villages for 8 objects along the mainline; 4 at villages for the Shuolong Connection Line); 12 objects within the evaluation scope of Component B (1 at school and 11 at villages); 1 object within the evaluation scope of Component C;

Water environment: the surface water protection targets of Component A are surface water bodies such as Baidou River, Xialei River and Guichun River, and the drinking water source conservation area in Shuolong Town, Daxin county. The Neitun Hub Interchange, which is the main line of the project and with chainage K0+000~K1+320, crosses Bukan water source conservation area in Liliang Village, Fuxin Town. To reduce the impact of project construction on this water source, the People's Government of Tiandeng County agreed in principle to relocate the Bukan water source in Liliang Village, Fuxin Town, Tiandeng County in accordance with the *Reply of the People's Government of Tiandeng County on Adjusting the Bukan Water Source in Liliang Village, Fuxin Town, Tiandeng County* (TDH [2019] No.134), and issued a letter of commitment on April 7, 2021, promising to relocate the water intake of Bukan water source in Liliang Village, Fuxin Town to Bulitun. After the relocation, the nearest distance from the water source to the project is about 2.5 km, which is not within the evaluation scope of this project, and the relocation is going through procedures at present. The surface water protection targets of Component B are the drinking water sources of Aitun in Shuolong Town and Shuolong Community in Shuolong Town (K0+460~K5+360 passes through the secondary protection zone of Aitun drinking water source protection zone in Shuolong Town and K9+400~K10+000 passes through the secondary protection zone of Shuolong Community drinking water source protection zone in Shuolong Town).

Ecological environment: There are 2 ecologically sensitive areas (the Guangxi Xialei Nature Reserve and the Huashan Scenic Area). Within the evaluation scope of Component A, there are 3 species of national Class II protected plants (Excentrodendron tonkinese, Cibotium barometz, and Zenia insignis), 4 species of protected plants at the autonomous region level (Acampe rigida, Cymbidium bicolor Lindl, Cheirostylis chinensis, and Spiranthes sinensis), 10 ancient trees, 14 species of national class-II protected animals, 58 species of protected animals at the autonomous region level, occupying 15.7 hm2 of key public welfare forest. Within the evaluation scope of Component B, there are 2 species of national Class II protected plants (Excentrodendron tonkinese and Cibotium barometz), 1 species of protected plants at the autonomous region level (Cymbidium bicolor), 2 ancient trees, 3 species of national class-II protected animals, 21 species of protected animals at the autonomous region level, occupying 1.08 hm2 of key public welfare forest. Component C is located in the landscape coordination area of the Huashan Scenic Area, and no national or regional-level protected plants are found.

III. Comparison and Selection of Construction Options

(1) Necessity of Comparison and Selection of Construction Options

At present, there is no direct expressway or Class I highway from the ending point of Guangxi Long'an - Shuolong Expressway (Chongzuo Border) to Shuolong Port, and the traffic capacity of Shuolong-Detian Highway is low and the road condition is poor, which makes it difficult to meet the traffic requirements of the increasing number of tourists and motor vehicles in Detian Scenic Area, and to meet the requirements of "Category-I Port Connecting Expressway or Class I Highway" in the *13th Five-Year Plan on Development Planning for Highway and Waterway Transportation of Chongzuo City* and the construction requirements of EW-15 Tieshan Port ~ Napo (Nonglong) in Guangxi Provincial Highway Network Planning. After completion, Component A and Component B connect the Shuolong

Port and the China-Vietnam Detian-Ban Goic International Tourism Cooperation Zone with other regions in the most convenient way, which greatly improves the capacity of external highways in the region, and it is also conducive to the national defense and response to emergencies for improving the Guangxi expressway network, and improving the reliability and traffic safety of the road network; It will definitely promote the economic development and cooperation among China, Vietnam and other ASEAN countries to jointly create an upgraded version of the Sino-ASEAN Free Trade Area, and jointly develop and build a Sino-Vietnam cross-border economic cooperation zone, and further promote Guangxi to become a fulcrum for the country in the new strategy of opening up an development in southwest and mid-south regions; It will be conducive to the development of the land in the area surrounding the highway. And there is also the immeasurable promotion effect to accelerate the progress of new urbanization, tourism and industrialization development, which better coordinates the development of urban and rural areas and regions, and improve the living standards of the people along the highway.

(2) Comparison of Route Options

The starting point of Component A, Wuzhou (Longyanzui) – Shuolong Highway (Chongzuo – Jingxi Expressway to Shuolong Port Section), is connected to the end point of Long'an - Shuolong Expressway, and the route is located near Neitun, Fuxin Township, Tiandeng County, and no route options are proposed; considering the alignment condition of the main line connecting the starting point of the Project to Chongzuo-Jingxi Expressway, in the feasibility study of Component A, Route D is still proposed as an alternative for Route K. After the relocation of Bukan water source in Liliang Village, the environmental conditions along the Route K and Route D are similar. Considering that the construction of Route D needs to change the original Busao Tunnel into a subgrade, which has a great social impact, it is determined that Route K recommended in the feasibility study is selected; the end point of the mainline is proposed to be near Bangtun in Shuolong Town, and the section from Bangtun to Shuolong Town adopts the technical standards of Class I highway, which will improve the road conditions to facilitate the travelling of local people, and no route options are proposed; the starting point of the connecting line is the end point of the main line, and no route options are proposed; four route options, i.e. Route A Option, Route L Option, Route B Option and Route C Option are proposed for the end point of the connecting line of the Project. Route A Option has great advantages in investment, land occupation, demolition, vegetation loss and water and soil loss, so it is determined that the Route A Option recommended in the feasibility study is selected.

The route of Component B, Detian-Shuolong Highway starts at the existing highway near the gate of Detian Scenic Area, and ends near Rentun, Shuolong Community, southeast corner of Shuolong Town, and it crosses the Shuolong Connecting Line of Component A. The starting point option of the route of the Project has been determined, and no route options are proposed. Influenced by the Route A Option and Route K Option of Gutun-Shuolong Section, Component B has two end point options, i.e. Route A and Route K, and the comparison result is influenced by the comparison result of Route A Option and Route K Option. After comparison and demonstration, the Route K end point option is selected. The feasibility study of Component B proposes Route K Option, Route B Option and Route C Option for Longhong Section, and Route K Option and Route A Option for Gutun - Shuolong Section; Route K has great advantages in investment, construction difficulty and planning, and has little impact on ecological environment, water environment, sound environment and ambient air environment. Therefore, it is determined that the Route K Option recommended in the feasibility study is selected.

IV. Project Overview and Analysis

(1) Project Overview

Component A, the Wuzhou (Longyanzui)–Shuolong Highway (Chongzuo–Jingxi Expressway to Shuolong Port Section), is a newly built project, with a total occupied area of 2004.96 mu, including a permanent land area of 1391.96 mu and a temporary land area of 613 mu. The recommended option for the main line (Route K) is 12.263km long in total. The whole line is constructed as a two-way four-lane expressway with a design speed of 100 km/h, a subgrade width of 26 m, and asphalt concrete pavement. The 5.416 km long connecting line (Route A) starts from the Bangtun Intersection at G359. It goes south along the Liliang–Shuolong Section (Class-II highway) of the Tiandeng Connecting Line, passes through Sanjiadian, then turns to the southeast, passes through Longmei, and ends at Rentun toward Longzhou in the east of Shuolong Town. It connects with border highways in front of the proposed bridge head of the Guichun River, and it is constructed as a two-way four-lane Class-I highway with a design speed of 80 km/h, a subgrade width of 25.5 m, and asphalt concrete pavement. There are 7 bridges (3768m), exclusive of interchanges, 7 tunnels (5075.5m), 1 toll station, 1 maintenance work area (co-built with toll station), 20 culverts and 3 passages along the whole highway. The total investment is RMB 2,705,091,232.00 only.

The Project will be commenced in October 2021 and completed in October 2024, with a construction period of three years.

Component B (Detian–Shuolong Highway) is an upgrading project, is an upgrading project, with a length of 13.632 km, which is divided into 2 sections: Detian to Tourist Center and Tourist Center to the north end of the Shuolong Medium Bridge. The route from Detian to Tourist Center (K0+000 ~ K9+362.310) is 9.362 km in length and is built as a class II highway with a design speed of 40 km/h and a subgrade width of 10 m. The road section (K3+860 ~ K5+260) near the class I water source conservation area is built as a Class-III highway with a design speed of 30 km/h and original subgrade width (7.5m). At the urban section (K7+050 ~ K7+280), considering the road profile, the road is built as a class II highway with a design speed of 40 km/h, a road width of 16 m, and sidewalks on both sides. At the restricted section (K8+400 ~ K8+700), the road is designed with a speed limit of 30 km/h and a subgrade width of 10 m to avoid large filling and excavation. The section of Tourist Center – north end of the Shuolong Medium Bridge (K9+362.310 – K13+632.053) is 4.270km long; the general road section is of Class-II highway standard, with a design speed of 40km/h and a subgrade width of 16m; the road section with separated subgrade (left line K9+362.310 – K10+155.050, right line YK0+000 – YK1+053.383) refers to the Class-II highway standard, with a design speed of 40km/h and a single subgrade width of 8.5m; the urban road section (K12+520 – K13+632.053) refers to the Class-II highway standard, with a design speed of 40km/h, a road width of 17.5m, and sidewalks on single (inner) side taking into account the urban road sections. There is no bridge on the whole line, but only one 395m long one-way two-lane tunnel. The total investment is RMB 270,227,837.00 only. The Project is scheduled to be commenced in October 2021 and completed for operation in June 2023, with a construction period of 20 months.

Component C is the Shuolong Port (Shuolong Gate) (Phase II) under Shuolong Port Infrastructure (Upgrading) Project in Daxin County. It functions as an integrated service area, mainly to provide customs clearance and passenger boarding and alighting services, parking of customs passing vehicles and the development of border port tourism services. The planning land area of Phase II is about 18,533.72 m2 (about 27.83 mu), with a total floor area of 11,668.03 m2, including the Port Service Center, service station, public restroom, ecological parking lot and ancillary road revegetation project, Guichun River revetment landscape park and basement. The total investment is RMB 107,938,400 only. The Project is scheduled to be commenced in December 2021 and completed in February 2023, with a construction period of 15 months.

Route of the Detian (Daxin)–Huashan (Ningming) Highway (Shuolong–Tianxi Section) Project starts from the vicinity of Bami, Shuolong Town, runs from north to south, passing through Shuolong Town, Kanwei Township, and Baowei Township within Daxin County, Zhubu Township and Xiangshui Town within Longzhou County, and Tingliang Township within Ningming County, and ends at Tianxi Interchange Exit of Nanning-Friendship Pass Expressway in Tingliang Township, Ningming County. The route is 84.171 km in length and is constructed in three phases. From the design starting point of Phase II Project to 105 m towards Shuolong Town, and from the starting point to about 250m towards the Yanying border region residents trade point, the road section of a total length of about 355 m is associated to the Project.

(2) Identification of Environmental Impacts

Environmental impact during the construction period: excavation and filling of subgrade, soil borrowing and spoil works will cause damage to surface vegetation and aggravate water and soil loss; transportation of road construction materials and paving may produce a large amount of dust and asphalt fume, which will pollute the ambient air. Mechanical noise will affect the sound environment quality along the route. The discharge of construction wastewater will affect the quality of surface water. Construction vehicles will also increase the traffic load of the existing roads in the region, causing traffic congestion and increasing probability of occurrence of accidents.

Environmental impact during the operation period: with the increase of traffic volume, traffic noise has a certain impact on the acoustic environment along the route; automobile exhaust will have a slight impact on the surrounding ambient air quality; road (bridge) runoff is discharged into surface water through ditches or bridge deck outlets on both sides of the proposed highway, which may have an impact on the water quality of nearby water bodies. Hazardous goods transportation accidents on the proposed highway lead to leakage of toxic, harmful, inflammable and explosive goods, which pollute water quality, endanger aquatic ecological environment, destroy land ecological environment and pollute groundwater quality by infiltration. The noise and tail gas of vehicles in parking lot of Component C have certain impact. The stench from communal toilets and garbage produced by tourists will also have certain impact. Domestic sewage is discharged into Shuolong Wastewater Treatment Plant through the municipal sewage pipe network after being treated by the three-stage septic tank, and finally discharged into Guichun River, which may have an impact on the water quality of Guichun River.

V. Environmental Impact Prediction and Measures

1. Ecological Impact and Measures

(1) Component A

The mainline of Component A (chainage K7+885 - K10+715) and the connecting line (chainage AK3+600 - AK4+600) cross the experimental area of Xialei Nature Reserve, with a total crossing length of about 3.83 km. According to the conclusions of the special report of Component A crossing Xialei Nature Reserve, the impact of Component A on the ecological system and landscape, biological community and habitat, and main protected objects of Xialei Nature Reserve are relatively small, and the impact on the species and populations of Xialei Nature Reserve and the biosafety of the nature reserve is moderate impact. The construction of Component A has some negative impacts on Xialei Nature Reserve, which are mainly as follows: the connectivity of habitat is affected to some extent, thereby leading to the impact on the migration, dispersion and reproduction of important species; invasive plants spread further, and the accessibility of the nature reserve is improved, which leads to an increase in the management cost and difficulty of the nature reserve. On the premise of actively taking protection and restoration measures, properly coordinating the relationship with relevant interest groups can alleviate the impact of the proposed highway on the nature reserve.

The mainline of Component A (chainage K11+500 - K12+263) and the connecting line (chainage AK0+000 - AK5+416) cross the Class II Reserve of the Huashan National Scenic Area, with a total crossing length of 6.179 km. According to the special report of Component A crossing Huashan Scenic Area, Component A does not involve special scenic spots and Class I scenic spots. The scenic spots along the route are mainly the Class III scenic spots of Duxiu Peak and Yuejin Channel. There are few scenic spots on both sides of the highway, and the terrain along the route changes relatively little. During construction, it will inevitably cause some damage to the vegetation along the route. The interference to the vegetation will be reduced as much as possible through planning, design and compensatory restoration. The Project will have little impact on the original nature of the landform and vegetation in Huashan Scenic Area. The route will pass through the Scenic Area only along the periphery of the zone of concentrated scenic spots, so it will have little impact on integrity of the scenic spots and improve the accessibility of the Scenic Area.

The plant losses caused by the construction of Component A are mainly common species and artificial species. The protected plants, such as excentrodendron tonkinese, zenia insignis Chun, cibotium barometz and ancient trees, are all outside the road reserve boundary. After adopting protective measures such as hanging signboards and provision of enclosure, the protected plants are less affected by the construction; the key public welfare forests occupied by the Project are all the key public welfare forests at autonomous region level, with the vegetation types of monsoon forest and warm shrubs, etc., and mainly fall into the water conservation forests. The area of the key public welfare forests occupied by the Project is very small compared with the area occupied in counties along the route. The distribution of vegetation types near the each forest area are similar or better than that of the key public welfare forests to be occupied. With the policy of "compensating every piece of land occupied", the sustainable performance of forest's leading ecological functions will not be impaired and the impact on its overall ecological service capacity will be little.

There are 7 bridges and 7 tunnels in Component A, with a bridge-tunnel ratio of 71.4% for the main line and 28.22% for the connecting line, thus maintaining the ecological connectivity on both sides of the highway to a certain extent, and reducing the blocking of the highway on the national Class II protected animals (Hoplobatrachus rugulosus and Fejervarya multistriata) and autonomous region-level protected animals (Hylarana guentheri, Bungarus fasciatus, Pycnonotus jocosus and Callosciurus erythraeus).

There are 3 spoil grounds, 3 temporary stock yards (located in 1#, 2# and 3# spoil grounds respectively) and 1 production and living area in the Project. The environmental impacts of construction and living areas, borrow yards, spoil grounds and temporary stock yards are mainly land occupation, damage to vegetation and discharge of pollutants such as wastewater, tail gas and noise. Site selection greatly affects damage to vegetation, so it is necessary to avoid occupying the land with well-developed natural vegetation as far as possible. The fore-mentioned sites can be provided on the permanent land of the Project, thus reducing the area of temporary land occupation; avoid occupying cultivated land and forest land, try to occupy wasteland and abandoned land to further reduce the ecological impact of temporary land occupation.

Common fish are mainly distributed in the bridge site assessment area. The impact of major bridge construction on the water environment is mainly manifested by the increase in concentration of suspended substance in the water body, and the concentration of petroleum substances in the water body will also increase under the condition of improper treatment or management. The primary productivity is reduced mainly by affecting photosynthesis such as algae in the water body, which leads to a decrease in bait, thus imposing certain impact on fish. The impact of the Project on fish is limited to the construction area. There are no "three grounds" and other protection areas for fish in the assessment area, so it does not affect the protection of fish species resources. The increase in concentration of suspended solids in water will lead to a decrease in plankton biomass in the construction area. After the construction, with the dilution and self-purification of water, the water quality will gradually improve, and the plankton can basically return to the level before construction. The aquatic benthonic animal is also distributed in similar environments in other nearby areas. From the perspective of species protection, the construction of the Project has little impact on these species. Cofferdam construction technology is adopted in the construction of bridge foundation, so as to minimize the disturbance to rivers, and the impact on aquatic organisms is small and temporary, which can be basically restored upon the operation of the project.

(2) Component B

① The biomass loss caused by the project construction is about 1112.51 t, and the lost species are mainly common species and artificial species.

② The protected plants distributed within the assessment scope include Excentrodendron tonkinese, Cymbidium bicolor Lindl, Cibotium barometz and ancient trees. Among them, except one Ficus microcarpa and five clusters of Cymbidium bicolor Lindl, the rest are all located beside the existing road, which are within the project area and are affected by the project construction if the construction site is expanded to both sides by the centerline of the existing road. Other protected plants and ancient trees are at a certain distance from the current highway, so they are less affected with proper construction protection measures.

③ Amphibious animals mainly inhabit rivers, canals and irrigated lands along the highway. The Project is a reconstruction and expansion project, and most of the road sections are to widen the existing roads, mostly located on both sides of the existing roads. Affected by the current highway occupation and operation, most amphibious animals in the assessment area have moved to undisturbed areas far away from the highway except for a small number of amphibious animals living in roadside cultivated lands under the human settlement environment. Therefore, the construction of the Project has little impact on the individual number and population of amphibious animals in the assessment area.

④ The sections of autonomous region-level protected animals, such as C. versicolor, E. radiata, P. mucosus, Naja atra, etc., are mainly shrubs, woodlands near water and other habitats.

Affected by the current highway occupation and operation, the naturally sensitive reptiles in the assessment area have moved to undisturbed areas far away from the highway, and the construction activities such as subgrade excavation for reconstruction and expansion of the project have relatively little impact on reptiles.

⑤ At present, the Employer initially selects the spoil ground and the construction, production and living area, which are located on the north side plot of the existing border highway at the exit of Longhongtun Tunnel (the north side of CNOOC). This plot is the resettlement land reserved by Shuolong Town, and there are two restrictive factors for the site location, one is that it is in Huashan Scenic Area, and the other is that it is in the water source protection area (Class II Reserve) of Shuolong Community in Shuolong Town. Affected by the route direction, it is inevitable that the spoil area and the construction, production and living area will be located in Huashan Scenic Area. Through the demonstration and analysis of the crossing subject, the project has little impact on Huashan Scenic Area after the compensation and restoration measures are taken, and the crossing subject has been approved by the competent authorities. The site selection of temporary buildings is located in the water source area, but it is not in the catchment area of the water source area. There is no water conservancy connection with the water source area, which has little impact on the water quality of the water source area, and the local government is adjusting the location of the water source area. After adjustment, the site does not involve the water source area, and the site selection is basically reasonable.

As the route of Component B does not cross Xialei Nature Reserve, it has little impact on the Reserve. The whole route of the Project is located in Huashan Scenic Area, and Component B is the Detian - Shuolong Section in the Shuolong-Detian-Renai Class II Highway Upgrading and Reconstruction Project. According to the *Report on Landscape Impact Assessment of Shuolong-Detian-Renai Class II Highway Upgrading and Reconstruction Project in Daxin County* Passing through Huashan Scenic Area compiled by Guangxi Urban-Rural Planning Design Institute, when tourists visit Guichun River, most of the line is visible. The terrain along the line is featured by small topography change. In spite of the inevitable vegetation destruction along the route during construction, the interference to the vegetation will be minimized through planning, design and compensatory restoration, so the route has little impact on the landform and vegetation primitiveness of Huashan Scenic Area. The route will pass through the Scenic Area only along the periphery of the zone of concentrated scenic spots, so it will have little impact on integrity of the scenic spots and improve the sightseeing conditions of scenic spots.

The land occupation and construction activities of Component B will inevitably cause some damage to the vegetation in the assessment area. The natural vegetation affected along the route mainly includes artificial forests and scrub-grass lands. There is a small quantity of new permanent land occupation, with a short distance. The construction activities have no impact on the plant species diversity in the assessment area, which will not reduce the plant species diversity in the assessment area. The adverse impact of highway construction on the vegetation in the assessment area can be mitigated through landscaping and vegetation restoration for temporary land. The vegetation along the original road will be occupied by the construction of the Project. It is estimated that the biomass reduction caused by the permanent occupation of the Project will be 1112.51 t, accounting for 4.39% of the total biomass in the assessment area. All the plant species occupied by road sections along the project are common species in the area and are widely distributed.

Three kinds of national class II protected plants are found within the evaluation scope, including about 4 Excentrodendron tonkinese, 7 Cymbidium bicolor Lindl and 9 Cibotium barometz, with 5 Cymbidium bicolor Lindl at 2m on the left side of K11+80 attached to 1 class III ancient tree-Ficus microcarpa Linn. f. Because it is located on the current road side, if the road section will be widened from the center line to both sides in the expansion scheme, the tree with 5 Cymbidium bicolor Lindl will have to be transplanted. In addition, the protected plants close to the project route include 2 Cymbidium bicolor Lindl located at 15m on the right side of K13+50, and 2 Excentrodendron tonkinese located at 15m on the right side of K13+50 respectively. There is a certain distance between the rest of the protected plants and the project land boundary. The project construction has little impact on them.

There are two ancient trees in the assessment area, one of which is a Ficus microcarpa located beside the existing highway on the LHS of K11+150. The horizontal translation design of the route shall be preferentially made, and the growth range of the Ficus microcarpa shall be bypassed as much as possible to avoid impact on it. Another ancient tree, Litchi chinensis, 20m to the RHS of K12+560, is located outside the project area. As long as the protective measures are taken and the construction workers protect the tree well, the construction activities will have little impact on the tree.

The impact on wild animals during the construction period is inevitable and inescapable, but it only involves in the construction area. Component B is a reconstruction and expansion project. The construction activities are mainly concentrated in certain areas on both sides of the existing highways. There are a large number of human settlements and ecological environments of cultivated land distributed along the existing highways. Human activities are frequent along the highways. The affected wild animals along the highways have migrated to areas far away from human activities and they mainly move for food in the assessment area. The construction activities will have little impact on the them. Under the measures, such as the strengthening of the education and supervision of construction personnel, prohibition of hunting of wild animals, and reasonable arrangement of tunnel blasting time, the reconstruction and expansion project has little impact on the wild animals in the evaluation area.

The existing highway of Component B has been put into service for many years. The existing highway has separated and blocked the original ecological environment and living activities of amphibious animals and reptiles along the route. Amphibious animals and reptiles along the route have migrated to the side far away from the highway. The reconstruction and expansion of the Project have little impact on the blocking of surrounding animals.

Component B occupies a relatively small proportion of key public welfare forests (with an area of 1.08 hm2) compared with that in Daxin Country, and it will not impair the sustainable performance of its dominant ecological function, and has no great impact on its overall ecological service capacity. In addition, a field investigation on ecological public welfare forests through which the Project passes through shows the distribution of vegetation types near the each forest area are similar or better than that of the key public welfare forests to be occupied. With the policy of "compensating every piece of land occupied", the ecological service capacity of regional key public welfare forests would not change greatly.

One spoil ground and one construction area are proposed for Component B. Affected by the route direction, it is inevitable that the spoil area and the construction, production and living area will be located in Huashan Scenic Area. Through the demonstration and analysis of the crossing subject, the project has little impact on Huashan Scenic Area after the compensation and restoration measures are taken, and the crossing subject has been approved by the competent authorities. The site selection of temporary buildings is located in the water source area, but it is not in the catchment area of the water source area. There is no water conservancy connection with the water source area, which has little impact on the water quality of the water source area, and the local government is adjusting the location of the water source area. After adjustment, the site does not involve the water source area, and the site selection is basically reasonable.

(3) Component C

As the project route does not cross Xialei Nature Reserve, it has little impact on the reserve. The Project is located in the landscape coordination area of Huashan Scenic Area.

The construction of the Project coordinates with the landscape of Huashan Scenic Area, and does not damage the scenic area landscape. The construction is helpful to improve the supporting infrastructure of the scenic area, and the construction during the construction period will cause certain damage to the site in the scenic area. After the project is completed, the project landscape will enhance the beauty of Huashan Scenic Area.

With the excavation of the construction site, the existing vegetation will be lost due to the construction, most of the biological individuals will be removed, and a few individuals will be transplanted, which will cause the destruction of the original landform, reduce or lose the water and soil conservation function of the original landform, and increase water and soil loss. The current project land occupation includes wood land and a small amount of non-irrigated land. The land occupation of the Project is planned as port construction land. After the construction project occupies, the current land occupation changes from non-irrigated land and wood land to port construction land, which changes the regional ecosystem.

The land occupied by the project mainly consists of wood land and non-irrigated land ecosystems. Ecologically, they are "producers", and when the port is established, the vegetation in the permanently occupied area of the Project will disappear completely. However, as the Project occupies a small area, the original vegetation form in this area is single, the natural vegetation is common in the local area, and the artificial vegetation is wood land and crops, the loss of biomass reduced by the construction can be compensated by greening. The construction will not reduce the ecological diversity of regional species, and has little impact on regional natural vegetation and no obvious impact on regional ecology. The permanent land occupation of the proposed project needs to occupy the original vegetation, resulting in the loss of vegetation biomass. The Project will occupy permanent land and lose a certain amount of biomass. After the project is completed, greening will be carried out with an area of 4,735 m², which will maximize the biomass of the nature strip and make up for some of the biomass loss caused by the construction. Generally speaking, the land occupation of the Project loses a certain amount of biomass, but the amount is small, which has a slight impact on the regional ecosystem.

Most of the land occupied by the Project is developed non-irrigated land, wood land, etc. Human production and living activities are frequent, and the common animals are rodents such as voles. In addition, there are some common reptiles, amphibians, birds and other species, which are rarely seen in this land. In general, terrestrial animals will gradually move to the surrounding areas with the construction of the Project, so the construction has little impact on them.

The Project does not occupy basic cultivated land, and the agricultural production land within the occupied area is small. According to the field investigation, most of the agricultural farming areas occupied by the Project are non-irrigated land, and there is basically no commercial crops. Changing the original land use mode of the land after the construction has a certain impact on agricultural production, but the impact is limited.

2. Impact on and Measures for Water Environment

(1) Component A

There are 2 bridges in Component A with piers in water, and the bridges mainly cross the Xialei River and Guichun River. It involves pier construction in water for bridges. It is proposed to adopt the technology of "steel cofferdam+cast-in-place bored pile". Reasonably arrange the operation sequence of pile foundation of the river-crossing bridge to avoid the flood period of the river. Steel cofferdam construction shall be carried out in the dry season, and advanced technology shall be adopted to shorten the operation time. The cofferdam construction and working surface cleaning shall be completed before the flood season. During the construction period, the bridge construction mainly affects the water body within 100m downstream of the bridge.

The construction and production wastewater is treated by deoiling and precipitation, and then used for sprinkling water on the construction site to reduce dust. Domestic sewage from construction camps is treated by temporary septic tanks and used for surrounding agricultural irrigation, which has little impact on the environment.

Sewage from toll stations (built together with maintenance work area) during the operation period can be reused and not be discharged outside after being treated by oil separator and MBR sewage treatment system to the standard for toilet flushing, road cleaning and urban greening indicated in the *Reuse of Recycling Water for Urban– Water Quality Standard for Non-portable Urban Use* (GB/T18920-2002) and *Reuse of Recycling Water for Highway Service Area—Water Quality* (JT/T645.1-2016).

(2) Component B

Local sections of Component B is close to Guichun River. The following measures are recommended to avoid the adverse impact of the construction of sections along the river on the water quality of Guichun River: construction material stacking area is not provided in this area; before construction, build temporary intercepting and drainage ditches and sedimentation tanks. Construction wastewater and rainwater runoff are reused after sedimentation to reduce dust as much as possible, and not discharged at will; do not carry out road excavation and pavement construction in rainy season as far as possible, and backfill and compact the excavated surface in time to reduce the impact of water and soil loss; strengthen management, carry out civilized construction education for construction workers, and randomly discarding construction waste and domestic garbage into water bodies is prohibited; strengthen equipment maintenance to avoid leakage. After taking the above measures, the construction of sections along the river will have little impact on the water quality of Guichun River.

The construction and production wastewater is treated by deoiling and precipitation, and then used for sprinkling water on the construction site to reduce dust. Domestic sewage from construction camps is treated by temporary septic tanks and used for surrounding agricultural irrigation, which has little impact on the environment.

There is no service facilities in Component B, and no domestic sewage is produced and discharged during the operation period.

(3) Component C

The wastewater of the Project is mainly domestic wastewater. The domestic sewage treated by the three-stage septic tank meets the requirements of Class III standard specified in the *Integrated Wastewater Discharge Standard* (GB 8978-1996). The treated domestic sewage of the Project meeting standard will be discharged into Shuolong Town Wastewater Treatment Plant, and will be discharged to Guichun River after being treated to meet Level I Class B standard of *Discharge Standard of Pollutants for Municipal Wastewater Treatment Plant* (GB18918-2002) and its amendment.

Shuolong Sewage Treatment Plant was put into use in October 2015. The Sewage Treatment Plant uses a multi-stage composite moving bed bio-membrane reactor treatment process, and it treats 1,000 tons of sewage every day. The water discharge of the Project is 8.8 t/d, accounting for 0.9% of the sewage treatment capacity of Shuolong Town. The current water supply in Shuolong Town is 600t/d, and the water discharge is calculated as 80% of its water supply, so the water discharge of the residents in Shuolong Town is 480t/d. Therefore, Shuolong Sewage Treatment Works can still receive the domestic sewage produced by the Project. The project is located within the pollutant receiving scope of Shuolong Town Sewage Treatment Works. After field survey, the municipal sewage pipe network has been built, so it is feasible to introduce domestic wastewater into Shuolong Town Sewage Treatment Works for treatment. Domestic sewage has little impact on Guichun River after being treated by Shuolong Town Wastewater Treatment Plant.

3. Noise Impact and Measures

The noise generated by loaders in the process of demolition & relocation and subgrade excavation has the greatest impact, and the daytime noise level at the construction site boundary is about 21.0dB(A) higher than the daytime noise limit specified in the *Emission Standard of Environment Noise for Boundary of Construction Site* (GB12523-2011), and the nighttime noise level is about 36.0dB(A) higher than the nighttime noise limit; the daytime noise level at the construction site boundary in the process of subgrade filling is about 19.0dB(A) higher than the daytime noise limit specified in the *Emission Standard of Environment Noise for Boundry of Construction Site* (GB12523-2011), and the nighttime noise level is about 34.0dB(A) higher than the nighttime noise limit; the daytime noise level at the construction site boundary in the process of construction of bridge pile foundation is about 19.0dB(A) higher than the daytime noise limit specified in the *Emission Standard of Environment Noise for Boundry of Construction Site* (GB12523-2011), and the nighttime noise level is about 34.0dB(A) higher than the nighttime noise limit; the daytime noise level at the construction site boundary in the process of road paving is about 19.5dB(A) higher than the daytime noise limit specified in the *Emission Standard of Environment Noise for Boundary of Construction Site* (GB12523-2011), and the nighttime noise level is about 34.5dB(A) higher than the nighttime noise limit.

There are 7 tunnels in Component A, 1 tunnel in Component B and no tunnels in Component C, and blasting operations may be required. According to the relevant data, the sudden instantaneous sound level in the blasting can reach 130dB(A), which can greatly changes the surrounding acoustic environment and frighten the nearby people. The blasting impact range is a radius of 500m from the blasting hole. The investigation finds that there are 4 sensitive targets (Bulitun, Longruntun, Rentun and Longhong) within a 500m radius of the tunnel. The Project may bring a great instantaneous impact to them, but the impact is temporary. The adverse impact will disappear when the blasting operation is completed.

There are 6 tunnels in Component A and 1 tunnel in Component B, and blasting operations may be required. According to the relevant data, the sudden instantaneous sound level in the blasting can reach 130dB(A), which can greatly changes the surrounding acoustic environment and frighten the nearby people. The blasting impact range is a radius of 500m from the blasting hole. The investigation finds that there are 4 sensitive targets (Bulitun, Longruntun, Rentun and Longhong) within a 500m radius of the tunnel. The Project may bring a great instantaneous impact to them, but the impact is temporary. The adverse impact will disappear when the blasting operation is completed.

The blasting vibration of Longdong Tunnel and Longhong Tunnel in Component A has little impact on the safety of houses in Longruntun near the tunnel, while the blasting of Shuolong Tunnel in Component A and Longhong Tunnel in Component B has certain influence on nearby sensitive points in Rentun and Longhongtun. The blasting vibration velocity is affected by factors such as one-time charge and geological conditions. When the engineering geological conditions are determined, the charge for blasting directly affects the vibration intensity and the safety distance. Therefore, the Assessment suggests adopting the current mature millisecond blasting technology, reducing the one-time blasting charge, selecting reasonable blasting parameters, millisecond delay intervals and other measures to reduce the vibration impact of blasting.

By the mid-term operation period of the Project, all sensitive points of Component A meet the requirements of the corresponding standards in Environmental Quality Standard for Noise (GB3096-2008) in the daytime, and the corresponding standards in Environmental Quality Standard for Noise (GB3096-2008) are exceeded in Bangtun, Sanjiatun and Rentun at night, with the exceeding amount of 1-7.9dB (A). The excessive noise affects a total of about 197 residents, and the points sensitive to excessive noise are provided with sound proof windows.

By the mid-term operation period of the Project, the noise at all sensitive points of Component B in daytime meet the requirements of the corresponding standards in the *Environmental Quality Standards for Noise* (GB3096-2008), and noise at the sensitive points in 6 villages in nighttime exceeds the corresponding standards in the *Environmental Quality Standards for Noise* (GB3096-2008), with the excess of 0.6~6.7dB (A). About 53 households/195 residents are affected by the noise exceeding the standard. Replace the windows of houses at the sensitive points where the noise exceeds the standards with double-layer hollow soundproof windows, with an area of 530m2.

For Component C, the noise generated by motor vehicles can be greatly reduced and has little impact on the surroundings after such measures as low-speed driving, no honking and enhanced greening are taken. The noise generated by the passengers and business activities is characterized by low intensity, discontinuity and irregularity. In general, the social activity noise has little impact on the surroundings. The anti-vibration and vibration reduction measures shall be improved during installation of fans, and silencers shall be installed at openings. All kinds of pumps shall be installed in their own machine rooms, and sound-absorbing materials shall be used indoors. During installation, the equipment shall be balanced and vibration reduction measures shall be taken, and noise reduction shall be realized by obstruction from surrounding buildings.

4. Environmental impact on the atmosphere and countermeasures

During the construction period of the project, the main air pollution sources are dust caused by material transportation, loading and unloading, earthwork filling and excavation, and concrete mixing. In the absence of dust control measures, the area within 150 meters of the downwind of the construction site is seriously affected by dust.

Component A is equipped with 1 toll station (built together with the maintenance work area), which uses clean energy such as electricity and liquefied gas, and the main air pollution source during the operation period of the project is automobile exhaust. According to the analogy analysis, the 24-hour average value and the 1-hour average value of nitrogen dioxide and carbon monoxide within the highway assessment range meet the requirements of Class II Standard of the *Ambient Air Quality Standard* (GB3095-2012) in the long-term operation.

There are 6 tunnels in Component A and 1 tunnel in Component B. By analogy analysis, the concentration distribution of exhaust pollutants at the tunnel portal attenuates with the increase of plane distance from the portal center which has the highest concentration, and the attenuation is significant without terrain obstruction. Atmospheric stability has a great impact on the concentration distribution of pollutants outside the tunnel portal. When the atmosphere is stable, the diffusion ability of pollutants is inhibited, and when the atmosphere is unstable, the turbulent motion is strengthened, the pollutants discharged from the portal diffuse rapidly, and the concentration of pollutants around the portal is low. The maximum CO concentration at 60 m and 90 m outside the tunnel portal does not exceed 10.00 mg/m^3 and 8.5 mg/m^3 respectively. Therefore, the tunnel pollutants of the project have a minor impact on the ambient air at sensitive points 60 m away.

For Component C, a variety of grass and trees shall be planted for greening near the ground parking spaces, and green belts shall be provided accordingly. Meanwhile, ventilation of underground garages shall be improved to reduce the impact of automobile exhaust on the surrounding environment. In addition, it is required to flame out for temporary parking, so as to reduce the working hours of the engine and exhaust emission. Therefore, the automobile exhaust in the ground parking lot has little impact on the sensitive points and air environment. The amount of waste gas produced by toilets can be reduced through daily cleaning, and the waste gas pollutants are led to the outside for unorganized emission through the exhaust fans. The domestic garbage shall be classified and stored in garbage bins and delivered to the environmental sanitation department for concentrated treatment every day.

5. Impact of solid waste and countermeasures

(1) Environmental impact analysis of solid waste during the construction period

An amount of 473,000 m3 permanent spoil is discarded by the Component A, and 64,300 m3 of permanent spoil is discarded by the Component B. Due to the quantity of waste earthwork & stonework is relatively large, if the spoil ground is not arranged reasonably or the contractor piles up the slag at will, it is easy to cause the unplanned distribution of waste earthwork & stonework and spoils along both sides of the work area, crowding out a considerable amount of agricultural and forestry land, making it difficult to control water and soil loss, causing great adverse effects on the ecosystem around the spoil grounds and bringing great difficulties to the recovery and utilization of temporary land at the spoil ground. It will also bring great adverse effects on the landscape environment along the route. Abandoned earthwork of subgrade shall be timely transported by the Employer to the spoil ground and temporary spoil yard determined in the project design. It is strictly prohibited to pile up along the construction area at will, and corresponding protective measures shall be taken according to the Soil and Water Conservation Scheme of the project.

The domestic waste of the construction camp generally contains many organic substances, which are prone to causing the reproduction of a large number of bacteria and mosquitoes. If domestic waste cannot be collected and disposed of centrally, it will easily lead to an increase in the incidence rate of infectious diseases in the camp and the proneness of spreading infectious diseases. Villages are scattered around some construction camps, and the stench generated by randomly dumped domestic waste will bring certain adverse effects on the health of residents in surrounding villages and the surrounding landscape environment. Therefore, small garbage cans are provided in the construction camp of the project for centralized collection and then the local environmental sanitation department is entrusted to transport and dispose of them. It is not allowed to throw the garbage everywhere or mix them with construction waste, which will affect environmental hygiene.

In Component C, it is strictly forbidden to randomly dump temporary soil dumps along the construction area, and protective measures shall be taken correspondingly. The Contractor should have management personnel to carry out on-site management on the transportation and disposal of spoil, so as to avoid careless loading and unloading. Small garbage cans are set up in the construction camp for centralized collection and then entrusted to the local sanitation department for removal and disposal. It is not allowed to throw them indiscriminately or mix them with construction waste, which will affect environmental hygiene.

(2) Environmental impact analysis of solid waste during the operation period

If the household garbage generated by service and management facilities along the route is not properly collected and disposed of, it will have a considerable adverse impact on the sanitation and landscape environment around the service facilities. During the operation stage of the Project, the maintenance workers will maintain the whole route of the highway, clear, collect and centrally dispose of the garbage dropped by the running vehicles or passengers along the route. Therefore, this category of solid waste generally does not have a big adverse impact on the environment along the route.

The micro amount of oily sludge produced by the oily sewage treatment facilities in the toll station of the Project is hazardous waste, which is collected by the toll station operation entity and then regularly disposed of by an entrusted qualified entity.

The general solid waste and hazardous waste generated by the project are properly disposed of and the environmental management is strengthened. The hazardous waste generated during the operation period of the project has little impact on the surrounding environment.

Garbage cans are provided at sightseeing and rest areas for passengers provided by Component C, and sanitation personnel is arranged to clean and collect domestic garbage which shall be cleaned and transported by the sanitation department on a regular basis. Publicity is enhanced along the route, and signs of "No littering and protect the tourist attraction environment" are set up.

6. Environmental risks and countermeasures

The Components A and B do not involve the production, usage, and storage of toxic, hazardous, inflammable, and explosive dangerous substances and the main environmental risks are caused by indirect behaviors such as transported goods or oil leakage led by traffic accidents of vehicles on highways. The functional orientation of Component B is mainly the tourism highways and border highways. The running vehicles mainly include private cars and tourist buses entering and leaving scenic spots, as well as a small number of border trade vehicles. Most of the dangerous substances are the gasoline and diesel oil in automobile fuel tanks. When the vehicles encountered a traffic accident, it may cause vehicle-carried gasoline or diesel oil leaking into the surrounding environment and flowing into the Guichun River, which may cause water quality deterioration and affecting the water quality of Guichun River Water Source Conservation Area. When a fire occurs in the leaked oil products, the exhaust gas generated from combustion will cause ambient air pollution to the surrounding air.

The probability of occurrence of two air pollution risk accidents (the fuel leakage and the fire) at the same time is extremely low; and since the leaked fuels mainly come from the traffic accident vehicle-carried fuel, the quantity of fuel leakage will be small. The combustion products are mainly particulate matter and carbon dioxide, which mainly causes suffocation to the human body. Most sections along the route of the Project have wide terrain, so it is difficult for pollutants to gather to suffocation level. At the same time, due to the high air mobility and rapid diffusion of gas pollutants, the duration of the accident impact is short and the impact is small.

For Component B, most sections of Guichun River are located near the route of the Project, and 1 water intake for the township water source is set up at the Guichun River. Also, the water source for Shuolong Community comes from Guichun River. In the case of traffic accident occurred on the project highway, vehicles may rush into Guichun River and cause fuel leakage directly into the surface water, or the leaked fuel on the pavement may enter the Guichun River along with the surface runoffs, which may pollute the water quality of Aitun Water Source in Shuolong Town and the water quality of Shuolong Community Water Source taken from Guichun River. Once the pollutants directly enter the above-mentioned water sources, the content of petroleum pollutants in the water sources will exceed the standard, resulting in deterioration of water quality, and in severe cases, the water supply of the water sources will be interrupted directly.

In order to reduce the impact of project environmental risks on water quality of water sources, it is proposed to put forward risk prevention measures from several aspects such as risk sources, influencing ways and sensitive objects, etc. The details are as shown below:

① Risk source control measures

The project does not involve sewage discharge, and the occurrence of water pollution risk accidents is mainly caused by fuel leakage led by traffic accidents of vehicles on the highway. Therefore, by limiting the vehicle type entering the section and controlling the probability of traffic accidents, the occurrence of water pollution risks can be controlled from the source. According to the statistics of transportation departments, traffic accidents mainly occur in the process of drivers' bad driving behaviors such as fatigue driving, inattention in the driving process, speeding and illegal overtaking. The traffic accidents caused by locomotive faults are relatively few. Therefore, in order to effectively control the occurrence of traffic accidents, it is necessary to correct the bad driving behavior of drivers, and measures such as limiting the speed of vehicles, limiting the number of vehicles and setting up warning traffic signs can be taken.

Speed control: as the section of K0+000~K5+500 is close to the national border, the designed speed of this section is 40km/h, which alleviates the occurrence probability of accidents to a certain extent, and speed limit signs are set at both ends of the section. The water intake of Yuejin Canal is located at the sightseeing spots along the river in the K7+800 Detian Old Kapok Scenic Area. It is not convenient for tourists to pass through the anti-collision guardrail. It is suggested to set speed reduction belts and speed limit signs at both ends of the Section of K7+500~K8+100 to control the speed.

Limiting traffic flow: this section is located in Detian Grand Scenic Spot. Huashan Scenic Area. According to the special opinions of scenic spots on the highway crossing scenic spots, it is suggested that the highway shall be included in the scenic highway planning. The EIA suggests that the project construction department should further strengthen communication with the scenic area management department, incorporate the section into the internal roads of the scenic area, and control the passenger flow, so as to avoid excessive traffic flow on the section increasing the probability of risk accidents.

Set warning signs: the overtaking prohibited signs shall be set up at K3+900~K5+300 near the primary land conservation area of Aitun water source in Shuolong Town and K7+600~K8+000 near the water inlet of Yuejin Canal; and the signs such "You have entered the secondary conservation area for Aitun water source in Shuolong Town, please drive with cautions" shall be set up at both ends of the section of K0+460~K5+360; and the signs such as "You have entered the secondary conservation area for Shuolong Community water source in Shuolong Town, please drive with cautions" shall be set up at both ends of the section of K9+400~K10+000.

② Control Measures of Environmental Impact Paths

As the section of K0+000~K5+500 is close to the national border, a national defense border guardrail has been set in this section, which can effectively prevent vehicles in an accident from rushing into Guichun River. However, the existing highway is not provided with drainage ditches, and the surface runoff directly flows into the Guichun River. In order to reduce the impact of accident wastewater on the water source area, this assessment suggests that the project shall build an intercepting drainage ditch about 11.3km away from the section of K3+980~K5+110, which is close to the primary land conservation area for the Aitun water source in Shuolong Town, and build a sedimentation tank on the mountainside of K5+300 to collect the surface runoff. After sedimentation treatment, it will be discharged into the downstream section of Aitun Dam in Guichun River to reduce the impact of surface runoff on the water quality of the Aitun water source in Shuolong Town.

③ Alternative Measures for Environmentally Sensitive Target

The Shuolong Community Water Source Plant is located in the market town of Shuolong Town, which is connected to Guichun River through Yuejin Canal. The water from the river will be supplied to water users in the market town after purification treatment. At the end of Yuejin Canal, there is the Shuolong Town Power Plant, whose water quantity and flow rate are affected by the opening and discharging of the power station. Therefore, it is suggested to strengthen monitoring at the water intake of the water plant. Once the water quality in the canal is found to be affected by leakage pollution, the water supply shall be stopped immediately, and the government shall be reported to start the emergency plan at the same time, and the water supply shall be resumed after the pollution treatment finished and the water samples are tested to be qualified.

Aitun Water Source in Shuolong Town is a planned water source, and no water intake project has been carried out yet. It is suggested that the water intake video surveillance system and rapid water quality analyzer should be set up during the construction of the water intake project in this water source area to monitor the water quality. Once pollution occurs, water intake and water supply shall be stopped immediately, and the government shall be reported to start the emergency plan. The water supply shall be resumed after the pollution treatment finished and the water samples are tested to be qualified.

VI. The Process of Environmental and Social Evaluation

Carry out the environmental and social assessment on the Project in three stages, namely the environmental impact assessment, social stability risk assessment, and the social assessment and resettlement stages.

VII. Social Impact of the Project

The construction of the Project is conducive to improving the transportation infrastructure in the project area, directly promoting the development of transportation, tourism, commerce, and related industries, and resulting in economic development, social prosperity of the project area. However, when the Project is under construction and after it is put into operation, it will have certain adverse effects on some relevant interest groups.

Interested parties of the project can be roughly divided into five groups: governments at all levels and relevant agencies in the project area, project implementing agencies and contractors, various groups served by the project, households affected by land acquisition and demolition, and groups affected by construction.

The social benefits of the Project include: (1) Building a regional international transportation hub to promote economic exchanges and cooperation between Guangxi, the other provinces, and ASEAN countries, especially Vietnam; (2) Promoting the local economic prosperity of Chongzuo City, Daxin County, and Detian County, and realizing the prosperity of the border and the people; (3) The construction of the Project will, directly and indirectly, provide more employment opportunities, being conducive to promoting the increase of employment and income level of labor, especially the poverty-stricken household and women in the villages along the line; (4) The construction of the Project is conducive to perfecting the structure of the regional road network, improving traffic conditions, and enhancing travel efficiency; (5) The construction of the Project will help the local people to expand the scope of activities, increase their knowledge and improve their quality.

Negative impacts and risks of the Project include: (1) Impacts and risks caused by land acquisition and house demolition; (2) During the construction period of the Project, due to the need for road construction, the existing traffic on the relevant roads in the region will be temporarily organized by detouring and half-width passage, which will reduce the vehicle operation speed and affect the normal traffic. (3) During the construction process, noise, dust, and automobile exhaust will be generated during the transportation of road-building materials. During the operation period of the Project, automobile noise and exhaust pollution will affect local residents, organizations, enterprises, and schools on both sides of the line at varying degrees.

The population affected by permanent LA in the Project is 844 households with 3,635 people; the collectively-owned farmland acquisition involves 7 villages/communities, and the affected population is 833 households with 3,590 people; the acquisition of state-owned farmland involves 11 households with 45 people in Aijiang Forest Farm of Daxin County. The total compensation for permanent expropriation of rural collective land in the project is RMB

58,613,200, including RMB 49,636,200 for affected villagers and RMB 8,977,000 for village collective.

The project temporarily covers an area of 677 mu, affecting 816 people in 186 households. The total compensation for temporary land occupation calculated on the above basis is RMB 3,428,100, of which RMB 1,212,600 is for the affected village collectives.

For land damaged during the temporary land occupation, the land user will reclaim such land in strict conformity with the reclamation program approved by the land and resources authority to ensure that it is restored to the original condition. If the reclamation does not meet the requirements, the construction contractor will pay the land reclamation fee specially used for land reclamation.

The families, collectives, and organizations affected by the demolition of the local agricultural supporting makeshift houses and temporary office are compensated with money; and the families affected by the demolition of residential and commercial housing are compensated with money and homestead of equal area. A total of 3858.16 square meters of the demolition of various houses (including residential and business housing) in Shuolong Community is required for the Project, and the total amount of compensation for demolition and subsidies for temporary resettlement and relocation is RMB 3,670,200. The township government is responsible for selecting the reconstructed homesteads for resettlement of relocated households with demolished houses (residential houses) according to the tasks arranged by the natural resources bureau of the county. The relocated households will apply to the natural resources bureau of the county for construction on their own according to the principle of "one new site for one occupied site" and the total area of the homestead occupied by the family not exceeding 150 m2. At present, the resettlement scheme initially determined by the Housing and Urban-Rural Development Bureau of Daxin County for 10 households with residential and operating houses to be demolished is as follows: 3 households are resettled in different places, and the resettlement site is initially selected in Longhongtun within the same community; 7 households will be resettled at the original site: After the existing houses are demolished, the site is merged with the open spaces behind the houses or on the left and right sides to the homesteads for the construction of new houses. Among them, 3 households occupy homesteads of the same size and 4 households occupy smaller homesteads. Monetary compensation will be given for the difference in the homestead area. Business houses are mainly the brick-concrete houses located beside the Gutun Highway whose usage has changed from "residential to commercial" and makeshift houses with iron ceilings for small shops. The relocation design is based on the principle of restoring the original functions, original scale, and original standards, and the final compensation standard is based on the compensation agreement signed between the land user and the relocated families.

The acquisition and demolition sub-headquarters shall be responsible for numbering the unowned tombs, taking photos of their surroundings, and then having them relocated by hired workers.

The vulnerable groups affected by this project have been supported by specific departments and policies, so it is not necessary for this project to formulate a development plan for vulnerable communities to support these low-income families.

In order to help the resettled people create an environment of self-reliance and self-development, and try to restore or improve the living standards of immigrants in a short time, the project implementing agency will cooperate with the labor and social security, finance, education, science and technology, women's federations and other departments in Tiandeng and Daxin county to organize free training on technical skills for land-losing people caused by this Project. Technical training will be carried out according to the adjustment of economic structure, the change of labor market and the requirements of employers in each county, adhering to the principle of practicality and effectiveness. The technical training will be an effective action to restore and improve the income of affected people.

Considering that the main labor force in many affected families lacks necessary job skills, especially women, over half of women are assured to participate in each training. Affected people, who are trained to gain labor skills, can find jobs nearby. Technical training will cover all affected persons.

VIII. Mechanisms for Public Participation and Complaint

The owner of this project attaches great importance to public participation and has conducted extensive consultation to ensure public participation during environmental assessment, social stability risk assessment, and social evaluation and resettlement plan preparation. During the implementation phase of the project, public participation will be further encouraged and effective consultation will be carried out with them.

As required by AIIB’s *Environmental and Social Framework*, an appropriate appeal mechanism shall be established in accordance with the ESP and ESS to learn the APs’ environmental and social concerns and grievances on the compensation for land requisition and resettlement, to ensure that they (subject to negative impacts) can protect their rights and interests through this mechanism.

The project establishes an open appeal channel to receive and respond to stakeholders' concerns, complaints and appeals. The contact information and mailing address of the organizations and personnel receiving appeals from the affected population will be displayed on the bulletin board near the construction site, town government, village committee and village government.

The scope of appeals includes, but is not limited to, the following:

(1) Issues related to LA compensation and resettlement, including the measurement of affected land and houses, calculation of compensation fees, payment of compensation fees, and resettlement for production and living of resettled people, etc.;

(2) Issues related to the safety of people's lives and property related to construction, including any personal injury caused by inadequate construction protection; Property losses of related people or entities caused by construction activities, including damage degree judgment, loss quantity measurement, and compensation calculation, etc.;

(3) Prevention and control of environmental pollution related to construction, including noise pollution caused by vehicle traffic, and machinery, etc.; Air pollution caused by construction activities; Water pollution caused by treatment of various wastes;

(4) Damages to cultural resources out of the project area

The channels of appeal are as follows:

(1) Letter or e-mail;

(2) Appeal by telephone. All telephone complaints should be recorded and submitted to the grievance redress team;

(3) Oral, where all oral appeals shall be submitted to the grievance redress team in writing;

The above appeal modes have been disclosed in the affected area, and mass media utilized to strengthen publicity and reportage to make the stakeholder groups full aware of their appeal right.

This project has established a public complaint channel, including village committees, forest farm resettlement team, township government, land requisition and demolition sub-headquarters of the project, county natural resources bureau, housing and urban-rural construction bureau, county human resources and social security bureau, ecological environment bureau, compliant handling bureau, project resettlement leading group, project implementation office of Guangxi Chongzuo Border Connectivity Improvement Project, court, etc. The resettled person or stakeholder groups may also file an appeal directly with the project resettlement leading team or AIIB, which should make a disposition.

IX. Analysis of Impact on Poverty-stricken Households

Fuxin Township of Tiandeng County and Shuolong Township of Daxin County in the construction area of the project had relatively high incidence of poverty. According to the materials provided by the township government, the poverty-stricken population in Shuolong Township in 2019 was 4,306, totaling 1,155 households, accounting for 31.66% of the total population in the town. There are 11,113 poverty stricken population from 2,711 households in Fuxin Township, accounting for 33.60% of the total population of the town. Generally speaking, the numbers of poverty stricken population in both towns are higher than the average level of the whole county. The poverty stricken population in both towns accounts for more than one third of the total population of the town.

According to statistics, the population affected by the permanent expropriation of agricultural land in the project is 844 households totaling 3635 people, including 78 people from 18 households and 4 people from 1 household affected by the demolition of ancillary facilities. According to statistics, the vulnerable groups identified by the government (including households enjoying the minimum subsistence allowance, households enjoying the five guarantees and poverty-stricken households registered in 2015, the same below) are 194 households with 760 people, accounting for 20.91% of the total population affected. Among them, there are 11 households enjoying the five guarantees with 48 people, accounting for 6.32% of the total population of vulnerable groups; there are 71 households enjoying the minimum subsistence allowance with 274 people, accounting for 36.05%; and there are 112 poverty-stricken households with 438 people, accounting for 57.63%. The vulnerable groups affected by the Project are all households affected by land acquisition, and there are no vulnerable groups in households affected by house demolition.

For households enjoying the five guarantees, households enjoying the minimum subsistence allowance and poverty-stricken households, the government has adopted different support policies. The questionnaire survey on 160 affected households of the Project shows that the per capita disposable income of the 160 households is 13,250.01 yuan, the annual per capita income of households enjoying the minimum subsistence allowance is 7,439.86 yuan, and the annual per capita income of poverty-stricken households is 10,017.10 yuan. The low-income standard issued by the Chongzuo Municipal Government for rural households in 2019 is 6,000 yuan per capita per year. It indicates that the annual per capita income of poverty-stricken households has been well above the low-income line after several years of government support. In order to ensure poverty-stricken households get rid of poverty stably, the government's support policy will last for another 2-3 years. If some households still have difficulties in living after the support policy is stopped and meet the standard of minimum living guarantee, these households will enjoy the minimum subsistence allowance and receive a living subsidy monthly from the government.

X. Gender

At the end of 2018, Daxin County had a total population of 385013 (according to the data of the public security bureau), of which the male population was 199153, accounting for 51.7% of the total population, and the female population was 185860, accounting for 48.3% of the total population. Shuolong County had a total population of 10,540, of which the male population was 5,448, accounting for 51.7% of the total population, and the female population was 5,092, accounting for 48.3% of the total population.

Tiandeng County had 119,100 registered households with a total population of 458,700, of which the male population was 243,500, accounting for 53.1% of the total population, and the female population was 215,200, accounting for 46.9% of the total population. Fuxin County had a total population of 25,040, of which the male population was 12,793, accounting for 51.1% of the total population, and the female population was 12,247, accounting for 48.9% of the total population.

In the 246 households investigated, there are 1162 people of which 581 are male, accounting for 50.0% and 581 are female, accounting for 50.0%.

According to the investigation, the final evaluation of Development Plan for Women in Chongzuo City (2011-2020) is under way in the project area. The women's federations of counties have not carried out special women development plans, but they cooperate with other business authorities every year to promote the development of women. The main activities include:

(1) Trainings in various production technologies are conducted for women, mainly in agricultural planting, aquaculture and handicraft processing;

(2) The Women’s Federation helps urban and rural women who meet the conditions for small secured loans to apply for small secured loans;

(3) The Women’s Federation conducts employment trainings and migrant work trainings jointly for women with the Human Resources and Social Security Bureau, the Agriculture Bureau, the Poverty Relief Office and other departments, including legal and rights protection knowledge, basic professional training, such as housekeeping and cleaning skills.

(4) Assist women in getting non-agricultural jobs, including the provision of information on going out for non-farming jobs, car rental to designated places and reimbursement of ticket fares for working outside.

The Resselement Action Plan Task Force pays special attention to the conditions of the women in the project area during the socio-economic survey. They try to fully understand women's education, employment and income, family status, social status, participation in public affairs, etc. in the process of the questionnaire survey and panel discussion.

The results of the questionnaire survey of 246 families show that the female population with a higher education level is slightly larger than the male population. In general, the educational level of females is lower than that of males. In terms of the employment situation, the proportion of men in the employed population is slightly higher than that of women, that is, in the division of labor in the local villagers' households, males perform more household economic functions, while females undertake more responsibilities of household work, taking care of the elderly and education of their children. Although there are some differences between females and males in the industrial and occupational distribution of employment, there is no significant difference between females and males in terms of the employment distribution breadth. In terms of family income, the economic income created by women is clearly lower than that of men. This is mainly because women under the age of 40 need to pick up and drop off their children, cook and tutor their homework because their children are small. There are fewer migrant female workers than male. Meanwhile, Also among the male and female population who go out to work, the income of males is generally higher than that of females because the type of work they are engaged in requires high physical strength. However, for the same type of work, the income of females and males is equivalent with no obvious difference.

Women are the main beneficiaries of the project. The positive impact of the project on women is mainly shown in: (1) The project can provide certain direct and indirect employment opportunities for women; (2) It can promote the improvement of women's cultural level and professional skills; (3) It can improve women's ability to participate in public affairs.

Women in the Project-affected Area have played an important role in family affairs and social life. Most of the women interviewed have already known about the construction of the project in their villages and have no objection to the construction of the project. All the women have talked about their own opinions and suggestions on the compensation and resettlement of land requisition for the project. The hope, in line with men, is that the compensation for land expropriation will be paid in time according to the standards set by the government, and the old-age pension will be more secure in the future. Young women hope to get some training opportunities to improve their labor skills and will be able to work in more stable and well-paid jobs near their village in the future. Middle-aged and elderly women hope that the project will provide some employment opportunities suitable for their age and physical condition. In general, they all hope that they can take care of their family and meanwhile have a suitable job, so as to raise the level of household income and better secure children's education, family unexpected expenses and future old-age care.

Women are equally entitled to all compensation payments, training programs and other assistances, and all resettlement sites and compensation received are common property of family couples. Names of both husband and wife should be filled in when they handle relevant certificates, to protect the property of relocated personnel. For the sake of assurance, the project implementation agency will make necessary explanations and publicity to the women in the community to ask them to pay close attention to resettlement in the resettlement phase.

In the project, a gender action plan should be implemented to enhance women's awareness and ability to participate in public affairs, increase their employment, improve their social status, and promote equal opportunities for men and women to benefit from the project. The gender action plan mainly includes:

(1) Public participation and consultation. It is mandatory to make sure that the women in the project area participate in the consultation, supervision, and assessment in each stage of the project preparation, implementation, and subsequent operation of the project, their opinion being consulted and respected. The project Employer shall strengthen contact and cooperation with the project district government office and Women's Federations at all levels, and disseminate information by radio and television, publicity boards, publicity brochures and other ways so as to protect women's right to know about matters related to project construction. For public participation such as forums on issues related to project construction, 40% of women's participation shall be ensured; women's opinions should be taken into account in decision-making and plan preparation.

(2) Increasing employment opportunities. In the preparation phase of the project, the project Employer should fully understand the employment needs and intentions of women, and try its best to create employment opportunities for women during the implementation and operation phases of the project. Some jobs suitable for women, such as toll collectors and cleaners, should be provided to women in priority. **It is suggested that 1/3 of the jobs created by the project be provided to women.**

(3) The project Employer should pay more attention to female-headed single-parent households by providing them with employment opportunities, so as to improve their living conditions and enhance their self-confidence. For particularly difficult female-headed households, the government and the project Employer shall adopt appropriate assistance policies to ensure that these families benefit from the project as well as other families.

XI. Overview of Ethnic Minorities in the Project Area

The main population in the affected area of the Project is Zhuang people. The Zhuang population in Daxin County accounts for 96.89% of the total population of the county. Other ethnic groups include Han, Miao, Yao, Dong, Hui, Yi, Jing, Shui, Tujia, Mulao, etc., who are the descendants of officers and soldiers left over from past dynasties' wars and cadres dispatched south. Most of them live in towns, factory and mine areas, a few live in villages. And there are also a small number of Vietnamese who get married across national boundaries. The registered population of Shuolong Town is all Zhuang people, and a small number of other ethnic minorities live with local families, mostly through marriage. The Zhuang population in Tiandeng County accounts for 98.9% of the total population. The other ethnic groups are Yao, Han, Miao, Dong, and other nationalities. Fuxin Town, Liliang and Xuanjie villages affected by the Project have no other ethnic minority settlements, and the registered population is all Zhuang population. Among the population affected by the Project, there are only a few other ethnic minorities. The folk culture, production, and living habits of these ethnic minorities and Zhuang ethnic groups are basically the same as those of the local Han ethnic groups.

In the project area, Zhuang people are indigenous people with a long history, which is the main ethnic group in the local area and plays a leading role. Although the Zhuang language exists, Chinese is still the common language among middle-aged and young people of the Zhuang nationality. Sawndip, the writing system used by the Zhuang People in ancient times is no longer used. The Zhuang alphabetic writing system created by the government is not widely used in the project area. In addition, Zhuang people do not use the Latin-based Zhuang alphabet in their daily life, nor do they use the Zhuang language and Zhuang alphabet in school education. The local Zhuang nationality does not have their own unique ethnic culture, and the Zhuang and Han nationalities are in a state of cultural integration. The Zhuang people mainly rely on migrant work and non-agricultural business to obtain income and do not rely on land and agricultural resources for living. They have no collective attachment to the land and other natural resources in the village where their ancestors live. There is no political, economic, cultural, or educational system different from the mainstream society in counties, towns, and villages of the project area. Therefore, the local Zhuang people do not meet the definition of indigenous people in AIIB, and ESS3 is not applicable. The preparation of a development plan for indigenous peoples is not required for the project.

XII. Working Conditions and Community Health and Safety

By ensuring that the staff is treated fairly, the project unit provides them with a safe and healthy working environment and takes measures to prevent accidents, injuries, diseases, and employment of child labor, promotes the establishment of a good relationship between staff and management, and promotes the development benefit of the project. Project units should also ensure the health and safety of local communities in the project area.

XIII. Organizational Structure and Responsibilities

The organizations responsible for the relevant matters of the Project include the Project Management Organization, the LA Compensation and Resettlement Organization, and the Monitoring and Evaluation Organization.

The Project Management Organization mainly consists of the project leading group, the project management office and the project implementation office; The LA Compensation and Resettlement Organization mainly includes the leading team for resettlement of Guangxi Chongzuo Border Connectivity Improvement Project, the project implementation office of Guangxi Chongzuo Border Connectivity Improvement Project, the land acquisition and demolition sub-headquarters of Tiandeng for Guangxi Chongzuo Border Connectivity Improvement Project, the land acquisition and demolition sub-headquarters of Daxin, Natural Resources Bureau, Housing and Urban-Rural Construction Bureau and Human Resources and Social Security Bureau of Tiandeng County and Daxin County, People's Governments of Fuxin Town, Tiandeng County and Shuolong Town, Daxin County, and villagers' committees of affected villages along the route; The Monitoring and Evaluation Organization shall be an experienced third-party organization recruited by the Employer in a public way.

XIV. Environmental and Social Management and Environmental Resettlement Monitoring Plan

The implementation of the Resettlement Action Plan will be subject to internal supervision and external M&E. The project implementing agency is responsible for internal supervision and preparation of quarterly reports for submission to AIIB, focusing on monitoring whether the compensation and resettlement for LA and relocation of the Project meet the requirements of Resettlement Action Plan and compensation policies. Guangxi Chongzuo City Construction Investment Development Group Co., Ltd. recruits experienced third parties through open means for external monitoring and evaluation, and evaluates whether the resettlement targets have been achieved from the outside of the resettlement agency. Such independent agency will regularly prepare evaluation reports on the resettlement progress, compensation payment and other measures and submit them to AIIB until the resettlement is completed to ensure that the affected people, especially the subsistence allowance households, low-income households, and other vulnerable groups, can maintain their living standards and are not suffer from the Project.

XVI. Mitigation Measures

For the negative impacts of the project on the environment and society, the following mitigation measures are taken:

(1) Land acquisition and relocation shall strictly follow the national and local laws, regulations, and policies, and resettlement work shall be carried out efficiently; (2) Removal of special structures shall be planned in advance; (3) Take various measures to mitigate impacts during construction; (4) Reasonably select site for temporary land occupation and guarantee the quality of land reclamation after the land occupation is completed; (5) Prevent the impacts of noise and vibration on the life of local inhabitants.

1 Assessment Process and Main Environmental and Social Concerns

1.1 Assessment Process

According to the Environmental and Social Framework issued by AIIB, the *Environmental Protection Law of the People's Republic of China*, the *Environmental Impact Assessment Law of the People's Republic of China* and the *Regulations on Environmental Protection Management of Construction Projects* (Decree No.253 of the State Council), the preliminary work results of the Project have been analyzed and studied, field survey and investigation have been conducted for many times, relevant data and information have been collected, the feasibility study and design of the Project has been carried out, importance has been given to the whole-process risk management and the protection of ecologically sensitive areas and social impacts within the area of the Project, and public participation survey has been conducted in accordance with relevant national regulations. This Report is prepared on the basis of the results of related special studies, expert advice and public participation opinions on the Project.

1.2 Main Environmental and Social Issues Concerned

This environmental impact assessment mainly focuses on the following issues:

(1) Whether the Project location meets the requirements of relevant laws, regulations, and planning;

(2) The potential impact on the ambient environment during the construction and operation of the Project, in particular, whether the traffic noise during the operation will affect the sensitive protection targets in the Project area;

(3) The impact possibly caused by construction of the Project on Guangxi Xialei Nature Reserve and Guangxi Huashan Scenic Area;

(4) The feasibility and reliability of environmental protection facilities and pollution prevention measures to be adopted for the Project.

This social impact assessment mainly focuses on the following issues:

(1) Social benefits and adverse impacts;

(2) Key shareholders and the impacts on them;

(3) Impacts caused by land acquisition and relocation, and resettlement;

(4) Impacts on poverty population;

(5) Impacts on women;

(6)Impacts on ethnic minorities;

(7) Social risks and mitigation measures.

2 Legal and Regulatory Framework

The preparation bases of the project mainly include the provisions of the *Environmental Protection Law of the People's Republic of China*, *Environmental Impact Assessment Law of the People's Republic of China*, *Regulations on the Administration of Construction Project Environmental Protection* and *Notice on Reinforcing Environmental Impact Assessment Management of Construction Project Funded by International Finance Corporation*, as well as the requirements in the *Environmental and Social Framework* of the AIIB. The EIA activities shall not only conform to relevant domestic laws, regulations, policies and standards, but also follow relevant AIIB policies.

2.1 China's Environmental Protection Related Laws and Regulations and Departmental Regulations

(1) Environmental Protection Law of the People's Republic of China (Enforcement Date of Amendment: January 1, 2015);

(2) Environmental Impact Assessment Law of the People's Republic of China (Enforcement Date of Amendment: December 29, 2018);

(3) Forest Law of the People's Republic of China (Enforcement Date of Amendment: March 19, 2018);

(4) Law of the People's Republic of China on Air Pollution Prevention and Control (Enforcement Date of Amendment: January 1, 2016);

(5) Law of the People's Republic of China on Water Pollution Prevention and Control (Enforcement Date of Amendment: January 1, 2018);

(6) Law of the People's Republic of China on Noise Pollution Prevention and Control (Enforcement Date of Amendment: December 29, 2018);

(7) Law of the People's Republic of China on Solid Waste Pollution Prevention and Control (Enforcement Date of Amendment: September 1, 2020);

(8) Land Administration Law of the People's Republic of China (Enforcement Date of Amendment: August 28, 2004);

(9) Law of the People's Republic of China on Water and Soil Conservation (Enforcement Date of Amendment: March 1, 2011);

(10) Urban and Rural Planning Law of the People's Republic of China (Enforcement Date of Amendment: April 24, 2015);

(11) Highway Law of the People's Republic of China (Enforcement Date of

Amendment: November 4, 2017);

(12) Agriculture Law of the People's Republic of China (Enforcement Date of Amendment: January 1, 2013);

(13) Wild Animal Conservation Law of the People's Republic of China (Enforcement Date of Amendment: October 26, 2018);

(14) Law of the People's Republic of China on Road Traffic Safety (Enforcement Date of Amendment: May 1, 2011);

(15) Law of the People's Republic of China on Cultural Relics Protection (Enforcement Date of Amendment: November 4, 2017);

(16) Flood Control Law of the People's Republic of China (Enforcement Date of Amendment: July 2, 2016);

(17) Regulations on the Administration of Construction Project Environmental Protection (Enforcement Date of Amendment: October 1, 2017);

(18) Regulations on the Implementation of the Forest Law of the PRC (Enforcement Date of Amendment: March 19, 2018);

(19) Regulations on Implementation of Land Administration Law of the People's Republic of China (Enforcement Date of Amendment: July 29, 2014);

(20) Regulations on Protection of Basic Farmland (Enforcement Date of Amendment: January 8, 2011);

(21) Regulations on Implementation of Law of the People's Republic of China on Water and Soil Conservation (Enforcement Date of Amendment: January 8, 2011);

(22) Regulations on Implementation of Law of the People's Republic of China on Cultural Relics Protection (Enforcement Date of Amendment: January 13, 2016);

(23) Regulations of the People's Republic of China on River Management (Enforcement Date of Amendment: March 19, 2018);

(24) Law of the People's Republic of China on Response to Emergencies (Enforcement Date of Amendment: November 1, 2007);

(25) Regulations on Safety Management of Hazardous Chemicals (Enforcement Date of Amendment: December 7, 2013);

(26) Regulations of the People's Republic of China on Protection of Basic Farmland (Enforcement Date of Amendment: January 8, 2011);

(27) Regulations of the People's Republic of China on Nature Reserves (Enforcement Date of Amendment: October 7, 2017);

(28) Regulations of the People's Republic of China on Implementing Protection of

Terrestrial Wild Animals (Enforcement Date of Amendment: February 6, 2016);

(29) Regulations of the People's Republic of China on Wild Plants Protection (Enforcement Date of Amendment: October 7, 2017);

(30) Labor Law of the People’s Republic of China (Chinese Presidential Decree No. 28, second amendment on December 29, 2018);

(31) Production Safety Law of the People’s Republic of China (Chinese Presidential Decree [2014] No. 13);

(32) Law of the People's Republic of China on Prevention and Control of Occupational Diseases (Chinese Presidential Decree [2011] No. 52).

(33) Notice of the State Council on Issuing the Program for National Ecology and Environment Protection (GF [2000] No. 38 State Council Document);

(34) Classification Management List of Environmental Impact Assessment of Construction Projects (2021 edition) came into force on January 1, 2021;

(35) Notice on Improving Nature Reserve Management (GBF [2010] No. 63);

(36) Notice on Further Strengthening Supervision and Management over Development and Construction Activities Involving Nature Reserves (HF [2015] No. 57);

(37) Notice on Issuing the Guidelines for Preparing Special Reports on Ecological Impact of Construction Projects Involving National Nature Reserves (for Trial Implementation) (HBH [2014] No. 1419);

(38) Opinions on Further Improving Protection of Basic Farmland (GTZF [2005] No. 196);

(39) Notice of the Ministry of Natural Resources on Doing a Good Job in Pre-examination of Land for Major Construction Projects Occupying Permanent Basic Farmland (ZRZG [2018] No.3), December 20, 2018;

(40) Notice on Strengthening and Improving the Protection of Permanent Basic Farmland (ZRZG [2019] No.1), May 20, 2019;

(41) List of Wild Plants under Special Protection of the State (First Batch, 1999);

(42) List of Wild Animals under Special Protection of the State (issued in 1989 and amended in 2002);

(43) Guidelines for Environmental Protection of Centralized Drinking Water Sources (for Trial Implementation) (HB [2012] No. 50);

(44) Notice of the State Council on Issuing the Action Plan for Air Pollution Prevention and Control (GF [2013] No. 37);

(45) Notice of the State Council on Issuing the Action Plan for Water Pollution

Prevention and Control (GF [2015] No. 17);

(46) Notice on Implementing Environment Supervision over Transportation Projects (JHF [2004] No. 314);

(47) Notice on Setting Additional Content of Construction Safety Supervision and Construction Environmental Protection Supervision in Construction Supervision over Highway and Waterway Projects (JZJF [2007] No. 158);

(48) Notice on Strengthening Environmental Impact Assessment for Highway Planning and Construction (HF [2007] No. 184);

(49) Notice of the Ministry of Environmental Protection on Issuing the Technical Policy for Prevention and Control of Ground Traffic Noise Pollution (HF [2010] No. 7);

(50) Measures for Environmental Protection Management of Transport Construction Projects (Decree No.5 of the Ministry of Transport, enforced on June 1, 2003);

(51) Notice on Issues Concerning Environmental Noise in Environmental Impact Assessment of Such Construction Projects as Highways and Railways (including Light Rails) (State Environmental Protection Administration, HF [2003] No. 94);

(52) Opinions on Implementing the Strictest Cultivated Land Protection System in Highway Construction (JGLF [2004] No. 164);

(53) Instructions on Further Strengthening Ecological Protection and Water & Soil Conservation in Mountainous Highway Construction (JGLF [2005] No. 441);

(54) Notice on Strengthening Environmental Impact Assessment for Highway Planning and Construction (State Environmental Protection Administration, National Development and Reform Commission, and Ministry of Transport, HF [2007] No. 184);

(55) Response Plan for Unexpected Traffic Incidents of Highways (Ministry of Transport of the People's Republic of China, JGLF [2009] No. 226);

(56) Opinions on Further Strengthening Ecological Environment Protection (State Environmental Protection Administration, HF [2007] No. 37);

(57) Announcement on Defining National Key Areas for Prevention and Control of Soil Erosion (announcement No. 2 of 2006 issued by the Ministry of Water Resources of the People's Republic of China);

(58) Notice on Further Strengthening Management of Environmental Impact Assessment and Prevention of Environmental Risks (HF [2012] No. 77);

(59) Notice on Effectively Strengthening Risk Prevention and Strictly Managing Environmental Impact Assessment (HF [2012] No. 98);

(60) Measures for Public Participation in Environmental Impact Assessment (Decree

No.4 of the Ministry of Ecology and Environment, July 16, 2018).

(61) Regulations on Management of Pollution Prevention and Control in Drinking Water Source Conservation Areas (amended by Decree No.16 of the Ministry of Environmental Protection on December 22, 2010);

(62) Notice on Further Strengthening Environmental Protection of Decentralized Drinking Water Sources (HB [2010] No.132, September 26, 2010);

(63) Notice of the Ministry of Land and Resources on Conscientiously Implementing Regulations on Protection of Basic Farmland and Further Improving Protection of Basic Farmland (GTZF [1999] No. 122);

(64) Instructions on Further Strengthening Ecological Protection and Water & Soil Conservation in Mountainous Highway Construction (JGLF [2005] No. 441, September 23, 2005);

(65) Measures for Management of National Public Welfare Forests (State Forestry Administration, Ministry of Finance, LZF [2013] No.71, put in force on April 27, 2013);

(66) Instructions on Strengthening the Prevention and Control of Environmental Noise Pollution and Improving the Urban and Rural Sound Environmental Quality" (HF [2010] No.114, December 15, 2010);

(67) Notice on Issuing the Technical Policy for Prevention and Control of Ground Traffic Noise Pollution (HF [2010] No. 7, January 11, 2010);

(68) National Response Plan for Unexpected Environment Incidents (GBH [2010] No. 119, December 29, 2014);

(69) Management Measures for Response to Unexpected Environment Incidents (Decree No. 34 of the Ministry of Environmental Protection, June 5, 2015);

(70) Regulations on Management of Road Transport of Dangerous Goods (Decree No.36 of 2016 of the Ministry of Transport, amendment put in force on April 7, 2016);

(71) Appendixes I, II, and III to Convention on International Trade in Endangered Species of Wild Fauna and Flora (2017);

(72) List of the First Batch of Invasive Alien Species in China (2003);

(73) List of the Second Batch of Invasive Alien Species in China (2010);

(74) List of the Third Batch of Invasive Alien Species in China (2014);

(75) List of Invasive Alien Species in Natural Ecosystems of China (Fourth Batch) (2017);

(76) Interim Measures of National Development and Reform Commission for Assessment of Social Stability Risk of Major Fixed Asset Investment Projects (FGTZ [2012]

No. 2492), August 2012;

(77) Notice of General Office of National Development and Reform Commission on Issuing the Program for Preparing the Chapter and the Assessment Report of Social Stability Risk of Major Fixed Asset Investment Projects (for Trial Implementation), February 2013;

(78) Interim Measures of Development and Reform Commission of Guangxi Zhuang Autonomous Region for Assessment of Social Stability Risk of Major Fixed Asset Investment Projects (GFGTZ [2013] No. 833);

(79) Regulations on Work Safety Management of Construction Projects (Decree No. 393 of the State Council);

(80) Regulations of the People's Republic of China on Highway Management (Decree No. 543 of the State Council);

(81) Regulations on Work-related Injury Insurance (Decree No. 586 of the State Council);

(82) Regulations on Highway Safety Protection (Decree No. 593 of the State Council);

(83) Regulations on Work Safety Management of Construction Projects (Decree No. 393 of the State Council).

2.2Technical Guidelines and Codes for Environmental Impact Assessment

(1) Technical Guideline for Environmental Impact Assessment of Construction Project – General Program (HJ 2.1-2016);

(2) Technical Guidelines for Environmental Impact Assessment – Atmospheric Environment (HJ2.2-2018);

(3) Technical Guidelines for Environmental Impact Assessment – Surface Water Environment (HJ/T 2.3-2018);

(4) Technical Guidelines for Environmental Impact Assessment – Groundwater Environment (HJ610-2016);

(5) Technical Guidelines for Noise Impact Assessment (HJ 2.4-2009);

(6) Technical Guidelines for Environmental Impact Assessment - Ecological Impact (HJ 19-2011);

(7) Technical Guidelines for Environmental Risk Assessment on Projects (HJ 169-2018);

(8) Specification for Environment Impact Assessment of Highways (JTGB 03-2006);

(9) Design Specifications of Highway Environmental Protection (JTG B04-2010);

(10) Indexes of Land for Construction of Highway Engineering Projects (JB [2011] No.124);

(11) Code for Design of Sound Insulation of Civil Buildings (GB 50118-2010);

(12) Technical Specifications for Urban Fugitive Dust Pollution Prevention and Control (HJ/T 393-2007);

(13) Technical Specifications Requirements for Monitoring of Surface Water and Waste Water (HJ/T 91-2002);

(14) Technical Specifications for Regionalizing Environmental Noise Function (GB/T 15190-2014);

(15) Technical Guideline of Biodiversity Impact Assessment (DB 45/T 1577-2017).

2.3Guangxi Laws, Regulations and Codes on Environmental Protection

(1) Regulations of Guangxi Zhuang Autonomous Region on Environmental Protection (the amendment was put in force on September 1, 2016);

(2) Measures of Guangxi Zhuang Autonomous Region for Protection of Wild Plants (put in force on February 1, 2009);

(3) *List of the First Batch of Wild Plants under Special Protection of Guangxi Zhuang Autonomous Region* (GZF [2010] No. 17, March 30, 2010);

(4) Regulations of Guangxi Zhuang Autonomous Region on Management of Protection of Terrestrial Wild Animals (4th amendment on March 23, 2012);

(5) Regulations of Guangxi Zhuang Autonomous Region on Management of Protection of Aquatic Wild Animals (4th amendment on March 23, 2012);

(6) Measures of Guangxi Zhuang Autonomous Region for Management of Forests (2nd amendment on June 3, 2004);

(7) Regulations of Guangxi Zhuang Autonomous Region on Protection of Agricultural Environment (amendment on June 3, 2004);

(8) Measures of Guangxi Zhuang Autonomous Region for Implementing the Fishery Law of the People's Republic of China (amendment enforced on March 31, 2010);

(9) Measures of Guangxi Zhuang Autonomous Region for Implementing the Flood Control Law of the People's Republic of China (enforced on January 1, 2005);

(10) Regulations of Guangxi Zhuang Autonomous Region on River Management (enforced on January 1, 2001);

(11) Regulations of Guangxi Zhuang Autonomous Region on Cultural Relics Protection (enforced on January 1, 2014);

(12) Regulations of Guangxi Zhuang Autonomous Region on Protection of Old and Famous Trees (enforced on June 1, 2017);

(13) Implementation Plan of Guangxi Zhuang Autonomous Region for Joint Prevention and Control of Air Pollution to Improve the Regional Air Quality (GZBF [2011] No. 143, August 3, 2011);

(14) Response Plan for Unexpected Environment Incidents of Environmental Protection Department of Guangxi Zhuang Autonomous Region (Revision of 2019);

(15) Notice on Issuing Measures for Management of Examination and Approval at Levels of Environmental Impact Assessment Documents of Construction Projects of Guangxi Zhuang Autonomous Region (Amendment 2018), GHF [2018] No. 8;

(16) Regulations of Guangxi Zhuang Autonomous Region on Protection of Drinking Water Sources (January 8, 2017);

(17) Working Program of Action Plan for Prevention and Control of Water Pollution of Guangxi (GZBF [2015] No. 131);

(18) Measures for Management of Public Welfare Forests of Guangxi Zhuang Autonomous Region (July 6, 2011);

(19) List of Wild Animals under Special Protection of Guangxi Zhuang Autonomous Region (GZF [1993] No. 17);

(20) Biodiversity Protection Strategy and Action Plan of Guangxi Zhuang Autonomous Region (2013-2030) (GHF [2014] No. 12);

(21) *Regulations of Guangxi Zhuang Autonomous Region on Work Safety* (Announcement No. 86 of the 10th CPC Standing Committee of Guangxi Zhuang Autonomous Region).

(22) Regulations on the Administration of Forest and Wildlife Nature Reserves in Guangxi Zhuang Autonomous Region (revised in 2016);

(23) Comments of the People's Government of Guangxi Zhuang Autonomous Region on Implementing the "Three Lines and One Single" Zoning Control of Ecological Environment (GZF [2020] No.39).

2.4 Relevant Requirements of AIIB

This Report is prepared in accordance with the Environmental and Social Framework issued by AIIB. Relevant policy requirements set out in the Environmental and Social Framework include:

(I) Basic definitions and provisions in the Environmental and Social Framework

Client: means the recipient of the Bank financing for a Project and any other entity responsible for implementation of the Project.

Project: means the specific set of activities for which the Bank financing is provided, as defined in the agreement governing such financing, regardless of the financing instrument or the source of such financing or whether the Project is financed in whole or in part by the Bank.

The environmental and social framework includes:

Environmental and Social Policy (ESP), including the compulsory environmental and social requirements of a Project.

Environmental and social standards. Three associated mandatory environmental and social standards (ESSs) set out more detailed environmental and social requirements relating to the following:

ESS 1: Environmental and Social Assessment and Management;

ESS 2: Involuntary Resettlement;

ESS 3: Indigenous People.

Environmental and Social Exclusion List. The Bank will not knowingly finance a Project that involves activities or items specified in this list (Exclusion List).

Scope of Application of Environmental and Social Policy (ESP): All projects. The AIIB requires each client to manage the environmental and social risks and impacts associated with its Project in a manner designed to meet the ESP and the applicable ESSs in accordance with the environmental and social management plan (ESMP), and environmental and social management planning framework (ESMPF), as applicable, required for the Project under this ESP and ESSs.

(II) Classification of Items

AIIB classifies the proposed projects into four categories as follows:

Category A. A Project is categorized A if it is likely to have significant adverse environmental and social impacts that are irreversible, cumulative, diverse or unprecedented.

Category B. A Project is categorized B when: it has a limited number of potentially adverse environmental and social impacts; the impacts are not unprecedented; few if any of them are irreversible or cumulative; they are limited to the Project area; and can be successfully managed using good practice in an operational setting. AIIB requires the Client to conduct an initial review of the environmental and social implications of the Project.

Category C. A Project is categorized C when it is likely to have minimal or no adverse environmental and social impacts.

Category F1. A Project is categorized FI if the financing structure involves the provision of funds to or through a financial intermediary (FI) for the Project.

(III) Requirements for Environmental and Social Standards

When AIIB has determined, in consultation with the Client, that the Project has potentially adverse environmental or social risks and impacts, it requires the Client:

• To conduct an environmental and social assessment relating to these risks and impacts, and design appropriate measures to avoid, minimize, mitigate, offset or compensate for them, all as required under ESS 1.

• If the Project would result in Involuntary Resettlement, to address this in the social section of the assessment report, complemented by more in-depth coverage, as required under ESS 2. The Client covers Involuntary Resettlement in a Resettlement Action Plan or resettlement planning framework (RPF) which is provided to the AIIB as a freestanding document, an annex to the assessment report, or incorporated into the report as a recognizable element.

• If the Project would affect Indigenous Peoples, to address this in the social section of the assessment report, complemented by more in-depth coverage, as required under ESS 3. The Client covers impacts on Indigenous Peoples in an Indigenous Peoples plan (Indigenous Peoples plan) or Indigenous Peoples planning framework (IPPF), which is provided to AIIB as a freestanding document, an annex to the assessment report, or incorporated into the report as a recognizable element.

2.5 Relevant Planning

2.5.1Planning Documents

(1) Guangxi Expressway Network Plan (2018-2030) (November 2018);

(2) Working Program for Construction of Expressways Passing through Every County (July 2014);

(3) Water Function Zoning of Guangxi (amended) (Water Resources Department of Guangxi Zhuang Autonomous Region, 2016);

(4) Ecological Function Zoning of Guangxi Zhuang Autonomous Region (GZBF [2008] No. 8, February 14, 2008);

(5) Main Function Zoning of Guangxi Zhuang Autonomous Region (GZF [2012] No. 89, November 21, 2012);

(6) The 13th Five-Year Plan for Environmental Protection and Ecological Construction of Guangxi;

(7) Water Function Zoning of Chongzuo City (Water Resources Bureau of Chongzuo City, January 2017);

(8) The 13th Five-Year Plan for Highway and Waterway Transportation Development of Guangxi (2016-2020);

(9) Master Plan for Ports of Chongzuo City;

(10) Master Plan for Land Use of Tiandeng County (2006-2020);

(11) Master Plan for Land Use of Daxin County (2006-2020);

(12) Master Plan for Shuolong Town of Daxin County and Master Plan for Port Economic Zone of Shuolong Town (2016-2030);

(13) *Master Plan for Huashan Scenic Area* (October 1993) and the official reply;

(14) Master Plan for Xialei Nature Reserve at the Level of Guangxi Autonomous Region

(2017-2026) (Guangxi Forest Inventory & Planning Institute, January 2018);

(15) Technical Report on Division of Protection Areas of Drinking Water Sources in Urban Area of Tiandeng County and the official reply to the report;

(16) Technical Report on Division of Protection Areas of Drinking Water Sources in Townships and Towns of Tiandeng County and the official reply to the report;

(17) Technical Report on Division of Protection Areas of Centralized Drinking Water Sources in Rural Area of Tiandeng County and the official reply to the report;

(18) Technical Report on Division of Protection Areas of Drinking Water Sources in Townships and Towns of Daxin County and the official reply to the report;

(19) Technical Report on Division of Protection Areas of Centralized Drinking Water Sources in Rural Area of Daxin County and the official reply to the report;

(20) Regulatory Detailed Planning of Shuolong Town, Daxin County

2.5.2 Environmental Function Division

2.5.2.1Function zoning of atmospheric environment

No function zone in terms of atmospheric environment is identified within the assessment area. According to *Ambient Air Quality Standards* (GB 3095-2012), Class I zones include natural reserves, scenic spots and other areas in need of special protection; Class II zones include the residential quarters designated in town planning, mixed areas of business, transportation and living, cultural areas and rural areas. Therefore, Class I standard in *Ambient Air Quality Standard* (GB3095-2012) are adopted for Xialei Nature Reserve and Huashan Scenic Area, while Class II standard in *Ambient Air Quality Standard* (GB3095-2012) for other areas.

2.5.2.2 Surface water environment

The surface waters near the highway mainly include the Xialei River, the Guichun River and the Baidou River. According to the *Water Function Zoning of Chongzuo City* (issued in January 2017), the highway crossing the Xialei River is within the Xialei River Daxin Development and Utilization Zone–Xialei River Daxin Yixian Transitional Zone, while the highway crossing the Guichun River is within the China-Vietnam Heishui River Nature Reserve, and the Baidou River has no water function zoning. The river section that finally flows into the Heishui River belongs to the Xialei River Daxin Development and Utilization Zone–Xialei River Daxin Yixian Transitional Zone, so the water quality standards of the Xialei River Daxin Development and Utilization Zone–Xialei River Daxin Yixian Transitional Zone shall prevail. See Figure 7 for the water function zoning of surface water bodies along the project, and see Table 2.5-1 for specific standards.

Table 2.5-1 Water Function Zoning of Rivers and Reservoirs Crossing the Project

S/N	Name of Crossing/adjacent Rivers And Reservoirs	Water Function Zoning of River Reaches	Water Quality Target
1	Xialei River	Xialei River Daxin Development and Utilization Zone–Xialei River Daxin Yixian Transitional Zone	III
2	Guichun River	China-Vietnam Heishui River Nature Reserve	III
3	Baidou River	/	III

2.5.2.3 Groundwater environment

No function zone in terms of groundwater environment is identified within the assessment area. According to *Standard for Groundwater Quality* (GB/T 14848-2017), Class III criteria are adopted for centralized domestic drinking water sources and industrial and agricultural water.

2.5.2.4 Acoustic environment

The main areas along the Project are towns, townships and rural areas, and no acoustic environment function zone is identified. According to the requirements in *Environmental Quality Standard for Noise* (GB 3096-2008) and *Technical Specification for Regionalizing Environment Noise Function* (GB/T 15190-2014), the villages along the Project but not accessible by traffic arteries are identified as Class 1 acoustic environment function zones, and the following standards are adopted for villages with traffic trunk passing.

① If the buildings by the highway are mainly higher than three floors (inclusive), the area of the first row of buildings facing the highway is identified as Category 4a acoustic environment function zone, and the area behind as Category 2 acoustic environment function zone.

② If the buildings by the highway are mainly lower than three floors (including open ground), the area within 35 m of the ROW is identified as Category 4a acoustic environment function zone, and the area beyond as Category 2 acoustic environment function zone.

This Project is a traffic artery, and the function zones will be identified as mentioned above after being put into operation.

2.5.2.5 Ecological environment

According to the *Ecological Function Zoning of Guangxi Zhuang Autonomous Region* (2008), the Project is located in an important biodiversity protection function zone in karst mountain areas of southwest Guangxi.

Table 2.5-2Characteristics of Ecological Function Zoning in Project Area

Class I Zone	**Class II Zone**	**Class III Zone**	**Location and Area**	**Main Ecological Problems**	**Eco-environmental Sensitivity**	**Dominant Eco-service Function**	**Ecological Conservation and Development Direction**
Ecological regulation function zone	Biodiversity Protection Function Zone	Biodiversity protection function zone in karst mountain areas of southwest Guangxi	This area involves 14 districts and counties in southwest Guangxi and covers an area of 19,500 km2.	Severely damaged natural forests, resulting to low forest coverage and prominent rocky desertification; relatively fragmented habitats, with serious invasion of foreign species such as fragrant eupatorium herb, threating biodiversity; ecological damage and serious soil erosion resulting from steep slope reclamation and disordered exploitation of local minerals; and frequent	Extremely sensitive to soil erosion and rocky desertification	Biodiversity Protection	Accelerating the development of water source conservation forests and soil and water conservation forests; protecting natural ecosystems and habitats of important species; handling drought; ecological restoration of mining areas.

				occurrence of drought damage.			

3 Natural Environmental, Social and Economic Conditions

3.1 Natural Environmental Conditions

3.1.1 Geographical Location

Wuzhou (Longyanzui) - Shuolong Highway (Chongzuo - Jingxi Expressway to Shuolong Port Section) is located in Tiandeng County and Daxin County of Chongzuo City. The main line starts from the vicinity of Neitun Village, Fuxing Township, Tiandeng County, connects to Long'an-Shuolong Expressway, and goes southwest through villages such as Buli, Xuanjie and Yining to Bangtun. Shuolong Connecting Line connects the end point of the main line, goes southwards through villages such as Guitun, Mengtun and Rentun, crosses the Guichun River, and reaches the vicinity of Shuolong Port at Shuolong Town, Daxin County, the end point of the Project. The start point of the Project is at N22°53′, E106.56′, and the end is at N22°49′, E106°50′.

Detian-Shuolong Highway is located in Daxin County. It starts from Detian Scenic Area, passes through Liudeng, Aijiang Village, Wanlong, Longhong and Gutun, and ends at the north bank of the Guichun River near Shuolong Town Port. It crosses the Shuolong Connecting Line of Component A.

Chongzuo City faces Southeast Asia, with its back to the Southwest China, its east to Nanning City, its southeast to Fangchenggang City, and its north to Baise City. It governs Jiangzhou District and five counties, namely Fusui, Daxin, Tiandeng, Longzhou and Ningming, and Pingxiang City, a county-level city. Among them, Ningming, Longzhou, Daxin and Pingxiang in the west and southwest border Vietnam, with a 533km long border line, which is the prefecture-level city in Guangxi with the longest border on land, with a total area of 17440km^2.

Tiandeng Town, the county seat of Tiandeng County, is 183km away from Nanning, 45km away from the China-Vietnam border, bordering Long'an County in the east, Daxin County in the south, Pingguo County and Debao County of Baise City in the northeast and northwest respectively, Tiandong County of Baise City in the north, Jingxi County of Baise City in the west, 64km from east to west, 63km from north to south. The main traffic arteries include Tiandeng-Nanning Class II highway which is 180km long, Tiandeng-Chongzuo Class II highway which is 116km long and Tiandeng-Tiandong Class III tar coated road which is 80km long. Tiandeng Town, the political, economic, cultural and information center of the county, is located in the eastern part of Tiandeng County. The downtown is in flat terrain, with the Hongling River and the Lichuan River running through the northeast part and is surrounded by mountains.

Daxin County is located in the northern part of Chongzuo City, between E106°39′~E107°29′ and N22°29′~N23°05′. It borders Jiangzhou District in the southeast, Long’an County in the northeast, Tiandeng County in the north, Jingxi County in the northwest, Longzhou County in the southwest and Vietnam in the west. The national boundary is about 40km long and 143km away from Nanning, the capital of the autonomous region.

Please see Attached Drawing 1 for the detailed geographical location of the Project.

3.1.2 Geologic Aspects

3.1.2.1 Landform

Tiandeng County is dominated by low hills, with a mountainous area of 1696.42 km2, accounting for 77.98% of the total area. The soil hills account for 22.60% of the total area; limestone mountains account for 41.50% of the total area; siliceous gray rock mountains account for 10.31% of the total area; and half-soil and half-stone mountains account for 3.57% of the total area. The terrain of the county is high in the southwest and low in the northeast. The highest point is the main peak of the Shicheng Mountain in the southwest, with an altitude of 1073.7m. The lowest point is Donghe Depression in Tiannan Village in the northeast, with an altitude of 263m. The average altitude is 450-650m. Karst landform accounts for 77.4% of the total area of the county. This region is located in the transition zone between Yunnan-Guizhou plateau platform and Guangxi hilly and mountainous areas. The mountain range trend is basically consistent with the direction of the tectonic line. The overall terrain is high in northwest and low in southeast, which is consistent with the flow of rivers in the region from northwest to southeast.

Daxin County is located on the southern edge of Yunnan-Guizhou Plateau. The landform of the county is higher in the north and slightly lower in the south, with many small basins developed between the mountains. The strata exposed in the county are Cambrian, Devonian, Carboniferous, Permian and Quaternary systems. Cambrian system, lower Devonian system and lower carboniferous system are siliceous, sandy and argillaceous calcareous lithofacies, which form soil hills and hilly land, accounting for about 20% of the total area of the county, and are forestry development areas. The upper Devonian system, upper Carboniferous system and Permian systems are calcareous lithofacies, forming peak clusters, peak forests and arc-peak landforms, accounting for about 25% of the total area of the county. The Quaternary system is composed of clay, sub-clay, clayey silt or clastic rocks, developed in small karst plains, round depressions and trough valleys, accounting for about 25% of the total area of the county. It is the main farming area, including Leiping, Taocheng and Quanming small karst plains with larger areas.

The area along the Project is mountainous and hilly, and the areas along the route are mainly limestone mountains, peak cluster valleys and peak forest valleys.

Figure 3.1-1Photos of Landform along the Line

3.1.2.2 Geological Structures

1. Wuzhou (Longyanzui)-Shuolong Expressway (Chongzuo-Jingxi Expressway to Shuolong Port Section)

① Geological structure

The project area is located in the Xidaming Mountain uplift zone of Youjiang regenerated geosyncline, adjacent to Xialei-Lingma depression in the north, with a series of folds and faults developed.

Folds: The main fold in the project area include Datun-Longliang wide and gentle syncline. The syncline extends towards N70°E by about 13 km and ends at Heishui River fracture in the west and Longliang in the east. The syncline has a wide core (about 3~4 km) and upper Devonian System stratum (D3) outcrops, and there is outcrop of Middle Donggangling terrace stratum of Devonian System at both wings where the rock stratum inclines by 10-20°. The western ring has gentle land and the south-eastern wing has steep land. The northwestern section of the syncline is cut by a NE-extending thrust fault. Section K1+693~K10+000 of the main line runs approximately parallel to the extension direction of the syncline. The spatial form and extension direction of folds play an important role in controlling the development of Jietun-Butun underground river system in this area.

Faults: The project area has complicated tectonic setting and is dominated by NW-extending and NE-extending fractures. Structural characteristics of the main fractures are as show in the table below:

Table 3.1-1Schedule of Faults along the Line

Name	Trend	Geological features	Relation with the line
Heishui River Fracture	N45°W	A composite fracture runs north-westwards from Laituan at Chongzuo and flows along Heishui River valley through eiping at Daxin and Hurun at Jingxi into Kuiwei. It is 100 km long and controls Paleozoic sedimentary facies and magmatic activities.	Section K12+240~K12+440 obliquely overpasses the fracture zone
Yining-Liliang Fault	N65°E	A reverse fault, trending NW, starting from Yining in the southwest, extending in NE direction, and ending in Liliang, with a total length of about 8 km, obliquely cutting wide gentle Datun-Longliang syncline, where there is obvious characteristics of steep cliff. This fault is the boundary between the upper and middle Devonian Donggangling strata where they are in unconformable contact with each other.	Section K6+900~K7+000 obliquely crosses the fault.
Xialei-Lingma Fracture Zone	N80°E	It is a large regional fracture composed of a series of NEE faults. It starts in the vicinity of Xialei at Daxin County, extends eastward through Shicheng Mountain and ends at Lingma in Wuming County, with a total length of about 210 km. Most of the faults are thrust faults trending SE at a dip angle of 40~65° which along with axis-like compact complex folds make up NEE fault-fold zone.	It is 4 km from the north of the line.

Figure 3.1-2Schematic Diagram of Major Fractures near the Project Area

Most of the above faults directly intersecting the line are covered with Quaternary unconsolidated layers. There is no obvious sign of activity, and the area has stable geological environment. Impact of the faults on the highway of this Project is as stated below:

a. The rock mass near the faults and their influence zones is relatively broken, and the side slope and tunnel surrounding rock are easy to collapse;

b. When a bridge crosses a fault zone, the bearing stratum of pier and abutment foundation may have insufficient strength and deformation stability;

c. Since the fault fracture zones are natural water conduction corridors, and the limestone widely developed in this area is soluble, it is easy to develop into karst caves and underground catchment zones in the fault fracture zones.

2. Detian-Shuolong Highway

The project area is located in the Xidaming Mountain uplift zone of Youjiang regenerated geosyncline, adjacent to Xialei-Lingma depression in the north, with a series of folds and faults developed.

Folds: The main fold in the project area include Datun-Longliang wide and gentle syncline. The syncline extends towards N70°E by about 13 km and ends at Heishui River fracture in the west and Longliang in the east. The syncline has a wide core (about 3~4 km) and upper Devonian System stratum (D3) outcrops, and there is outcrop of Middle Donggangling terrace stratum of Devonian System at both wings where the rock stratum inclines by 10-20°. The western ring has gentle land and the south-eastern wing has steep land. The northwestern section of the syncline is cut by a NE-extending thrust fault.

Faults: The project area has complicated tectonic setting and is dominated by NW-extending and NE-extending fractures. The main fracture is the Heishui River fracture, which runs to N45°W and is a composite fracture, starting from Laitan in Chongzuo to NW direction, along the Heishui River valley, passing through Leiping in Daxin and Hurun in Jingxi, and ending at Kuiwei, with a total length of about 100km, controlling Paleozoic sedimentary facies and magmatic activities.

3.1.2.3 Formation lithology

1. Wuzhou (Longyanzui)-Shuolong Expressway (Chongzuo-Jingxi Expressway to Shuolong Port Section)

The exposed strata along the line are simple, mainly including Quaternary System (Q), Upper Devonian and Donggangling Terrace of Middle Devonian System, and there are diabase or peridotite vein outcrops. The geological map of the route scheme is as follows. Stratigraphic distribution and characteristics along the line are summarized as follows:

Quaternary system (Q): very widely distributed, mainly including diluvial and eluvial layers. The alluvial-diluvial layer (Qal+pl) is mainly composed of clay, silty clay, muddy clay, gravel, gravel, etc., about 2~5m thick and widely distributed in all river channels, alluvial-diluvial terraces, karst basin bottoms, mountain gullies, gullies, etc.; the eluvial layer (Qel+dl) is mostly composed of hard plastic clay, silty clay and gravelly clay, with a thickness ranging from 1 to 3m, and mainly distributed on the slope surface.

Upper Devonian series (D_3): mainly limestone, distributed in Section K1+693~K6+250 of the main line, partially covered by Quaternary system, about 6.943km long in total, accounting for 39.5% of the total length of the Project (including the connecting line). The strata are in unconformable contact with the Donggangling Stage of Middle Devonian (D2d) through faults.

Donggang Mountain stage (D_{2d}) of middle Devonian series: also mainly limestone, distributed in Section K6+250~K11+740 of the main line and Section AK0+400~AK5+410 of the connecting line, partially covered by Quaternary system, about 10.5km long in total, accounting for 60% of the length of the Project (including the connecting line).

Mesozoic intrusive rocks (βμ): it mainly includes diabase or olivine diabase vein, exposed sporadically along the section K11+740~K11+862 of the connection line.

2. Detian-Shuolong Highway

The strata exposed along the Project mainly include Quaternary, Permian, Carboniferous and Devonian systems, among which Carboniferous strata are the most widely distributed, followed by Devonian system, and Permian and Quaternary systems are slightly less. Stratigraphic distribution and characteristics along the line are summarized as follows:

① Quaternary system

Widely distributed above the second terrace of the river along the line, including the Pleistocene strata of sub-clay, glutenite, calcareous loam, cave stalactite and clay, rich in accumulation type limonite and cobalt manganese iron ore.

② Permian system

Mainly limestone and dolomite, with chert and clastic limestones in the lower part, bauxite, coal-bearing seam and feralite in the upper part.

③ Carboniferous system

The lower Carboniferous series is composed of carbonate rocks and siliceous rocks, while the middle and upper Carboniferous series is a set of neritic carbonate deposits, mainly limestone and dolomite.

④ Devonian system

Mainly Devonian clastic rock series (sandstone, shale, mudstone), middle Devonian carbonate rock (mainly limestone and dolomite, also including marl, siliceous rock) and upper Devonian carbonate rock, as well as siliceous shale and limestone with phase change relationship, with a thickness of more than 1,000m.

3.1.2.4 Seismic intensity

According to *Seismic Ground Motion Parameters Zonation Map of China* (GB 18306-2015) implemented by the state on June 1, 2016, within the route range: ① the characteristic period of seismic ground motion response spectrum is 0.35s; ② the peak acceleration of seismic ground motion is 0.05g.

According to Article 3.1.2 in The *Rules for Seismic Design of Highway Bridges* (JTG/TB 02-01-2008, hereinafter referred to as the "Rules"), the large, medium and small bridges in this Project are classified as Class B in terms of seismic fortification. According to Articles 3.1.3 and 3.1.4 in the Rules, Class B bridges must be subjected to seismic design under E1 earthquake and E2 earthquake, and the seismic fortification measures for Class B bridges shall be raised by one level.

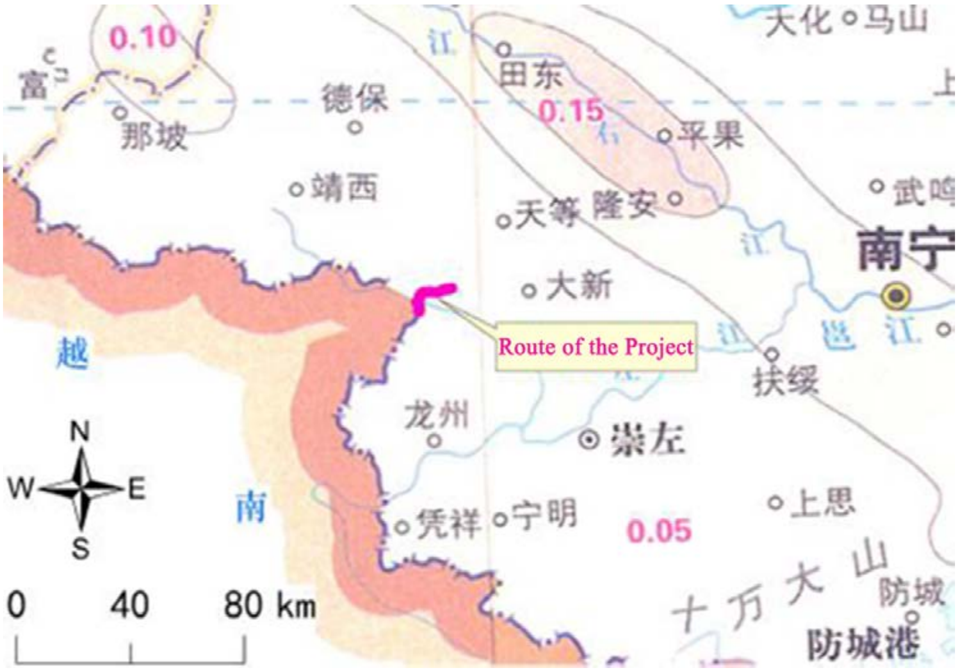


Figure 3.1-3Peak Peak Acceleration of Seismic Ground Motion in Proposed Project Area

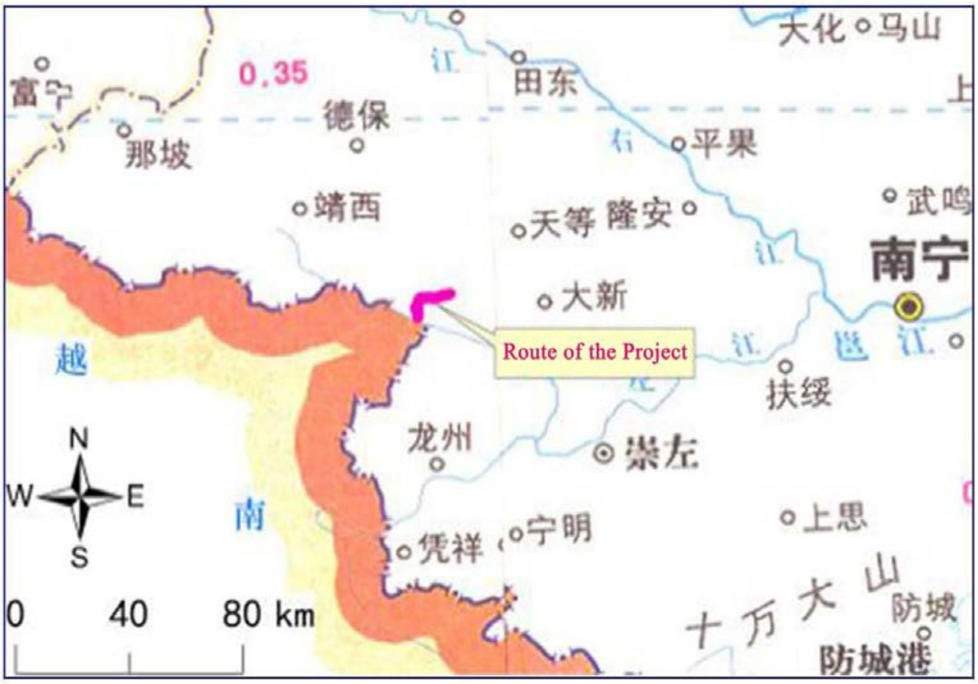


Figure 3.1-4Characteristic Period Diagram of Seismic Ground Motion Response Spectrum in Proposed Project Area

3.1.2.5Major geological issues

The unfavorable geological conditions along the line are mainly karst and rock pile, and the special rock and soil are mainly soft soil and red clay.

① **Karst**

Mainly karst caves, karst depressions, funnels, sinkholes and underground rivers.

Karst cave: a karst cave has meandering body and large number of branch caves and is above groundwater level where there is no constant running water and red clay may fill and there are large-sized complicated karst caves of different elevations dispersed in an overlapping manner.

Karst depression: most of the depressions are long and narrow and have length that is 1-5 folds of width and less than 30 m depth.

Funnel: closed depression in the shape of a funnel is a result of corrosion or karst cave roof collapse; it is large in the upper part and small in the lower part, and there are sinkholes or avens at the bottom.

Sinkhole (window): a channel leading from the surface to underground rivers or karst caves that is as a result of water corrosion, mechanical erosion and collapse of fissures in rock masses.

Underground river: as the main line of the Project is located at Jietun-Botun underground river system, there are underground rivers at some sections.

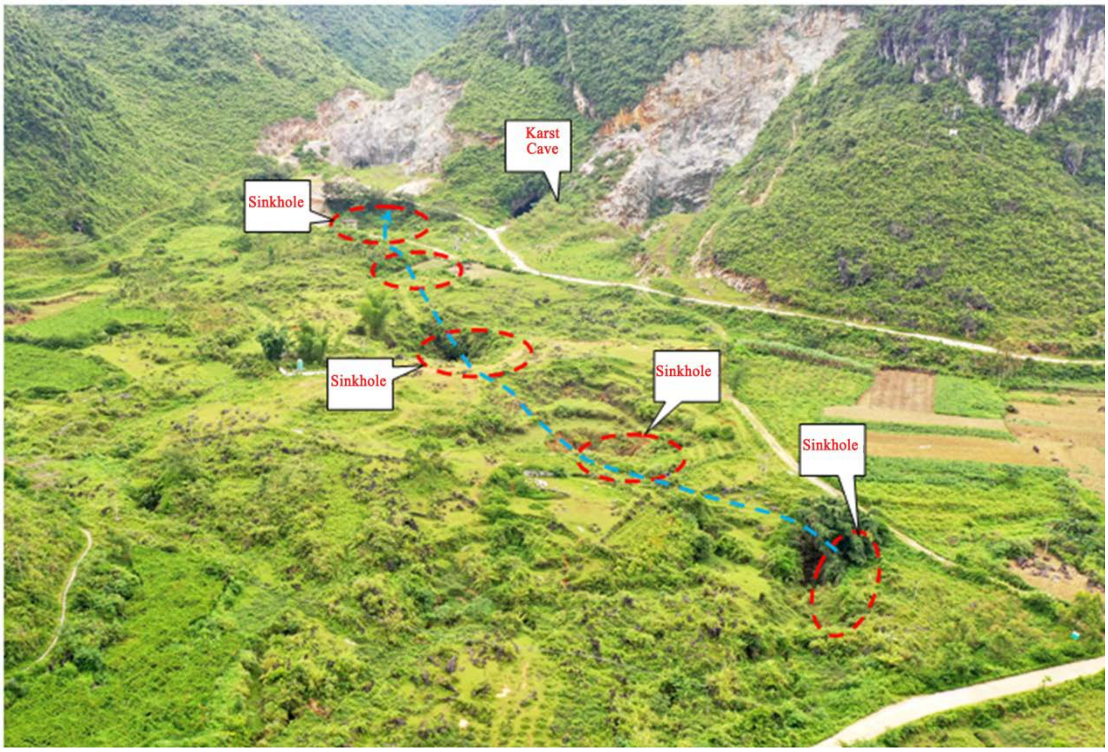


Figure 3.1-5Distribution of Sinkholes and Underground Rivers around Hub and Interchange at the Start Point of the Project

Karst cave

Underground river

Sinkhole

Kasrt funnel

② Talus and rockfall

They are deposits as a result of limestone peak cluster collapse and accumulation of falling rocks at the foot of the slope. They are steep in the upper and gentle in the lower part. The deposit mass rock has grain size up to a few meters.

Rock heap

Rockfall

③Soft soil

Soft soil is developed along the line and distributed in low-lying areas such as valleys and gullies between hills, mostly paddy fields and ponds. Due to low-lying terrain, abundant groundwater or accumulated water on the surface, the soil is softened and organic matter is deposited due to long-term immersion in water, mainly saturated cohesive soil and muddy clay, which are typically soft plastic with a thickness of 1 ~ 7m and different distribution ranges.

④Red clay

Red clay is a special clay as a result of laterization of carbonate at humid and hot environment. It overlies carbonate rock system and has 1-3m thickness and is in brownish red and brownish yellow color. It has shrinked surface and it is hard in the upper part and soft in the lower part, and there are fissures.

Soft soil

Red clay

3.1.3 Climate and Meteorology

The region where the Project is located belongs to subtropical monsoon climate zone, with distinct seasons. The annual average temperature in Tiandeng County is about 20.9℃, with an average maximum of 26.98℃ (July) and an average minimum of 12.11℃ (January). The extreme maximum air temperature for years is 38.3°C, and the extreme minimum air temperature for years is 0.1°C. This region enjoys abundant rainfall, with annual average rainfall of 1427.7mm. The rainy season is from May to August, and the average monthly rainfall is 276.54mm; the dry season is January, February, November and December, and the monthly rainfall is 35.34 ~ 55.77 mm. The measured maximum wind speed for years is 6.4 m/s, the average wind speed for years is 1.4 m/s, and the prevailing wind direction is southeast wind. The annual average sunshine duration is 1524.36h, and the annual average relative humidity is 78.2%. The annual average temperature in Daxin County is 21.3℃, the extreme maximum temperature is 39.8℃ and the minimum temperature is -2.2℃. The annual average rainfall is 1,354 mm, mostly concentrated in summer and autumn, but less in winter and spring. The annual average sunshine duration is 1579h and the frost-free period is 341d.

3.1.4 Hydrology

1. Surface Water

Most of the regions along the project are located in karst mountain areas, with valleys developed, seasonal small streams, depressions and karst caves distributed everywhere. The rivers along the line fall into the Pearl River system, and flow into the Zuojiang River. The main river crossed by the line is the Guichun River.

Guichun River: It is a Level 1 tributary of the Zuojiang River and originates from Butoutun in Pangling Village, Xinwei Township, Jingxi County where the outlet of the Butou Underground River is; flows southeast (called the Pangling River) to the vicinity of Shizi Mountain in Wulong Village, Xinjing Town, Jingxi County where the Longtan River flows in from the left bank (still called the Longtan River); passes through Huadong Town and flows to the Shijiudu Bridge in Aibo Village where the Enquan River flows in from the right bank (called the Nantan River); flows southeast, passes through Daxing Village in Yuewei Town, and flows to No. 74 Boundary Marker at the Doulun Pass where it flows into Vietnam and is called the Guichun River; passes through Tongnuo in Trùng Khánh District, Vietnam, flows to Namu where it turns northeast, flows to Detian Village, Shuolong Town, Daxin County, Guangxi, China and turns southeast (the boundary river between Vietnam and China); flows to 2km downstream of Aijiang Village in Shuolong Town where it turns east, flows to 4km east of Shuolong where the Xialei River flows in form the left bank (called the Heishui River); flows southeast to about 3km downstream of Ping’an Street of Leiping Town where the Taocheng River (also called the Xiangshui River and the Daxin River) flows in from the left bank; flows to Gongyi Village where the Mingshi River flows in from the right bank, enters Jiangzhou District at Kangbatun in Xinli Village, and flows to 1.6km upstream of Xinhe Town where the Lanwei River flows in form the left bank, turns southwest, and flows into the Zuo River at Mianjiang Village, Xiangshui Township, Longzhou County which is the boundary between Jiangzhou Didstrcit and Longzhou County. It has a total length of 197km and an average gradient of 2.76‰, including 37km in Vietnam, 15km across the border between Vietnam and China. Its catchment area is 6025 km^2, with 505km^2 in Vietnam, and 5520 km^2 in Guangxi, China, with an average annual discharge of 83.7 m^3/s, annual runoff modulus of 26.0 L/s•km^2, maximum discharge of 150 m^3/s, minimum discharge of 24.8 m^3/ s, annual runoff of 2,641 million m^3, and annual runoff depth of 821.2mm.

Xialei River, a Level 1 tributary on the left bank of the Heishui River, originates 1.2km northwest of Niantun, Wuping Street, Wuping Township, Jingxi County, flows southeast to the Sanhu River in Bada Village, Xialei Town, Daxin County, and flows to Niandi Village in Shuolong Town where it flows into the Heishui River from the left bank. It has a total length of 78km, an average gradient of 6.87‰, and the catchment area is 1200km.

2. Groundwater

(1) Wuzhou (Longyanzui)-Shuolong Expressway (Chongzuo-Jingxi Expressway to Shuolong Port Section)

Groundwater in the project area is classified into pore water and karst water in Quaternary loose superstratum considering factors such as groundwater, runoff, sources of replenishment, water storage capacity and storage medium.

Pore water in Quaternary loose superstratum is widely distributed in Quaternary alluvial-proluvial and eluvial layers along the line. The aquifer consists of sandy soil, gravel, gravel soil, silty clay, etc. Groundwater is abundant in some sections such as river bank terraces where depth of burial of water is shallow. Such groundwater is replenished by atmospheric water, and the sections near rivers, ditches and reservoirs receive surface water. Volume of water is subject to impact of rainfall intensity and duration. Rainwater flows into surface gullies or bedrock fissures in forms such as porous flow and complements surface water.

Karst water: the water-bearing formation is composed of soluble rocks such as limestone. This kind of groundwater is stored in karst cavities, karst underground rivers and fissured pipelines. The pipelines have good connectivity, strong fluidity, clear water quality and obvious seasonal variation of water quantity. It mainly comes from atmospheric precipitation, a small amount of Quaternary pore water and local upper stagnant water, and is discharged in the form of springs, seepage and other forms in surface ravines and low-lying areas.

Surface water and groundwater along the line are of high quality and result in slight corrosion to steel bars in concrete.

(2) Detian-Shuolong Highway

According to the groundwater factors such as depth runoff, recharge sources, water abundance and storage medium, the types of groundwater in the project area mainly include bedrock fissure water and carbonate karst water.

Bedrock fissure water: distributed in Section K0+000~K5+500. The lithology of water-bearing rock group is sandstone of C_3^d and C_3^e, siltstone mixed with shale, etc.. The groundwater occurs in the structural fissures of the rock mass. The water abundance is closely related to the development degree of fissures in rock mass, geological structure, landform and atmospheric precipitation. There is abundant rainfall in mountain areas. The northern part of the Project is a mountainous and hilly area, and the southern part is a river valley alluvial area. The water body is mainly the Guichun River, with only a small amount of groundwater occurring in fissures in rock. Sandstone joints and fissures are well developed, to provide better storage space. The groundwater runoff modulus of bedrock fissure water is 2 ~ 5 L/s·km^2, and the water-bearing rock group has medium water abundance.

Carbonate karst water: distributed in Section K5+550~K13+564, the water-bearing rock groups are D_1y, D_2d^1, D_2d^2 light gray to gray black dolomite with dolomitic limestone, variegated siltstone, quartz sandstone, gravelly sandstone, conglomerate with shale and argillaceous limestone. The type of landform is river valley alluvial zones, the water level is generally shallow, groundwater is mainly supplied by atmospheric precipitation, and the areas close to rivers, ditches and ponds also receive lateral supply of surface water. The amount of water is obviously affected by rainfall intensity and duration. It is discharged into surface gullies or lower karst in the form of seepage. The groundwater runoff modulus is 10 ~ 40 L/s·km^2, and the groundwater depth near the river bank is less than 10m, with abundant water.

3.2 Social and Economic Conditions

3.2.1Guangxi Zhuang Autonomous Region

Geographical location: Guangxi Zhuang Autonomous Region is located in South China, between E104°28′~E112°04′ and N20°54′~N26°24′. The tropic of cancer traverses in the middle. It is bounded by Guangdong Province in the east, Beibu Gulf in the south and Hainan Province across the sea, Yunnan Province in the west, Hunan Province in the northeast, Guizhou Province in the northwest and Vietnam in the southwest. The administrative area covers a total area of 237,600 km^2, accounting for 2.47% of the total area of China, and governs about 40,000 km^2 of Beibu Gulf waters. Guangxi Zhuang Autonomous Region enjoys a superior location. Situated in low latitudes, it borders Beibu Gulf in the south, faces

Southeast Asia, and adjoins Vietnam in the southwest, Guangdong, Hong Kong and Macao in the east, central China in the north, and the southwest of China in the back. It is the most convenient access to the sea for the southwest. It borders Beibu Gulf in the south with a continental coastline of about 1,629 km long and an island coastline of 461 km long. The coastal mudflat covers an area of more than 1,000 km^2. It is the combination of the resource-based economy in western China and the open economy in southeast China, so that it is at an important position in the economic exchanges between China and Southeast Asia.

Guangxi Zhuang Autonomous Region is composed of 14 prefecture-level cities, 8 county-level cities, 63 counties (including 12 ethnic autonomous counties), 40 municipal districts, 799 towns, 319 townships (including 59 ethnic townships), and 133 subdistrict offices. The capital is Nanning. At the end of 2018, the resident population of the Region was 56.59 million, an increase of 590,000 from the end of the previous year. The Region had a permanent population of 49.26 million, growing by 410,000 compared with that at the end of the previous year, including 24.74 million urban population, accounting permanent population 50.22% of the total resident population (urbanization rate of resident population), growing by 1.01% compared with that at the end of the previous year. The urbanization rate of the registered population was 31.72%, growing by 0.49% compared with that at the end of the previous year.

In 2019, the region's GDP was RMB 2123.714 billion, with a per capita GDP of RMB 42,964.

At the end of the year, the region had a total registered population of 56.95 million and a resident population of 49.60 million, of which 25.343 million was urban population, accounting for 51.09% of the resident population.

There were 28,532,000 employees in the region at the end of the year, including 13,148,000 urban employees. The total number of migrant workers in the region was 12,872,000, including 8,942,000 out-migrant workers, a decrease of 2.0%, and 3.93 million local migrant workers, an increase of 8.8%. The consumer price index (CPI) in the region rose by 3.7% over the previous year, and the producer price index (PPI) of agricultural products rose by 15.5%.

In the whole year, the per capita disposable income of residents in the whole region was RMB 23,328 (RMB 34,745 for urban residents and RMB 13,676 for rural residents), and the per capita monthly income of migrant workers in the whole region was RMB 3,909, with an increase of 7.0% over the previous year. In the whole year, the per capita consumption expenditure of the whole region was RMB 16,418 (RMB 21,591 for urban residents and RMB 12,045 for rural residents).

The poverty headcount ratio in the region at the end of the year was 1.2%, 2.1 percent lower than that at the end of the previous year. In the whole year, the per capita disposable income of rural residents in poverty-stricken areas (33 national-level poverty-stricken counties) was RMB 11,958, an increase of 11.1% (6.7% after adjusting for inflation) over the previous year.

The whole region of Guangxi has been lifted out of poverty on November 20, 2020.

Table 3.2-1Main Economic and Social Indicators of Guangxi over the Years

Year	Population (10,000 persons)	GDP		Industrial composition (RMB 100 million)			Per capita GDP (RMB)
		(RMB 100 million)	Index	Primary industry	Secondary industry	Tertiary industry	
2000	4751	2079	100.00	557	732	790	4652
2001	4788	2279	108.30	576	771	932	5058
2002	4822	2523	119.78	602	846	1075	5558
2003	4857	2821	132.00	659	984	1178	6169
2004	4889	3434	147.57	818	1254	1362	7461
2005	4925	4076	167.05	912	1511	1653	8788
2006	4961	4828	189.60	1032	1879	1917	10296
2007	5002	5955	218.24	1241	2425	2289	12555
2008	5049	7172	246.17	1454	3038	2680	14966
2009	5092	7759	280.39	1458	3382	2919	16045
2010	5159	9570	320.20	1675	4512	3383	20219
2011	5199	11721	359.59	2047	5675	3398	25326
2012	5240	13035	400.22	2172	6247	4615	27952
2013	5282	14450	441.04	2291	6731	5428	30741

Year	Population (10,000 persons)	GDP		Industrial composition (RMB 100 million)			Per capita GDP (RMB)
		(RMB 100 million)	Index	Primary industry	Secondary industry	Tertiary industry	
2014	5475 (registered households)	15673	478.53	2413	7325	5934	33090
2015	5518 (registered households)	16803	517.29	2566	7695	6542	35190
2016	5579 (registered households)	18245	555.05	2799	8220	7227	37876
2017	5600 (registered households)	20396	594.46	2907	9298	8192	41955
2018	5659 (registered households)	20353	634.89	3012	8080	9261	41489
Average annual growth rate							
2000-2005	0.72%	10.81%		6.89%	11.96%	12.26%	10.01%
2005-2010	0.93%	13.90%		8.44%	19.51%	10.81%	12.84%
2010-2015	1.35%	10.07%		7.11%	9.43%	12.21%	8.60%
2015-2018	0.84%	7.07%		5.95%	2.09%	12.78%	6.17%
2000-2018	0.98%	10.81%		7.22%	11.56%	11.93%	9.74%

Notes: 1. According to the Guangxi Statistical Yearbook and the statistical bulletin, the indicators are the current year's prices;

2. The economic growth rate is calculated at comparable prices, the same below.

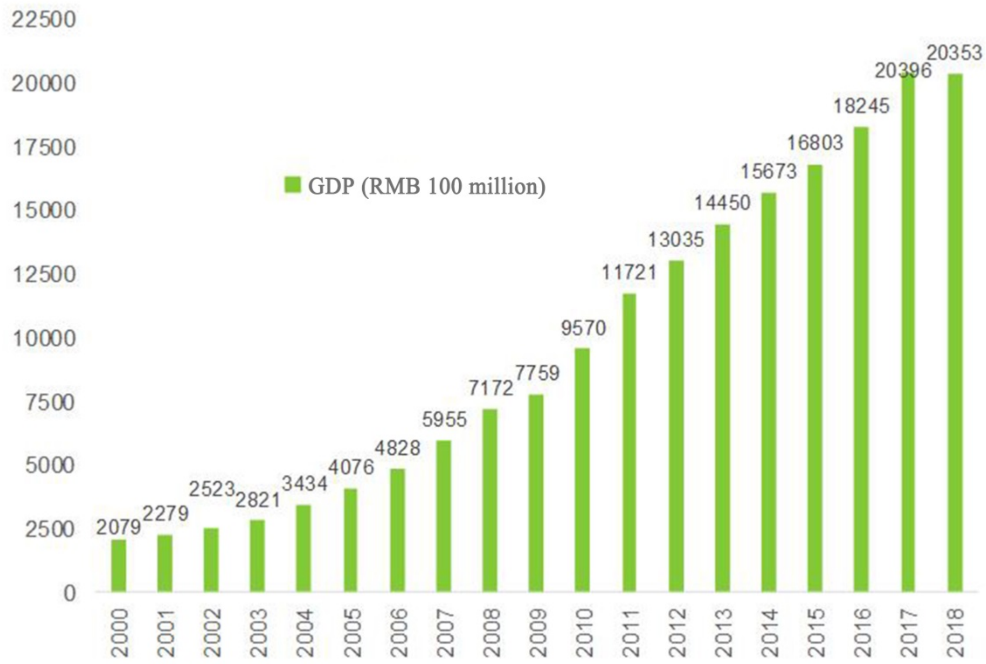


Figure 3.2-1Guangxi GDP Growth Trend

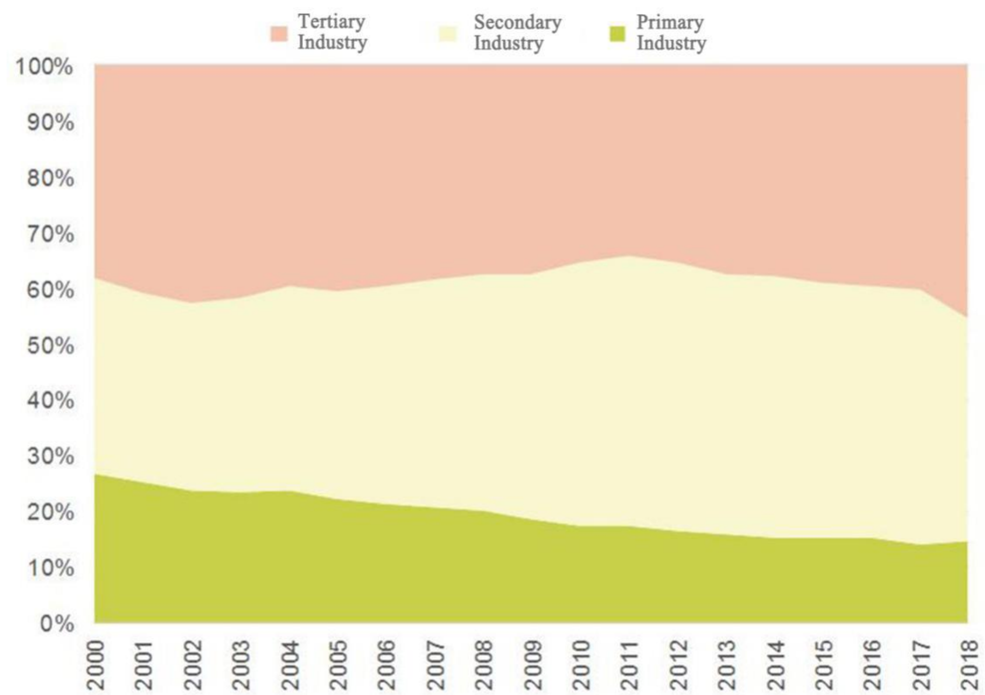


Figure 3.2-2Three Changes in Guangxi's Industrial Structure

3.2.2Chongzuo City

Chongzuo City was established in August 2003 and is the youngest city in Guangxi. It is located in the southwest of Guangxi, between E106°33′21″~E108°06′35″ and N21°35′45″~N23°22′26″. It borders Nanning City, Qinzhou City and Fangchenggang City in the east and southeast, Vietnam in the south and west, and Baise City in the north. Chongzuo City is China's southern gate, with location advantages in terms of transportation as being close to the border, being close to expressway, adjacent to the capital, adjacent to ASEAN and close to the gulf. Nanning-Friendship Pass Expressway, Chongzuo-Qinzhou Expressway and Chongzuo-Jingxi Expressway have been completed and put into service, Hunan-Guangxi Railway, national highways G322, G358, G359 and G219 run through the city from north to south. It is one of the few land port cities on China's southern border where railways and highways are connected to the domestic major transportation network. At present, Chongzuo City has basically formed a high-grade highway network with national, provincial and inter-county highways as the skeleton and a "ring+radiation" traffic network pattern with Chongzuo City as the center, realizing Chongzuo City's connection with the expressways to Nanning (the capital of Guangxi), Qinzhou City and Baise City, and basically meeting the traffic requirement of "one-hour traffic circle".

The city has a total area of 17,300 km^2, of which 520,200 hectares are cultivated land, accounting for 30% of the total land area. The per capita cultivated land area is higher than the average level in Guangxi. Chongzuo is located in the resource-rich area of western Guangxi and is an important base for sucrose and manganese industry. Its manganese ore reserve rank first in China, and it also has abundant bauxite, rare earth, bentonite, iron ore and other mineral resources. Chongzuo is a famous eco-tourism city with a forest coverage rate of 54.92%. It is one of Guangxi's four major tourist destinations with world cultural heritage rock paintings on the Zuo River and famous scenic spots such as Detian Waterfall, Asia's largest transnational waterfall, and Friendship Pass, one of China's nine famous scenic spots.

Chongzuo City has 7 counties (cities, districts), 75 townships (41 towns, 34 townships), 3 subdistrict offices, 752 villagers' committees and 95 community residents' committees under its jurisdiction.

In 2019, its GDP reached RMB 76.046 billion, an 8.5% increase year on year. The fiscal revenue was RMB 6.125 billion, an increase of 6.4% over the previous year. The value of foreign trade imports and exports was RMB 189.339 billion, up 28.3% over the previous year.

At the end of 2019, the total registered population was 2,523,200, including 1,331,700 males and 1,191,500 females. The resident population was 2,110,300, including 844,100 urban population, accounting for 40.0% of permanent population, and 1,266,200 rural population.

The per capita disposable income of residents was RMB 20,967 (RMB 33,297 for urban residents and RMB 13,320 for rural residents). The per capita consumption expenditure of urban residents was RMB 20,291, while that of rural residents was RMB 8,685.

The rural poverty stricken population of Chongzuo City decreased from 341,800 at the end of 2015 to 10,900 at the end of 2019, and the poverty headcount ratio decreased from 18.16% to 0.54%. On May 9, 2020, Chongzuo City got rid of poverty in an all-round way.

See Table 3.2-2 for the social and economic development of Chongzuo City, Figure 3.2-3 for the growth trend of GDP over the years, and Figure 3.2-4 for the three changes in industrial structure.

Table 3.2-2Main Economic and Social Indicators of Chongzuo City over the Years

Year	Population (10,000 persons)	GDP		Industrial composition (RMB 100 million)			Per capita GDP (RMB)
		(RMB 100 million)	Index	Primary industry	Secondary industry	Tertiary industry	
2003	227.89	106.49	100.0	40.71	25.48	40.30	4687
2004	229.67	128.73	112.1	48.35	34.23	46.15	5627
2005	230.65	151.13	127.7	55.34	43.63	52.17	6566
2006	233.20	194.03	149.5	66.45	66.58	61.00	8366
2007	236.89	231.87	174.3	76.24	78.12	77.51	10826
2008	240.01	264.8	194.9	80.78	94.32	89.70	12226
2009	241.96	304.36	219.4	86.94	107.41	110.01	13921
2010	234.77	392.37	248.2	114.85	149.11	128.41	18734
2011	236.50	491.85	274.3	144.98	197.42	149.45	24531
2012	238.13	530.51	306.6	142.96	216.96	170.60	26288

Year	Population (10,000 persons)	GDP		Industrial composition (RMB 100 million)			Per capita GDP (RMB)
		(RMB 100 million)	Index	Primary industry	Secondary industry	Tertiary industry	
2013	246.52	584.63	337.9	149.44	248.24	186.95	28886
2014	248.18	649.72	365.9	147.28	277.45	224.99	31942
2015	248.80	682.82	395.2	155.25	274.61	252.96	33400
2016	250.54	766.20	427.6	167.69	310.69	287.82	37161
2017	249.94	907.62	467.4	181.25	398.20	328.17	43678
2018	-	1016.49	520.2	-	-	-	-
Average annual growth rate							
2003-2005	0.60%	12.99%		11.88%	25.57%	9.18%	12.31%
2005-2010	0.35%	14.22%		9.22%	20.67%	13.01%	13.82%
2010-2015	1.17%	9.75%		4.34%	11.00%	12.51%	8.48%
2015-2017	0.23%	8.75%		1.92%	13.58%	7.44%	8.50%
2003-2017	0.66%	11.64%		6.76%	16.78%	11.47%	10.91%

Notes: 1. According to the Guangxi Statistical Yearbook and the statistical bulletin, the indicators are the current year's prices;

2. The economic growth rate is calculated at comparable prices, the same below.

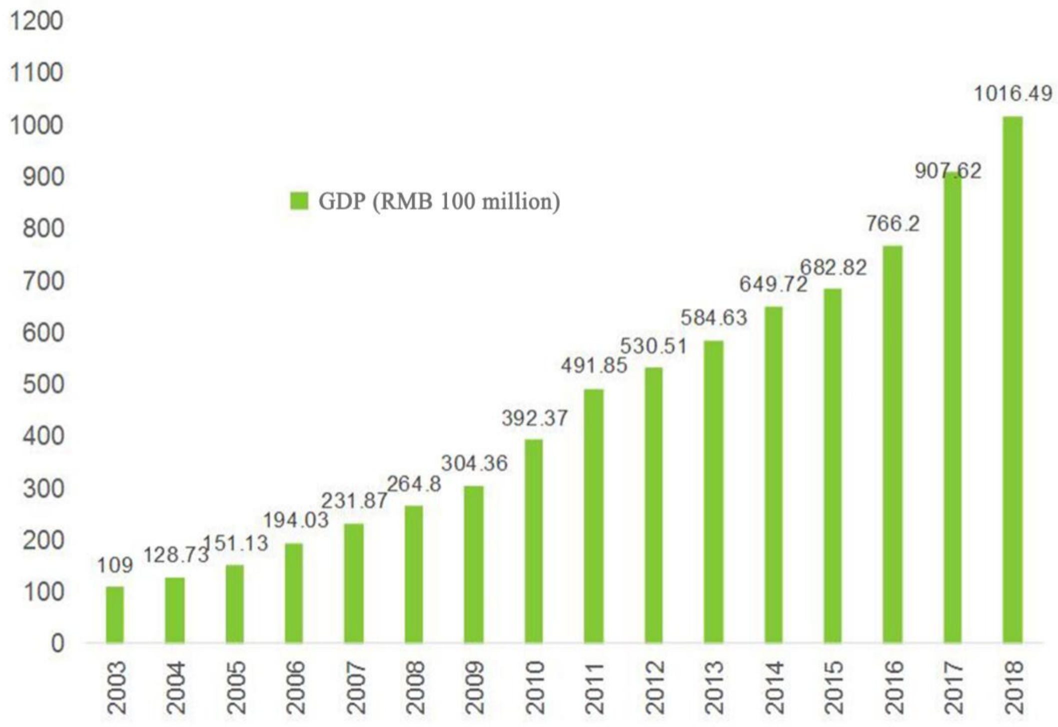


Figure 3.2-3Chongzuo GDP Growth Trend

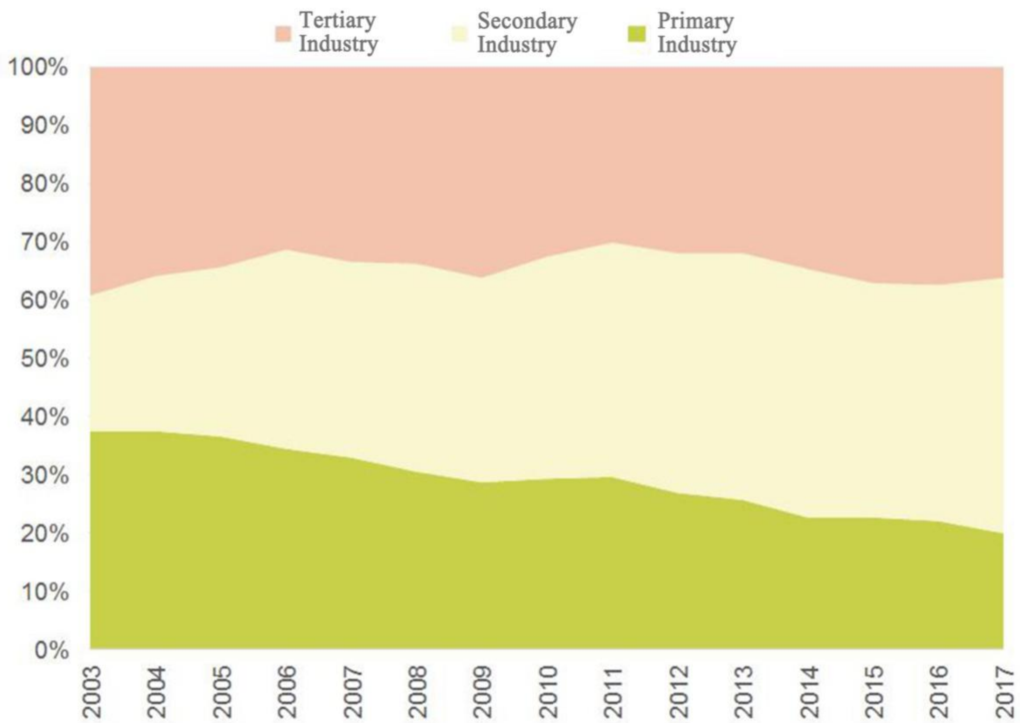


Figure 3.2-4Three Changes in Chongzuo's Industrial Structure

3.2.3Tiandeng County

Tiandeng is located in the southwest of Guangxi Zhuang Autonomous Region and under the jurisdiction of Chongzuo City. It is located between N22°51′~N23°23′ and E106°45′~E107°23′. It borders Longan County and Pingguo County in the east, Daxin County in the south, Jingxi County in the west, Debao County in the northwest and Tiandong County in the north. Tiandeng Town, the county seat, is 125 km away from Nanning, the capital of the autonomous region. It borders Long’an County and Daxin County in the east at Xiamaitun in Kongmin Village, Tuokan Township; borders Long’an County and Pingguo County in the northeast at Xiafeitun in Huili Village, Jinjie Town, and Pingguo County and Tiandong County at Longzhangtun in Mengyang Village; borders Daxin County in the south at Shengtun in Shengma Village, Longming Town; borders Daxin County in the southeast at Jiuhan Village in Fuxin Township, with the county border about 9 km from China-Vietnam border; borders Jingxi County and Debao County in the west at Balong Village in Bahe Township; and borders Debao County and Tiandong County in the northwest at Minzu Village in Xiangdu Town, The transverse distance is 64 km from east to west, and the longitudinal distance is 63 km from north to south. The total area of the county is 2,159.23 km2.

In 2018, Tiandeng County had 6 towns and 7 townships under its jurisdiction, namely: Tiandeng Town, Xiangdu Town, Longming Town, Jinjie Town, Dongping Town, Fuxin Town, Banghe Township, Dukang Township, Tuokan Township, Jinyuan Township, Ninggan Township, Pingxiang Township and Xiaoshan Township. The county seat is at Tiandeng Town. Tiandeng County has Zhuang, Han, Yao, Miao, Dong and other ethnic groups, of which the Zhuang population accounts for 98.9% of the total population.

At the end of 2019, the annual GDP of the county was RMB 7.341 billion, and the fiscal revenue was RMB 382 million.

At the end of the year, the county had 119,100 registered households with a total registered population of 459,500, of which the male population was 243,900 and the female population is 215,600. The per capita disposable income of all residents in 2019 was RMB 16,518 (RMB 29,058 for urban residents and RMB 11,588 for rural residents).

Tiandeng County used to be a national-level poverty-stricken county, which is an area of extreme poverty, a concentrated contiguous poverty-stricken area and a key county for national poverty alleviation and development in Guangxi. It was successfully lifted out of poverty in May 2020.

See Table 3.2-3 for the social and economic development of Tiandeng County, Figure 3.2-5 for the growth trend of GDP over the years, and Figure 3.2-6 for the three changes in industrial structure.

Table 3.2-3Main Economic and Social Indicators of Tiandeng County over the Years

Year	Population (10,000 persons)	GDP		Industrial composition (RMB 100 million)			Per capita GDP (RMB)
		(RMB 100 million)	Index	Primary industry	Secondary industry	Tertiary industry	
2000	40.5	8.10	100.00	4.38	1.08	2.64	2014
2005	41.01	13.18	164.07	5.05	3.45	4.67	3231
2006	41.51	14.91	181.14	5.41	4.2	5.31	3615
2007	42.31	19.65	212.62	6.58	6.31	6.76	4689
2008	42.94	27.65	257.49	8.21	10.64	8.79	8462
2009	43.32	28.85	279.12	8.28	11.12	9.45	8757
2010	42.92	35.60	313.97	9.28	15.59	10.74	10997
2011	43.15	39.70	333.34	11.74	16.64	11.32	11953
2012	43.47	40.76	354.04	11.89	16.04	12.84	12280
2013	45.09	43.31	381.30	12.71	16.63	13.97	13149
2014	45.1	46.36	406.09	12.76	18.04	15.57	14094
2015	45.43	51.94	436.16	13.13	17.34	21.48	15750
2016	45.64	56.12	455.35	14.13	18.18	23.81	16952
2017	45.55	61.89	489.05	13.76	20.71	27.42	18581
2018	45.87	63.50	518.39	13.97	17.53	32.00	18969
Average annual growth rate							
2000-2005	0.25%	10.41%		3.06%	26.36%	12.27%	10.13%
2005-2010	0.91%	13.86%		5.42%	26.20%	10.26%	12.83%
2010-2015	1.14%	6.80%		6.14%	1.15%	13.75%	5.59%
2015-2017	0.13%	5.89%		-0.70%	6.01%	9.60%	5.75%
2000-2017	0.69%	9.79%		4.19%	15.89%	11.79%	9.03%

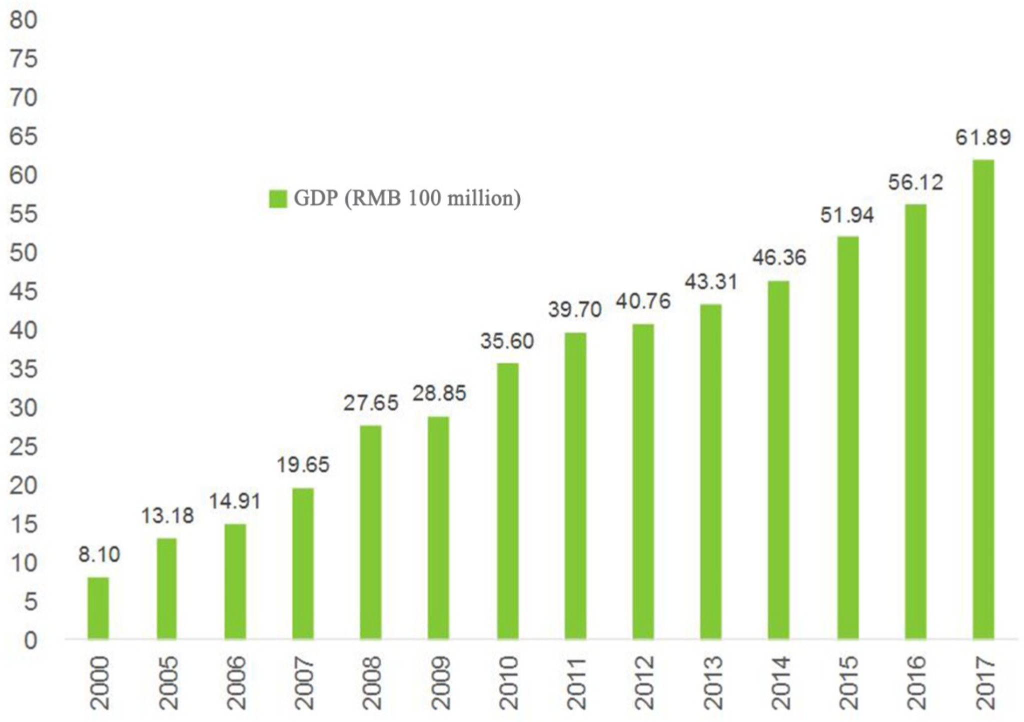


Figure 3.2-5Tiandeng GDP Growth Trend

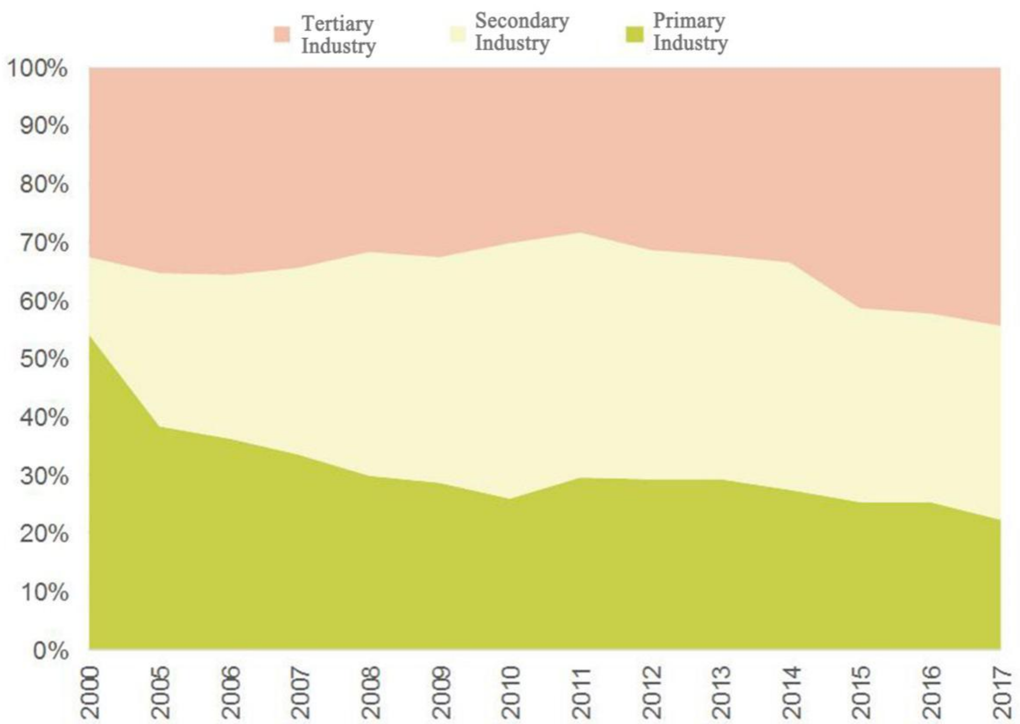


Figure 3.2-6Three Changes in Tiandeng's Industrial Structure

3.2.4Daxin County

Daxin County is located on the southern edge of Yunnan-Guizhou Plateau and in the southwest of Guangxi Zhuang Autonomous Region, between latitude 22°29′-23°05′, longitude 106°39′-107°29′, with a total area of 2742 km^2. The location advantage is obvious, since it borders Jiangzhou District of Chongzuo City in the southeast, Longan County in the northeast, Tiandeng in the north, Jingxi County in the northwest, Longzhou County in the southwest, and Vietnam in the west. The national boundary line is 43 km long. It has a national first-class port, Shuolong Port, and 3 cross-border trade points between border residents, Yanying, Shuolong and Detian. Located at the intersection of three central cities, Nanning, Baise and Chongzuo, as one of the major convenient land routes leading from China to Vietnam and Southeast Asian countries, it has the advantages of being located along the border, and adjacent to the sea, the provincial capital and the airport.

Daxin County has 14 townships (towns), 1 overseas Chinese economic management zone, 146 administrative villages (communities) and 1,356 natural villages, namely: Taocheng Town, Quanming Town, Longmen Township, Wushan Township, Changming Township, Fulong Township, Naling Township, Lanwei Township, Encheng Town, Leiping Town, Baowei Township, Kanwei Township, Shuolong Town, Xialei Town and Daxin Overseas Chinese Economic Management Zone. The county seat is at Taocheng Town.

In 2019, the annual GDP of the county was RMB 9.867 billion, and the fiscal revenue was RMB 393 million.

The total population of the county at the end of the year was 385,495, including 199,437 males and 186,058 females. The county had a resident population of 310,000, including urban population of 91,000, accounting for 29.35% of the resident population. Daxin County is home to 15 ethnic groups, including Zhuang, Han, Yao and Miao, with the Zhuang population accounting for 98% of the total population.

The annual per capita disposable income of all residents in the county was RMB 19,871 (RMB 34,918 for urban residents and RMB 14,042 for rural residents).

Daxin County used to be a national-level poverty-stricken county, which is an area of extreme poverty, a concentrated contiguous poverty-stricken area and a key county for national poverty alleviation and development in Guangxi. It was successfully lifted out of poverty in April 2019.

See Table 3.2-4 for the social and economic development of Daxin County, Figure 3.2-7 for the growth trend of GDP over the years, and Figure 3.2-8 for the three changes in industrial structure.

Table 3.2-4Main Economic and Social Indicators of Daxin County over the Years

Year	Population (10,000 persons)	GDP		Industrial composition (RMB 100 million)			Per capita GDP (RMB)
		(RMB 100 million)	Index	Primary industry	Secondary industry	Tertiary industry	
2000	35.4	9.52	100.00	4.33	2.9	2.3	2699
2005	35.87	22.33	178.85	6.92	9.13	6.29	6233
2006	36.2	26.58	199.95	8.34	10.93	7.32	7378
2007	36.7	36.94	255.82	9.98	17.03	9.93	10136
2008	37.08	43.6	271.35	11.46	20.37	11.77	13028
2009	37.28	46.95	311.24	11.62	22.39	12.94	13939
2010	35.98	56.52	333.26	14.81	27.74	13.98	17818
2011	36.23	76.05	390.42	19.2	40.05	16.8	25549
2012	36.39	82.19	439.98	19.54	44.3	18.35	27446
2013	37.53	90.70	485.42	19.92	50.78	19.99	30172
2014	37.83	93.90	517.94	19.85	51.71	22.34	31087
2015	38.1	99.44	554.36	21.22	45.25	32.98	32775
2016	38.34	109.38	594.28	23.17	48.76	37.45	35916
2017	38.26	128.73	642.41	24.7	61.57	42.45	42027
2018	38.5	135.00	674.54	25.04	68.46	48.10	45967
Average annual growth rate							
2000-2005	0.26%	12.33%		4.03%	19.14%	15.83%	12.03%
2005-2010	0.06%	13.26%		9.52%	17.47%	10.35%	13.19%
2010-2015	1.15%	10.71%		6.26%	9.05%	17.40%	9.45%
2015-2017	0.21%	7.65%		2.08%	10.36%	7.34%	7.42%
2000-2017	0.46%	11.56%		6.04%	14.56%	13.62%	11.05%

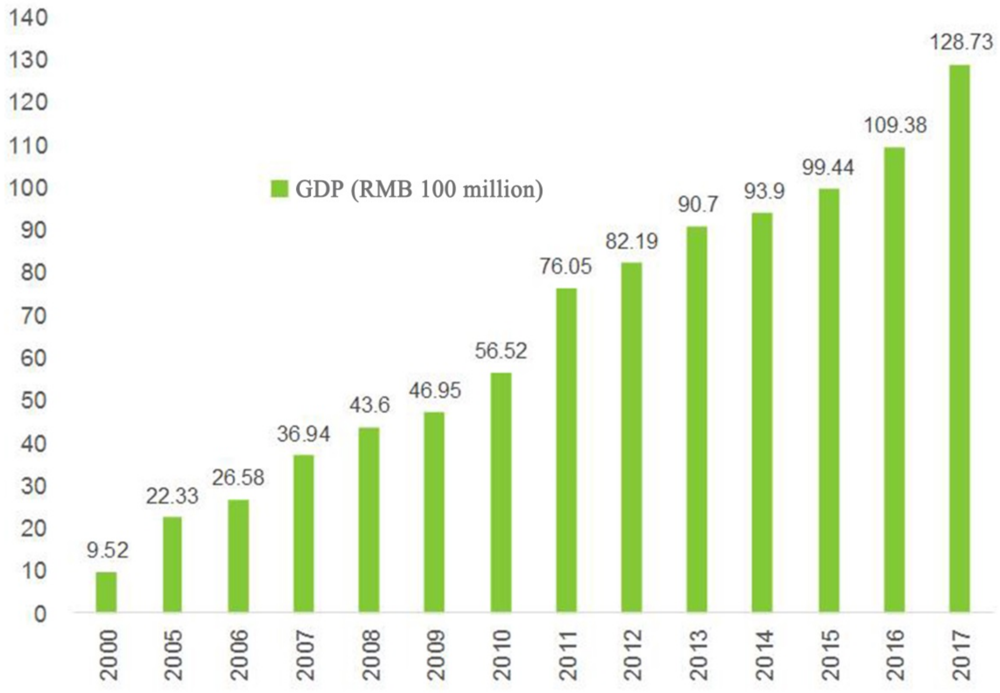


Figure 3.2-7Daxin GDP Growth Trend

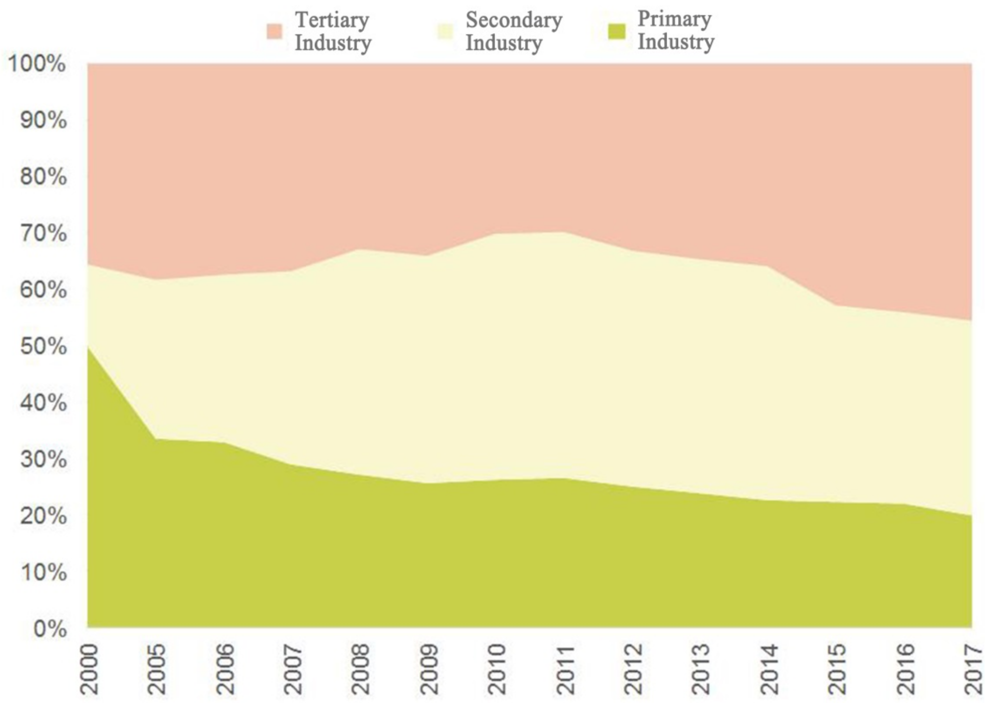


Figure 3.2-8Three Changes in Daxin's Industrial Structure

4 Environmental Impact

4.1 Identification of the Environmental Impact Factors

See Table 4.1-1 for identification of environmental impact factors of the Project and Table 4.1-2 for characteristics of pollutant emission.

Table 4.1-1 List of Identification of Environmental Impact Factors for the Project

Description		Potential Environmental Impact	Environment Elements
Construction Period	Land requisition and relocation	Decrease in the area of cultivated land and forest land	Social economy and ecological environment
		Demolition and relocation of houses and public utilities	
	Earthworks and stoneworks	Water and soil loss, water pollution	Ecological environment, surface water environment
		Vegetation deterioration	
	Subgrade works, pavement works, bridge construction	Dust, exhaust gas	Ambient air and ecological environment
		Construction noise	Acoustic environment
		Suspended Substance	Surface water environment
	Tunnels	Construction noise, wastewater from tunnel construction	Acoustic environment, surface water environment
	Material transportation, construction	Dust	Ambient air
		Waste gas	
		Noise	Acoustic environment
Operation Period	Vehicle driving	Noise	Acoustic environment
		Vehicle exhaust	Ambient air
	Line	Land Use	Ecological environment, social economy and landscape
		Road (bridge) surface runoff	Water environment
		Alignment, modeling and greening	Landscape
	Toll Station and Service Facilities	Exhaust gas, waste water discharge, solid waste	Ambient air, water environment

Table 4.1-2 List of Characteristics of Pollutant Emission of the Project

Stage	Bridge type	Sources	Main pollution factors	Discharge Location	Pollution Degree	Discharge Characteristics
Construction Period	Noise	Noise from transportation, construction machinery		Construction site	Severe	Discontinuity
	Air	Transportation,	TSP	Construction	Severe	Linear pollution

Stage	Bridge type	Sources	Main pollution factors	Discharge Location	Pollution Degree	Discharge Characteristics
		construction machinery		site	impact of dust in dry season	
		Batching	TSP	Mixing station	Medium	
	Waste water	Living of construction personnel	COD、BOD_5	Construction camp	Slight	
		Batching		Mixing station	Longitude	
		Structure construction		Construction site	Slight	
	Solid wastes	Domestic wastes		Construction camp	Slight	
		Construction waste		Abandoned earth and stone, and construction wastes.	Medium	
		Falling during transportation		Material transportation section	Medium	
Operation Period	Noise	Vehicle driving		Along the highway	Medium	Continuity
	Air	Vehicle exhaust and oil fume from the canteen	NO2, CO, THC, oil fume from the canteen	Along the route or to the services	Slight	Point sources in the services, linear pollution in other places
	Waste water	Road pavement (bridge deck) rainwater runoff, domestic sewage and car washing wastewater from toll	COD, BOD5, petroleum	Along the highway	Slight	

Stage	Bridge type	Sources	Main pollution factors	Discharge Location	Pollution Degree	Discharge Characteristics
		stations and port service centers				
	Solid wastes	Along the line, toll stations and port service centers	Domestic wastes	Along the route or to the services	Slight	
	Pollution accident	Pollution accident caused by transport of toxic and hazardous substances	Hazardous goods in the form of gas, liquid and solid	Place of accident	Uncertain, depending on materials and emergency response capability	Uncertain

4.2 Level, Scope and Period of Assessment

4.2.1 **Evaluation Grade**

According to the environmental protection industry standard of the People's Republic of China - *Technical Guidelines for Environmental Impact Assessment* (HJ2.1-2016, HJ2.2-2018, HJ2.3-2018, HJ610-2016, HJ2.4-2009, HJ964-2018, HJ19-2011 and HJ169-2018), the comprehensive engineering nature and environmental characteristics of the project location, the assessment level and evaluation scope of Wuzhou (Longyanzui) - Shuolong Expressway (Chongzuo–Jingxi Expressway to Shuolong Port section) are shown in Table 4.2-1, that of Detian-Shuolong Highway are shown in Table 4.2-2, and that of Shuolong Port (Phase II of Shuolong Gate) are shown in Table 4.2-3.

Table 4.2-1 Classification of Assessment (Chongzuo-Jingxi Expressway - Shuolong Port Section)

Assessment contents	Assessment Level	Criteria	Component A
Ambient air	Class III	According to the Technical Guidelines for Environmental Impact Assessment - Atmospheric Environment (HJ2.2-2018), for grade highway project, the pollutants discharged from the main centralized emission sources (such as service areas, etc.) along the route shall be calculated.	A total of 1 toll station is set up along the whole route. There are no centralized heating facilities such as boilers and centralized emission sources. The main line and connecting

Assessment contents	Assessment Level	Criteria	Component A
			line of the Project pass through Guangxi Xialei Nature Reserve (experimental area), which is Class I environmental functional area. There are no service facilities in the section passing through the Reserve. The main pollutants in the operation period are CO and NO2 contained in vehicle exhaust emissions, which may affect the air environmental quality along the route. The impact is assessed as Class III.
Surface water environment	Class II	Judgment of water pollution impact assessment level: According to Technical Guidelines for Environmental Impact Assessment – Surface Water Environment (HJ2.3-2018), the discharge mode is indirect discharge, and the assessment level is Level 3B.	During the operation period, the toll station (jointly built with the maintenance work area) wastewater will be reused after treatment (reaching the standard) and will not be discharged outside. It is judged from the water pollution type that the assessment level is Level 3B.
		Judgment of impact assessment level of hydrological factors: According to HJ2.3-2018, the vertical projection area of the works A1 ≤ 0.05km^2; the disturbed water bottom area of the works is A_2 ≤ 0.2km^2; the proportion of water area occupied by the water crossing section is > 5%, < 20%, and the assessment level is Level 2; the scope of impact involves conservation objectives such as nature reserves, and the assessment level shall not be lower than level 2.	The works involve a vertical projection area of river-crossing bridge A1 = 0.00652 ≤ 0.05km^2; the Project has underwater piers at Bangtun Bridge and Shuolong Guichun Bridge, and the disturbed water bottom area of the works is A2 = 0.000016 ≤ 0.2km^2; the proportion of water area occupied by water crossing section = 16% (> 5%, ＜ 20%); the corresponding assessment level is level 2.
Groundwater environment	Simple analysis	According to Appendix A of HJ610-2016, in highway projects, except that the filling stations are classified as Class II, others are classified as Class IV. The	There is no filling station in the Project, and the whole route is of Class IV project.

Assessment contents	Assessment Level	Criteria	Component A
		assessment of impact on groundwater environment is not performed for Class IV construction works.	Therefore, it only briefly discusses the impacts on groundwater environment in the assessment.
Acoustic environment	Class I	According to the Technical Guidelines for Environmental Impact Assessment - Acoustic Environment (HJ2.4-2009), the noise level in sensitive points within the assessment scope of the Project after completion increases by ＞ 5dB(A), so the assessment level is Level I.	After the completion of the Project, the maximum increase of the long-term acoustic environment in sensitive points is 22.2 dB (A) ＞5 dB (A), with a large number of affected population, so the assessment level is Level I.
Soil environment	Not involved	According to Appendix A of HJ 964-2018, in highway projects, except that the filling stations are classified as Class III, others are classified as Class IV. .	According to Appendix A of HJ 964-2018, there is no filling station in the Project, so the Project is determined as Class IV project, for which assessment on soil environmental impact may not be carried out.
Ecological environment	Class I	According to the Technical Guidelines for Environmental Impact Assessment - Ecological Environment (HJ19-2011), the areas with an area of less than 20km^2 or a length of less than <100km and classified as special ecological sensitive area and important ecologically sensitive area are assessed as Level I.	The total length of the route is 17.679km<100km, the permanent and temporary land occupation is 2004.96 mu =1.3366km^2<20km^2, and there are special ecologically sensitive areas and important ecologically sensitive areas in the affected area. The assessment level is Level I.
Environmental risks	Simple analysis	According to HJ 169-2018, this standard is applicable to construction projects involving the production, use and storage (including pipeline transportation) of toxic, hazardous and combustible and explosive substances. Risk potential is I, so simple analysis can be carried out.	The Project is a highway project. The Project does not involve the production, use and storage of toxic, harmful, combustible and explosive substances. The occurrence of risks is caused by indirect actions. The hazardous substances is the fuel in the automobile fuel tank, and its quantity is far less than the critical quantity (2500t), so Q<1, and the risk potential is I, so simple analysis is carried

Assessment contents	Assessment Level	Criteria	Component A
			out.
Assessment Level of AIIB	Category A	A Project is categorized A if it is likely to have significant adverse environmental and social impacts that are irreversible, cumulative, diverse or unprecedented. These impacts may affect areas outside the project site, either temporarily or permanently.	The Project is a highway project, and the construction process will have direct or indirect impact on the surrounding environment, including damage to the natural environment and environmental pollution. The impact on the environment is often irreversible, so it is assessed as Category A.

Table 4.2-2 Classification of Assessment (Detian-Shuolong Highway)

Assessment contents	Assessment Level	Criteria	Component B
Ambient air	Class III	According to the Technical Guidelines for Environmental Impact Assessment - Atmospheric Environment (HJ2.2-2018), for grade highway project, the pollutants discharged from the main centralized emission sources (such as service areas, etc.) along the route shall be calculated.	There are no service facilities such as service areas and no centralized emission sources in the Project. The main pollutants in the operation period are CO and NO2 contained in vehicle exhaust emissions, which may affect the air environmental quality along the route. The assessment shall be carried out in three classes.
Surface water environment	Class III	According to Technical Guidelines for Environmental Impact Assessment - Surface Water Environment (HJ2.3-2018), assessment level of indirect discharge is determined as Level III B.	There are no service facilities such as service areas and no sewage emission sources in the Project, and judging from the water pollution type, the assessment level is Level III A.
		According to HJ2.3-2018, for the Project, the vertical projection area A1≤0.05km2; the disturbed water bottom area A2≤ 0.2km2; the proportion of water area occupied by water crossing section is ≤5%; the assessment level of impacts of hydrological factors is Level III.	There is no bridge in the Project, which does not involve hydrological factors such as water temperature, runoff and affected surface waters. Therefore, simple analysis is only made for hydrological factors.
Groundwater environment	Simple analysis	According to Appendix A of HJ610-2016, in highway projects, except that the filling stations are classified as Class II, others are classified as Class IV. The assessment of impact on groundwater environment is not performed for Class IV construction works.	There is no filling station in the Project, which is categorized IV. Assessment of groundwater environmental impact may not be carried out.
Acoustic environment	Class I	According to the Technical Guidelines for Environmental Impact Assessment - Acoustic Environment (HJ2.4-2009), the noise level in sensitive points within the assessment scope of the Project after completion increases by	After the completion of the Project, the maximum increase of the long-term acoustic environment in sensitive points is 18.3 dB (A) ＞ 5 dB (A), with a large number of affected

Assessment contents	Assessment Level	Criteria	Component B
		＞ 5dB(A), so the assessment level is Level I.	population, so the assessment level is Level I.
Soil environment	Not involved	According to Appendix A of HJ 964-2018, in highway projects, except that the filling stations are classified as Class III, others are classified as Class IV, for which assessment on soil environmental impact may not be carried out.	There is no filling station in the Project, so the Project is determined as Class IV project, for which assessment on soil environmental impact may not be carried out.
Ecological environment	Class III	According to the Technical Guidelines for Environmental Impact Assessment - Ecological Environment (HJ19-2011), the areas with an area of less than 2km^2 or a length of less than <50km and classified as significant ecological sensitive area are assessed as Level III.	The total length of the route is 13.564km<50km, the permanent land occupation is 420.5 mu =0.28km^2<20km^2, and there are special ecologically sensitive areas in the affected area. The assessment level is Level III.
Environmental risks	Simple analysis	According to HJ 169-2018, this standard is applicable to construction projects involving the production, use and storage (including pipeline transportation) of toxic, hazardous and combustible and explosive substances. Risk potential is I, so simple analysis can be carried out.	The Project is a highway reconstruction and expansion project. The Project does not involve the production, use and storage of toxic, harmful, combustible and explosive substances. Risk potential is I, so simple analysis can be carried out.
Assessment Level of AIIB	Category A	A Project is categorized A if it is likely to have significant adverse environmental and social impacts that are irreversible, cumulative, diverse or unprecedented. These impacts may affect areas outside the project site, either temporarily or permanently.	The Project is a local road project, and the construction process will have direct or indirect impact on the surrounding environment, including damage to the natural environment and environmental pollution. The impact on the environment is often irreversible, so it is assessed as Category A.

Table 4.2-3 Classification of Assessment (Shuolong Port (Phase II of Shuolong Gate))

Assessment contents	Assessment Level	Criteria	Component C
Ambient air	Class III	According to the Technical Guidelines for Environmental Impact Assessment - Atmospheric Environment (HJ2.2-2018), for grade highway project, the pollutants discharged from the main centralized emission sources (such as service areas, etc.) along the route shall be calculated.	The main pollutants in the operation period of the Project are CO and NO_2 contained in vehicle exhaust emissions from the parking lot, which may affect the air environmental quality along the route. The impact is assessed as Class III.
Surface water environment	Class III	According to Technical Guidelines for Environmental Impact Assessment - Surface Water Environment (HJ2.3-2018), assessment level of indirect discharge is determined as Level III B.	The domestic sewage of the Project is discharged into Shuolong Sewage Treatment Plant through the municipal sewage pipe network after being treated by the three-stage septic tank. Judging from the water pollution type, the assessment level is Level III B.
Groundwater environment	Simple analysis	According to Appendix A of HJ610-2016, in highway projects, except that the filling stations are classified as Class II, others are classified as Class IV. The assessment of impact on groundwater environment is not performed for Class IV construction works.	There is no filling station in the Project, which is categorized IV. Assessment of groundwater environmental impact may not be carried out.
Acoustic environment	Class II	According to the Technical Guidelines for Environmental Impact Assessment - Acoustic Environment (HJ2.4-2009), the acoustic environment functional area of the project is Class 1 and Class 2 specified in GB3096, and the assessment level is level 2.	The acoustic environment functional area of the Project is Class 2 specified in GB3096, and the assessment level is Level II.
Soil environment	Not involved	According to Appendix A of HJ 964-2018, in highway projects, except that the filling stations are classified as Class III, others are classified as Class IV, for which assessment on soil environmental impact may not be carried out.	There is no filling station in the Project, so the Project is determined as Class IV project, for which assessment on soil environmental impact may not be carried out.

Assessment contents	**Assessment Level**	**Criteria**	**Component C**
Ecological environment	Class III	According to the Technical Guidelines for Environmental Impact Assessment - Ecological Environment (HJ19-2011), the areas with an area of less than 2km2 or a length of less than <50km and classified as significant ecological sensitive area are assessed as Level III.	The permanent land occupation of the Project is 27.83 mu =0.019 km^2<20 km^2, and there are major ecologically-sensitive areas in the affected area. The assessment level is Level III.
Environmental risks	Simple analysis	According to HJ 169-2018, this standard is applicable to construction projects involving the production, use and storage (including pipeline transportation) of toxic, hazardous and combustible and explosive substances. Risk potential is I, so simple analysis can be carried out.	The Project is a construction project of port infrastructures. It does not involve the production, use and storage of toxic, harmful, combustible and explosive substances. Risk potential is I, so simple analysis can be carried out.
Assessment Level of AIIB	Category A	A Project is categorized A if it is likely to have significant adverse environmental and social impacts that are irreversible, cumulative, diverse or unprecedented. These impacts may affect areas outside the project site, either temporarily or permanently.	The Project is a construction project of port infrastructures, and the construction process will have direct or indirect impact on the surrounding environment, including damage to the natural environment and environmental pollution. The impact on the environment is often irreversible, so it is assessed as Category A.

4.2.2 Assessment Scope

1. Wuzhou (Longyanzui)-Shuolong Expressway (Chongzuo-Jingxi Expressway to Shuolong Port Section)

(1) Atmospheric environment

The assessment level of atmospheric environment of the Project is Level III, and the survey and assessment scope is within 200m on both sides of the center line of the highway.

(2) Surface water environment

Surface water bodies within 200m on both sides of the center line of the highway; when the route crosses a large-scale surface water body, the scope shall be expanded to the water area within 500m upstream to 3000m downstream of the river-crossing bridge.

(3) Acoustic environment

Within 200m on each side of the center line of the highway.

(4) Ecological environment

The assessment scope of ecological environment shall cover the areas directly and indirectly affected by all activities of the Project. According to the construction scale, the nature and characteristics of the Project and the environmental characteristics along the route, the specific assessment scope is determined as follows:

The scope of survey and assessment for the sections passing through Guangxi Xialei Nature Reserve and Guangxi Huashan National Scenic Area will be expanded to the entire special or significant ecologically sensitive area. The assessment scope of other sections is within 300m on both sides of the center line. The assessment scope of temporary land occupation areas such as borrow and spoil ground and temporary stock yard and ancillary facilities along the route is the land occupation area and within 100m of surrounding areas.

The assessment scope of aquatic ecology is consistent with that of surface water.

(5) Environmental risks

The impact of hazardous articles leakage during transportation on water environment protection targets such as Xialei Nature Reserve and Huashan Scenic Area during the operation period is mainly considered.

2. Detian-Shuolong Highway

(1) Atmospheric environment

The assessment level of atmospheric environment of the Project is Level III, and the assessment scope of impacts on atmospheric environment is not considered for Level III project.

(2) Surface water environment

The Project does not have bridges and does not cross water bodies, but the Project passes through 2 surface water source conservation area, of which 1 water intake is located in Guichun River, and the other 1 water intake is in Yuejin Channel. The assessment scope of surface water is within 500m upstream to 1000m downstream of the water intake of Shuolong Aitun water source, Guichun River and Yuejin Channel.

(3) Acoustic environment

Within 200m on each side of the center line of the highway.

(4) Ecological environment

The assessment scope of ecological environment shall cover the areas directly and indirectly affected by all activities of the Project. According to the construction scale, engineering properties and characteristics and environmental characteristics along the project, the specific assessment scope is determined as follows: The south side is bounded by the national boundary, and the north side is bounded by the 300m-meter extension of the highway center line.

The assessment scope of aquatic ecology is consistent with that of surface water environment.

3. Shuolong Port (Phase II of Shuolong Gate)

(1) Atmospheric environment

The assessment level of atmospheric environment of the Project is Level III, and the assessment scope of impacts on atmospheric environment is not considered for Level III project.

(2) Surface water environment

There is no bridge crossing water in the Project, and the assessment scope of surface water is within 500 m~ upstream to 3,000 m downstream of the sewage outlet of Shuolong Sewage Treatment Plant;

(3) Acoustic environment

Within 200m of the plant boundary.

(4) Ecological environment

The assessment scope of ecological environment shall cover the areas directly and indirectly affected by all activities of the Project. According to the construction scale, the nature and characteristics of the Project and the environmental characteristics along the route, the specific assessment scope is determined as follows: within 300 m around the plant boundary.

4.2.3 Stages to be Evaluated

1. Wuzhou (Longyanzui)-Shuolong Expressway (Chongzuo-Jingxi Expressway to Shuolong Port Section)

The assessment period is divided into design period, construction period and operation period. According to the construction time and construction period proposed in the feasibility study report of the Project, the specific assessment period of the Project is determined as follows:

(1) Design period: The preliminary preparations for the Project is 12 months, namely from June 2019 to June 2020.

(2) Construction period: The Project is planned to be commenced in December 2021 and completed in February 2023.

(3) Operation period: The Project is planned to be put into operation in March 2023.

For the ecologically environmental impact assessment of the Project, focus on the analysis of the impact during the construction period and only make general impact review during the operation period; the noise impact shall be predicted and assessed during the operation period, and the assessment periods are the first year, the seventh year and the fifteenth year after the project is completed and put into operation (i.e., 2025, 2031 and 2039). The noise impact during the construction period shall also be taken into account. The assessment of water environmental impact shall be mainly carried out during the construction period, while the risk assessment during the operation period shall be made; the impact on atmospheric environment shall be analyzed generally.

2. Detian-Shuolong Highway

The assessment period is divided into design period, construction period and operation period. According to the construction time and construction period proposed in the feasibility study report of the Project, the specific assessment period of the Project is determined as follows:

(1) Design period: The preliminary preparations for the Project is 12 months, namely from June 2020 to December 2021.

(2) Construction period: The Project is planned to be commenced in October 2021 and completed in June 2023, with a construction period of 20 months.

(3) Operation period: The assessment periods are the first year (2023), the seventh year (2029) and the fifteenth year (2038) from the completion of the Project.

For the ecologically environmental impact assessment of the Project, focus on the analysis of the impact during the construction period and only make general impact review during the design period and operation period; the noise impact shall be predicted and assessed during the operation period, and the assessment periods are the first year, the seventh year and the fifteenth year after the project is completed and put into operation (i.e., 2023, 2029 and 2038). The noise impact during the construction period shall also be taken into account. The assessment of water environmental impact shall be mainly carried out during the construction period, while the risk assessment during the operation period shall be made; the impact on atmospheric environment shall be analyzed generally.

3. Shuolong Port (Phase II of Shuolong Gate)

The assessment period is divided into design period, construction period and operation period. According to the construction time and construction period proposed in the feasibility study report of the Project, the specific assessment period of the Project is determined as follows:

(1) Design period: The preliminary preparations for the Project is 12 months, namely from January 2020 to December 2020.

(2) Construction period: The Project is planned to be commenced in December 2021 and completed in February 2023.

(3) Operation period: March 2023.

For the ecologically environmental impact assessment of the Project, focus on the analysis of the impact during the construction period and only make general impact review during the design period and operation period; assess the noise impact during construction period and operation period; focus on the assessment of water environmental impact during the construction period, and only make simple analysis of the risk assessment during the operation period; only make general impact analysis on atmospheric environment.

4.3 Key Points of Assessment

According to the impact of project construction on environmental factors, the assessment during the construction period shall focus on ecological environment, acoustic environment and water environment. During the operation period, the impacts on water environment and sound environment and pollution prevention and control measures shall be the highlighted.

Table 4.3-1 Environmental Impact Factors and Key Points of Assessment

S/N	Assessment Focuses	Key Assessment Contents
1	Acoustic	Impacts of construction noise during construction period and road traffic

	environment	noise during operation period on sensitive points along the route, prediction of impact scope, degree and preparation of environmental protection measures etc.
2	Water environment	The impact of construction and operation on drinking water source protection areas along the route, the impact of subgrade, tunnel and bridge construction on water environmental protection targets and measures to mitigate the impact, the emergency plan for transportation of hazardous chemicals during operation period and demonstration of prevention and control measures for water environmental pollution.
3	Ecological environment	The impact of project construction on agricultural ecology and natural ecology along the route, including farmland occupation and vegetation protection measures, protection of rare animals and plants and ecological restoration measures; rationality demonstration of location of spoil yard and rationality analysis of high fill and deep excavation sections. Focus on analyzing the impact of the project construction on Guangxi Xialei Nature Reserve and Guangxi Huashan National Scenic Area.

4.4 Environmental Quality and Pollutant Emission Standards

Based on the preliminary investigation of the regional environmental conditions of the Project, the scale and characteristics of the Project construction, the environmental function zoning along the highway, and the Environmental Quality Standard for Noise (GB 3096-2008), the EIA standards for the Project are as follows:

4.4.1 **Environmental Quality Standards**

4.4.1.1 **Ambient Air Quality Standard**

Wuzhou (Longyanzui) to Shuolong Expressway (Chongzuo–Jingxi Expressway to Shuolong Port Section): Section K7+750~K10+560 of the main line and Section AK3+600~AK4+600 of the connecting line pass through the pilot area of Xialei Nature Reserve of Guangxi; Section K11+500~K12+263 (end point) of the main line chainage and Section AK0+400~AK5+416 of the connecting line of the Project pass through Class II conservation area of Guangxi Huashan Scenic Area, and Class I criteria in Ambient Air Quality Standard (GB3095-2012) are adopted for the sections passing through the nature reserve and scenic area, while Class II criteria for the other sections that do not pass through the nature reserve.

Detian-Shuolong Highway: The whole line is located in the Class II conservation area of Guangxi Huashan Scenic Area, and Class I criteria in Ambient Air Quality Standard (GB3095-2012) are adopted to assess the environmental air quality in the

region.

Shuolong Port (Phase II of Shuolong Gate): The project is located in the landscape coordination area of the Huashan Scenic Area in Guangxi, and the air quality of the assessment area shall reach the Class I criteria stipulated in the Ambient Air Quality Standard (GB3095-2012).

Table 4.4-1 Ambient Air Quality Standard (GB 3095-2012) (Excerpt)

S/N	Pollutants	Average Time	Concentration limit		Unit
			Class I	Class II	
1	Sulfur dioxide (SO_2)	Annual mean	20	60	μg/m^3
		24hr average	50	150	
		1hr average	150	500	
2	Nitrogen dioxide (NO_2)	Annual mean	40	40	
		24hr average	80	80	
		1hr average	200	200	
3	Carbon monoxide (CO)	24hr average	4	4	mg/m^3
		1hr average	10	10	
4	Ozone (O_3)	Daily maximum of average 8h	100	160	μg/m^3
		1hr average	160	200	
5	Particulates (≤ 10μm)	Annual mean	40	70	
		24hr average	50	150	
6	Particulates (≤ 2.5μm)	Annual mean	15	35	

4.4.1.2 **Environment Quality Standards for Surface Water**

The proposed project crosses Xialei River, Guichun River, Baidou River and other surface water bodies, and implements the Class III standard of Environmental Quality Standards for Surface Water (GB3838-2002). The Class II standard of Environmental Quality Standards for Surface Water (GB3838-2002) shall be adopted for the intake of Aitun Water Source, Guichun River and the intake of Shuolong Community and the Class II and III standards of Environmental Quality Standards for Surface Water (SL63-94) shall be adopted for the assessment of suspended solids.

Table 4.4-2 Environmental Quality Standards for Surface Water (GB 3838-2002) (Excerpt)

S/N	Pollutant Index	Standard Limit for Class II	Standard Limit for Class III	Unit
1	Water temperature	Artificially caused ambient water temperature change shall be limited at: Maximum weekly average temperature rise ≤ 1; maximum weekly average temperature drop ≤ 2.		℃
2	pH Value	6~9		Dimensionless

3	Dissolved oxygen	≥6	≥5	mg/L
4	Permanganate Index	≤4	≤6	
5	Biochemical oxygen demand for five days	≤3	≤4	
6	COD	≤15	≤20	
7	NH3-H	≤0.5	≤1.0	
8	TP	≤0.1	≤0.2	
9	Suspended Substance	≤25	≤30	
10	Petroleums	≤0.05	≤0.05	
Remark: Refer to Class II/III criteria in Resources Quality Standards for Surface Water (SL 63-94) for the criteria of suspended substances				

4.4.1.3 **Environment Quality Standards for Groundwater**

Class III criteria in Standard for Groundwater Quality (GB/T 14848-2017) are adopted for the groundwater quality in the region of the Project, and the details are shown in Table 4.4-3.

Table 4.4-3 Standard for Groundwater Quality (GB/T 14848-2017) (Excerpt)Unit: mg/L, except for pH

S/N	Item	Category III
1	pH Value	6.5~8.5
2	Total hardness (in terms of CaCO3) ≤	450
3	Oxygen consumption ≤	3.0
4	Nitrate (in terms of N) ≤	20.0
5	Nitrite (in terms of N) ≤	1.0
6	NH3-N ≤	0.50
7	TC (MPNb/100mL or CFUc/100mL) ≤	3.0
8	Fe ≤	0.3
9	Mg ≤	0.1

4.4.1.4 **Environmental Quality Standard for Noise**

According to Environmental Quality Standards for Noise (GB3096-2008), Technical Specifications for Regionalizing Environmental Noise Function (GB/T 15190-2014) and Notice on Issues Concerning Environmental Noise in Environmental Impact Assessment of Such Construction Projects as Highways and Railways (including Light Rails) (State Environmental Protection Administration, HF [2003] No. 94), the acoustic environment assessment standard for the Project is determined as follows:

1. Assessment of Current Conditions

Status assessment: according to the Environmental Quality Standard for Noise (GB 3096-2008), Class 1 criteria are adopted for villages in principle, and Class 2 criteria in the Environmental Quality Standards for Noise are adopted for the acoustic environment status of villages along the Project (areas other than the Category 4 acoustic environment function zone) where there are highways, provincial roads and other traffic arteries pass through; and the following standards are adopted for the current situation of the regional acoustic environment of sensitive points that are located near the existing traffic arteries:

(1) For the areas within the assessment scope on both sides of the existing traffic arteries, if the buildings by the highway are mainly higher than three floors (inclusive), Class 4a criteria in the Environmental Quality Standards for Noise are identified to be applicable to the area of the first row of buildings facing the highway, and Class 2 criteria in the Environmental Quality Standards for Noise to the area behind.

(2) If the buildings by the highway are mainly lower than three floors (including open ground), Class 4a criteria in the Environmental Quality Standards for Noise are identified to be applicable to the area within 35m of the ROW, and Class 2 criteria in the Environmental Quality Standards for Noise to the area beyond.

Class 1 criteria are adopted in rural areas along the Project but not accessible by grade roads.

2. Impact Assessment

(1) For the areas within the assessment scope on both sides of the Project, if the buildings by the highway are mainly higher than three floors (inclusive), Class 4a criteria in the Environmental Quality Standards for Noise are identified to be applicable to the area of the first row of buildings facing the highway, and Class 2 criteria in the Environmental Quality Standards for Noise to the area behind.

(2) If the buildings by the highway are mainly lower than three floors (including open ground), Class 4a criteria in the Environmental Quality Standards for Noise are identified to be applicable to the area within 35m of the ROW, and Class 2 criteria in the Environmental Quality Standards for Noise to the area beyond.

(3) According to the requirements in the document HF [2003] No.94, the outdoor noise criteria of 60dB(A) during the daytime and 50dB(A) during the nighttime are adopted for

schools, hospitals (sanatoriums, nursing homes) and other special sensitive buildings within the assessment scope.

See Table 4.4-4 for the above environmental quality standards for noise.

Table 4.4-4 Quality Standard for Acoustic Environment (GB3096-2008) (Excerpt), HF [2003] No.94

Unit: dB(A)

Category	Daytime	Nighttime	Area of Application
1	55	45	Areas mainly for residential purpose and villages not accessible by grade roads
2	60	50	Areas mainly for commercial finance and trade markets, or mixed zones of residential areas, business areas, and industrial areas where quietness for residential areas needs to be maintained.
Schools and hospitals	60	50	Schools, hospitals (nursing homes, old people's homes) and other special sensitive buildings
4a	70	55	Areas on both sides of a traffic artery where the impact of traffic noise on environment needs to be prevented.

4.4.2 **Discharge Standards for Pollutants**

4.4.2.1 **Waste Gas Emission Standard**

The relevant emission standards in the Integrated Emission Standard of Air Pollutants (GB 16297-1996) are adopted for the emission of air pollutants during the construction period, and the details about the standard limits are shown in Table 4.5-5.

Table 4.4-5 Integrated Emission Standard of Air Pollutants (GB16297-1996) (Excerpt)

S/N	Pollutants	Concentration limit		
		Monitoring Point	Concentration	Unit
1	Particulates (TSP)	The highest concentration point outside perimeter	1.0	mg/m^3
2	Sulfur dioxide (SO_2)		0.40	
3	Nitrogen oxide (NOx)		0.12	
4	Asphalt fume		No obvious unorganized emission from the production equipment shall exist	

4.4.2.2 **Waste Water Discharge Standard**

The production wastewater and domestic wastewater during the construction period will be reused after being treated or used as agricultural fertilizer, and will not be discharged. The sewage discharged from service facilities during the operation period will be reused after being treated to the standard for flushing toilets, road cleaning and urban greening (Table

4.4-6) in accordance with The Reuse of Urban Recycling Water - Water Quality Standard for Urban Miscellaneous Water Consumption (GB/T 18920-2002).

Table 4.4-6 The Reuse of Urban Recycling Water - Water Quality Standard for Urban Miscellaneous Water Consumption (GB/T 18920-2002)Unit: pH, mg/L

S/N	Item	Toilet Flushing	Road Sweeping	Urban Greening
1	pH (dimensionless)	6~9		
2	TDS ≤	1500	1500	1000
3	Anionic surfactant ≤	1.0	1.0	1.0
4	Coliform group (Nr./L)	3	3	3
5	DO ≥	1.0	1.0	1.0
6	*Suspended substance (SS)	70	70	70
7	*COD⩽	50	50	50
8	BOD_5⩽	10	15	20
9	NH_3-N⩽	10	10	20
10	*Petroleum ≤	1.0	1.0	1.0

*Note: Class I discharge criteria in Integrated Wastewater Discharge Standard (GB 8978-1996) are adopted for suspended substances, and the discharge standards in Wastewater Reuse of Highway Service Area - Water Quality (JT/T 645.1-2016) are adopted for COD and petroleum.

4.4.2.3 **Nose Emission Standard**

Emission Standard of Environment Noise for Boundry of Construction Site (GB12523-2011) should be executed during the construction period.

Table 4.4-7 Emission Standard for Ambient Noise of Construction Site (GB 12523-2011)Unit: dB(A)

Category	Daytime	Nighttime
Emission standard	70	55

5 Comparison of Options

5.1 Necessity of Comparison and Selection of Construction Options

5.1.1 Wuzhou (Longyanzui) – Shuolong Highway (Chongzuo – Jingxi Expressway to Shuolong Port Section)

1. The existing roads cannot meet the requirements of the *13th Five-Year Plan on Development Planning for Highway and Waterway Transportation of Chongzuo City*

There are no expressways and Class-I highways directly connecting the ending point of Guangxi Long'an-Shuolong Highway (Chongzuo Border) to Shuolong Port. The existing roads mainly include National Highway G219, National Highway G359, Border Highway (formerly S325), and County Highway X532 to Shuolong Port (Class-I Port). The existing roads are Class-I or Class-III highways, which cannot meet the requirements of "Class I Port Connecting Expressway or Class I Highway" in the *13th Five-Year Plan on Development Planning for Highway and Waterway Transportation of Chongzuo City.*

2. Position and Function of the Project

The proposed project – Wuzhou (Longyanzui) to Shuolong Expressway (Chongzuo-Jingxi Expressway to Shuolong Port section) is a section of Chongzuo-Jingxi Expressway to Shuolong Port of EW-7 - Wuzhou (Longyanzui) to Shuolong Expressway which is described in the Expressway Network Planning of Guangxi (2018-2030). The proposed project enhances communication among Nanning, Baise, Chongzuo and Tiandeng County, Daxin County which are under its administration and the national Class-I port – Shuolong Port which is at the border of China and Vietnam, and the China-Vietnam Detian-Ban Goic International Tourism Cooperation Zone and the Shuolong town. It is a significant international land passage to realize the interconnection and interchange among China, Guangxi and the ASEAN, Vietnam.

The implementation of the Project connects the Shuolong Port and the China-Vietnam Detian-Ban Goic International Tourism Cooperation Zone with other regions in the most convenient way, which greatly improves the capacity of external highways in the region, and it is also conducive to the national defense and response to emergencies for improving the Guangxi expressway network, and improving the reliability and traffic safety of the road network; It will definitely promote the economic development and cooperation among China, Vietnam and other ASEAN countries to jointly create an upgraded version of the

Sino-ASEAN Free Trade Area, and jointly develop and build a Sino-Vietnam cross-border economic cooperation zone, and further promote Guangxi to become a fulcrum for the country in the new strategy of opening up an development in southwest and mid-south regions; It will be conducive to the development of the land in the area surrounding the highway. And there is also the immeasurable promotion effect to accelerate the progress of new urbanization, tourism and industrialization development, which better coordinates the development of urban and rural areas and regions, and improve the living standards of the people along the highway.

5.1.2 Detian-Shuolong Highway

1. The existing roads cannot meet the requirements of the *Guangxi Provincial Conventional Highway Network Plan*

The existing border highway, Shuolong-Detian Highway, is in low traffic capacity and poor road conditions, which make it difficult to meet the traffic requirements of the increasing number of tourists and motor vehicles in Detian Scenic Area. Some sections have certain pavement damage, which cannot meet the construction requirements of "west-east road 15" Tieshan Port-Napo (Longlong) in the *Guangxi Provincial Conventional Highway Network Plan.*

2. Position and Function of the Project

The proposed project highway belongs to the Shuolong-Detian Scenic Area section in "west-east road 15" Tieshan Port-Napo (Longlong) in the Guangxi Provincial Conventional Highway Network Plan. The proposed project will improve the connection between Shuolong Town and Xialei Town, China-Vietnam Detian-Ban Goic International Tourism Cooperation Zone and Shuolong Town, and it is an important international land route for interconnection and interchange between China (Guangxi), ASEAN and Vietnam.

The implementation of the project connects the Shuolong Port and the China-Vietnam Detian-Ban Goic International Tourism Cooperation Zone with other regions in the most convenient way, which greatly improves the capacity of external highways in the region, and it is also conducive to the national defense and response to emergencies for improving the Guangxi expressway network, and improving the reliability and traffic safety of the road network; It will definitely promote the economic development and cooperation among China, Vietnam and other ASEAN countries to jointly create an upgraded version of the Sino-ASEAN Free Trade Area, and jointly develop and build a Sino-Vietnam cross-border economic cooperation zone, and further promote Guangxi to become a fulcrum for the country in the new strategy of opening up an development in southwest and mid-south regions; It will be conducive to the development of the land in the area surrounding the highway. And there is also the immeasurable promotion effect to accelerate the progress of new urbanization, tourism and industrialization development, which better coordinates the development of urban and rural areas and regions, and improve the living standards of the people along the highway.

5.1.3 Shuolong Port (Phase II of Shuolong Gate)

1. The current port service center cannot meet the requirements of border tourism

At present, the facilities of the port service center are outdated and the site is narrow, which makes it difficult to meet the traffic requirements of the increasing number of tourists and motor vehicles at the border, and cannot meet the consumption requirements of tourists.

2. Position and Function of the Project

The implementation of the Project will vigorously drive China-Vietnam trade and tourism cultural exchanges, to achieve mutual complementarity by advantages and mutual benefits in economic development, so that the people in the two countries can actually enjoy the benefits of economy and trade. The cross-border trade economy between China and Vietnam involves a wide variety of commodities, with complementary structures and resources. The trade covers northern Vietnam, Central China, Southwest China and Beibu Gulf Economic Zone, with huge market potential, which is conducive to promoting industrial upgrading and resource integration between the two countries, advancing bilateral cooperation in agricultural development, transportation, electricity, fertilizer, cement, and communication, and speeding up investment and construction between the two countries, and bringing more benefits to the Chinese and Vietnamese people.

5.2 **Comparison of Route Options**

5.2.1 **Wuzhou (Longyanzui) – Shuolong Highway (Chongzuo – Jingxi Expressway to Shuolong Port Section)**

5.2.1.1 **Study on the Starting and Ending Points of Route Options**

5.2.1.1.1 Study on the Starting Point of the Main Line

According to Guangxi Expressway Network Planning (2018~2030), this project and the Long 'an Expressway under construction belong to the important part of "EW-4" Cangwu (Longyanzui)-Shuolong Expressway, which belongs to different sections and should be connected in sequence to form a complete "EW-4" line. According to the Reply of the Department of Transport of the Guangxi Zhuang Autonomous Region on the Technical Design of the Intersection Scheme between the Ending Point of Guangxi Long’an-Shuolong Expressway (Chongzuo Border) and Chongzuo-Jingxi Expressway (GJHS [2018] No.92), Reply of the Department of Transport of the Guangxi Zhuang Autonomous Region on the Construction Drawings Design of Two Stages of Guangxi Long’an-Shuolong Expressway (Chongzuo Border) (GJHS [2019] No.9), the end point of Longan-Shuolong Highway (Chongzuo border) in Guangxi is located near Neitun, Fuxin Township, Tiandeng County, and the starting point of the Project is connected to the end point of Long'an-Shuolong Expressway. Therefore, the starting point scheme of the Project is relatively clear; it is located near Neitun, Fuxin Township, Tiandeng Country and there is no alternative option.

In consideration of the alignment of the main line connecting the start point of the Project to Chongzuo-Jingxi Expressway, and in addition to Route K in the Project, Route D is still proposed as an alternative for Route K in the feasibility study of the Project, which starts from the vicinity of Buliangtuan, setting up the connection with Buliang T-type hub interchange and Chongzuo-Jingxi Expressway, which is 2.6km away from the start point of Route K towards to Jingxi, and thus there shall be a common route of 2.6km for the traffic transfer of Long’an-Shuolong Expressway and Chongzuo-Jingxi Expressway, and meanwhile, the former 230m-long Busao Tunnel in Chongzuo-Jingxi Expressway shall be demolished and excavated as a roadbed.

The chainage range of Route D is DK0+000~DK6+336, and the route goes southwest through Buliang, Bujie and Bujie, ends in vicinity of Longkalang, connecting to Route K at K7+900, with a length of 6.336Km.

Figure 5.2-1 Schematic Diagram of Starting Point of Line K and Line D

The comparison on major technology and economy of Route K and Route D is as seen in the following table.

Figure 5.2-1 Quantities of Main Works of Route D and Route K

S/N	Indicator	Unit	Route K (K0+000~K7+900)	Line D (DK0+000~DK6+336)	Remarks

S/N	Indicator	Unit	Route K (K0+000~K7+900)	Line D (DK0+000~DK6+336)	Remarks
1	Design speed	km/h	100	100	
2	Route length	km	7.9	6.336	
3	Subgrade width	m	26	26	
4	Carriageway width	m	2-2*3.75	2-2*3.75	
5	Minimum radius of circular curve	m/location	1000/2	1150/1	
6	Maximum longitudinal slope	%/location	3.9/1	2.8/1	
7	Minimum radius of convex vertical curve	m/location	20000/1	35000/1	
8	Minimum radius of concave vertical curve	m/location	12000/1	11700/1	
9	Super major and major bridges	m/Nr.	3716.5/5	1274/2	Bridges on main line including interchanges
10	Medium bridge	m/Nr.	-	86/1	Bridges on main line including interchanges
11	Tunnel	m/Nr.	1548/3.5	2197/4.5	
12	Bridge-tunnel ratio	%	66.6	56.1	
13	Culvert	Nr.	3	10	Including those within the interchange range
14	Interchange	Nr.	0.5	1	
15	Separated interchange	m/Nr.	-	-	
16	Occupied land	Mu	805	515	

According to the figure above, the construction mileage of Route D is about 1.6 km shorter than that of Route K, but it is 649 m longer than that of Route K for the tunnel. In addition, a distance of 2.6km shall be shared for the transportation of Route D leading to Long'an-Shuolong Expressway and Chongzuo-Jingxi Expressway. In the future, the shared route section may be rebuilt and expanded. At the same time, the original 230m-long Busao Tunnel of the Chongzuo-Jingxi Expressway is required to be demolished and excavated as subgrade, which has a great social impact. Through overall consideration, Route K option recommended in the Feasibility Study Report is approved through assessment.

Table 5.2-2 Comparison of Environmental Factors between Route D and K

Environmental Factors		Route K	Line D	Recommendation
Social environment	Land area	805 Mu	515 Mu	Route D
		Route D has the least land occupation		
Ecological environment	1. Terrain and vegetation type	The main vegetation types in the assessment scope are shrub-grass and monsoon forest. There are some economic forests (mainly planted with litchi and pear) in the middle and lower parts of hills and flat areas, and paddy field crops and dry land crops are distributed in flat areas.		Route K, Route D
		The area where two options pass through is less disturbed by human activities, but the regional vegetation diversity is low, and the degree of influence on vegetation diversity is equivalent.		
	2. Biomass loss of terrestrial vegetation and influence on wild animals	Route K is 7.9 km long, the total length of bridges and tunnels is 5,264.5 m, and the bridge-tunnel ratio is 66.6%.	Route K is 6.336 km long, the total length of bridges and tunnels is 3,557 m, and the bridge-tunnel ratio is 56.1%.	Route K
		Both options are located in the same area with similar vegetation types along the route. The bridge-tunnel ratio of Route K is relatively high, which is beneficial to reduce the land occupation of subgrade and biomass loss, and has less impact on animal habitat, so Route K is better than Route D.		
	3. Drinking water source conservation area	No Drinking Water Source Conservation Area	No Drinking Water Source Conservation Area	After relocation, the impact of Route K and Route D is equivalent
		The relocation procedure is under way for Line K crossing the water source, and the water source conservation area will not be involved after the relocation		
Acoustic environment and air environment		There are sensitive points in the evaluation scope, including three villages.	There are sensitive points in the evaluation scope, including three villages.	Route K, Route D

	The number and distance of sensitive points involved around Route K and Route D are the same, and the impact degree of the two routes on sensitive points along the route is equivalent		
Comprehensive comparison results	Recommendation		

Generally speaking, after the relocation of Bukan water source in Liliang Village, the environment along Route K and Route D is similar, so the environmental impact of construction is not very different. Considering that the original Busao Tunnel is changed to subgrade for the construction of Route D, the social impact is relatively large, so the environmental impact assessment agrees with the option of Route K.

5.2.1.1.2 Study on the Ending Point of the Connecting Line

The Project mainly serves the demand of rapid connection between local traffics, such as Shuolong Town in Daxin County, Shuolong Port, Detian Cross-border Waterfall Scenic Spot and the surrounding high-grade road network. In combination with the topographic conditions, local government demands, regional national and provincial highways and local road network layout, to facilitate local people's travel, and maximize the traffic attraction to improve the construction benefits of expressway network, and in line with the principle of fast access of port vehicles to and from the expressway, the end point of the main line of the Project is proposed to be near Bangtun, Shuolong Town, and the technical standard of Class I highway is adopted for the section from Bangtun to Shuolong Town, which is convenient for local people's travel, and there is no alternative option.

5.2.1.1.3 Study on the Starting Point of the Connecting Line

The starting point of the connecting line is the end point of the main line, and there is no alternative option.

5.2.1.1.4 Study on the Ending Point of the Connecting Line

In the comparison of route options of the Project, combined with the route end point options, a total of 4 options are proposed, i.e. Route L with end point connecting the original border highway in the west of Shuolong Town, Route A and Route B with end point connecting the original border highway in the east of Shuolong Town, and Route C with end point connecting the original border highway in the north of Shuolong Town.

1. Route L: connect the end point of the original border highway to the west of Shuolong

Town

The ending point is located in the west of Shuolong Town, near Longhongtun to the direction of Detian Cross-border Waterfall in Daxin County, and connects Shuolong-Detian Highway (the original border highway, to be upgraded into Class-II highway). The ending point is westwards to Detian Cross-border Waterfall in Daxin County, eastwards to Shuolong Town and Shuolong Port, and the ending point is about 1km from the tourism distribution center. The ending point position corresponds to Route L.

2. Route A: connect the end point of the original border highway to the east of Shuolong Town

The ending point is near Mitun Village, southeast corner of Shuolong Town, and connects Detian (Daxin) - Huashan (Ningming) Highway (Shuolong-Tianxi Section). The connecting section between Detian (Daxin)-Huashan (Ningming) Highway (Shuolong-Tianxi section) and the end point of Route A is an existing border highway, which is to be upgraded into a Class I highway with a design speed of 60 km/h and a subgrade width of 22.5m. The position of the ending point corresponds to Route A, which is about 0.46km away from the existing Shuolong Bridge crossing the Guichun River along the original border highway.

3. Route B: connect the end point of the original border highway to the east of Shuolong Town

The ending point is in front of Shapaiya Mountain in the east of Shuolong Town towards Longzhou. It connects Detian (Daxin County) - Huashan (Ningming) Highway (Shuolong-Tianxi Section) after crossing Guichun River. The ending point position corresponds to Route B, and is about 1.5km from the ending point of Route A.

4. Route C: connect the end point of the original border highway to the north of Shuolong Town

The ending point is at the intersection of the County Road X532 and the original Border Highway, connecting to Shuolong Section of X532. The ending point leads to Shuolong Town and Shuolong Port through original Border Highway in the east and to Detian Cross-border Waterfall in Daxin County via original Border Highway in the west. The ending point position corresponds to Route C.

5. Conclusion of Option Selection for End Point of Shuolong Connecting Line

The above-mentioned four options for the end point of Shuolong Connection Road correspond to the comparison and selection results of Options of Route A, Route L, Route B and Route C respectively. Combined with the comparison and study of the following route options, Route A has less traffic interference to the existing X532 and Shuolong Town, has relatively little influence on the sensitive sites along the route, avoids bypassing the drinking water source conservation area of Shuolong Town and is the most convenient access to the Gate connecting Shuolong Port. Therefore, end point option of Route A is proposed for Shuolong Connection Road of the Project.

5.2.1.2 **Comparison of Local Options**

According to the main control factors affecting the Project, combined with topography, geology, route smoothness and other conditions, alternative Route L, Route B and Route C are proposed for the connecting line section for comparison with Route A.

Figure 5.2-2 Schematic Diagram of Routes A, B, C and L for the Connecting Line

5.2.1.3 **Comparison of Engineering Factors in Those Options**

5.2.1.3.1 Comparison of Engineering Factors for Connecting Line of the Project

See Table 5.2-3 for comparison of main technical and economic factors of the four options of the connecting line.

Table 5.2-3 Comparison of Works Quantities of Shuolong Connecting Line

S/N	Indicator	Unit	Route A	Route L	Route B	Route C
1	Design speed	km/h	80	80	80	80
2	Route length	KM	5.416	5.295	5.905	4.537
3	Subgrade width	m	25.5	25.5	25.5	25.5
4	Carriageway width	m	2-2*3.75	2-2*3.75	2-2*3.75	2-2*3.75
5	Minimum radius of circular curve	m/location	370/1	250/2	370/1	250/1
6	Maximum longitudinal slope	%/location	3.0/1	5.0/1	3.00/2	5.00/1
7	Minimum radius of convex vertical curve	m/location	15000/1	7000/1	10000/1	6300/1

8	Minimum radius of concave vertical curve	m/location	7500/1	3200/1	3200/1	3200/1
9	Earthworks for subgrade	10,000 m3	43.0249	42.8885	46.4289	109.1132
10	Average earthwork and stonework per kilometer	10,000 m3	7.9	8.1	7.9	24.1
11	Asphalt concrete pavement	1,000 m2	87.080	90.160	110.354	98.045
12	Subgrade Drainage and Protection	m3	17350	26974	33382	29282
13	Bridge-tunnel ratio	%	28.2	24.0	16.6	3.5
14	Major bridge	m/Nr.	-	-	-	-
15	Medium bridge	m/Nr.	98.5/1	-	98.5/1	-
16	Tunnel	m/Nr.	1430/1	1270/3	880/3	160/1
17	Culvert	Nr.	11	12	15	13
18	Channels	Nr.	-	-	-	-
19	Occupation of land/Basic farmland	Mu/Mu	330/115	361/90	447/116	390/109
20	Houses to be relocated	m2/household	-	1495/7	1490/7	2397/11
21	Separated interchange	m/Nr.	-	-	-	-
22	Rest area	Nr.	-	-	-	-
23	Level crossing	Nr.	3	3	3	2
24	Estimated total investment	RMB 100 million	4.50	5.14	5.17	2.85

25	Advantages	① It has little influence on the township and is most closely connected with Shuolong Port; ② Low investment; ③ Less land occupation and less earth and stone quantities; ④ The ratio of bridge to tunnel is the highest, with little ecological impact; ⑤ The quantity of demolition works is the smallest.	① It has little influence on the township, and it is the most convenient way to Detian Waterfall; ② The ratio of bridge to tunnel is relatively high, with little ecological impact; ③ Less earthwork.	① It has little influence on the township, and it is the most convenient way to Longzhou; ② The quantity of demolition works is the smallest.	① The least investment; ② The shortest construction mileage, less tunnels and smaller quantities; ③ The additional land occupation is less.

26	Disadvantages	① Pass through Huashan Scenic Area (Class II protection area) and Guangxi Xialei Autonomous District Nature Reserve (experimental area).	① Pass through Huashan Scenic Area (Class II protection area) and the Class II water source conservation area in Shuolong Town, Daxin County; ② Highest investment.	① Pass through Huashan Scenic Area (Class II protection area) and Guangxi Xialei Autonomous District Nature Reserve (experimental area); ② The investment is relatively high; ③ Large occupation area; ④ The longest route	① Pass through the township, which is not conducive to the development of the township; ② Pass through Class I protection area of drinking water source and Huashan Scenic Area (Class II protection area); ③ The quantities of earth work are the largest; ④

27	Recommended option	Recommendation	-	-	-

According to the comparison results in Table 5.2-3, Route A has larger advantages in investment, land occupation and demolition. Considering engineering factors, the Route A is recommended through assessment.

5.2.1.3.2 Comparison of Environmental Factors for Connecting Line of the Project

According to the environmental impact factors, the environmental factors of Route L, B and C recommended in the *Feasibility Study* for the connecting line are compared with that of Route A, and the comparison results are shown in Table 5.2-4. The connecting line of the Project involves Huashan Scenic Area, Xialei Nature Reserve, Shuolong Town Water Source Protection Area and other sensitive areas, and the comparison results of impacts of sensitive areas are shown in Table 5.2-5.

Table 5.2-4 Comparison of Environmental Factors of Connecting Line Section

Environmental Factors		Route A	Route L	Route B	Route C	Recommendation
Social environment	1. Land area	330 Mu	361 Mu	447 Mu	390 Mu	Route A
		Route A has the least land occupation				
	2. Resettlement	-	Houses demolished: 1495 m2/7 households	Houses demolished: 1490 m2/7 households	Houses demolished: 2397 m2/11 households	Route A
		The demolition area and the number of relocated households in Route A are the least				
	3. Planning and local government's comments	In line with town planning.	In line with town planning.	Town planning is not involved.	In line with town planning.	Route A, Route B, Route L and Route C
Ecological environment	1. Terrain and vegetation type	The main vegetation types in the assessment scope are shrub-grass and monsoon forest. There are some economic forests (mainly planted with litchi and pear) in the middle and lower parts of hills and flat areas, and paddy field crops and dry land crops are distributed in flat areas.				Route C
		Except for Option C, the area where other options pass through is less disturbed by human activities, but the regional vegetation diversity is low, and the degree of influence on vegetation diversity is equivalent.				
	2. Biomass loss of terrestrial vegetation and influence on wild animals	The total length of Route A is 5.416km, with the total length of bridges and tunnels of 1528.5m and the ratio of bridges and tunnels of 28.2%	The total length of Route L is 5.295km, with the total length of bridges and tunnels of 1270m and the ratio of bridges and tunnels of 24.0%	The total length of Route B is 5.905km, with the total length of bridges and tunnels of 978.5m and the ratio of bridges and tunnels of 16.6%	The total length of Route C is 4.537km, with the total length of bridges and tunnels of 160m and the ratio of bridges and tunnels of 3.5%	Route L, Route A

Environmental Factors		Route A	Route L	Route B	Route C	Recommendation
		All options are located in the same area with similar vegetation types along the route. The bridge-tunnel ratio of Route A and Route L are relatively high, which is beneficial to reduce the land occupation of subgrade and biomass loss, and has less impact on animal habitat, so it is better than Route B and Route C.				
	3. Influence on aquatic ecological environment	Build one bridge across the Guichun River	-	Build one bridge across the Guichun River	-	Route L, Route C
		There are no river-crossing bridges and river sections in Routes L and C, which have little impact on aquatic environment.				
	4. Water and soil loss	The earthwork volume is 430,249 m3	The earthwork volume is 428,885 m3	The earthwork volume is 464,289 m3	The earthwork volume is 1,091,132 m3	Route L, Route A
		Route A and Route options have the smallest earthwork volume and have the minimum influence on soil erosion along the route.				
	5. Ecologically sensitive area	Route A passes through Class II protection area of Huashan Scenic Area with a length of 5.416km and Detian Waterfall, a special scenic spot, is not involved; the route passes through the experimental area of Xialei Nature Reserve in the form of a long tunnel with a length of 740m, and the tunnel portal is located	Route L passes through Class II protection area of Huashan Scenic Area with a length of 5.295km and Detian Waterfall, a special scenic spot is not involved; the route does not pass through the Xialei Nature Reserve	Route B passes through Class II protection area of Huashan Scenic Area with a length of 5.905km and Detian Waterfall, a special scenic spot is not involved; the route passes through the experimental area of Xialei Nature	Route C passes through Class II protection area of Huashan Scenic Area with a length of 4.537km and Detian Waterfall, a special scenic spot is not involved; the route does not pass through the Xialei Nature Reserve	Route L, Route C

<table>
<tr><th colspan="2">Environmental Factors</th><th>Route A</th><th>Route L</th><th>Route B</th><th>Route C</th><th>Recommendation</th></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><td>outside the Nature Reserve</td><td></td><td>Reserve with a length of 1.32km. There are 3 tunnels in the protection area.</td><td></td><td rowspan="2"></td></tr>
<tr><td colspan="4">Routes A and B both pass through the experimental area of Xialei Nature Reserve and the Class II Huashan Scenic Area; Routes L and C pass through the Class II Huashan Scenic Area, but not passing through Xialei Nature Reserve. Therefore, Routes L and C have less impact on ecologically sensitive areas</td></tr>
<tr><td rowspan="4">Water environment</td><td rowspan="2">1. Impact on water environment</td><td>One bridge across the Guichun River, with no underwater piers</td><td>-</td><td>One bridge across the Guichun River, with no underwater piers</td><td>-</td><td rowspan="2">Route L, Route C</td></tr>
<tr><td colspan="4">There are no river-crossing bridges in Routes L and C, which have little impact on water environment.</td></tr>
<tr><td rowspan="2">2. Drinking water source conservation area</td><td>No Drinking Water Source Conservation Area</td><td>Cross landside of Class II Shuolong Water Source Conservation Area</td><td>No Drinking Water Source Conservation Area</td><td>It is not feasible to cross the Class I Shuolong Water Source Conservation Area because of legal restrictions.</td><td rowspan="2">Route A, Route B</td></tr>
<tr><td colspan="4">Routes A and B do not involve drinking water source protection areas, so they are superior to Routes L and C.</td></tr>
<tr><td colspan="2">Acoustic environment and air environment</td><td>There are sensitive points in the evaluation scope, including four villages.</td><td>There are sensitive points in the evaluation scope, including two villages.</td><td>There are sensitive points in the evaluation scope, including three villages.</td><td>There are four sensitive points in the assessment scope, including three villages and one township.</td><td>Route L</td></tr>
</table>

Environmental Factors	Route A	Route L	Route B	Route C	Recommendation
	Route L involves two sensitive points, which has the least noise impact on the sensitive points.				
Comprehensive comparison results	Route A passes through the experimental area of Xialei Nature Reserve in the form of a tunnel, which has relatively light impact on environmentally sensitive areas. Route A has certain advantages in land occupation, demolition, vegetation loss, water and soil loss, etc. From the perspective of environmental assessment, Route A is feasible.	Route L passes through the Class II Shuolong Water Source Conservation Area (Yuejin Canal) in the form of tunnel. Since Yuejin Canal is located on the mountain where the tunnel is located, the project crossing the water source conservation zone will not have direct impact on Shuolong Water Source Conservation Area. From the perspective of environmental assessment, Route L is feasible.	Route B passes through Xialei Nature Reserve in the form of three short tunnels, with four tunnel portals in the Reserve and 500m-long subgrade, so Route B has a greater impact on Xialei Nature Reserve compared with Route A. Route B is not recommended.	The alignment of Route C that crosses the Class I Shuolong Water Source Conservation Area is not feasible because of legal restrictions. Route C is not recommended.	Route A, Route L

Table 5.2-5 Comparison Results of Impacts of Connecting Line on Sensitive Areas

Influence factors	**Route A**	**Route L**	**Route B**	**Route C**	Conclusion of comparison and selection
Land acquisition	330 Mu	361 Mu	447 Mu	390 Mu	Route A and Route L are recommended for less land occupation
Bridge-tunnel ratio	The total length of Route A is 5.416km, with the total length of bridges and tunnels of 1528.5m and the ratio of bridges and tunnels of 28.2%	The total length of Route L is 5.295km, with the total length of bridges and tunnels of 1270m and the ratio of bridges and tunnels of 24.0%	The total length of Route B is 5.905km, with the total length of bridges and tunnels of 978.5m and the ratio of bridges and tunnels of 16.6%	The total length of Route C is 4.537km, with the total length of bridges and tunnels of 160m and the ratio of bridges and tunnels of 3.5%	All options are located in the same area with similar vegetation types along the route. The ratios of bridges and tunnels of Routes A and L are higher, which is beneficial to reduce the land occupation of subgrade and biomass loss, and has less impact on animal habitat, so Routes A and L are better than Routes B and C and recommended.
Construction methods	Construction methods include bridge, tunnel and subgrade construction	Construction methods include subgrade construction and tunnel construction	Construction methods include bridge, tunnel and subgrade construction	Construction methods include subgrade construction and tunnel construction	--
Water and soil loss	The earthwork volume is 430,249 m3	The earthwork volume is 428,885 m^3	The earthwork volume is 464,289 m3	The earthwork volume is 1,091,132 m^3	The Project does not involve soil borrowing. The earthwork volumes of Routes A and L are smaller, and the land occupation for temporary spoil yard is the smallest, which has the least impact on water and soil loss along the route. Routes A and L are recommended.
Impact on ecologically sensitive area	Route A passes through Class II protection area of Huashan Scenic Area with a length of 5.416km and Detian Waterfall, a special scenic spot, is not involved; the route passes through the	Route L passes through Class II protection area of Huashan Scenic Area with a length of 5.295km and Detian Waterfall, a special scenic spot is not involved;	Route B passes through Class II protection area of Huashan Scenic Area with a length of 5.905km and Detian Waterfall, a special scenic spot is not involved;	Route C passes through Class II protection area of Huashan Scenic Area with a length of 4.537km and Detian Waterfall, a special scenic spot is not involved;	Routes A and B both pass through the experimental area of Xialei Nature Reserve and the Class II Huashan Scenic Area; Routes L and C pass through the Class II Huashan Scenic Area, but not passing through Xialei Nature Reserve. Routes L and C are recommended for less impact on ecologically sensitive areas

	experimental area of Xialei Nature Reserve in the form of a long tunnel with a length of 1000m, and the tunnel portal is located outside the Nature Reserve	the route does not pass through the Xialei Nature Reserve	the route passes through the experimental area of Xialei Nature Reserve with a length of 1.32km. There are 3 tunnels in the protection area.	the route does not pass through the Xialei Nature Reserve	
Impact on drinking water source conservation area	No Drinking Water Source Conservation Area	Cross landside of Class II Shuolong Water Source Conservation Area	No Drinking Water Source Conservation Area	It is not feasible to cross the Class I Shuolong Water Source Conservation Area because of legal restrictions.	Routes A and B do not involve drinking water source protection areas, so they are superior to Routes L and C. Routes A and B are recommended
Comprehensive comparison results					Route A is recommended

It can be seen from 5.2-4 and Table 5.2-5 that all the above four options pass through the Class II protection area of Huashan Scenic Area. Due to the limitation of topography, all options compared cannot avoid Xialei Nature Reserve and Shuolong Town Water Source Conservation Area at the same time.

Routes L and C bypass Xialei Nature Reserve but pass through Shuolong Town Water Source Conservation Area. Route C passes through the Class I protection area of Shuolong Town Water Source Conservation Area, so it is not feasible because of legal restrictions; Route L passes through the Class II protection area of Shuolong Town Water Source Conservation Area in the form of tunnel. According to field investigation and data collection, the water source of Shuolong Town is from Yuejin Canal, which is located on the mountain. However, the Project passes through the mountain body in the form of tunnel, so it will not have adverse impact on Yuejin Canal. Therefore, the environmental impact of Route L is less than that of Route C.

Routes A and B bypass Shuolong Town Water Source Conservation Area and pass through the boundary of experimental area of Xialei Nature Reserve. The whole section where Route A passes through Xialei Nature Reserve is designed to a tunnel, and the portals of the tunnel are located outside Xialei Nature Reserve. Route B passes through Xialei Nature Reserve in the form of three short tunnels, with four tunnel portals in the Reserve and

500m-long subgrade. Therefore, the impact of Route A on Xialei Nature Reserve is lighter than that of Route B, and Route A is obviously superior to Route B.

To sum up, from the perspective of environmental impact, Route A passes through Xialei Nature Reserve in the form of a tunnel, which has a relatively light impact on environmentally sensitive areas, while Route L passes through the Class II protection area of drinking water source in Shuolong Town in the form of a tunnel, which has a relatively light impact on drinking water source in Shuolong Town. Therefore, Route A and Route L are superior to Route B and Route C, and they are both environmentally feasible. Considering the factors for comparison comprehensively, Route A has certain advantages in land occupation, vegetation loss, water and soil loss, etc., so Route A recommended in the project feasibility study is agreed on in this evaluation.

5.2.1.4 Explanation for difficulty in bypassing Xialei Autonomous Region Nature Reserve in Guangxi

The recommended option (Route K) for the main line of the Project at K7+885~K10+715 passes through the experimental area of Xialei Nature Reserve in the form of tunnel, bridge and subgrade for about 2.83km, and the recommended option (Route A) for the connecting line at AK3+600~AK4+600 passes through the experimental area of Xialei Nature Reserve in the form of tunnel for about 1km, so the Project passes through Xialei Nature Reserve for a total length of about 3.83km.

If the highway avoids this ecological-sensitive area, its route can only be shifted to the north of Daxin County. According to the route, the Project is an extension from the end of Longan-Shuolong Expressway. It is a direct high-grade highway connecting Chongzuo City, Daxin County, Tiandeng County and Nanning City with the Shuolong Port, a national-level port at China-Vietnam border. If the Project is moved to the north, away from Shuolong Port, the route will be located in a remote mountainous area, far away from Shuolong Town and the Port. In that case, the expressway will have little economic radiance on Shuolong Town, Daxin County, and lost its significance in the original planning and routing.

See Figure 4-1 for the relationship between the Project and Xialei Autonomous Region Nature Reserve in Guangxi.

5.2.1.5 **Description of Reasons That the Huashan Scenic Area Cannot Be Bypassed**

The recommended option (Route K) for the main line at K11+500~K12+263 and recommended option (Route A for the connecting line at AK0+000~AK5+416 of the proposed project pass through the Class II protection area of Guangxi Huashan Scenic Area in the form of bridge, tunnel and subgrade for about 6.179km, in which the tunnel section is about 1440m long, the bridge section is about 226.5m long and the subgrade section is about 4512.5m long.

Shuolong Port, the planned ending point of the Project, is located within the planning scope of Huashan Scenic Area, and the port is located at the border between China and Vietnam, so there is no option to bypass Huashan Scenic Area. The line bypasses the main scenic spots of Huashan Scenic Area in design and not involving the core attraction of Detian Waterfall, and some sections runs into the class-2 conservation area, which has little impact on Huashan Scenic Area. The relationship between the Project and the Huashan Scenic Area is detailed in the attached Figure 5.

5.2.2 Detian-Shuolong Highway

5.2.2.1 Study on the Starting and Ending Points of Route Options

The Project is to upgrade the existing highway and is part of Shuolong-Ren'ai Highway, and it is directly connected to the end of Ren'ai-Detian Section. The starting point of the Project is located at the existing highway near the gate of Detian Scenic Area, and the ending point is near Rentun of Shuolong Community at the southeast corner of Shuolong Town, and crosses Shuolong Connecting Line of Component A. Restricted by the route option of Shuolong-Renai Section of current border highway, the starting point option of the Project has been determined, so there is no option comparison.

The ending point of the Project is planned to cross Component A near Renaitun. Affected by route comparison, there are two ending point options in the feasibility study of the Project: Route A is connected to Component A in the north of Renaitun, while Route K is connected to Component A in Renaitun. The two options are under the route comparison, so Route K is recommended according to the comparison results.

5.2.2.2 **Comparison of Local Options**

According to the main control factors affecting the Project, combined with topography, geology, route smoothness and other conditions, Route A, Route B and Route C are proposed to compare with Route K.

5.2.2.2.1 Alternatives of Route A and K

(1) Description of alternatives

① Route A (AK11+260~AK13+412.517)

Route A starts at K11+260 of the recommended option, turns northward at AK11+500, runs along the current foot of the mountain, occupying part of the long-term planning and construction land of Shuolong Town, crosses the mountains through a new 656m medium tunnel near the Border Underground Great Wall, along the periphery of Shuolong Town, and finally meets the proposed Shuolong connecting line. The route has a length of 2.153 km, and the route alignment is detailed in Figure 5.2-3.

② Route K (K11+200~K13+564)

Route K extends southward along the existing road from K11+260, and goes straight to the east at K12+100, and it is basically consistent with the road in the Master Planning of Shuolong Town, Daxin County. Finally, it intersects with the proposed Shuolong connecting line in a form of T-shaped intersection. The route has a length of about 2.372 km, and the route alignment is detailed in Figure 5.2-3.

Figure 5.2-3 Schematic Diagram of Route A and Route K Alternatives

(2) Engineering factors comparison

Table 5.2-6 compares the main technical and economic factors for Route A and Route K of the Project and Table 5.2-7 compares their pros and cons.

Table 5.2-6 Comparison of Works Quantities of Route A and Route K

Indicator	**Unit**	**Route A**	**Route K**	**Increase (+) or decrease (-) between Route A and Route K**	**Remarks**
		AK11+260~AK13+412.517	**K11+260~K13+632.053**		
Highway Class		Class II			
Route length	km	2.153	2.372	-0.211	
Design speed	km/h	40~60			
Subgrade width	m	16, 17.5 (sections in cities and towns)			
Carriageway width	m	4×3.5			
Minimum radius of circular curve	m/Nr.	125.715/1	65/1		
Earthworks for subgrade	10,000 m3	9.408	5.530	3.878	
Average earthwork and stonework per kilometer	10,000 m3	4.370	2.331	2.039	
Asphalt Concrete Pavement	1,000 m2	22.546	35.789	-13.243	
Subgrade Drainage	m^3	2701	3855	-1154	
Subgrade	m^2	6424	10819	-4395	

Protection					
Unfavorable geology section	m	110	170	-60	
Tunnel	m/Nr.	656/1	/	656/1	
Culverts	Nr.	4	8	-4	
Occupied land	Mu	80.1(12.2)	88.9（22.7）	-8.8（-10.5）	Numbers in brackets refer to the area of land occupied by existing roads
Houses to be relocated	m^2	2000	3430	-1430	
Level crossing	Nr.	4	5	-1	
Total Cost of the Project	RMB 10,000	14540.3787	5677.2031	8863.1756	
Average cost per kilometer	RMB 10,000	6753.5433	2393.4246	4360.1187	
Recommended option			Recommendation		

Table 5.2-7 Pros and Cons of Route A and Route K

Name of Scheme	Advantages	Disadvantages
Route K	1) It can utilize the existing border highway corridor, and is laid along the planned road of Shuolong Town, which conforms to the planning requirements. 2) It is close to the existing Shuolong Town, which can quickly improve the traffic service level of Shuolong Town. 3) No new tunnel is required, and the cost is low.	1) The new alignment is fitted to the existing roads at K11+600 and K12+000 with small radius, which is not conducive to driving safety. 2) The route passes through residential areas, with a large amount of demolition.
Route A	1) It can add an east-west corridor through Shuolong Town. 2) The route indicators are relatively high.	1) The ending point of the route intersects Shuolong connecting line, and the intersection is close to the tunnel entrance, which may lead to potential safety hazards. 2) The cost of building a new 656m tunnel is high. 3) As the route is close to the underground Great Wall Tunnel at Shuolong Frontier, the construction will affect its structure.

According to the comparison shown in Tables 5.2-6 and 5.2-7, although Route A provides a transit road for Shuolong Town, the overall cost is higher than that of Route K, and the tunnels of Route A may affect the Border Underground Great Wall Scenic Spot. On the basis of satisfying the required functions, Route K makes full use of the existing road. Based on the principles of saving investment and facilitating later maintenance, Route K Option is recommended this time.

(3) Comparison of environmental factors

Environmental factors are compared between Route A and Route K recommended by the Feasibility Study Report, and the results are detailed in Table 5.2-8. The impact on ecologically sensitive areas is also compared, with results presented in Table 5.2-9.

Table 5.2-8 Comparison of Environmental Factors between Route A and Route K

<table>
<tr><th colspan="2">Environmental Factors</th><th>Route A</th><th>Route K</th><th>Recommendation</th></tr>
<tr><td rowspan="10">Ecological environment</td><td rowspan="2">1. Terrain and vegetation type</td><td>A small part of Route A is reconstructed from old roads, and AK12+760~AK13+447 is a newly-built section, which requires a new 656m tunnel, and this section mainly occupies stone mountain shrubs and some farmland vegetation.</td><td>Most of Route K is routed along the existing border highways, and K13+200~K13+632.053 is a newly-built section, which mainly occupies farmland vegetation and a small amount of stone mountain shrubs.</td><td rowspan="2">Route K</td></tr>
<tr><td colspan="2">The new section of Route A is long and a new tunnel is required, which has a great influence on the regional natural vegetation; that of Route K is short, and the main type of vegetation affected is farmland, which has a relatively small influence on natural vegetation.</td></tr>
<tr><td rowspan="2">2. Biomass loss of terrestrial vegetation and influence on wild animals</td><td>656 m/1 Nr.</td><td>N/A</td><td rowspan="2">Route K</td></tr>
<tr><td colspan="2">There is no tunnel in the Route K option, and the loss of vegetation biomass is small.</td></tr>
<tr><td rowspan="2">3. Influence on aquatic ecological environment</td><td>N/A</td><td>N/A</td><td rowspan="2">Route K, Route A</td></tr>
<tr><td colspan="2">There is no bridge in both options, which has little impact on aquatic ecological environment.</td></tr>
<tr><td rowspan="2">4. Water and soil loss</td><td>The earthwork volume is 94,080 m3</td><td>The earthwork volume is 55,300 m3</td><td rowspan="2">Route K</td></tr>
<tr><td colspan="2">Route K option has the smallest earthwork volume and has the minimum influence on soil erosion along the route.</td></tr>
<tr><td>Ecologically sensitive area</td><td>The whole line crosses the Huashan Scenic Area, and the tunnel is close to the underground Great Wall, a Class III</td><td>The whole line crosses the Huashan Scenic Area and is far away from the underground Great Wall, a Class III scenic spot.</td><td>Route K</td></tr>
</table>

Environmental Factors		Route A	Route K	Recommendation
		scenic spot.		
		Route K has the least disturbance to the scenic area.		
Water environment	1. Impact on water environment	N/A	N/A	Route K, Route A
		There is no bridge in both options, which has little impact on the water environment.		
	2. Drinking water source conservation area	About 300 m of road section is adjacent to the Level II conservation area of the community water source in Shuolong Town, but it does not pass through the conservation area.	About 100 m of road section is adjacent to the Level II conservation area of the community water source in Shuolong Town, but it does not pass through the conservation area.	Route K, Route A
		Both routes do not involve drinking water source conservation areas, and are adjacent to water source conservation areas, with the same degree of influence.		
Acoustic environment and air environment		There are four sensitive points in the assessment scope, including one village, one township and two schools.	There are two sensitive points in the assessment scope, including one village and one township.	Route K
		The assessment scope of Route K option does not involve schools, and the route has the least noise influence on the sensitive points.		
Comprehensive comparison results		--	Recommendation	

Table 5.2-9 Comparison of Impact on Ecologically Sensitive Areas

Environmental Factors	Route A	Route K	Recommended option
Land acquisition	80.1 mu	88.9 mu	Route A
	It occupies a small land area, and the newly-built section is about 0.7 km (including a 656 m tunnel)	It occupies a large land area, but most of it is subject to reconstruction and expansion, and the newly-built section is about 0.4 km	
Engineering conditions of sections in sensitive areas	The whole line is located in the Huashan Scenic Area and partially under the ground line (tunnel), and the tunnel section is close to the underground Great Wall, with poor engineering conditions.	The whole line is located in the Huashan Scenic Area, all on the surface (road surface). Most areas are reconstructed from the existing roads, and a few new areas are located in farmland, with good engineering geology .	Route K
	Both routes are located in the Huashan Scenic Area. However, Route A involves underground works, and the tunnel of Route A is close to the underground Great Wall and may pass through this scenic spot,		

	with poor engineering conditions.		
Bridge-tunnel ratio	The bridge-tunnel ratio is 30.5%, and the newly-built section is long. Most of the sections are located in the mountainous area from the north side to the east side of Shuolong Town.	The bridge-tunnel ratio is 0%, some sections are newly built, most of it is subject to reconstruction and expansion, and the newly built sections are mainly located in farmland on the south side of Rentun.	Route K is slightly superior.
	Route A has one more tunnel than Route K, and the bridge-tunnel ratio is higher, but the newly-built section of Route A is longer than that of Route K, and most of the sections are located in the mountainous area on the north side of Shuolong Town, and the occupied vegetation types are mainly stone mountain shrubs and farmland vegetation; most sections of Route K are reconstructed from old roads, the newly-built section is mainly farmland habitat, and the occupied vegetation types are mainly road greening tree species and farmland vegetation. To sum up, although the bridge-tunnel ratio of Route A is relatively high, its impact on the ecosystem is slightly greater than that of Route K.		
Construction methods	Construction methods include subgrade construction and tunnel construction	Construction method is mainly subgrade construction	Route K
	Subgrade construction mainly includes mechanical excavation, backfilling and road pavement, while tunnel construction includes opening excavation, smooth blasting, presplitting blasting and barrel supporting. Route A option includes tunnel works, involving blasting construction, and Route A is close to the entrance of the underground Great Wall, so tunnel blasting may affect the safety and stability of the underground Great Wall.		

It can be seen from Table 5.2-8 that both routes are adjacent to the Level II conservation area of the community water source in Shuolong Town, but they do not pass through the conservation area, with the same degree of influence; both routes are located in the Huashan Scenic Area, but the tunnel construction may cause certain damage to the scenic spot resources as the tunnel of Route A is close to the Class III scenic spot (underground Great Wall); both routes will pass through the planning area of Shuolong Town, but there are two schools within the assessment scope of Route A, and the influence of Route A on the sensitive targets of acoustic environment and air environment involved is greater than that of Route K.

It can be seen from Table 5.2-9 that both routes are located in the Huashan Scenic Area. Route A has a small land acquisition area, relatively high bridge-tunnel ratio, and less disturbance to land and surface vegetation. Although the bridge-tunnel ratio of Route K is low, most section of the route are reconstructed from old roads, and the newly-built sections are farmland habitats, while Route A has more newly-built sections, and most of them occupy stone mountain vegetation, which has a slightly greater impact on the ecosystem than Route K.

Route A is close to the entrance of the underground Great Wall, the engineering conditions of tunnel works are poor, and the tunnel blasting construction may affect the safety and stability of the underground Great Wall. Therefore, Route K is better in the comparison of sections in sensitive areas.

To sum up, Route K is approved as recommended in the feasibility study report from the perspectives of environmental protection and the impact of project construction on sensitive areas, since it has less impact on ecological environment, water environment, acoustic environment and air environment and has less impact on the sensitive area-underground Great Wall than Route A.

5.2.2.2.2 Alternatives of Route B and K

(1) Description of alternatives

① Route K (K9+362.310~K10+155.050 left breadth and YK0+000~YK1+053.383 right breadth)

Route K is designed with a separated subgrade. A single-tube two-lane tunnel will be newly built for section K9+362.31~K10+155.050 on the left line, and the existing road of section YK0+000~YK1+053.383 on the right line will be reconstructed and expanded. For existing roads, road sections of lower classes will be straightened in such a way that demolition is minimized. The line length is 0.8km on the left and 1.053km on the right, and the route alignment is detailed in Figure 5.2-4.

② Route B (BK9+362.310~BK10+155.053)

Route B starts at K9+362.31 and ends at K10+155.050 of the recommended scheme, and its alignment is the same as section K9+362.31~K10+155.050 on the left line of Route K. It is provided with two two-lane small spacing tunnels and 0.8km long. The route alignment is detailed in Figure 5.2-4.

Figure 5.2-4 Schematic Diagram of Route B and K Alternatives

(2) Engineering factors comparison

Table 5.2-10 compares the main technical and economic factors for Route B and K of the Project and Table 5.2-11 compares their pros and cons.

Table 5.2-10 Quantities of Route B and K

Indicator	Unit	Route B	Route K	Increase (+) or decrease (-) between Route A and Route K	Remarks
		BK9+362.310~BK10+155.053	K9+362.310~K10+155.050 and YK0+000~YK1+053.383		

Highway Class		Class II			
Route length	km	0.793	0.923	-0.13	
Design speed	km/h	40~60			
Subgrade width	m	16、8.5*2			
Carriageway width	m	4×3.5			
Minimum radius of circular curve	m/Nr.	260/1	60/1		
Maximum longitudinal slope	%/Nr.	2.9/1	6.8/1		
Minimum radius of convex vertical curve	m/Nr.	1200/1	850/1		
Minimum radius of concave vertical curve	m/Nr.	/	750/1		
Earthworks for subgrade	10,000 m3	4.416	2.094	2.322	
Average earthwork and stonework per kilometer	10,000 m3	5.569	2.269	3.300	
Asphalt Concrete Pavement	1,000 m2	5.927	10.794	-4.867	
Subgrade Drainage	m^3	618	2340	-1722	
Subgrade Protection	m^2	5573	11129	-5556	
Unfavorable geology section	m	355	405	-50	
Tunnel	m/Nr.	395/1 (small spacing)	395/1 (single-tube)	395/1 (single-tube)	
Culverts	Nr.	3	4	-1	
Occupied land	Mu	28（2.1）	43.2（10.8）	-15.2（-8.7）	Numbers in brackets refer to the area

					of land occupied by existing roads
Houses to be relocated	m^2	0	0	0	
Level crossing	Nr.	0	0	0	
Total investment	RMB 10,000	7789.1659	5323.3525	2465.8134	
Average cost per kilometer	RMB 10,000	9822.4034	5767.4458	4054.9576	
Recommended option			Recommendation		

Table 5.2-11 Pros and Cons of Route B and K

Name of Scheme	Advantages	Disadvantages
Route K	(1) The left tunnel scheme makes full use of the horizontal and vertical alignment of the existing road in the scenic spot, which will not cause demolition, has little impact on the tourist center, and can satisfy the requirement that vehicles on the east side can quickly and conveniently enter the tourist service center. 2) The right line is reconstructed and expanded from and has a high utilization rate of existing roads. 3) The right line will widen existing roads and only allow one-way traffic in the tourist season so as to facilitate the driving off of tourists from the tourist attraction. Two-way traffic may be allowed in the tourist off-season to facilitate the travel of residents along the line. It is flexible in traffic organization. 4) Lower construction costs. 5) The tunnel is easier to construct than small spacing tunnels.	1) The alignment is relatively poor as existing roads are used for the right line.
Route B	1) The alignment is relatively favorable. The tunnel has two separated tubes closely located. The land occupied is less. 2) The right tube of the tunnel can facilitate the vehicles from the tourist center to leave the scenic spot quickly through the tunnel.	1) It features all new construction and a low utilization of existing roads. 2) The construction cost is higher and the tunnel construction is more difficult.

According to the comparison shown in Table 5.2-10 and 5.2-11, although Route B is better aligned that vehicles from the tourist center can leave the tourist attractions quickly via the tunnel, Route K has a lower construction cost on the whole and is thus recommended based on the principle of saving investment, utilizing existing roads, reducing demolition and facilitating subsequent maintenance.

(3) Comparison of environmental factors

Environmental elements are compared between Route A and K recommended by the Feasibility Study Report, and the results are detailed in Table 5.2-12. The impact on ecologically sensitive areas is also compared, with results presented in Table 5.2-13.

Table 5.2-12 Comparison of Environmental Elements between Route B and K

<table>
<tr><th colspan="2">Environmental Factors</th><th>Route B</th><th>Route K</th><th>Recommendation</th></tr>
<tr><td rowspan="10">Ecological environment</td><td rowspan="2">1. Terrain and vegetation type</td><td>The entire length is newly built, including a two-way four-lane tunnel of 395m long and a subgrade of approximately 400m following the tunnel. The land occupied is grown mainly with rocky mountain shrubs and also some farmland vegetation.</td><td>The left breadth is newly constructed and about half of Route B in scale. The right breadth is reconstructed and basically arranged along existing roads; the land occupied is grown with mainly rocky mountain shrubs, some farmland vegetation and road greening vegetation.</td><td rowspan="2">Route K</td></tr>
<tr><td colspan="2">Route K is less destructive to the vegetation than Route B since it is reconstructed from existing roads apart from new construction in scale some half that of Route B.</td></tr>
<tr><td rowspan="2">2. Biomass loss of terrestrial vegetation and influence on wild animals</td><td>395m/tunnel (double-tube four-lane)</td><td>395m/tunnel (single-tube two-lane)</td><td rowspan="2">Route K</td></tr>
<tr><td colspan="2">Route K is designed with a single-tube two-lane tunnel, the opening is small, and less vegetation will be impacted.</td></tr>
<tr><td rowspan="2">3. Influence on aquatic ecological environment</td><td>N/A</td><td>N/A</td><td rowspan="2">Route K, Route B</td></tr>
<tr><td colspan="2">There is no bridge in both options, which has little impact on aquatic ecological environment.</td></tr>
<tr><td rowspan="2">4. Water and soil loss</td><td>The cut volume is 44,160 m3.</td><td>The cut volume is 20,940 m3.</td><td rowspan="2">Route K</td></tr>
<tr><td colspan="2">Route K option has the smallest earthwork volume and has the minimum influence on soil erosion along the route.</td></tr>
<tr><td rowspan="2">Ecologically sensitive area</td><td>The whole line is newly built and crosses the Huashan Scenic Area.</td><td>The whole line crosses the Huashan Scenic Area and only the left breadth is newly built.</td><td rowspan="2">Route K</td></tr>
<tr><td colspan="2">Route K has the least disturbance to the scenic area.</td></tr>
<tr><td rowspan="3">Water environment</td><td rowspan="2">1. Impact on water environment</td><td>N/A</td><td>N/A</td><td rowspan="2">Route K, Route B</td></tr>
<tr><td colspan="2">There is no bridge in both options, which has little impact on the water environment.</td></tr>
<tr><td>2. Drinking water source conservation</td><td>The whole line crosses the Level II community water source conservation area in</td><td>The left breadth crosses the Level II community water source conservation area in Shuolong Town and is</td><td>Route K is slightly superior.</td></tr>
</table>

Environmental Factors		Route B	Route K	Recommendation
	area	Shuolong Town and is designed with tunnels locally.	designed with tunnels locally.	
		The water source protection zone is crossed by both routes but only by one breadth of Route K, which has less impact on the water environment.		
Acoustic environment and air environment		There are sensitive points in the evaluation scope, including one village.	There are sensitive points in the evaluation scope, including one village.	Route K or Route B
		Both routes have an equal number of sensitive points and are comparable in impact.		
Comprehensive comparison results		--	Recommendation	

Table 5.2-13 Comparison of Impact on Ecologically Sensitive Areas

Environmental Factors	Route B	Route K	Recommended option
Land acquisition	28 mu	43.2 mu	Route K
	Route B occupies less land but the entire section is new, and only half breadth of Route K is newly built.		
Engineering conditions of sections in sensitive areas	The whole line is located in the Huashan Scenic Area and partially under the ground line (tunnel), with poor engineering conditions.	The whole line is located in the Huashan Scenic Area and partially under the ground line (tunnel), with poor engineering conditions.	Route K
	Sensitive areas are crossed by both routes, but Route K is less disturbing as only its left breadth is concerned and the scale is half that of Route B. In addition, the tunnel is single-tube for Route K and double-tube for Route B, and Route B has worse engineering conditions.		
Bridge-tunnel ratio	The bridge and tunnel ratio is 49.8%, and the new section has a relatively large scale.	The bridge and tunnel ratio is 49.8%, and the new section has a relatively large scale.	Route K is slightly superior.
	The bridge and tunnel ratio is the same for both routes, but Route K has less impact on the ecological environment as its new section (left breadth) is only half that of Route B.		
Construction methods	Construction methods include subgrade construction and tunnel construction	Construction methods include subgrade construction and tunnel construction	Route K is slightly superior.
	The construction schemes of both routes involve tunnel construction and subgrade construction, and Route K has a smaller tunneling scale and is thus easier to construct than Route B.		

According to Table 5.2-12, both routes cross the Level II community water source conservation area in Shuolong Town and the Huashan Scenic Area, while Route K has a smaller new section scale and thus less impact on the water source area and the scenic area. Half of its breadth is reconstructed and expanded and requires a small cut volume, which has less impact on the ecosystem and soil erosion. Both routes have an equal impact on the sensitive targets of the sound and air environment involved.

According to Table 5.2-13, both routes are located within the Huashan Scenic Area, while Route B is newly built for the entire length and is more disturbing to the ecologically sensitive areas and the ground vegetation. The tunnels of both routes have the same length, while Route K is designed with a single-tube tunnel. Its construction method and bridge and tunnel ratio have less impact on the ecosystem, demonstrating that Route K is better in the comparison of sections in sensitive areas.

To sum up, Route K is approved as recommended in the feasibility study report from the perspectives of environmental protection and the impact of project construction on sensitive areas, since it has less impact on the sensitive areas, ecological environment, and water environment.

5.2.2.2.3 Alternatives of Route B and K

(1) Description of alternatives

① Route K (K8+530~K12+180)

The route is basically arranged along the existing roads from K8+530~K12+180, passes by the tourist center northward at K8+530, crosses Longhong with a separated subgrade, and is straightened along the existing roads until Hongniling. The route has a length of 3.650km, and its alignment is detailed in Figure 5.2-5.

② Route C (K8+530~CK11+126.83)

Route C starts at K8+530 and ends at K12+180 of the recommended scheme, with the ending chainage of CK11+126.830. It is basically laid along the Guichun River, without tunnel. The route has a length of 2.597km. The route alignment is detailed in Figure 5.2-5.

Figure 5.2-5 Plan of Route C and K

(2) Engineering factors comparison

Although Route C of the Project has a better horizontal alignment, its lengthways gradient is relatively large, and the existing tourist center is completely bypassed, which is contrary to the project's construction purpose, so no more engineering comparison is made with Route K. Table 5.2-14 shows the pros and cons of both routes.

Table 5.2-14 Pros and Cons of Route C and K

Name of Scheme	Advantages	Disadvantages
Route K	1) The route passes by the tourist center and vehicles on the east side can thus	1) The route has a long detouring distance.

	enter the tourist service center rapidly and conveniently. 2) It has a high utilization rate of existing border highways. 3) Residents along the route receive more benefit.	
Route C	1) After completion, it is a road along the river with good landscape and can be connected to surrounding scenic spots;	1) Sections along the river have complex geological conditions, big ups and downs, large cut and fill volumes, small profile indicators, and an unreasonable combination of horizontal and vertical indicators. 2) It rarely utilizes the existing roads and bypasses the tourist distribution center, which makes it inconvenient for tourists to come and go and may cause congestion on the way to the tourist center during the peak tourist season. 3) Residents along the route receive little benefit.

The above analysis and comparison show that Route K passes by the tourist center, reutilize the existing tourist service center, reduces road congestion during the peak tourist season, and can serve more residents along the route, so it is recommended this time.

(3) Comparison of environmental factors

Since the feasibility study report does not include an engineering comparison, this evaluation only briefly compares Route C and K in terms of environmental elements and ecologically sensitive areas in Table 5.2-15 and 5.2-16.

Table 5.2-15 Comparison of Environmental Factors between Route C and K

Environmental Factors		**Route C**	**Route K**	**Recommendation**
Ecological environment	1. Terrain and vegetation type	The whole section is a new subgrade section, and the land occupied is mainly grown with rocky mountain shrubs and farmland vegetation.	The tunnel is the only section newly built, and the land occupied is mainly at the entrance and exit and grown with rocky mountain shrubs.	Route K
		The whole section of Route C is a new subgrade section and has a relatively large impact on the natural vegetation involved.		
	2. Biomass loss of terrestrial vegetation and influence on wild animals	The whole line is a subgrade section, and the new cut volume is the largest.	A tunnel is newly built and the remainder of the route is reconstructed.	Route K
		The whole line of Route C is a subgrade section and has a relatively large cut volume; only the tunnel is newly built for Route K, so the new cut volume is relatively small and the vegetation involved is less.		
	3. Influence on aquatic ecological environment	N/A	N/A	Route K, Route C
		There is no bridge in both options, which has little impact on aquatic ecological environment.		
	4. Water and	The whole section is a subgrade section, and the	A tunnel is newly built, and waste earthwork and	Route K

	soil loss	cut volume and in turn the possible amount of soil erosion are the largest.	stonework are less.	
		Route K option has the smallest earthwork volume and has the minimum influence on soil erosion along the route.		
	5. Ecologically sensitive area	The whole line crosses the Huashan Scenic Area, and the whole section is a new subgrade and requires excavation.	The whole line crosses the Huashan Scenic Area and requires opening excavation for the new tunnel.	Route K
		Route K has the least disturbance to the scenic area.		
Water environment	1. Impact on water environment	N/A	N/A	Route K, Route C
		There is no bridge on both routes and thus little impact on the water environment.		
	2. Drinking water source conservation area	It does not crosses the water source area.	A section of about 640m crosses the Level II community water source conservation area in Shuolong Town.	Route C
		Route C does not involve the water source area. Route K crosses the Level II water source conservation area, but the source is the Yuejin Canal that sources from the Guichun River. The catchment area crossed by the route has no hydraulic connection with the Yuejin Canal, so the water quality will not be directly affected.		
Acoustic environment and air environment		No sound or air sensitive point is involved.	There are sensitive points in the evaluation scope, including two villages.	Route C
		The assessment scope of Route K option does not involve schools, and the route has the least noise influence on the sensitive points.		
Comprehensive comparison results		--	Recommendation	

Table 5.2-16 Comparison of Impact on Ecologically Sensitive Areas

Environmental Factors	Route C	Route K	Recommendation
Land acquisition	The whole section is a new subgrade and occupies the largest area of land.	Most of the route is reconstructed and expanded and thus the land newly occupied has a small area.	Route K
Engineering conditions of sections in sensitive areas	The whole line is located in the Huashan Scenic Area, the new section is a subgrade section, and it occupies the largest area of land.	The whole line is located in the Huashan Scenic Area, only a small part is newly built, and the land occupied has a small area.	Route K
	Both routes are located in the Huashan Scenic Area, Route K occupies the least land, has the smallest quantity of works and enjoys better engineering conditions with environmental protection construction considered for the section in ecologically sensitive areas.		
Ecological	The whole section is a new	The new section is less and the	Route K

damage	subgrade section, involves large cut volume, and is most destructive to the ecology.	route is mostly reconstructed and expanded. It has the smallest cut volume and thus the least ecological damage.	
	Route K has the least ecological damage.		
Construction methods	Construction method is mainly subgrade construction	Construction methods include subgrade construction and tunnel construction	Route K
	Subgrade construction mainly includes mechanical excavation, backfilling and road pavement, while tunnel construction includes opening excavation, blasting and barrel supporting. Route C is relatively undulated lengthways, and it is thus difficult to construct and has a great ecological impact.		

As shown in Table 5.2-15, Route C does not cross the water source area, and Route K crosses but has no hydraulic connection with the Level II community water source conservation area in Shuolong Town, so the construction and operation of both routes have little impact on the water source area. Both are located in the Huashan Scenic Area, while Route K has the smallest cut volume and the least impact on the scenic area and the ecological environment and involves two villages, and Route C does not involve any sound sensitive point and has the least impact on sound and air sensitive targets in the environment along the route.

As can be seen from Table 5.2-16, both routes are located in the Huashan Scenic Area. Route K has the smallest land occupation area and cut volume and less disturbance to land and ground vegetation in ecologically sensitive areas. The whole line of Route C is comprised of subgrade sections and has the largest land occupation area and quantity of works and no doubt the greatest impact on the ecologically sensitive areas. It can be seen from the results of comparing road sections in sensitive areas that Route K is superior.

To sum up, Route K has the least impact on the ecological environment and the Huashan Scenic Area from the perspective of the impact of the project construction on environmentally sensitive areas, the water environment is not affected by either route, and Route C has the least impact on the sound and air environments. Since ecological damage is often difficult to restore and the impact on sound and air sensitive targets can be minimized through environmental protection measures, Route K as recommended in the feasibility study report is approved after comprehensive consideration.

5.2.2.3 Description of Reasons That the Huashan Scenic Area Cannot Be Bypassed

Huashan Scenic Area, located in Ningming, Longzhou and Daxin County in the southwest of Nanning, Guangxi Zhuang Autonomous Region has landscape composed of cliff murals of the ancient Zhuang nationality which are distributed within an area of more than 2,800 km2. There are 64 large murals, and Huashan and Mingjiang have largest number of murals. The Huashan Scenic Area is in the form of continuous strip geographically. The 200-mile riverside scenery is dominated by Zuojiang ancient cliff murals. The pastoral landscape along the 500-mile highway is composed of limestone peak clusters, peak forest depressions and river valleys.

The Project is to upgrade the Detian to Sholong section of the existing border highway, all located within the planned Huashan Scenic Area, and due to limitations of the existing border highway, the Huashan Scenic Area cannot be bypassed. The Project starts near the gate of Detian Scenic Area and ends near the Shuolong Port, bypassing the main attraction of the Huashan Scenic Area and not involving the core attraction of Detian Waterfall. The Report for Landscape Impact Assessment of Shuolong-Detian-Renai Class II Highway Upgrading Project in Daxin County Passing through Huashan Scenic Area demonstrates that the project construction has little impact on the Huashan Scenic Area. The relationship between the Project and the Huashan Scenic Area is detailed in the attached Figure 5.

5.2.2.4 Description of Reasons That the Shuolong Drinking Water Source Cannot Be Bypassed

According to the Demarcation Scheme of Centralized Drinking Water Source Conservation Areas for Villages and Towns in Daxin County and its approval, two water source conservation areas are demarcated in Shuolong Town, namely, the community water source conservation area and the Aitun water source conservation area, as shown below.

5.2.2.4.1 Demarcation of the Community Water Source Conservation Area in Shuolong Town

(1) Level I conservation area

① Water area: A water area of the length from 1,000m upstream to 100m downstream of the water intake (Yuejin Canal) and of the width that can be submerged by a 5-year flood. It covers 0.012km2.

② Land area: A land area of 50 m in depth on each side of the water area in the Level I conservation area. It covers 0.106km^2.

(2) Level II conservation area

① Water area: A water area of the length from 3,000m upstream to 300m downstream of the water intake and of the width that can be submerged by a 10-year flood. The water area of the Level I conservation area is not included. It covers 0.022 km^2.

② Land area: A land area of 1,000 m in depth on each side of the water area in the Level I and II conservation areas and bounded by Shuolong - Detian Highway in the south. The land area of the Level I conservation area is not included. It covers 1.305km^2.

5.2.2.4.2 Demarcation of the Aitun Water Source Conservation Area in Shuolong Town

(1) Level I conservation area

① Water area: A water area of the length from 1,100m upstream to 100m downstream of the water intake and of the width that can be submerged by a 5-year flood from the middle thread of channel (national boundary) to the left bank. It covers 0.031km^2.

② Land area: A land area of 50 m in depth on the left side of the water area in the Level I conservation area (bounded by Shuolong - Detian Highway). It covers 0.035km^2.

(2) Level II conservation area

① Water area: A water area of the length from 4,700m upstream to Aitun Dam downstream of the water intake and of the width that can be submerged by a 10-year flood from the middle thread of channel (national boundary) to the left bank. It covers 0.169 km^2.

② Land area: A catchment land area of 1,000 m in depth on the left side of the water area in the Level I and II conservation areas. The land area of the Level I conservation area is not included. It covers 7.995km^2.

5.2.2.4.3 Description of Reasons That the Water Source Conservation Areas Cannot Be Bypassed

(1) Description of reasons that the community water source conservation area in Shuolong Town cannot be bypassed

Combined with the demarcation scheme of water source conservation areas in Shuolong Town, the land area of the Level II community water source conservation area in Shuolong Town is bounded by the existing border highway beyond the scope of the water source. According to the alignment of the existing highways, the section connects Longhongtun with Longhong Tourist Service Center, and it turns south from the east at Longhongtun first and then turns north to Longhong Tourist Service Center at a sharp bend. Its curvature is large and its turning radius is smaller than the minimum turning radius required as a Class II highway, so it will be straightened and then cross the Level II water source conservation area according to the feasibility study report of the Project. In order to meet the construction target of upgrading the existing Class III border highway to Class II, the Project could not bypass the Level II community water source conservation area in Shuolong Town.

(2) Description of reasons that the Aitun water source conservation area in Shuolong Town cannot be bypassed

Combined with the demarcation scheme of water source conservation areas in Shuolong Town, the land area of the Level I Aitun water source conservation area in Shuolong Town is bounded by the existing border highway, and the Level II conservation area is 1,000 m deep based on the Level I conservation area and includes the existing border highway. The Project is to upgrade the existing border highways, primarily to widen their pavement and improve their class. In general, the route alignment is limited by the existing border highway and cannot bypass the Level II Aitun water source conservation area in Shuolong Town.

6 Project Overview and Analysis

6.1 Wuzhou (Longyanzui)-Shuolong Expressway (Chongzuo-Jingxi Expressway to Shuolong Port Section)

6.1.1 **Overview of Project Recommended Scheme**

6.1.1.1 Geographic location

The proposed Wuzhou (Longyanzui) to Shuolong Highway (Chongzuo - Jingxi Expressway to Shuolong Port section) is located in Tiandeng County and Daxin County of Chongzuo City. It is a component of the Wuzhou (Longyanzui) to Shuolong Expressway, one of the 7 east-west expressways in Expressway Network Planning of Guangxi (2018~2030). The general alignment of the route is east-west to north-south, and the Project consists of the main line and Shuolong connecting line. The starting point of the recommended option for the main line is connected to the Neitun Hub of Long'an-Shuolong Expressway. After passing through villages such as Buxuan and Baidou to the southwest, the route crosses the Xialei River to Bangtun; the Shuolong connecting line is connected to the ending point of the main line, and it goes south along the existing county highway X532, passes through Sanjiadian, turns to the southeast, and ends at Rentun in the east of Shuolong Town towards Longzhou after passing through Longmei, and connects with the original border highway at the planned bridge head of Guichun River.

The recommended option (Route K) for the main line has a total length of 12.263km. The whole route adopts the expressway standard, with a design speed of 100 km/h, two-way four lanes, a subgrade width of 26m and asphalt concrete pavement.

The connecting line (Route A) has a total length of 5.416km. The highway adopts the Class I highway standard, with a design speed of 80 km/h, two-way four lanes, a subgrade width of 25.5m and asphalt concrete pavement.

See Figure 1 for the geographical position of the Project, and Figure 2 for the plan and profile.

6.1.1.2 Basic information of the Project

Project Name: Wuzhou (Longyanzui)– Shuolong Highway (Chongzuo–Jingxi Expressway to Shuolong Port Section)

Project nature: new project;

Construction site: Tiandeng county and Daxin county, Chongzuo City;

Land acquisition and demolition: The total land area of the Project is 2004.96 mu, and permanent LA occurs in subgrade works area, bridge works area, tunnel works area and facilities area along the line, with an area of 1391.96 mu. Temporary land occupation occurs in spoil area, temporary dump, construction, production and living areas and construction access road, with an area of 613 mu.

Construction period: It is planned to be commenced in October 2021 and completed in October 2024, with a construction period of three years.

Construction scale: the mainline is of expressway standard, with construction mileage of 12.263km, two-way four lanes, design speed of 100km/h and subgrade width of 26m. The connecting line is of Class-I highway standard, and the construction mileage of the connecting line is 5.416km, with two-way four lanes, design speed of 80km/h, subgrade width of 25.5m.

Main quantities: there are 7 bridges (3768m), 7 tunnels (5075.5m), 1 toll station, 1 maintenance work area (built together with toll station), 20 culverts and 3 passages along the whole highway.

Project investment: the estimated investment is RMB 2,705,091,232, 20% of which is the capital owned by the owner and 80% of which is from bank loans. The total investment in environmental protection during the construction period is RMB 8.316 million, accounting for 0.31% of the total project investment.

6.1.1.3 **Construction Contents in Recommended Scheme**

The construction contents of the Project mainly include road engineering, bridge and culvert engineering, tunnel engineering, crossing engineering, connecting line engineering, traffic engineering and facilities engineering along the line.

Mainline of the Project: The mainline is of expressway standard, with construction mileage of 12.263km in Phrase I , two-way four lanes, design speed of 100km/h and subgrade width of 26m. There are one toll station and one management and maintenance station on the whole line, all built in the range of chainage K5+800~K6+100.

Project connecting line: The connecting line is of Class-I highway standard, and the construction mileage of the connecting line is 5.416km, with two-way four lanes, design speed of 80km/h, subgrade width of 25.5m.

Table 6.1-1 List of Main Economic and Technical Indicators

<table>
<tr><th>S/N</th><th colspan="2">Indicator</th><th>Unit</th><th>Mainline</th><th>Shuolong Connecting Line</th><th>Remarks</th></tr>
<tr><td>1</td><td colspan="2">Route length</td><td>km</td><td>12.263</td><td>5.416</td><td></td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Earthworks for subgrade</td><td>Excavation</td><td>m^3</td><td>589533</td><td>430249</td><td rowspan="2">Excluding the earthworks for road relocation, interchanges and facilities along the route</td></tr>
<tr><td>Filling</td><td>m^3</td><td>1829355</td><td>331740</td></tr>
</table>

S/N	Indicator		Unit	Mainline	Shuolong Connecting Line	Remarks
3	Asphalt concrete pavement		km^2	72.318	87.08	Excluding the interchanges
4	Special subgrade (soft foundation)		km	5.091	1.988	Calculated according to one side of division subgrade
5	Protection and drainage works (masonry)		km^3	26.358	16.566	Excluding the interchanges
6	Super major and major bridges		m/Nr.	3669.5/6	98.5/1	
7	Medium bridges		m/Nr.	-	-	
8	Total of bridges		m/Nr.	3669.5/6	98.5/1	
9	Super long tunnels		m/Nr.	-	-	
10	Long tunnels		m/Nr.	1182.5/1	1430/1	
11	Medium tunnels		m/Nr.	642.5/1	-	
12	Short tunnels		m/Nr.	1820.5/4	-	
13	Total of tunnels		m/Nr.	3645.5/6	1430/1	
14	Interchanges		Nr.	1	-	Jointly built with Long'an - Shuolong Expressway
15	Neitun Hub Interchange	Excavation for subgrade	m^3	352214	-	within the scope of main line for interchanges
		Filling for subgrade	m^3	139	-	
		Asphalt Concrete Pavement	km^2	7.946	-	
		Protection and drainage works (masonry)	km^3	2.814	-	
		Major bridges	m/Nr.	1443/1	-	
		Medium bridges	m/Nr.	-	-	
		Ramp bridges	m/Nr.	3026/6		within the scope of ramps for interchange
		Ramp tunnels	m/Nr.	201/1		
16	Culverts		Nr.	9	11	
17	Overpass		Pc.	-	-	
18	Channels		Nr.	3	-	
19	Monitoring and communication branch center		Nr.	1	-	
20	Maintenance work area		Nr.	1	-	
21	Service area		Nr.	-	-	
22	Rest area		Nr.	-	-	
23	Mainline toll station		Nr.	1	-	
24	Floor area		Mu	1062	330	
25	Demolished buildings		m^2	329.2	0	
26	Estimated Investment		RMB 100 million	22.37	4.68	27.05

6.1.1.4 Prediction of traffic volume of the Project

(1) Forecast of traffic volume of each road section

See Table 6.1-2 for the traffic forecast of each section of the Project in each characteristic year according to the Feasibility Study Report of Wuzhou (Longyanzui) – Shuolong Highway (Chongzuo – Jingxi Expressway to Shuolong Port Section) Project.

Table 6.1-2 Traffic Forecast Results of Each Road Section (unit: pcu/d)

Road Section		Forecast Period		
		2025 (the 1st year after operation)	2031 (the 7th year after operation)	2039 (the 15th year after operation)
Main line	K1+693~K11+763	5397	10518	19218
Connecting line	AK0+000~AK2+800	3424	7853	15008
	AK2+800~AK5+423	3091	7085	13544

(2) Structure of Vehicle Types

See Table 6.1-3 for the vehicle type ratio of the Project according to the Feasibility Study Report of Wuzhou (Longyanzui) – Shuolong Highway (Chongzuo – Jingxi Expressway to Shuolong Port Section) Project.

Table 6.1-3 Vehicle Type Ratio and All-day to Daytime Ratio of Traffic Flow

Year / Vehicle Type	Year 2025 (the 1st year after operation)	2031 (the 7th year after operation)	2039 (the 15th year after operation)
Small freight vehicle	8.87%	6.51%	2.97%
Medium freight vehicle	10.47%	9.45%	6.76%
Large freight vehicle	10.77%	10.96%	11.89%
Combination vehicle	3.79%	8.88%	17.30%
Small Passenger Vehicle	59.09%	58.66%	58.12%
Large Passenger Vehicle	7.01%	5.53%	2.97%

According to the predicted traffic volume, vehicle type ratio and day-night ratio of the Project, the equivalent conversion coefficient of small cars is 1, that of mid-size cars is 1.5, that of oversize cars is 2.5, and that of combination vehicles is 4.0. See Table 6.1-4 for the calculated day-night hourly traffic volume of various types of vehicles.

Table 6.1-4 Forecast of Traffic Volume for Various Types of Vehicles Unit: Nr./h

Road Section	Vehicle category	Year 2025		2031		2039	
		Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime
Main line of the Project K1+693~ K11+763	Small-sized vehicle	183	92	343	171	587	294
	Medium-sized vehicle	31	16	53	26	62	31
	Large-sized vehicles	14	7	35	17	87	44
	Total	229	115	430	215	737	368
Branch line of the Project AK0+000~ AK2+800	Small-sized vehicle	116	58	252	126	461	231
	Medium-sized vehicle	20	10	37	18	52	26
	Large-sized vehicles	9	4	28	14	66	33
	Total	145	73	316	158	579	290
Branch line of the Project AK2+800~ AK5+423	Small-sized vehicle	105	53	227	113	416	208
	Medium-sized vehicle	18	9	33	17	47	23
	Large-sized vehicles	8	4	25	13	60	30
	Total	131	66	286	143	523	261

6.1.1.5 Project design scheme

6.1.1.5.1 Subgrade Works

(1) Main line

It is constructed as per the two-way four-lane expressway, with the design speed of 100km/h and the subgrade width of 26m.

The integral subgrade of main line of the Project is 26m wide, in which the lane width is 2x2x3.75m, the width of hard shoulder is 2x3.0m, the width of soft shoulder is 2x0.75m, the width of medial strip is 2m, and the width of left marginal strip is 2x0.75m. The guardrail of the median strip adopts corrugated beam guardrail. In order to facilitate emergency rescue and maintenance, the median strip is provided with openings. The shoulder generally uses corrugated beam guardrail, and concrete guardrails are set up on steep sections and half-subgrade and half-bridge sections.

For the Project, the separated subgrade is 13m wide, in which the lane width is 2 x 3.75m, the width of the right hard shoulder is 3.0m, the width of soft shoulder is 2 x 0.75m, and the width of left hard shoulder is 1.0m. Corrugated beam guardrails are generally used for the shoulders at both sides, and concrete guardrails are set on steep sections.

The cross slope of both lane and hard shoulder is 2% and that of earth shoulder is 3%. The corresponding superelevation shall be provided when the radius of circular curve R < 4000m. The subgrade superelevation shall be transitioned by rotating the outer lanes around the edge of the median strip, thus to form independent one-way superelevation sections. At this time, the median strip shall be at the original level, with the superelevation transitioned within the full-relief section. The design elevation of subgrade is edge elevation from the median strip.

When the route is on a continuous uphill section and the traffic capacity and operation safety are affected, a climbing lane with a width of 3.50 m shall be set up. In continuous long and steep downhill sections, escape ramps shall be set up at appropriate locations with a width of 3.50 m.

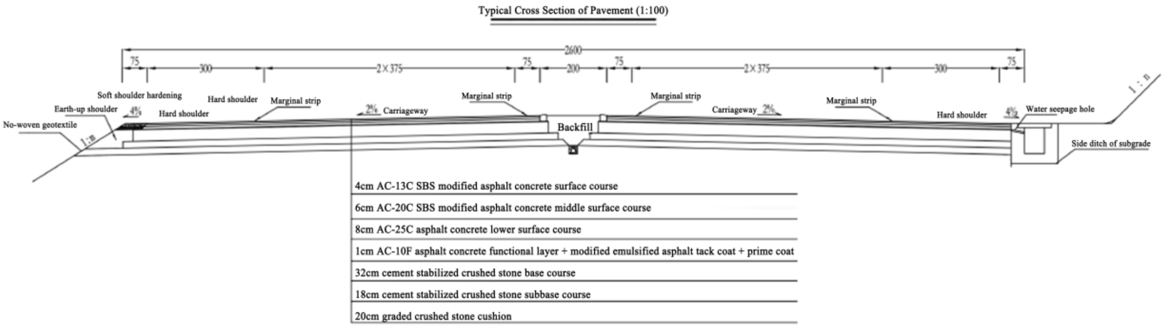


Figure 6.1-1 Cross-section of Pavement Structure of Mainline of the Project

6.1.1.5.2 Shuolong Connecting Line

Shuolong Connection Road adopts the Class-I highway standards, with a design speed of 80km/h and a subgrade width of 25.5 m. The corresponding structure of subgrade cross section includes one 2m medial strip , two 0.5m left marginal strips, four 3.75m lanes of two way, two 3.0m right hard shoulders, and two 0.75m soft shoulder on each side. The crown slope of both lane and hard shoulder is 2% and that of earth shoulder is 3%. The corresponding superelevation shall be provided when the radius of horizontal curve R < 2500m. The subgrade superelevation shall be transitioned by rotating the outer lanes around the edge of the median strip, thus to form independent one-way superelevation sections. At this time, the median strip shall be at the original level, with the superelevation transitioned within the full-relief section.

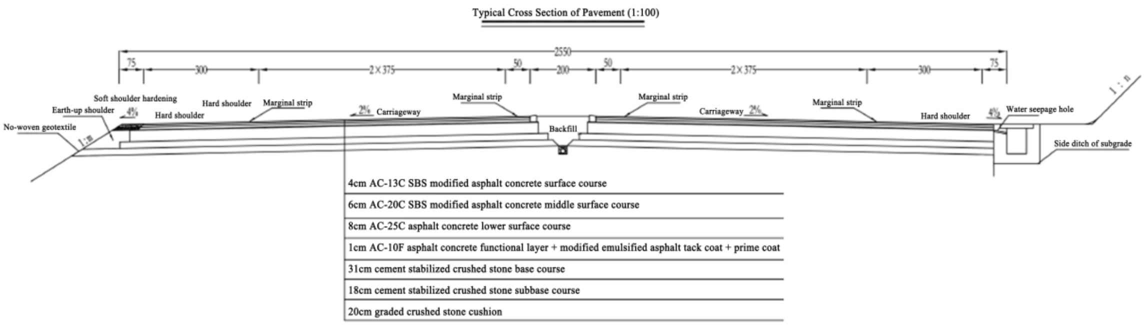


Figure 6.1-2Cross-section of Pavement Structure of Shuolong Connecting Line of the Project

6.1.1.5.3 Subgrade Drainage

60 x 80 cm rectangular side ditches shall be set on both sides of subgrade in excavation section, and sewers shall be arranged under the side ditches. When the cutting is relatively high, a platform shall be set every 10 m high, with a slope of 3%. Intercepting ditches, generally 60×60cm rectangular ditches, shall be set up at the places where the catchment area at the top of the slope is large and may affect the excavation side slope.

1m wide berm shall be set at the slope toe of fill subgrade, and a 60×60cm rectangular drainage ditch shall be set at the outside of the berm. Chutes shall be set up at the steep junction of filling and excavation to direct the water from side ditches or intercepting ditches out of the scope of drainage ditches or subgrade.

According to the filling and excavation and in combination with the terrain, all kinds of ditches and pipes shall be reasonably set up in the whole road section to form a drainage system. Various drainage facilities and water inlet and outlet shall be smoothly connected with the existing ditches on both sides of the subgrade or shall be led to low-lying areas. At the same time, attention shall be paid to avoid scouring the subgrade and farmland along the route.

6.1.1.5.4 Pavement Works

According to the design scheme of the project, asphalt concrete pavement is adopted as the pavement structure of the mainline the project, and the pavement structure is as follows:

General section: 4cm fine-grained modified asphalt concrete (AC-13C) + 6cm medium-grained modified asphalt concrete (AC-20C) + 8cm coarse-grained asphalt concrete (AC-25C) + 2.5cm thick modified asphalt synchronous crushed stone seal coat + 36cm cement stabilized crushed stone + 20cm low-dose cement stabilized crushed stone + 20cm graded crushed stone cushion, with a total pavement thickness of 96.5 cm.

Stone excavation section: 4cm fine-grained modified asphalt concrete (AC-13C) + 6cm medium-grained modified asphalt concrete (AC-20C) + 8cm coarse-grained asphalt concrete

(AC-25C) + 2.5cm thick modified asphalt synchronous crushed stone seal coat + 36cm cement stabilized crushed stone + 20cm graded crushed stone cushion.

6.1.1.5.5 Bridge and culvert works

1. Bridge Works

The mainline of the Project contains 1 super major bridge (1268m) and 5 major bridges (2401.5m). The Connecting Line contains 1 major bridge (97m). Bridges of the Project are laid out by crossing valleys, rivers and channels to adapt to the topography. See Table 6.1-5 for the details of bridges in the recommended scheme of the Project.

Table 6.1-5 List of Recommended Bridge Schemes(excluding interchange)

S/N	Chainage		Bridge Name	Bridge Length (m)	Hole Number × Hole Diameter (m)	Structure Type
Main line						
1	Left carriageway	ZK2+468	Nongwan No. 1 Viaduct	408	10×40	Fabricated prestressed concrete small box beam
	Right carriageway	YK2+428		328	8×40	
2	Left carriageway	ZK3+555	Nongwan No. 2 Viaduct	450	11×40	Fabricated prestressed concrete small box beam
	Right carriageway	YK3+566		450	11×40	
3	Left carriageway	ZK5+165	Buxuan Elevated Major Bridge	607	20×30	Fabricated prestressed concrete small box beam
	Right carriageway	YK5+187		577	19×30	
4	Left carriageway	ZK6+960	Dunli Viaduct	848.5	28×20	Fabricated prestressed concrete small box beam
	Right carriageway	YK6+950		878.5	28×30	
5	Left carriageway	ZK8+795	Longkalang Super Viaduct	1248	3×40	Fabricated prestressed concrete small box beam
	Right carriageway	YK8+815		1288	3×40	
6	Left carriageway	ZK12+075	Bangtun Heishui River Major Bridge	128	3×40	Fabricated prestressed concrete small box beam
	Right carriageway	YK12+117		128	3×40	
		Total	6 bridges	3669.5		
Connecting line						
1	Left carriageway	LZK5+353	Shuolong Guichun River Major Bridge	98.5	3×30	Fabricated prestressed concrete small box beam
	Right carriageway	LYK5+337		98.5	3×30	
		Total	1 bridge	98.5		

(1) ZK2+468/ YK2+428 Nongwan No. 1 Viaduct

Nongwan No. 1 Viaduct is located at about 1000m in the north of Liliang Village, Fuxin Town, Tiandeng County, Chongzuo City, and it spans a depression. In combination of horizontal and vertical designs, a 10×40m fabricated prestressed concrete small box beam plans to be adopted for the left carriageway, and a 8×40m fabricated prestressed concrete small box beam plans to be adopted for the right carriageway of the superstructure. Column pier and hollow pier pile foundation will be used for the lower pier. The riser plate and rib pile foundation will be used for the abutment. The overall length of bridge at the left carriageway is 408m, and that at the right carriageway is also 328m. The bridge site area is peak cluster depression landform. The elevation of the bridge site area is 388~450m, and the terrain fluctuates largely, with the relative height difference of about 62m. The abutments at both sides are located at the slope of the mountain. Except karst, other unfavorable geological disasters such as landslide and debris flow are not found in the bridge site area. The subterrane at the bridge site is intermediary weathered limestone within the depth of exploration according to the geological mapping and exploration.

Figure 6.1-3 Current Situation of Bridge Site of Nongwan No. 1 Viaduct

(2) ZK3+555/ YK3+566 Nongwan No. 2 Viaduct

Nongwan No. 2 Viaduct is located at about 2m in the north of Liliang Village, Fuxin Town, Tiandeng County, Chongzuo City, and it spans a depression. In combination of horizontal and vertical designs, a 11×40m fabricated prestressed concrete small box beam plans to be adopted for the left carriageway, and a 11×40m fabricated prestressed concrete small box beam plans to be adopted for the right carriageway of the superstructure. Column pier and pile foundation will be used for the lower pier. The plate-type spread foundation will be used for the abutment. The overall length of bridge at the left carriageway is 450m, and that at the right carriageway is also 450m. The bridge site area is peak cluster depression landform. The elevation of the bridge site area is 358 ~ 414m, and the terrain fluctuates largely, with the relative height difference of about 56m. The abutments at both sides are located at the saddle of the mountain. Except karst and skylight, other unfavorable geological disasters such as landslide and debris flow are not seen in the bridge site area. According to the geological mapping and exploration, the subterrane at the bridge site is intermediary weathered limestone within the depth of exploration.

Figure 6.1-4 Current Situation of Bridge Site of Nongwan No. 2 Viaduct

(3) ZK5+165/YK5+187 Buxuan Viaduct

Buxuan Viaduct is located near Xuanjie Village, Fuxin Town, Tiandeng County, Chongzuo City, and it spans the Baidou River twice with a spanning width of about 13m. For the superstructure, the left carriageway is proposed to use 20 × 30m prefabricated prestressed concrete small box beam and the right carriageway is proposed to use 19 × 30m prefabricated prestressed concrete small box beam. For the substructure, the column pier pile foundation is used for the piers and the column abutment pile foundation and spill-through abutment pile foundation are used for abutment. The left carriageway of the bridge is 607 m long and the right carriageway is 577m long. The bridge site area is peak cluster depression landform, with micro-landform crossing mountain valleys and open valleys, and farmland is distributed on river bank. The elevation of the bridge site area is 364~394m, and the terrain fluctuates largely, with the relative height difference of about 30m. The abutments at both sides are located at the valley alluvial terrace. Unfavorable geological disasters such as landslide and debris flow are not found in the bridge site area. The subterrane at the bridge site is intermediary weathered limestone within the depth of exploration according to the geological mapping and exploration.

Figure 6.1-5 Current Situation of Bridge Site of Buxuan Viaduct

(4) ZK6+960/YK6+950 Dunli Viaduct

Dunli Viaduct is located near Dunlitun, Tiandeng County, Chongzuo City, and it spans the Baidou River for several times with a spanning width of about 13m. For the superstructure, the left carriageway is proposed to use 28 × 20m prefabricated prestressed concrete small box beam and the right carriageway is proposed to use 29 × 30m prefabricated prestressed concrete small box beam. For the substructure, the column pier pile foundation is used for the piers and the extended U-shaped abutment foundation and spill-through abutment pile foundation are used for abutment. The left carriageway of the bridge is 848.5m long and the right carriageway is 878.5m long. The bridge site area is peak cluster depression landform, with micro-landform crossing mountain valleys and open valleys. The cultivated land is mainly farmland. The elevation of the bridge site area is 351 ~ 375m, and the terrain fluctuates largely, with the relative height difference of about 25m. The abutment at the side of Chongzuo - Jingxi Expressway is located at the foot of mountain slope and the abutment at the side of Shuolong Highway is located at valley alluvial terrace with no unfavorable geological disasters such as landslide and collapse found in the bridge site area. According to the geological mapping and exploration, within the depth of exploration, there is underlying bed rock of intermediary weathered limestone at the bridge site.

Figure6.1-6 Current Situation of Bridge Site of Dunli Viaduct

(5) 0ZK8+795/ YK8+815 Longkalang Super Viaduct

Longkalang Super Viaduct is located in the east of Baidoutun, Shuolong Town, Daxin County, Chongzuo City, and it spans Baidou River. In combination of horizontal and vertical designs, 31×40m fabricated prestressed concrete box girder plans to be adopted for the left carriageway, and 32×40m fabricated prestressed concrete box girder plans to be adopted for the right carriageway of the superstructure. Column pier and hollow pier pile foundation will be used for the lower pier. The riser plate and rib pile foundation will be used for the abutment. The overall length of bridge at the left carriageway is 1248m, and that at the right carriageway is 1288m. The bridge site area belongs to peak cluster and depression landform, and the micro topographic features span the mountain slope and intermountain valley. The elevation of the bridge site area is 292 ~ 359m, and the terrain fluctuates largely, with the relative height difference of about 67m. The abutment at the side of Chongzuo - Jingxi Expressway is located on the mountain slope, and rock stack is located at the slope toe. The abutment at the side of Shuolong Highway is located at valley alluvial terrace. Except rock stack, other unfavorable geological disasters such as landslide and debris flow are not seen in the bridge site area. According to the geological mapping and exploration, the subterrane at the bridge site is intermediary weathered limestone within the depth of exploration.

Figure 6.1-7 Current Situation of Bridge Site of Longkalang Super Viaduct

(6) ZK12+075/ YK12+117 Bangtun Heishui River Major Bridge

Bangtun Heishui River Major Bridge is located in the north of Bangtun, Yixian Village, Shuolong Town, Daxin County, Chongzuo City, it spans Xialei River, the angle between the route and river is about 90°, and the river width is about 35m. A 3×40m fabricated prestressed concrete box girder plans to be adopted for the left carriageway, and a 3×40m fabricated prestressed concrete box girder plans to be adopted for the right carriageway of the superstructure. Column pier pile foundation will be used for the lower pier. The rib pile foundation will be used for the abutment. The overall length of bridge at the left carriageway is 128m, and that at the right carriageway is 128m. The bridge site area belongs to peak cluster and depression landform, and the micro topographic features span the intermountain valley. The intermountain valley is open, and farmland and villages are distributed on river bank. Xialei River winds through the bridge area from west to east. The elevation of the bridge site area is 232~238m, and the terrain is flat, with the relative height difference of about 6m. The abutments at both sides are located at the valley alluvial terrace. Unfavorable geological disasters such as landslide and debris flow are not seen in the bridge site area. According to the geological mapping and exploration, the subterrane at the bridge site is intermediary weathered limestone within the depth of exploration.

Figure 6.1-8 Current Situation of Bridge Site of Bangtun Heishui River Bridge

(7) LZK5+353/ LYK5+337 Shuolong Guichun River Medium Bridge

Shuolong Guichun River Medium Bridge is located in the east of Shuolong Community, Shuolong Town, Daxin County, Chongzuo City, it spans Guichun River, the angle between the route and river is about 90°, and the river width is about 38m. In combination of horizontal and vertical designs, 3×30m fabricated prestressed concrete box girder plans to be adopted for the left and right carriageways of the superstructure. Column pier pile foundation will be used for the lower pier. The rib pile foundation and plate-type spread foundation will be used for the abutment. The overall length of bridge at left and right carriageways is 97m. The bridge site area belongs to peak cluster and depression landform, and the micro topographic features span the intermountain valley. The intermountain valley is open, and the cultivated land is mainly farmland. There is a brook with the width of about 25 ~ 40m in the valley, and the brook winds through the bridge area from west to east. The elevation of the bridge site area is 267 ~ 277m, and the terrain does not fluctuate largely, with the relative height difference of about 10m. The abutments at both sides are located at the valley alluvial terrace. The abutment on Shuolong side connects the highways along Shuolong Port. Unfavorable geological disasters such as landslide and debris flow are not seen in the bridge site area. According to the geological mapping and exploration, the subterrane at the bridge site is intermediary weathered limestone within the depth of exploration.

According to the documents of the Guangxi Zhuang Autonomous Region People's Government, Notice of Guangxi Zhuang Autonomous Region People's Government on the Development Plan of Inland Water Transportation in Guangxi Zhuang Autonomous Region (GZF No.39 [2007]) and Reply of the State Council on the Comprehensive Planning of the Pearl River Basin (2012-2030) (GH No.37 [2013]), there is no navigation requirement for the bridges involved in the Project.

2. Culverts

The main line of the Project is designed with 9 culverts, and the connection road is designed with 11 culverts. The structural type is of reinforced concrete slab culvert. Integral or separate foundation shall be adopted respectively as per geological conditions. Within the scope no less than two times of the bore diameter on culvert top and both sides of the culvert, 5% cement soil or excavated rock ballasts shall be used for filling and symmetric tamping layer by layer. The wing wall shall be designed in the entrance/exit of culverts. During culvert construction, special attention shall be paid to the treatment of culvert foundation bottom. During construction, experiments can be conducted first to obtain necessary data, and site inspection shall be strengthened. Foundation construction can only be carried out after the bearing capacity meets the design requirements. For some culverts that are close to local roads, the culvert and passage types shall be adopted.

6.1.1.5.6 Tunnel Works

According to the route scheme, in the Project, Scheme K line is recommended for main line and Scheme A line is recommended for connecting line. The tunnel design details are as follows: In the K line scheme, there are 6 tunnels with a length of 3.6455km, including 1 tunnel with a length of 1.1825km, 1 medium tunnel with a length of 6.425km, and 4 short tunnels with a length of 1.8205km; in the scheme of connecting line A, there is a 1.43km long tunnel. See the following table for tunnel settings:

Table 6.1-6 Tunnel Setting

S/N	Tunnel Name and Structure Type		Start and End Chainages			Length (m)	Tunnel Type
I	Main line						
1	Nongwan Tunnel	Left line	ZK1+790	~	ZK2+261	471	Small interval
		Right line	YK1+860	~	YK2+261	401	
2	Buli No.1 Tunnel	Left line	ZK3+786	~	ZK4+230	444	Small interval
		Right line	YK3+793	~	YK4+243	450	
3	Buli No.2	Left line	ZK4+410	~	ZK4+860	450	Small interval

	Tunnel	Right line	YK4+390	~	YK4+895	505	
4	Longkalang Tunnel	Left line	ZK7+700	~	ZK8+172	472	Small interval
		Right line	YK7+725	~	YK8+173	448	
5	Longdong No.1 Tunnel	Left line	ZK9+560	~	ZK10+205	645	Separated
		Right line	YK9+580	~	YK10+220	640	
6	Longdong No.2 Tunnel	Left line	ZK10+300	~	ZK11+480	1180	Separated
		Right line	YK10+340	~	YK10+933	1185	
II	Shuolong Connecting Line						
1	Shuolong Tunnel	Left line	AZK3+570	~	AZK4+990	1420	Separated
		Right line	AYK3+540	~	AYK4+980	1440	

(1) Pavement Design of Tunnel

The pavement of the tunnel is designed with the composite pavement structure: 4cm thick fine modified asphalt concrete (AC-13C) + 6cm thick medium modified asphalt concrete (AC-20C) + 28cm thick cement concrete pavement slab + 20cm thick C20 concrete base + 15cm thick C20 sand-free macroporous concrete leveling layer=73cm. The 15cm thick C20 sand-free macroporous concrete permeable layer is additionally added in the substructure of the section without inverted arch, and the backfilling layer of the section with inverted arch is composed of C15 plain concrete.

The standard value of design flexural tensile strength of cement concrete pavement slab will ≥5.0MPa and the grade shall be ≥ C40. A modified emulsified asphalt waterproof lower seal coat and a transparent layer are arranged between the asphalt concrete surface layer and the semi-rigid base layer, and a sticky layer is arranged between the surface layers. The concrete design requirements of the prime coat, seal coat and adhesive coat shall be consistent with the requirements of the pavement outside the tunnel. Other requirements for tunnel pavement design are consistent with the pavement outside the tunnel. Matters not covered will be implemented in accordance with the current relevant codes, procedures, standards, detailed rules and regulations.

(2) Seismic Design of Tunnel

In seismic design, the seismic measures will be strengthened in the shallow buried section of the portal and the intersection section inside the portal In addition to strengthening the initial support, reinforced concrete structure will be adopted in the secondary lining.

① Seismic measures in portal section

Reinforced concrete anti-seismic lining and circumferential anti-seismic joints will be provided at the portal section, and the spacing can be appropriately adjusted according to specific conditions.

Shear reinforcements will be adopted between the lining of the portal and the end wall;

The height of the upward slope outside the portal will be reduced as much as possible and the slope will be protected.

② Seismic measures in cut-and-cover tunnel section

Reinforced concrete will be adopted for lining of cut-and-cover tunnels;

The arch waist will be backfilled with mortar rubble or low grade concrete

The cut-and-cover tunnel and the side wall will be designed with the separated structure.

③ Seismic fortification measures in barrel section

The initial support of the barrel will be adopted with the flexible structure

Settlement joints will be provided at the boundary of barrel lining, and the boundary of fault and hard/soft rocks and continuous V-class surrounding rock at intervals of 50m, and the settlement joints will have the same structure as anti-seismic joints.

(3) Tunnel Construction Scheme

Tunnel construction design will include the tunnel construction methods, geology forecast, monitoring and surveying, construction management plan, etc.

The V-grade shallow-embedded section of surrounding rock (shallow-embedded eccentric load) and the backward section with narrow pillar can be excavated by single side heading method. The removal of temporary wall must be carried out after the deformation of surrounding rock is stable, to avoid accelerated deformation and instability or collapse of surrounding rock. For V-grade deep-embedded section of surrounding rock and IV-grade weak (shallow-embedded) section of surrounding rock, three step or ring excavation is adopted to reserve core soil. If necessary, temporary inverted arch is added. The IV-grade deep-embedded section of surrounding rock can be excavated by two step method; the III and II-grade section of surrounding rock can be excavated by full section method.

(4) Muck Treatment

The bridge and tunnel account for a large proportion of the Project, and trackless transportation is adopted for tunnel mucking. How to treat the muck through construction organization and protect the environment will become the difficulty of the Project. The following scheme can be adopted for muck treatment:

① Tunnel works will produce a large amount of muck, and subgrade filling only accounts for limited muck. However, the amount of structure, concrete work and pavement work is huge, which requires a lot of sand and stone. Making full use of the tunnel muck can reduce the construction cost, improve the disaster resistance ability of the Project, and achieve the harmony between environmental protection and project construction.

② In addition to the utilization by the Project, muck can also play a significant role in the urban construction along the route, for example, it can be applied to the construction of local roads in mountainous areas.

③ If there is residual muck after the subgrade backfill and other works are completed, it can be stacked and protected in the spoil area outside the protection area. The spoil area is arranged outside the protection area, and the site selection of it is planned according to the design documents. Generally, it is selected at the feel mountain gully with gentle slope, avoid the stagnant valley of large catchment area, and there is no residential area below. The existing access road and the local road after reinforcement and widening will be used as far as possible, and the muck road will be rebuilt if it cannot be used. The spoil area shall meet the local environmental protection, water conservation and safety requirements. The construction of the spoil area will first clear the surface, remove the surface topsoil and loose layer, and then arrange retaining wall, drainage ditch and necessary slope protection. The muck will be compacted layer by layer, and the drainage system and surrounding retaining system will be well done. After the muck is treated, the greening will be carried out after covering the rehabilitation soil.

6.1.1.5.7 Crossing Works

(1) Interchange

The main line of Wuzhou (Longyanzui) - Shuolong Highway (Chongzuo-Jingxi Expressway to Shuolong Port Section) is 12.264 km and does not pass through town and township, an interchange is to be provided at the common interchange of start point of the Project and Long'an - Shuolong Expressway which is called Neitun Hub Interchange.

(2) Separated interchange bridge

There is elevated bridge at the intersection between the Project and local roads, and no separated interchange bridge is to be provided.

(3) Grade crossing

3 grade crossings are provided at the starting point of Shuolong Connecting Line. Shuolong Connection Road stretches from the north to the south on the whole and passes through Bangtun and has a canalized level crossing with G359 at ALK0+000, a canalized level crossing with Tiandeng Connection Road of Chongzuo-Jingxi Expressway at AK2+800 (county highway X532) and a canalized level crossing with Detian (Daxin)-Huashan (Ningming) Highway at the end point of the connection road (AYK5+416). And a level crossing with Detian-Shuolong Class II Highway is to be provided at AK5+250, quantities of which are included in Detian-Shuolong Class II Highway.

(4) Passageways

Considering layout of the existing rural road network and rural planning, rural pattern and long-term development, 3 passageways are to be provided at the intersections between the main line and the major rural roads. Passageways with reinforced concrete cover are to be provided. Considering geologic conditions, integral or separate passageways are to be provided. A settlement joint is to be provided in the culvert at interval of 4-6 m, into which bituminous linen or other elastic waterproof material is to be filled. 5% cement or rock ballast is to be used to replace the fill within no less than two folds of span on both sides of the passageway, and compaction in layers is required. Entrance/exit of the passageway is aliform. During passageway construction, special attention shall be paid to treatment of culvert foundation bottom. Test on the site is required, and foundation construction can be started only if the bearing capacity meets the design requirements. At some position of the passageway, side ditch with cover plate can be provided in the culvert which can be concurrently used for drainage.

(5) Pedestrian overpass

No pedestrian overpass is to be provided in the Project.

6.1.1.5.8 Traffic Engineering and Facilities Along the Route

Service facilities include service areas, parking areas and bus stops. According to the setting of expressway network service areas around the Project and the spacing required in the specification, the route of the Project is short, and provided with one mainline toll station, one monitoring and communication sub-center, one maintenance work area and one bridge & tunnel management station, which are to be jointly constructed within the chainage range of K5+800~K6+100.

Table 6.1-7 List of Service Management Facilities for the Project

S/N	Service Facility	Chainage (location)	Position relationship with sensitive areas
1	Toll station, communication monitoring sub-center, maintenance work area and bridge and tunnel management station are jointly built	K5+800~K6+100	Ecological sensitive areas and water source protection areas are not involved.

6.1.1.6 **Construction Organization Scheme**

See Figure 6.1-9 for the construction flow chart.

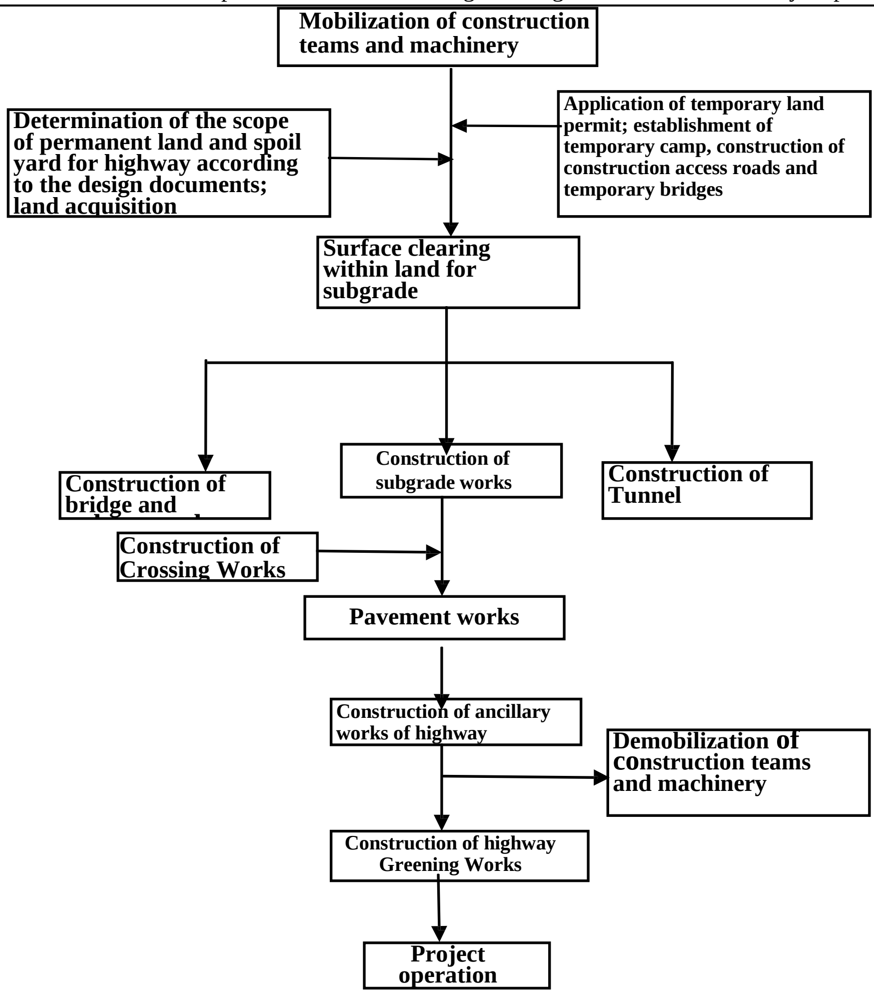


Figure 6.1-9 Construction Flow Chart of the Project

Main construction process is as follows.

1.Subgrade Clearing Works

In addition to bridge and tunnel sections, the original topsoil (such as planting soil) must be stripped before subgrade filling or excavation, and the thickness is generally about 40~50cm. The topsoil shall be stripped by bulldozers and other construction machinery, and transported by dump trucks to the temporary storage yard, so as to be used for greening or reclamation in the later stage of the project. And the soft soil subgrade shall be treated.

2. Subgrade

Mechanized construction shall be adopted for earthwork of subgrade engineering. Excavators and loaders shall be adopted to cooperate with dump trucks for transportation, bulldozers and graders shall be used for leveling, and road rollers shall be used for compaction. The soil cutting construction can be completely carried out by bulldozer. However, blasting method shall be adopted for rock cutting of high excavation. According to different topographic and geological conditions, different blasting methods shall be adopted, so that the broken rock particles can meet the requirements of clearing, and the earthwork can be removed mechanically.

3. Subgrade Protection and water drainage

In the early stage of subgrade construction, after excavation of culvert foundation, the water flow on both sides of subgrade is often connected through embedded small concrete pipes, and temporary intercepting and drainage ditches are excavated at the cutting slope and the lower slope of subgrade to guide the water flow and prevent the rain from scouring the subgrade. The subgrade surface will be covered with straw or geotextile in rainy season to prevent rain erosion. With the continuation of subgrade works, the culvert foundation will be laid according to the design, and the corresponding circular concrete pipe will be laid (for circular pipe culvert), or the culvert body will be constructed, and the filler on both sides will be backfilled and the reinforced concrete slab will be installed (for slab culvert). At the same time, with the basic formation of subgrade, precast concrete will be used for drainage facilities such as intercepting and drainage ditches, which will be constructed manually by line hanging. According to different design requirements, mortar rubble facing wall or retaining wall will be adopted for subgrade slope toe, and stone masonry and mortar structure will be adopted for framework slope protection.

4. Bridge works

For highway bridge foundation construction, the cast-in-place pile foundation or expanded foundation shall be adopted, and shall be constructed or poured in situ.

The bridge construction procedure is: leveling the construction site → foundation construction (drilling or manual hole digging) → bridge superstructure construction. Cast-in-situ bored piles shall be used for the pile foundation of the cross-river bridge. In case of groundwater or a small amount of groundwater, dug cast-in-situ piles shall be used. Before the bored pile construction, the construction platform should be set up, the casing should be buried, and then the drilling rig should be set up to drill holes. Dig out the mud pit before drilling; solid the wall by slurry circulation when drilling; transport the earth and stones to mud pit for sedimentation during circulation; utilize the circulated slurry and clean the settling basin on a regular basis, the sediment of which shall be transported to the spoil area for gathering and stacking. In the process of drilling, the drilling depth should be measured in time, the unearthed soil samples should be judged, the consistency of the test mud should be observed, and checks shall be performed to see whether the pile bottom elevation required by the design has been reached. After the drilling depth reaches the design elevation, corresponding methods shall be adopted for hole cleaning according to the design requirements and geological conditions. Reinforcing cages shall be made according to design while drilling holes. After hole cleaning is qualified, the reinforcing cages of pile foundation bound on site shall be hoisted into the drilled holes. After the reinforcing cage is accurately positioned, the concrete shall be poured into the borehole through the tremies. Dig out the mud pit before drilling of bored cast-in-place pile; solid the wall by slurry circulation when drilling; transport the earth and stones to mud pit for sedimentation during circulation; utilize the circulated slurry and clean the mud pit on a regular basis, the sediment of which shall be transported to the spoil area for gathering and stacking. For the pier with an expanded foundation, the excavated earth and stones shall be piled up in the spoil area near the pier.

The superstructures of large and medium-sized bridges in the project are equipped with prestressed concrete T-shaped continuous beams. The post-tensioned prestressed concrete T-beam is constructed by the precast installation method. The specific construction processes are as follows: the concrete T-beam (hollow slab prefabrication) is prefabricated first, and then the bridge erecting machine is adopted for erection. The erection procedure is as follows: the gantry crane moves the beam to the trolley on the beam transportation rail, and the trolley sends it to the main beam at the back of the bridge erecting machine; and then, the flat car for beam transportation is adopted for beam feeding. The bridge is divided into the left and right breadths. The order of beam erection is as follows: the right breadth shall be erected first, and then the bridge erecting machine returns to erect the left breadth.

5. Tunnels

The tunnel works of the Project are all constructed by the New Austrian Tunneling Method. The construction method is summarized as the arched roof in advance of wall tunneling; namely, during the excavation of the portal, a small area of rock mass of the upper arch body is excavated first, and the excavated upper arch body is immediately supported and protected; and then the whole portal is excavated and the side wall is protected. The tunnel body is excavated and protected gradually by repeating the above construction method.

When excavating rock mass during construction, since rock mass is the main bearing unit in the tunnel structure system, in order to fully protect rock mass, reduce disturbance to rock mass and avoid excessive damage to its strength, methods such as smooth blasting, presplitting blasting or mechanical excavation shall be adopted.

In the process of supporting and protecting the chamber, anchor bolts, meshes and wet shotcrete shall be used for initial support, and supporting measures such as steel grating, large pipe sheds and small conduits for grouting shall be taken for supplementation; at the same time, in order to improve the mechanical performance of the supporting structure and maintain the stability of the tunnel, the supporting structure of the excavation face shall be enclosed as soon as possible to form a closed cylindrical structure.

6. Pavements

During construction, the subbase course and base course are paved by pavers in layers, and compacted by rollers; the prime coat oil shall be sprayed by spreaders on each surface course. Pavers are equipped with dump trucks to continuously pave the asphalt mixture, and rollers are used for compaction. The asphalt mixture and cement are provided by the centralized mixing plant.

7. Critical Works

The overview of construction organization for controlling works of similar projects is as follows:

1. Construction organization for super major bridge

(1) The general layout of construction shall be determined according to the actual situation of the project, including the planning of construction access road, project management department, mixing plant,

prefabrication yard and steel bar processing yard.

(2) Construction method

① Pile foundation construction: cofferdam → steel casing installation → drilling → hole cleaning → reinforcing cage processing and placement → underwater concrete pouring.

② Substructure construction: pile cap construction → pier construction → abutment capping → bearing installation.

③ Superstructure construction: installation of suspended poured hanging baskets → concrete construction → prestressed construction.

④ Approach road subgrade construction: subgrade filling → subgrade compaction.

⑤ Pavement construction: base course construction → asphalt concrete surface course construction.

2. Construction organization for tunnels and long tunnels

(1) The general layout of construction mainly includes the site selection of main working face, the layout of spoil area and spoil dumping road, the layout of bulk material stacking yard and material warehouse,

and the layout of production houses and facilities.

(2) Construction method

① Construction at the portal: vegetation removal → excavation and protection of the side slope and heading slope of the portal → drainage of the portal.

② Portal construction: portal construction → open-cut tunnel construction → construction inside the tunnel.

③ Construction of Tunnel Body:

④ Transportation for slag removal: loaders and dump trucks shall be adopted for transportation of slag removed.

⑤ Support and lining: initial support → bolt-shotcrete support construction → long pipe shed construction → advanced small conduit construction → top and foundation reinforcement of mid-partition.

⑥ Tunnel lining: formwork erection → steel bar fabrication and installation → concrete pouring.

⑦ Inverted arch and bottom pavement construction.

⑧ Construction of tunnel pavement and other ancillary works.

3. Construction organization for overpass: the overpass includes interchange and separated interchange, and the construction method is roughly the same as that of bridges, culverts and subgrade.

6.1.2 Land Occupation and Demolition of the Project

6.1.2.1 Land occupation of the Project

A total of 1,391.96 mu of land will be permanently occupied according to the recommended scheme of this Project, and 613 mu of land will be temporarily occupied during construction. Among them, the main line permanently occupies a total of 1061 mu of land, and temporarily occupies 468 mu of land during construction; the connection road permanently occupies a total of 330 mu of land, and temporarily occupies 145 mu of land during construction.

Construction mileages and land occupation areas of main line and connecting line within each administrative district along the Project are as shown in Table 6.1-8 below. Areas of land occupation by category are listed in Table 6.1-9.

Table 6.1-8 Construction Mileages and Land Occupation Areas of Main Line and Connecting Line within Each Administrative District

Administrative Districts	Chainage at Starting and Ending Points	Mileage (km)	Permanent Land Occupation (mu)	Temporary Land Occupation (mu)	Land Occupation Per Kilometer (ha/km)
Main line					

Tiandeng County	K0+000~K7+900	7.9	906.74	344	7.652
Daxin County	K7+900~K12+263	4.363	155.22	124	2.372
Connecting line					
Daxin County	AK0+000~AK5+416	5.416	330	145	4.062

Table 6.1-9 Quantities of Lands Occupied for Main Line and Connecting Line by Category

Administrative Districts	Prime farmland and paddy field	Prime farmland and dry land	Paddy field	Dry land	Vegetable plot	Fish pond	Orchard	Economic forest	Woodland	Wasteland	Residential land	Existing Road	River	Total
Main line														
Tiandeng County	25	130	76	379		2			262		3	7.74	22	906.74
Daxin County	25	45	9	25					33			5.22	13	155.22
Connecting line														
Daxin County		115		112		5			78		1	19		330

6.1.2.2 Buildings Demolition and Relocation

Building demolition and relocation along the main line and connecting line in each administrative district are as shown in Table 6.1-10 below.

Table 6.1-10 Building Demolition and Relocation along Main Line in Each Administrative District

Administrative Districts	Chainage at Starting and Ending Points	Rural (including the village where the township government is located) house demolition - brick-concrete building (square meter)	Rural (including the village where the township government is located) house demolition - brick-tile building (square meter)	Rural (including the village where the township government is located) house demolition - iron shed simple house (square meter)
Main line				
Tiandeng County	K0+000~K7+900	81.8	150.4	97
Daxin County	K7+900~K12+263			
Connecting line				
Daxin County	AK0+000~AK5+416			

6.1.3 Setting of Earthwork Balance and Temporary Land

This chapter is extracted from relevant contents in the project feasibility study report (March 2021) and the report on the soil and water conservation plan of the Project.

6.1.3.1 Earthwork Balance of the Project

(1) Basic information of earth and stone fill and cut

The cut volume of the whole line (including the main line, connecting line, interchange ramp and maintenance work area) is about 1.86 million m3, and the fill volume is about 2.53 million m3, It includes: (1) about 590,000 m3 cut for the main line, mainly in Section Z(Y)K2~Z(Y)K4; and about 1.83 million m3 fill evenly distributed along the main line; (2) about 280,000 m3 cut and 220,000 m3 fill for the maintenance work area + tunnel management station + Monitoring and communication branch center + mainline toll station, which are mainly on Ramp A; (3) about 490,000 m3 cut for Neitun Hub Interchange (including for the ramps), mainly in Section Z(Y)K1+000~Z(Y)K1+790, with little fill for the interchange; and (4) about 430,000 m3 cut for the connecting line, mainly concentrated in Section AK0+000~AK2+900, and 330,000 m3 fill, evenly distributed along the main line. In addition to the cut for subgrade, the cut volume for the tunnels on the main line and connecting line is about 1.23 million m3, and 1.224 million m3 will be used for rolling stone, subgrade filling and soft foundation replacement as designed in the project feasibility study report, with a utilization rate of about 100%.

(2) Cut-fill balance scheme:

① The principle of proximity shall be implemented for cut-fill balance. In order to make full use of the excavated stone to prepare the crushed stone and other materials required by the Project, and to meet the requirement that the high-quality stone in the tunnel excavation and roadbed excavation shall be used as the structural crushed stone in the Project, the remaining subgrade excavation and the tunnel excavation slag shall be transported to backfill the embankment. In case of insufficient filling, it is considered to borrow soil from off-site borrow pits.

② Balance plan

Table 6.1-11 Earthwork Allocation Schedule (unit: 10,000m3)

Chainage	Cut from subgrade used for rolling yard and soft foundation	Cut from subgrade used for road relocation	Cut from tunnel used for subgrade	Cut from tunnel used for rolling yard and soft foundation	Remarks

K0+000-K5+000	46.7		40.68	3.02	Output from tunnel on Neitun Hub Interchange Ramp D, Nongwan Tunnel, Buli No.1 Tunnel and Buli No.2 Tunnel
K5+000-K7+000	10.1	1.39			This section including the yard for the facilities along the line
K7+000-K10+000				13.44	Output from Longchang Tunnel
K10+000-K12+604			36.5		Output from Longdong No.1 Tunnel, Longdong No.2 Tunnel and Shuolong Tunnel
AK0+000-AK5+416	11.7	3.8	10.42	18.38	Output from Shuolong Tunnel

Note: The earth-stone work of the subgrade includes the earth-stone work of the main line, connecting line, interchange ramp and maintenance work area.

③ The cut from subgrade and tunnels of this Project are fully utilized, and there is no spoil.

(3) Utility of machines for cut-fill balance:

① The pile is constructed by bulldozer

② The use of excavator and loader to cooperate with automobile construction

6.1.3.2 Permanent Spoil Areas

A total of 355,000 m3 of permanent spoil is produced during the construction of the Project. In this scheme, there are 3 spoil areas: 1# spoil area is located on the left side of K2+900; 2# spoil area is located on the right side of K4+330; 3# spoil area is located on the left side of AK0+350. Those spoil areas are set based on the branch ditches near the line, and there is no large catchment around. The spoil area covers a total area of 139.2 mu with a capacity of 665,000 m3, and the forest land, dry land and wasteland are occupied.

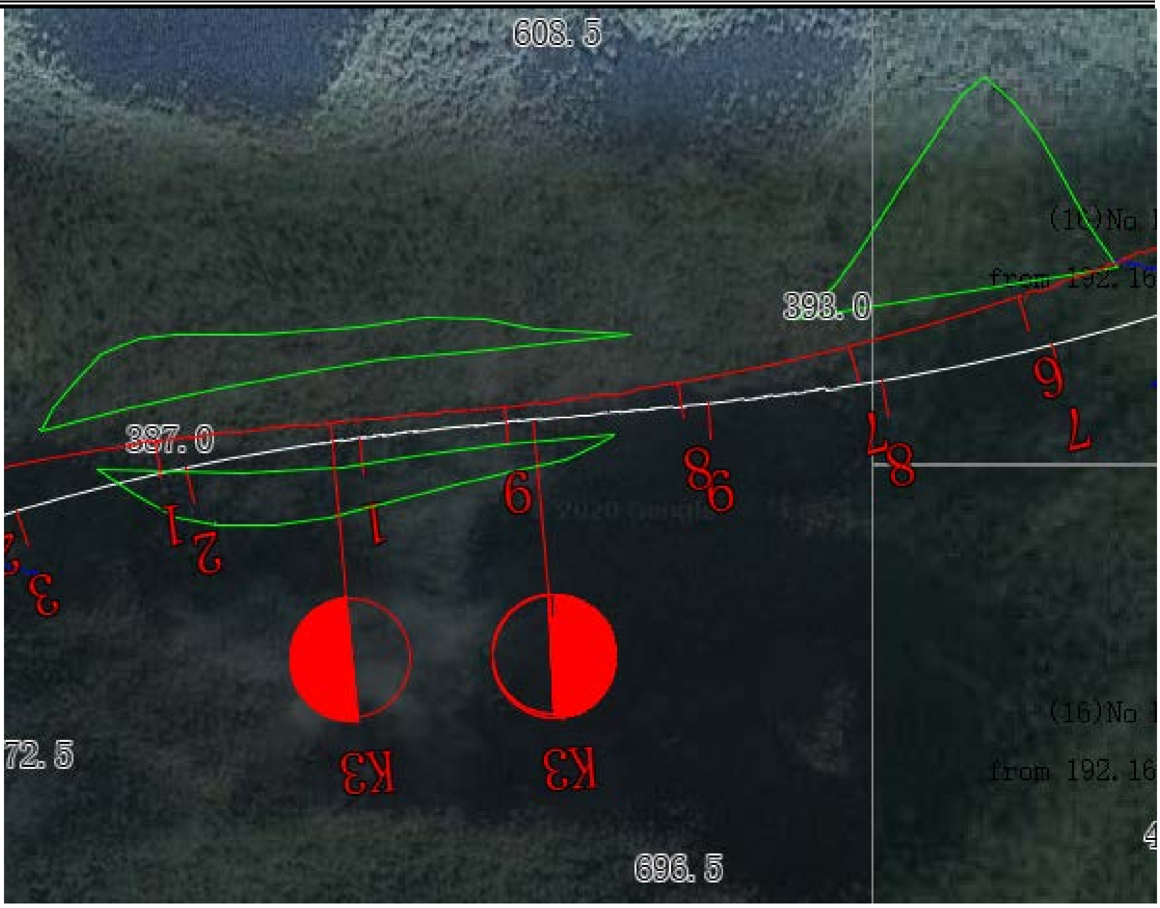


Figure 6.1-10 Site Selection of 1 # Spoil Area

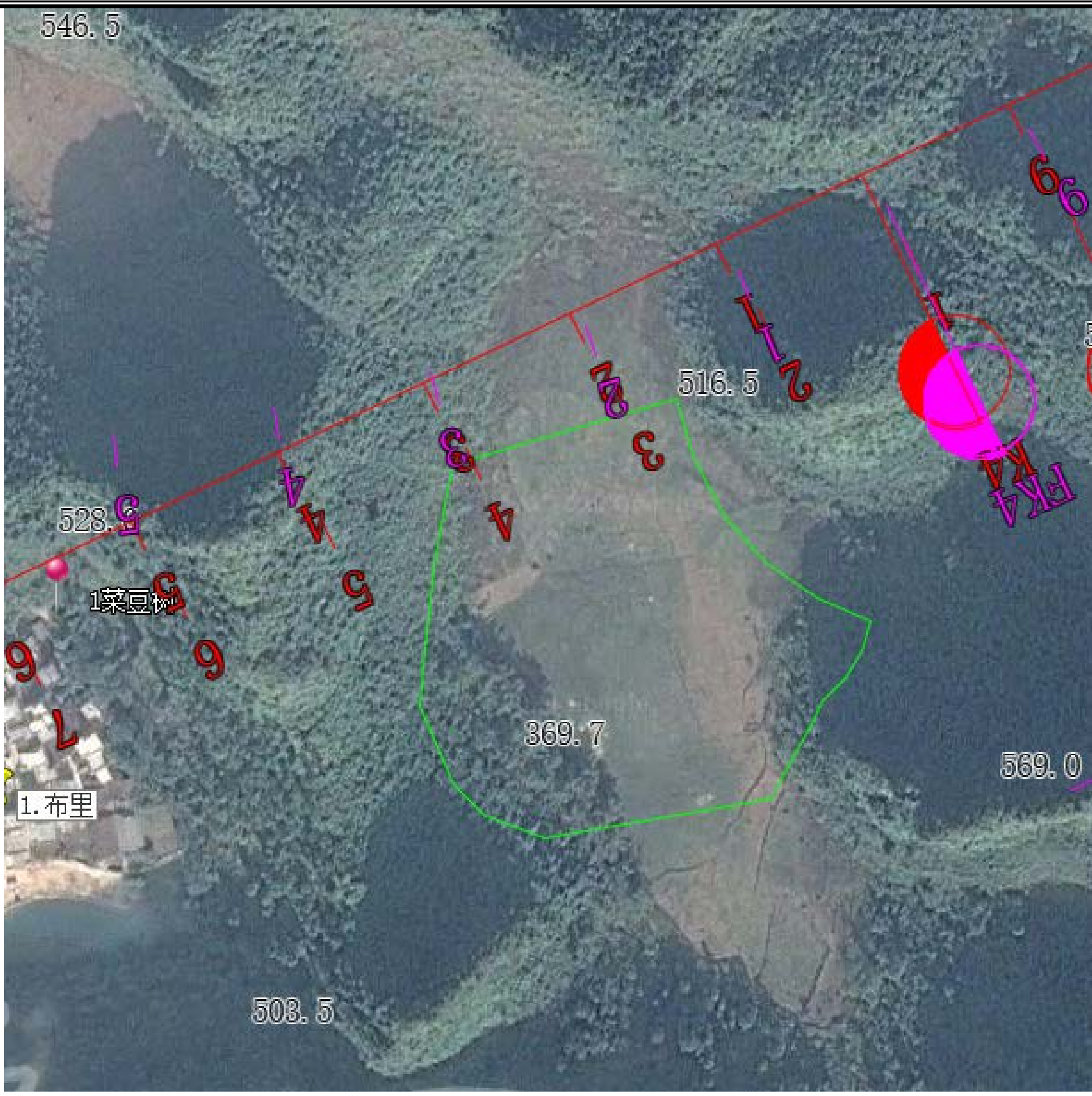


Figure 6.1-11 Site Selection of 2 # Spoil Area

Figure 6.1-12 Site Selection of 3 # Spoil Area

6.1.3.3 **Temporary dump**

In the Project, 135,000 m^3 of temporary soil is piled up (all is removed topsoil), for which 3 new temporary spoil grounds are to be provided, covering the total land area of 4 hm2, and in the three spoil areas respectively. 1# temporary spoil ground is located on the left side of K2+900, 2# temporary spoil ground on the right side of K4+330 and 3# temporary spoil ground on the left side of AK0+350. The dry land will be occupied, and all the spoil grounds are set alongside the subgrade and accessible with the aid of the subgrade.

6.1.3.4 **Construction production and living quarters**

It is proposed to provide two construction, production and living areas for the Project. The No.1 construction, production and living area is located near YK6+000, covering an area of about 100 mu. It is expected to install 2 mixers of model 180 with 10 bins, and an asphalt mixing station, equipped with at least one set of automatic metering asphalt concrete mixing station with capacity of 320t/h and above; it is provided with prefabricated house for the operators of the mixing station, concrete truck drivers and some project management personnel.

The No. 1 construction, production and living area is located near AK0+300 road section, covering an area of about 55 mu. The concrete mixing station is expected to be provided with two mixers of model 120 with 8 bins. In addition, two concrete mixing plants will be built at Neitun Interchange and Shuolong ending point to facilitate in the construction.

Figure 6.1-13 Site Selection of No.1 Construction, Production and Living Area

Figure 6.1-14 Site Selection of No.2 Construction, Production and Living Area

6.1.3.5 Construction roads

The existing highways along the vertical and horizontal directions of the Project are mainly national highway G359 (the former S316), Tiandeng Connecting Line of Chongzuo–Jingxi Expressway, border highway (the former S325), county road X532. The main highway pavement is asphalt pavement and cement. These Class II highways are close to or intersected or parallel to the Project, so the traffic on most road sections is convenient. Due to the undulating terrain, the steep mountain cross-slope, and the bad traffic in some sections of the Project, it is necessary to build longitudinal access roads. The setting of the construction access road should be combined with the construction of the rural road network to adapt to the needs of the new rural construction. For materials such as sand and gravel used for thwart highway construction, the Owner is required to sign an agreement with the supplier to ensure the supply. For the access roads for the entire route, most of the temporary vehicle access roads are considered, and some are existing roads. In the design, temporary land for access roads, prefabrication yards, mixing stations and rolling yards are included. The bridge-tunnel ratio of the Project is large, the terrain is complex, and the slope gradient needs to be considered in the construction of the access roads. Therefore, the actual access roads will be built in the form of curves, the long access roads need to be provided with meeting points, and the final construction length of the access road will have an error value of 15% ~ 20%. According to preliminary estimation in the early stage, it is necessary to build 7.5 kilometers of transverse access roads, widen 1.5 kilometers of existing township roads and build 360 meters of trestles. All routes of construction access roads are as follows:

Table 6.1-12 List of Construction Routes and Access Roads

S/N	Route	Length (km)	Remarks
1	Ramp G of Neitun Interchange	1.5	New access road
2	Entrance of Nongwan Tunnel	1.5	New access road
3	Entrance of Buli Tunnel	1	New access road
4	Longdong No.1 Tunnel	0.35	New access road
5	Entrance of Longdong No.2 Tunnel	0.5	New access road
6	Exit of Longdong Tunnel	1	New access road
7	Entrance of Shuolong Tunnel	1.2	New access road
8	Exit of Shuolong Tunnel	0.45	New access road
9	Existing village road K4	1.5	Village road widening
10	Longdong No.1 Tunnel	0.06	New trestle
11	Heishui River Major Bridge	0.1	New trestle
12	Guichun River Medium Bridge	0.2	New trestle

There is a village road near the ramp bridge, but because the height of the passage is only 3 meters, the construction machinery cannot access the site through the passage. Therefore, it is necessary to build a new access road at G Ramp.

Figure 6.1-15 Location of New Access Road (1.5 km) at G Ramp

During the visit, it was found that the mountain near the entrance of the new Nongwan Tunnel is a rocky mountain, the construction of the access road would take a long time, and the construction length would be about 1.5 Km long. See Figure 8-2 for its location plan.

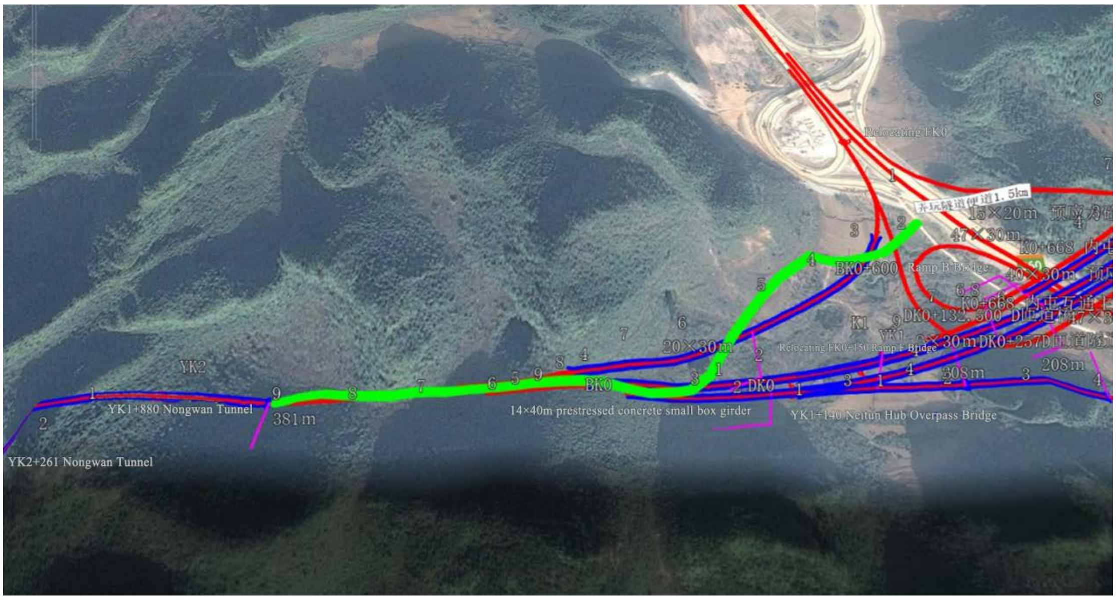


Figure 6.1-16 Location of New Access Road (1.5 Km) at Entrance of Nongwan Tunnel

There is a village road in K4 section, which is considered to be widened and built to the entrance of Buli Tunnel. In this case, there are residential areas nearby, and the noise and dust generated by construction may cause dissatisfaction among residents.

Figure 6.1-17 Village Road to be Widened in K4 Section for Building Access Road

Figure 6.1-17 shows the location of the new access road to the entrance of Buli Tunnel, in which the green line is the 1.5 km village road to be widened on K4 section, and the yellow line is the 1 km new access road to the entrance of Buli Tunnel.

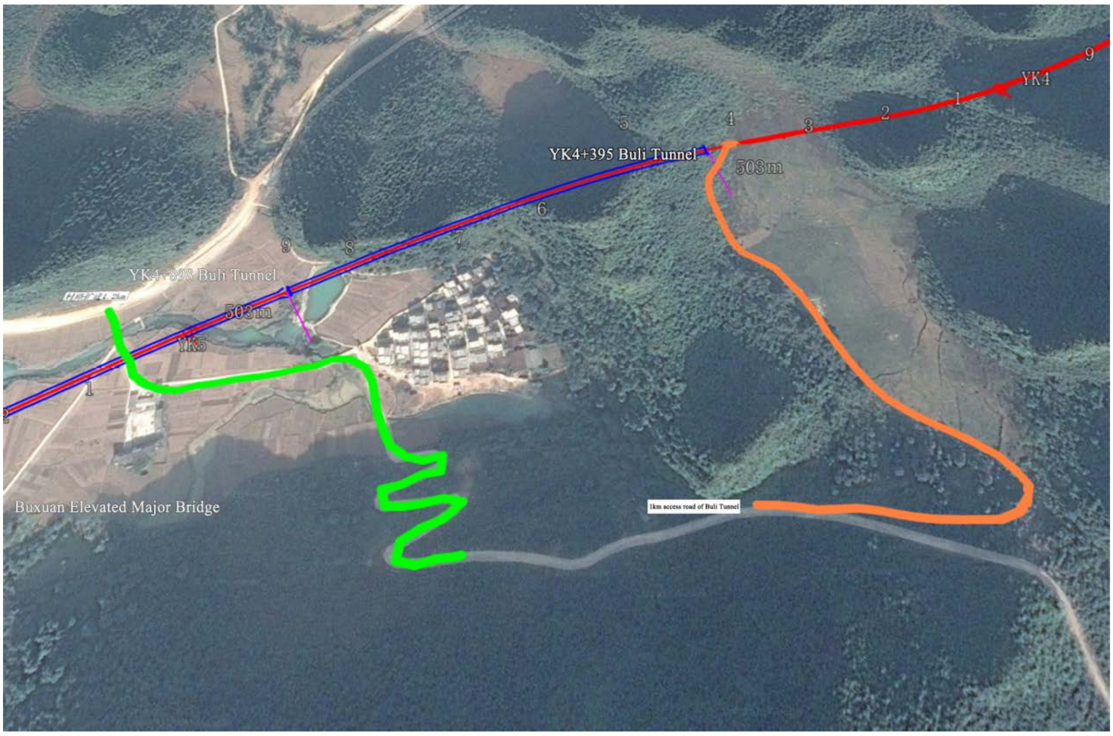


Figure 6.1-18 Location of New Access Road at Entrance of Buli Tunnel

Figure 6.1-18 shows the location of the new access road to the entrance of Longdong No.1 Tunnel, in which the red line is the 60m trestle to be built, and the yellow line is the 350m new access road to the entrance of Longdong No.1 Tunnel.

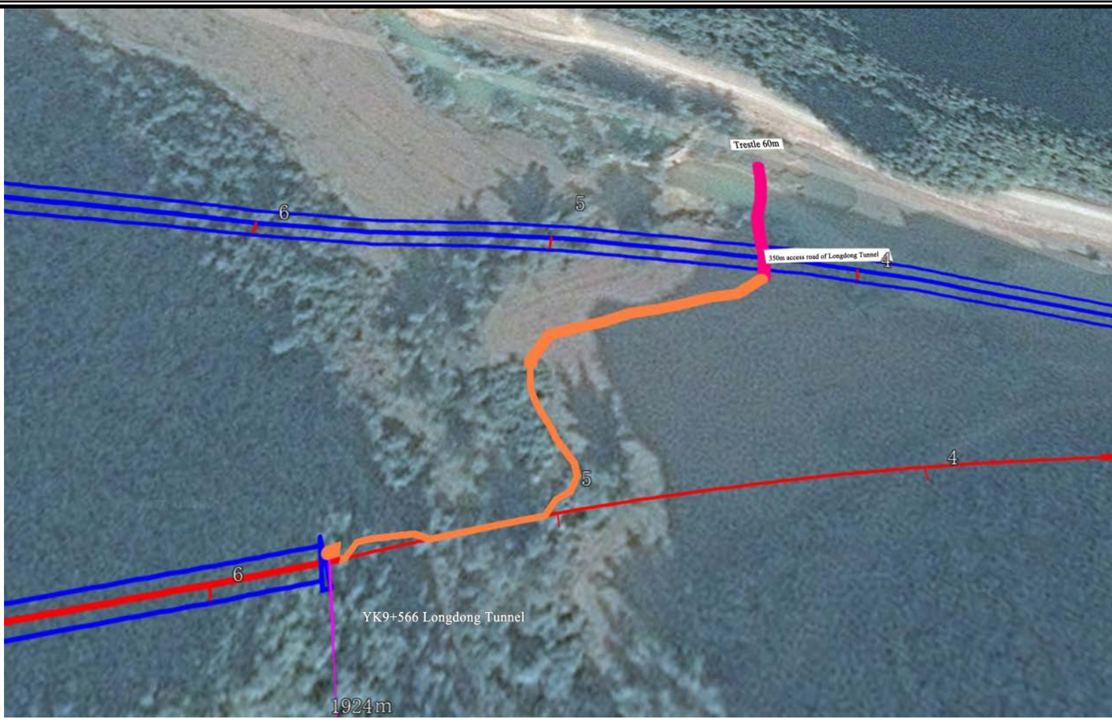


Figure 6.1-19 Location of New Access Road at Entrance of Longdong No.1 Tunnel

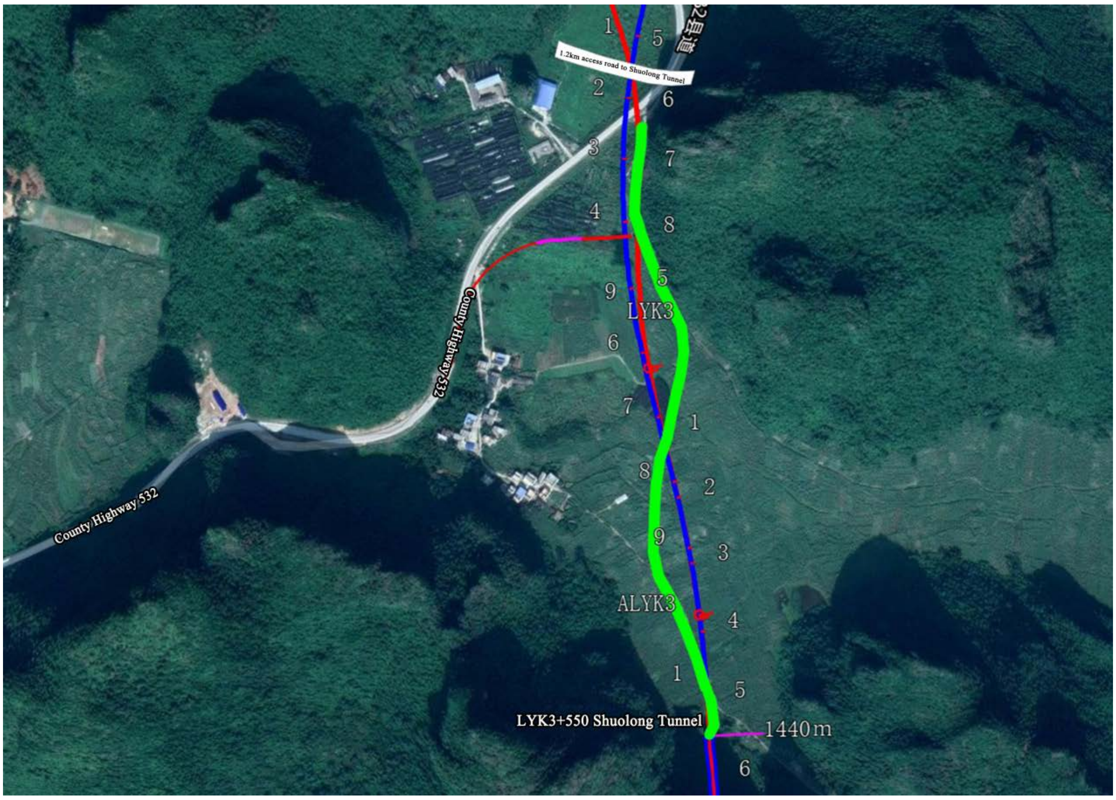


Figure 6.1-20 Location of New Access Road at Entrance of Shuolong Tunnel

The yellow line in Figure 6.1-20 is an existing village road. As the widening requires house requisition and demolition, the cost is relatively high, so it is considered to rebuild the access road along the main line; the green line is the 450m new access road at the exit of Shuolong Tunnel; the red line is the 200m trestle of Shuolong Guichun River Medium Bridge.

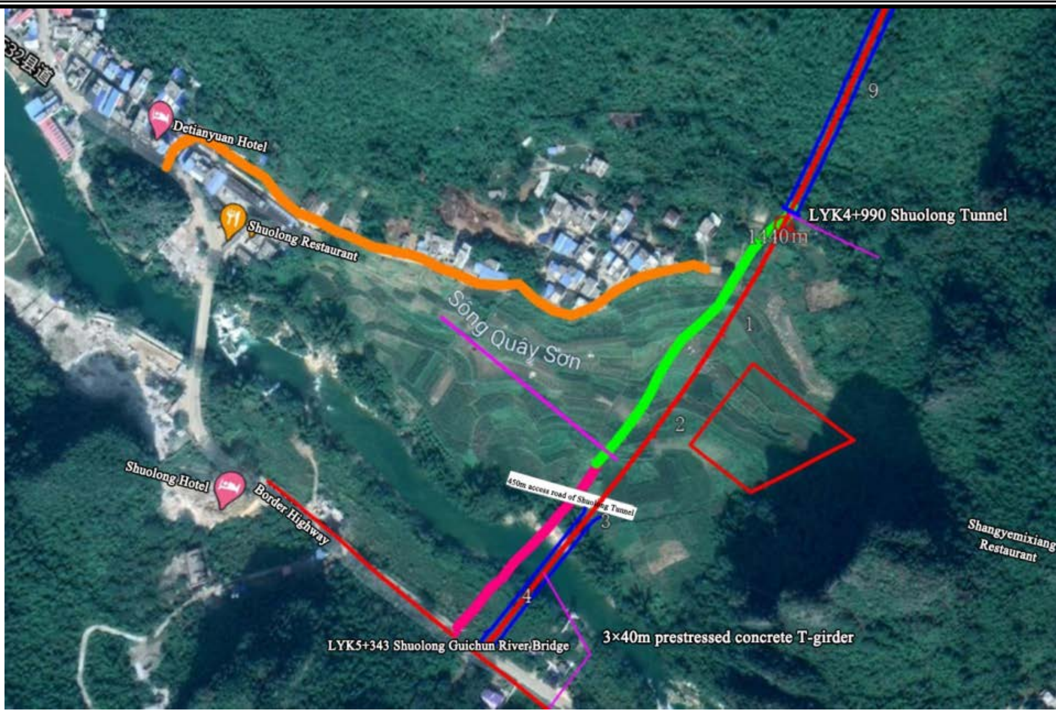


Figure 6.1-21 Location of New Access Road at Exit of Shuolong Tunnel and Trestle of Shuolong Guichun River Medium Bridge

For the wading section of Shuolong Guichun River Medium Bridge, a trestle with a height of 15 meters and a length of 200 meters is required according to the floodwater level line over the years.

Figure 6.1-22 Wading Section of Shuolong Guichun River Medium Bridge

Figure 6.1-23 Location of New Access Road (500m) at Entrance of Longdong No.2 Tunnel

Figure 6.1-23 shows the location of the new access road to the exit of Longdong Tunnel and the trestle of Bangtun Heishui River Major Bridge, in which the red line is the 100m trestle to be built of Bangtun Heishui River Bridge, and the green line is the 1 km new access road to the exit of Longdong Tunnel.

6.1.4 Engineering Analysis

6.1.4.1 Analysis of Plan Consistency

6.1.4.1.1 Analysis on Conformity with Urban Planning

The Project is mainly located in Daxin County and Tiandeng County, Chongzuo City, and mainly passes through Shuolong Town. According to the investigation, there are Daxin County and Tiandeng County and Shuolong Town along the line. The counties and towns have their own detailed urban planning and range. Urban planning is taken into full consideration in line layout. The principle of “kept away but not far from” is applied to allow coordination with urban planning. The main line of the Project is at a certain distance from the counties and is not included in the planning area of the counties, thus it has no interference with the planning of the counties along the line. Due to terrain conditions, the end section of Shuolong Connection Road is partially incorporated in the general urban planning for Shuolong Town. After soliciting opinions, the Shuolong Town People's Government agrees to the construction of the Project (see Annex 12).

Figure 6.1-24 Relationship between the Project and the Master Plan of Shuolong Town

6.1.4.1.2 Analysis on Conformity with Expressway Network Planning

1. Analysis on conformity of the Project with the Revision of Guangxi Expressway Network Plan (2018-2030)

The proposed Chongzuo-Jingxi Expressway - Shuolong Port Expressway is an important part of the expressway network in Guangxi Zhuang Autonomous Region. According to the expressways completed and under construction at present and the Guangxi Expressway Network Plan (2018-2030), the Project belongs to 7 transverse lines under planning. The project will be a cross-border channel in Nanning which passes through Chongzuo and leads to Vietnam and will greatly facilitate the exchange and communication between China and Vietnam and promote Sino-Vietnam connectivity. The Project will connect Shuolong Port and existing expressway network to make up an import transport network at frontier port in Guangxi Zhuang Autonomous Region and promote perfection of expressway network in Guangxi. Therefore, the Project conforms to the Revision of Guangxi Expressway Network Plan (2018-2030).

See Figure 6.1-25 for the relationship between the Project and the Revision of Guangxi Expressway Network Plan (2018~2030).

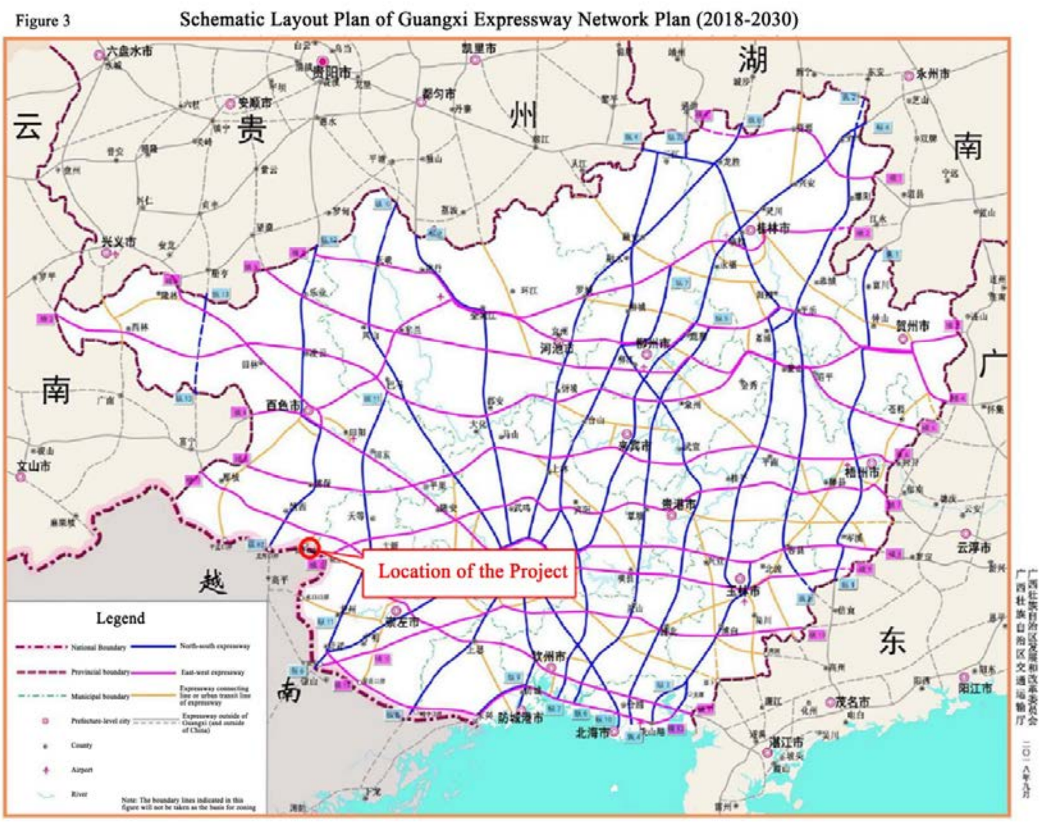


Figure 6.1-25 Location of the Project in Guangxi Expressway Network Plan

2. Analysis on conformity of the Project with the Environmental Impact Report on

Guangxi Expressway Network Plan (2018-2030)

See Table 6.1-13 for the specific requirements on the highway in the Environmental Impact Report on Guangxi Expressway Network Plan (2018-2030) (the review opinions of the Department of Environmental Protection of the Autonomous Region were obtained in September 2018 (GHH [2018] Document No. 2260) and the implementation of the EIA requirements for planning in this evaluation.

Table 6.1-13 Implementation of EIA Requirements for Planning in the Project EIA

S/N	Specific requirements of EIA for planning		Project Implementation
1	Suggestions on optimization and adjustment of route scheme	①Routes are forbidden to cross any core area or buffer zone of any nature reserve. On the premise of meeting the engineering and traffic requirements, the scheme as far away from the nature reserve as possible shall be selected, and measures shall be taken to keep away from the experimental area of the nature reserve to avoid dividing the nature reserve. ②In engineering design of the line, multiple schemes should be compared; it is forbidden for the line to cross the first-class protection zones of drinking water sources. On the premise of meeting the engineering and traffic requirements, the scheme as far away as possible from the second-class protection zones and quasi-protection zones of drinking water sources shall be selected. For the route which is restricted by engineering and technical conditions and has to cross the second-class protection zones and quasi-protection zones of drinking water sources, the construction scheme with the least impact on the protection zones should be selected on the basis of fully demonstrating the route direction and crossing mode, and the consent of the relevant competent departments should be obtained. ③It is forbidden to cross the geological relics protection areas at or above Grade II of the geological park, and measures shall be taken to avoid the geological relics protection areas below Grade II as far as possible. Due to the limitation by engineering and technical conditions, if it is necessary to cross the geological relics protection areas below Grade II, the consent of the relevant competent departments should be obtained.	①The Project can't avoid the Xialei Nature Reserve in Guangxi, and the route selected avoids the core area and buffer zone of the nature reserve at the autonomous region level. The section of the Project crossing the nature reserve is routed along the existing highway, and bridges and tunnels are used as far as possible to cross the nature reserve; therefore, basically, the nature reserve will not be further divided. ② Bukan water source conservation area in Liliang Village and Tiandeng County that the Project crosses at the chainage of K0+000~K1+320 have promised to relocate during construction period of the section. In addition, the scope of the water source is adjusted. After relocation, the Project will not pass through the water source conservation area.
2	Recommendations for Ecological Environment Protection Measures	The route should be as far away as possible from nature reserves and main habitats of animals; reasonable channels shall be set to ensure a certain bridge-tunnel ratio and minimize the barrier to animals; the publicity and education of construction personnel shall be strengthened, and measures such as water and soil conservation during construction shall be enhanced.	The section of the Project crossing the Xialei Nature Reserve does not involve the main habitats of wild protected animals; there are a certain number of bridges and tunnels in this evaluation, which can be used as passages for animals on both sides; the evaluation suggests strengthening the

S/N	Specific requirements of EIA for planning		Project Implementation
			publicity and education of construction personnel, prohibiting them from hunting wild animals, and taking corresponding water and soil conservation measures according to the water and soil conservation scheme of the Project.
3	Acoustic environmental protection measures	The route should avoid sensitive buildings as far as possible, construction time shall be arranged reasonably, the low noise route structure shall be adopted as far as possible, and appropriate noise reduction measures shall be taken for buildings with excessive noise.	Villages and schools are located along the project, and sensitive buildings have been avoided as much as possible; the Project is equipped with the asphalt concrete pavement to reduce the impact on sensitive points of acoustic environment from the source; this evaluation suggests that the construction of road sections near sensitive points should not be carried out at noon or night as much as possible, and measures such as setting sound insulation barriers and replacing sound insulation windows should be taken for sensitive points with excessive noise.
4	Recommendations for Environmental Protection Measures	Sewage and wastewater from ancillary facilities of traffic that cannot be included in the urban sewage collection system should be discharged after being treated up to standard by self-owned sewage treatment facilities; corresponding emergency facilities shall be set up for the sections crossing the second-class water source protection zones.	This evaluation requires that the project service and management facilities should be equipped with sewage treatment devices, and the sewage should be discharged into the surrounding branch ditch after being treated up to standard.
5	Suggestions on ambient air protection measures	Dust control shall be conducted during construction period, and the highway greening shall be strengthened.	The construction and living area of the Project shall be provided in maintenance area along the route, and be as far away from the sensitive target of ambient air as possible; measures such as sprinkling water for dust reduction shall be strengthened during the construction period.

To sum up, the project basically meets the relevant requirements of EIA for planning.

6.1.4.1.3 Analysis on Conformity with the *Main Function Zoning of Guangxi Zhuang Autonomous Region*

According to the *Main Function Zoning of Guangxi Zhuang Autonomous Region* (GZF

[2012] No.89), Tiandeng County belongs to the ecological functional area of southwest Guangxi, and it is a key ecological functional area at the level of autonomous region. Its function orientation is as follows: an important area for providing ecological products and protecting the environment, an important barrier for ensuring national and local ecological security, and a demonstration area for harmonious coexistence between man and nature. The development direction is as follows: the protection and restoration of the ecological environment and providing ecological products shall be taken as the primary task, the large-scale and high-intensity industrialization and urbanization development is inappropriate, the protective development can be implemented, suitable industries and tourism and other service industries that can be carried by resources and environment shall be developed according to local conditions, guidance shall be provided to launch the gradual and orderly transfer of part of the population, and the ecological service function shall be enhanced according to the characteristics of ecosystems in different regions to form important ecological functional areas. In areas rich in energy and mineral resources, according to the principle of "point-based development and surface-based protection", the energy and mineral resources should be developed moderately, and the characteristic advantaged industries that can be carried by local resources and environment should be developed. According to the comprehensive transportation network construction planning and layout of the state and autonomous region, overall planning shall be made for construction of transportation infrastructure.

According to the Main Function Zoning of Guangxi Zhuang Autonomous Region (GZF [2012] No.89), Daxin County belongs to the main producing area of agricultural products; its functional orientation is as follows: an important commodity grain production base in the whole region, an important area for ensuring the safety of agricultural products supply, and a demonstration area for the development of modern agriculture and the construction of a new socialist countryside. Development direction: the main function is to provide agricultural products, supplemented by other functions such as providing ecological products, service products and industrial products. It is not suitable for large-scale and high-intensity industrialization and urbanization development; improving the comprehensive agricultural production capacity shall be regarded as the focus. The cultivated land shall be strictly protected, the capability for ensuring food security shall be enhanced, the transformation of agricultural development mode shall be accelerated, the modern agriculture shall be developed, farmers' income shall be increased, the construction of a new socialist countryside shall be strengthened, the level of agricultural modernization and farmers' living standards shall be improved, and the food security and supply of agricultural products shall be ensured. In accordance with the principle of centralized layout and point-based development, the county urban areas and key towns shall be regarded as the focus to promote urban construction and industrial development, and guide the gathering of agricultural products processing, circulation, storage and transportation enterprises, so as to avoid excessive occupation of cultivated land caused by excessive decentralized development of industry.

To sum up, this a transportation infrastructure project, and its construction meets the requirements of the *Main Function Zoning of Guangxi Zhuang Autonomous Region*.

6.1.4.1.4 Analysis on Conformity with the *Ecological Function Zoning of Guangxi Zhuang Autonomous Region*

According to the *Ecological Function Zoning of Guangxi Zhuang Autonomous Region*, the whole region is divided into three first-class ecological functional areas: ecological regulation function area, product provision function area and human settlement guarantee function area.

On the basis of the first-class ecological functional areas, there are six second-class ecological functional areas in terms of the importance of ecological functions. Among them, the ecological regulation function area includes four second-class ecological functional areas: water conservation and biodiversity protection functional areas, water conservation functional areas, biodiversity protection functional areas and soil conservation functional areas; the product provision function area is an area providing agricultural and forestry products; the human settlement guarantee function is located in a central city.

On the basis of second-class ecological functional areas, 74 third-class ecological functional areas are established in terms of the spatial differences between ecosystems and ecological functions, geomorphic differences, land use combinations and leading functions.

The whole line of the Project is located in the 1-3-3 Karst Mountain Biodiversity Function Reserve in Southwest Guangxi, which is one of the third-class ecological functional areas.

The area with natural vegetation well preserved and strong water conservation ability is the source and water conservation area of large rivers. The ecological functional area is the best-preserved area of natural zonal vegetation (tropical monsoon forest and subtropical evergreen broad-leaved forest) in the region at present, with a relatively complete ecosystem structure, various biological species and a large number of rare, endemic and ancient biological species, and it is the main distribution area of nature reserves in the region. The service functions of water conservation and biodiversity conservation in these areas are extremely important.

The main ecological problems are as follows: the area of natural broad-leaved forest is reduced, the forest quality is reduced, and the water conservation function is weakened; especially in the dry season, the river water volume drops sharply; disasters such as mountain torrents, mudslides and landslides occur frequently in local areas during the rainy season; the area of sloping farmland is large, and the soil erosion is serious.

Main directions and measures of ecological protection: Important ecological function protection areas shall be planned and established, and the ecological functions of water conservation and biodiversity conservation shall be strengthened. The construction of ecological public welfare forests shall be strengthened, natural ecosystems shall be restored and rebuilt, the construction and management of nature reserves shall be enhanced, the biodiversity shall be maintained, and commercial forests shall be moderately developed; the advantages of ecological landscape and biological resources shall be utilized rationally, and ecological industries such as ecological agriculture, organic agriculture and ecological tourism shall be actively developed; the intensity of forest resources development and utilization shall be controlled; the development of industries that cause water pollution shall be strictly restricted; geological disasters shall be actively prevented and controlled.

This is an expressway project, basically with no pollutant emission. It covers ecologically sensitive areas such as Xialei Nature Reserve and Huashan Scenic Area. In this regard, this EIA report puts forward strict vegetation restoration measures and water and soil conservation measures; moreover, the Employer entrusts relevant organizations to prepare a crossing demonstration report for the Project crossing the above-mentioned ecologically sensitive areas and send it to the competent departments for approval according to relevant regulations. Therefore, the Project conforms to the *Ecological Function Zoning of Guangxi Zhuang Autonomous Region*.

6.1.4.2 Analysis of Environmental Impact Factors

According to the progress of the Project, the environmental impact is mainly reflected in three stages: design, construction and operation. The environmental impact analysis and identification in the three stages are made as follows.

6.1.4.2.1 Design Period

See Table 6.1-14 for the analysis of environmental impact at the project design stage.

Table 6.1-14 Environmental Impact Analysis at Design Stage

Type of design	**Engineering design contents**	**Environmental impact**
Site and route selection	Routing	The new road section of the project road changes the category of the original acoustic environment function area in the project site; thus, the category of the acoustic environment function area where some sensitive points close to the new road are located has been changed from Category 1 to Category 4a, and those sensitive points are significantly affected by traffic noise and automobile exhaust. The permanent occupation of farmland and woodland by highways reduces the output of agriculture and forestry. Route approaching or crossing sensitive areas such as water source protection areas may adversely affect water intake of the water source or surrounding ecology and water environment. Based on the reasonable route selection, the sensitive areas can be avoided to reduce the impact on water environment and the ecological impact. The overall planning of districts, counties and towns along the route should be fully considered in the process of project route selection, interchange site selection and design.
Earthworks	Earthwork balance	In view of the longitudinal allocation and balance of earth and stone, the number of borrow and spoil grounds and land occupation shall be reduced. Excessive spoil shall be used for farmland restoration, which is beneficial to agricultural production. The highway profile shall be designed reasonably, and the balance of fill and excavation shall be achieved as far as possible to reduce the spoil and the environmental impact in terms of ecology and solid waste.
Drainage works	Side ditches shall be adopted to collect rainwater	Road surface runoff of the Project shall be collected by the side ditches and then discharged into the channels along the line to avoid surface overflow.
Traffic Works	Crossing works	The new highway obstructs the passage of residents on both sides of the highway, and the setting of interchanges, passages and pedestrian bridges can reduce the effect of such obstruction.

6.1.4.2.2 Construction period

（1） Environmental Impact Analysis during Construction Period

At the construction stage, tasks such as subgrade excavation and filling, crossing works construction, and paving subgrade and asphalt concrete pavement will be carried out. Spoil grounds, construction roads, construction sites and construction camps shall be provided along the Project. The construction of these works will directly lead to the occupation of forest land and cultivated land, destruction of vegetation, soil erosion, construction noise, impact on the water quality of rivers and reservoirs across which bridges span, pollution of the ambient air by dust and asphalt fume, and a certain impact on the surrounding environment. See Table 6.1-15 for the identification of environmental impacts of major works at the construction stage of the Project.

Table 6.1-15 Identification of Major Environmental Impact Factors at Construction Stage

Environment Elements	Major Impact Factor	Impact analysis	Impact Property
Acoustic environment	Construction noise	A lot of construction machinery is involved in highway construction, and the noise of construction machinery is a sudden unsteady noise source, having a certain impact on the surrounding acoustic environment.	Short-term, reversible, harmful
	Transport vehicles	Almost all road construction materials of the Project will be transported by car, and the traffic noise of transport vehicles will affect the acoustic environment along the line.	
Ambient air	Dust	① During excavation and filling construction, a lot of dust escapes into the ambient air during loading, unloading, transportation, stacking and mixing of powdery materials; ② Transport vehicles for construction will generate dust when running.	Short-term, reversible, harmful
	Fumes from asphalting	① Dust generated in loading, unloading and mixing may have a great impact on sensitive points near the concrete mixing station or in the downward direction if any. The asphalt fume produced during asphalt mixing and paving contains toxic and harmful substances such as THC, TSP and benzoapyrene.	
Ecology	Permanently occupied land	① The Project mainly occupies forest land and cultivated land, and the destruction of vegetation will not be conducive to the restoration of local ecological environment and affect wildlife activities; ② Due to the occupation of farmland, the absolute amount of local cultivated land and the per capita cultivated land area will be reduced.	Long-term, irreversible, harmful
	Temporary land occupation	Temporary land occupation has a certain impact on ecology, surface vegetation and agricultural production.	Short-term, reversible, harmful
	Water and soil loss	① In the early stage of construction, soil and water loss will occur in the embankment, cutting and spoil area of the high-fill and deep-cut section; ② It is easy to damage the surface vegetation in the process of soil borrowing, resulting in the increase of soil and water loss in the region.	
	Construction of tunnel	① Influencing the mountain vegetation and vegetation at the portal; ② Influencing wild animals by construction activities.	
Surfacewater environment	Bridge construction	The Project spans water systems such as the Baidou River, the Xialei River and the Guichun River, the bridge construction will generate sludge, and improper management at the construction stage will lead to a small amount of mechanical oil leakage, which may affect the water quality.	Short-term, reversible, harmful
	Construction camp Construction site	Domestic sewage and construction waste water in construction camps and construction sites will also have a certain impact on the surrounding water quality.	
	Construction	Tunnel construction may cause water gushing, drainage of	

	of tunnel	groundwater and change regional hydrogeology. If the aquifer drilled in tunnel construction is the water source on which plants in the upper part of tunnel mountain depend, and it is difficult to block the drainage after water gushing, it may cause a large loss of water for vegetation growth, resulting in the death of vegetation on the top of mountain due to insufficient water.	
Solid wastes	Waste residue from construction	Storage of drilling slag of pile foundation and waste earthwork will occupy land and generate dust.	Short-term, reversible, harmful
	Domestic wastes	Domestic waste in construction camps pollutes environmental sanitation.	

（2）Environmental impact analysis at construction stage of critical works

See Figure 6.1-18 ~ Figure 6.1-20 for the construction procedures and pollution-producing nodes of bridges, tunnels and general sections.

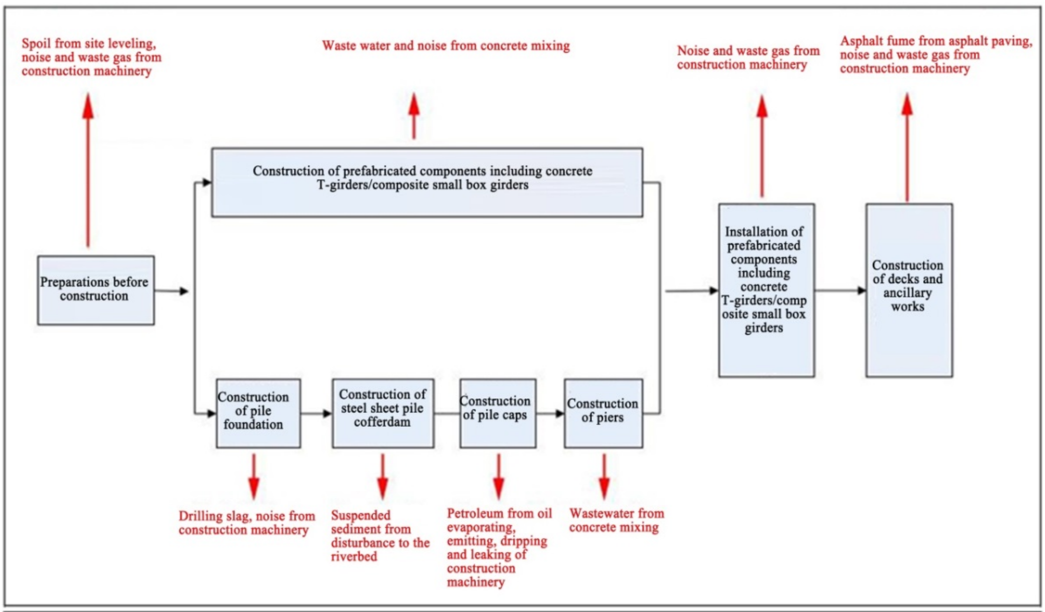


Figure 6.1-18 Construction Procedures and Pollution-producing Nodes of Bridge

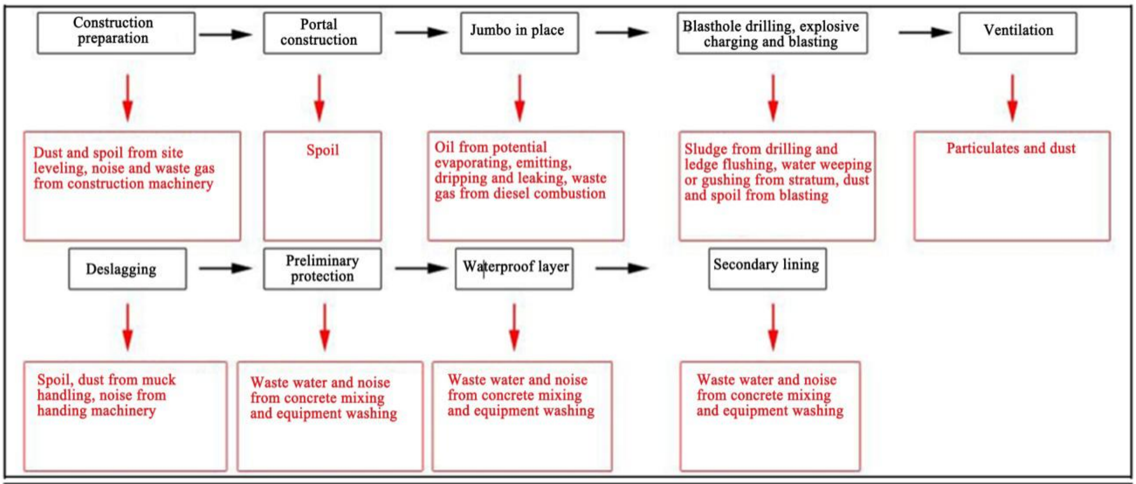


Figure 6.1-19 Construction Procedures and Pollution-producing Nodes of Tunnel

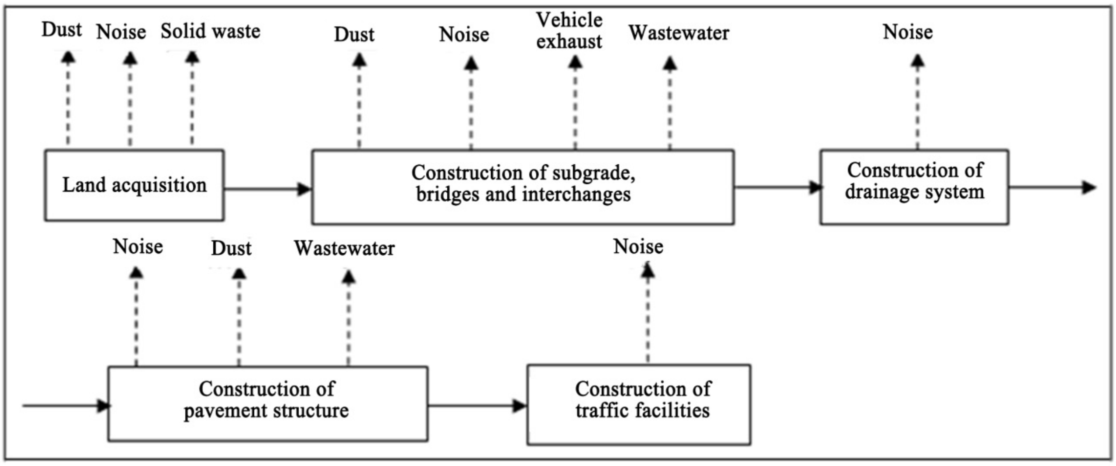


Figure 6.1-20 Construction Procedures and Pollution-producing Nodes of General Section

6.1.4.2.3 Operation period

After the Project is completed and opened to traffic, the ecological impact of temporary land occupation (spoil area, borrow area, construction camp, etc.) of the highway disappears gradually, the highway slope has been well protected, and the highway greening system has been built. Therefore, traffic noise will become the most important environmental impact factor at the operation stage. In addition, wastewater pollutants produced by vehicles carrying toxic and harmful substances and auxiliary road facilities (toll stations, etc.) cannot be ignored.

Table 6.1-16 Identification of Major Environmental Impacts at Operation Stage

Environment Elements	Influence factors	Engineering Impact Analysis	Impact Property
Acoustic environment	Traffic noise	The noise source from motor vehicles traveling on highways is unsteady. After highway operation, the engines, cooling systems, transmission systems and other components of vehicles will produce noise. In addition, the turbulent airflow, exhaust system, and friction between tires and road surface will also produce noise, resulting in a certain impact on residential areas and schools within a certain range along the line.	Long-term, harmful, irreversible, obvious
Ambient air	Automobile exhaust	The emission of automobile exhaust has an impact on the ambient air within a certain range on both sides of the highway; road dust from operating vehicles has an impact on air quality.	Long-term, harmful, irreversible, slight
Water environment	Pavement runoff	Rainfall scours the road surface, resulting in road surface runoff. When rainwater is discharged into the rivers along the road at the initial stage, slight pollution may occur.	Long-term, harmful, irreversible, slight
	Sewage discharge from auxiliary facilities	Sewage discharge from auxiliary road facilities (parking areas, toll stations, maintenance work areas, etc.) will generate certain pollution.	Long-term, harmful, irreversible, slight
	Accident caused by dangerous goods transportation	Vehicles carrying dangerous goods are involved in traffic accidents when passing through road sections in water source protection areas and river sections, resulting in leakage of dangerous goods, which may pollute water quality and water environment at water intake of water source protection areas; however, the probability of accidents is very low.	Long-term, harmful, reversible, severe
Ecology	Automobile noise	Traffic noise will affect the original habitat of animals near the highway, and thus some animals may be driven.	Long-term, harmful, irreversible, slight
	Expressway partition	The enclosed expressway will have a certain blocking and limiting effect on the activity range of terrestrial wild animals.	

6.1.4.3 Analysis on Source Strength of Pollution

According to the progress of the Project, the environmental impact of the Project is mainly reflected in two stages: construction period and operation period. The environmental impact analysis and identification in two stages are made as follows.

6.1.4.3.1 Construction period

(1) Ecological impacts

See Table 6.1-17 for the ecological impact sources of the main works during construction.

Table 6.1-17 List of Ecological Impact Analysis of Main Works of the Project at Construction Stage

S/N	Project Name	Analysis of Ecological Impacts	Nature and degree of impact

S/N	Project Name		Analysis of Ecological Impacts	Nature and degree of impact
1	Subgrade	Subgrade	Vegetation destruction, farmland occupation, and exposed subgrade cause soil erosion; the wild animals in the land occupation areas may be driven.	The impact is generally irreversible and great.
		Filling	Filling and rolling of vegetation will resulting in blocking of local natural runoff, and soil erosion is easy to occur.	Vegetation of the slope generated can be restored and the soil erosion can be controlled, but the high-fill section has been greatly affected.
		Excavation	Destroying of landforms and vegetation will easily lead to soil erosion and geological disasters, affecting the growth of vegetation.	There are great hidden dangers of soil and water loss in local deep-cut sections, causing great damage to vegetation.
2	Pavement		Water and soil loss	Medium and controllable impact
3	Bridge		Bridge construction destroys riparian vegetation and soil erosion is also easy to occur.	Slight and controllable impact
4	Tunnel		The vegetation and plants at the tunnel portal are destroyed, the spoil may result in soil erosion, and local geological disasters may occur during construction.	The damage to the tunnel portal is irreversible, but the impact is small and the spoil area can be restored; corresponding measures can be taken to control the geological disasters.
5	Culverts		Soil erosion is easy to occur	Slight and controllable impact
6	Service and Management Facilities		Land occupation leads to vegetation destruction, which may result in soil erosion.	The floor area is small, and the impact is slight and controllable.

See Table 6.1-18 for ecological impact sources of areas with land occupied by temporary works.

Table 6.1-18 List of Ecological Impact Analysis of Temporary Works of the Project at Construction Stage

S/N	Project Name	Analysis of Ecological Impacts	Nature and degree of impact
1	Construction Road	Vegetation and plants have been destroyed, farmland is occupied, and soil erosion occurs.	Permanent loss of vegetation in permanently occupied areas, restorability of vegetation in temporarily occupied areas, and moderate impact.
2	Spoil area and temporary spoil ground	Vegetation is filled and rolled and soil erosion is easy to occur.	After the completion, vegetation can be restored, soil erosion can be controlled and the impact is small.
3	Construction camp	The vegetation and plants in the land occupation area are destroyed, and soil	After the completion, vegetation can be restored, soil erosion can be

S/N	Project Name	Analysis of Ecological Impacts	Nature and degree of impact
		erosion is easy to occur.	controlled and the impact is small.
4	Surrounding areas of the tunnel	The vegetation and plants in the land occupation area are destroyed, farmland is occupied, and soil erosion is easy to occur.	After the completion, vegetation can be restored, soil erosion can be controlled and the impact is small.

(2) Impact on water environment

There are pollution sources such as bridges crossing surface water bodies, tunnels crossing mountains, and discharge of production and domestic sewage in construction camps. The specific forms of pollution sources in the Project are as follows:

① In the Project, there are 2 bridges across rivers with piers in water. The impact of bridge construction on water environment is mainly manifested in disturbing the water bottom during underwater construction, increasing the concentration of suspended solids such as sediment in water. In addition, the exposed construction surface on the bank side and the subgrade on the river side are washed away by rain, resulting in soil erosion and pollutants entering the surface water body; the concrete blocks dropped during the lifting and cleaning of bridge superstructures lead to the increase of SS concentration in the receiving water.

② The impact of tunnel construction on water environment is mainly manifested in water gushing in tunnel and construction wastewater discharge. In the Project, 4 (1820.5m) short tunnels with small clearances and 3 (3255m) long separated tunnels are built. In general, the amount of construction wastewater of long tunnels along the proposed highway is 200~300 m3/d, and that of short tunnels is about 100 m3/d.

③ Special mixing plants, storage yards, construction machinery, vehicle parking and maintenance areas and living areas are set up in large construction camps. Among them, flushing wastewater will be produced during the production of material mixing plant, containing high-concentration SS and COD; wastewater containing petroleum substances will be produced during equipment washing and maintenance in construction machinery and vehicle parking and maintenance areas; when the storage yard without protection is washed by rain, the rainwater runoff on the road surface of the sand and gravel stacking point mainly consists of sewage containing SS; sewage discharged from the living areas of construction personnel mainly contains COD, BOD5 and N-NH3.

The construction camp is also the main source of sewage in the Project, and the direct discharge of sewage will also have a great adverse impact on the receiving water body; if the construction camp is arranged near the river-crossing bridge, it is more likely to pollute the adjacent water body.

In the Project, there are two construction areas; if 100 workers are accommodated in each construction area, the domestic water consumption is 150 L/d per person and the domestic sewage is 80% of water consumption, the domestic sewage discharge of construction personnel is 24 t/d, and the annual sewage discharge is 8760t. According to comparison with similar projects, the composition and concentration of domestic sewage discharged from the proposed construction camp in the Project are shown in Table 6.1-19.

Table 6.1-19Composition and Concentration of Domestic Sewage in Construction Camp

S/N	Component	Concentration (mg/L)
1	Suspended Substance	100
2	BOD_5	110
3	COD_{Cr}	250
4	NH3-H	25
5	Animal and vegetable oil	50

(3) Impact on ambient air

① Construction dust raising

In the project construction stage, the excavation of subgrade, transportation, loading and unloading of road-building materials, concrete mixing, asphalt use and tunnel construction will produce a large amount of dust which will escape into the surrounding atmosphere, and dust pollution may occur in windy days during the stacking of building materials, adversely affecting the atmospheric environment around the construction site and construction road. According to the monitoring results of the construction sites of similar expressway projects without any dust reduction measures, the daily average concentrations of dust at 20m, 150m and 200m downwind the construction site are 13.03 mg/m3, 3.11 mg/m3 and 2.70 mg/m3 respectively.

② Exhaust gas from oil-fired machinery

The construction machinery of the Project mainly includes oil-fired machinery such as excavators, mixers, loaders, road rollers and diesel machines. The oil-fired machinery will produce exhaust gas in the process of operation, and the pollutants discharged mainly include SO2, CO, NOX and THC. Since most of the construction machinery is large, the emission coefficient of a single machine is relatively large, but the number of construction machinery is small and such construction machinery is scattered, the pollution is relatively light.

③ Dust raising of concrete mixing station

According to the relevant monitoring data of concrete mixing plants of similar expressway projects, for the dust produced by lime-soil mixing plants of expressways, the TSP concentrations at 50m, 100m and 150m downwind are 8.90 mg/m3, 1.65 mg/m3 and

1.00mg/m3 respectively.

④ Asphalt fume

Asphalt concrete pavement is used in the Project, asphalt fume pollution will occur in the process of on-site boiling and mixing of asphalt, and a few asphalt fumes will also occur in the process of paving asphalt pavement. The asphalt fume contains pollutants such as total hydrocarbon, total suspended particulates and benzoapyrene, having a certain impact on the air environment.

The asphalt concrete mixing equipment is equipped with an asphalt fume treatment device to collect and purify the asphalt fume uniformly and then discharge it through the exhaust pipe, so as to avoid the unorganized discharge of the asphalt fume as far as possible; in the process of paving asphalt concrete, the ambient air will be affected for a short time, its impact range is small and the duration is short. When paving asphalt, the closed heating and paving devices can be used to reduce the impact on the ambient air and sensitive points of the surrounding environment.

(4) Impact on acoustic environment

Noise during construction mainly comes from the operation of construction machinery and the running of materials transport vehicles. The demolition of buildings is performed by construction machinery such as excavators; large and medium-sized vehicles are mainly adopted for materials transport, and there are many types of construction machinery and equipment for expressways, with high source strength. According to the measured data of common highway construction machinery, the details of pollution source strength are shown in Table 6.1-20.

Table 6.1-20 List of Noise Source Strength of Main Construction Machinery for Highway Works

S/N	Type of Machine	Type	Distance from the measured point to the construction machinery (m)	Maximum sound level Lmax (dB(A))
1	Wheel loader	Type ZL40	5	90
2	Vibrating road roller	Type YZJ10B	5	86
3	Tandem vibratory road roller	Type CC21	5	81
4	Three-wheel roller	/	5	81
5	Tyred roller	Type ZL16	5	76
6	Bulldozer	T140 type	5	86
7	Hydraulic wheel excavator	Type W4-60C	5	84
8	Generator set (2 sets)	Type FKV-75	1	98
9	Impact well drill	Type 22	1	87

S/N	Type of Machine	Type	Distance from the measured point to the construction machinery (m)	Maximum sound level Lmax (dB(A))
10	Concrete mixer	Type JZC350	1	79
11	Paver	SSP220C-5	1	80

Blasting operations may be needed in local tunnel works and sections where rock slopes are excavated. According to relevant data, the instantaneous sound level of sudden blasting can reach 130dB(A), resulting in a great instantaneous impact on the surrounding acoustic environment; therefore, the blasting noise is also the main source of construction noise pollution.

(5) Blasting Noise and Vibration Source Intensity

Blasting operations may be required in tunnel construction, excavation and tunneling. According to relevant data, the instantaneous sound level of sudden blasting can reach 130dB(A), which can greatly changes the surrounding acoustic environment; therefore, noise from blasting is also the main noise pollution source in tunnel construction.

There are two long tunnels in the Project-Longdong Tunnel and Shuolong Tunnel. Explosive blasting may be required during tunnel construction. When blasting, the energy of explosive is transferred through the ground. When the energy reaches a certain level, it may cause damage to nearby buildings. The main protection object against blasting vibration of Zhufa Tunnel is the buildings around the tunnel. According to *Safety Regulations for Blasting* (GB6722-2011), the allowable safe vibration velocity for general civil buildings is 2.0~2.5 cm/s, and that for loess caves, adobe buildings and stone houses is 0.45~0.9cm/s. The allowable safe distance of blasting vibration has the following relationship with the maximum single-segment charge:

$$\mathrm{R} = \left({}^{K}/_{V}\right)^{1/a} Q^{1/3}$$

Where, R is the distance (m) of blast vibration;

Q is the charge (kg) for one blasting;

V is the vibration velocity (cm/s);

K and a are the coefficient and attenuation index related to topographic and geological conditions of blasting site.

It can be seen from the above that the safe distance of tunnel blasting is affected by the maximum one-time charge and the engineering geological conditions where the tunnel is located. There are only two long tunnels in the Project, and the engineering geological conditions are unchanged. Therefore, the only factor that affects the safe distance of blasting in Zhufa Tunnel is the maximum one-time charge required for tunnel blasting.

The charge of blasting is affected by blasting technology, surrounding rock strength, blasting parameters, etc. Referring to blasting schemes of similar tunnels, the general charge for full-face blasting is about 210 kg, and that for smooth blasting is about 140 kg.

(6) Impact of solid waste

The solid waste of the Project mainly comes from the abandoned earthwork of the Project and the domestic garbage in the construction camp.

There are a large number of abandoned earthworks widely distributed in the Project, mainly from subgrade excavation, replacement in sections with unfavorable geology, bridge pile foundation construction, tunnel excavation and other procedures. The total volume of abandoned earthworks in the Project is 355,000 m3.

In this evaluation, according to comparison with similar projects, if the number of construction workers is 200 and the per capita domestic garbage output is 1 kg/d, the total domestic garbage output is 200 kg/d and 72 t/a, and the total volume of garbage during construction is 144t.

6.1.4.3.2 Operation period

(1) Ecological impacts

After the operation of the Project, obvious ecological effect of corridor will be produced on the roadside, and invasion of alien species will become possible. At the same time, the roadside habitat will be divided, the local habitat will be fragmented and some animal activities will be obstructed. Other adverse effects are mainly reflected in the change of land use pattern around the Project and the consequent change of ecological pattern with the change of traffic environment and the deepening of planning and development activities on both sides of the road.

The impact of the Project on aquatic ecology is mainly reflected in the cross-river section, and the road runoff sewage may pollute the water quality of such section. Under normal circumstances, the bridge deck runoff water of the bridges crossing the Xialei River along the proposed highway will not affect the downstream rivers, and will not change the existing water quality category or affect the aquatic organisms in the water body; however, once an accident occurs in the waters across which the bridges span, oil and loaded materials may leak, resulting in pollution of the bridge deck or road surface. After rainfall, rainwater flows into the nearby waters through the proposed highway outlet, which will cause pollution from SS, oil and COD at varying degrees, resulting in pollution on the water quality of the above-mentioned water bodies and aquatic organisms in these water bodies.

(2) Surface water environment

① Runoff sewage generated by rainfall scouring the road surface

The factors affecting the pollution degree of road runoff include rainfall intensity, rainfall duration, traffic flow, interval between two rounds of rainfall, road width, and length of polluted road section. According to the measurement of road runoff pollution in southern China by South China Institute of Environmental Sciences of the Ministry of Environmental Protection, the concentrations of pollutants within one hour at the initial stage of rainfall and at subsequent stages are shown in Table 6.1-21.

Table 6.1-21 Concentrations of Rainwater Pollutants on Road Surface (Unit: mg/L)

Item	5~20 minutes	20~40 minutes	40~60 minutes	Mean Value
pH Value	7.0~7.8	7.0~7.8	7.0~7.8	7.4
SS(mg/L)	231.42~158.22	185.52~90.36	90.36~18.71	100
COD_{Cr}(mg/L)	7.34~7.30	7.30~4.15	4.15~1.26	5.08
Petroleum (mg/L)	22.30~19.74	19.74~3.12	3.12~0.21	11.25

Note: when the traffic volume and rainfall are known, if the rainfall lasts for 1 hour and the rainfall intensity is 81.6 mm, water samples shall be collected at different times within 1 hour.

② Sewage from transportation service facilities

There is one toll station and one maintenance work area (built together with the toll station) along the whole project.

1) Domestic sewage output

$$Q_S=（K\cdot q_1\cdot V_1）/1000$$

Where: *QS* represents domestic sewage discharge volume, t/d;

q1-water consumption quota per person per day, L/person·d;

V1-number of persons accommodated by toll stations and other facilities;

K-emission coefficient of domestic parking area (calculated as 0.9.)

The water consumption of fixed personnel in maintenance work areas and toll stations is calculated as 150 L/d, and the per capita water consumption of mobile personnel is calculated as 15 L/d.

2) Wastewater concentration

In accordance with the sewage discharge of existing expressway service facilities in Guangxi, the concentrations of main pollutants in the wastewater discharged by service facilities are determined as shown in Table 6.1-22.

Table 6.1-22 Concentrations of Main Pollutants in Wastewater from Service Facilities of the Project (Unit: mg/L)

Item / Services Description	pH value (dimensionless)	SS	COD	BOD_5	NH3-H	Petroleums

Item / Services Description	pH value (dimensionless)	SS	COD	BOD_5	NH3-H	Petroleums
Toll Station and Maintenance Work Area	7.5	300	300	250	5	2

④ Calculation of sewage volume from service facilities

See Table 6.1-23 for the estimation of sewage output and Table 6.1-24 for the output of main pollutants in the long term of operation of service facilities of the Project.

Table 6.1-23 List of Sewage Output from Service Facilities of the Project

S/N	Services Description	Number of persons accommodated by service facilities	Sewage volume (t/d)
1	Toll station (built together with the maintenance work area)	Fixed personnel: 30	4.05

Table 6.1-24 List of Sewage Output and Discharge from Service Facilities of the Project

Name of facility		Sewage Discharge Volume (t/a)	Pre-treatment discharge volume of pollutant (t/a)				
			SS	COD	BOD_5	NH3-H	Petroleums
Toll station (built together with the maintenance work area)	Generation Amount	1478.25	0.44	0.44	0.37	0.007	0.003
	Discharge Amount	1478.25	0.10	0.07	0.01	0.007	0.001

(3) Ambient air

① Emission of vehicle exhaust

After the Project is put into operation, the automobile exhaust of vehicles travelling on the highway has a certain negative impact on the atmospheric environment on both sides along the route, and the main pollutants from the automobile exhaust are CO and NO2.

(1) Formula for Calculating Pollution Source Intensity

The pollution caused by the tail gas emitted by vehicles on the highway can be treated as a line source, and the emission source strength of gaseous pollutants in the tail gas can be calculated according to the calculation formula for line source strength of pollutants emitted by vehicles in the *Specifications for Environmental Impact Assessment of Highways* (JTGB03-2006):

$$Q_j = \sum_{i=1}^{3} 3600^{-1} A_i E_{ij}$$

Where, Q_j— Emission source intensity of type j gaseous pollutant, mg/(s.m);

A_i— Hourly traffic volume of the forecast year for type i vehicle, vehicle/h;

E_{ij} — Single vehicle emission factor of type j emission, type i vehicle in the forecast year, mg/(Vehicle.m).

(2) Selection of Single Vehicle Emission Factors

The single vehicle emission factor parameters for vehicle pollutants of the Project are those recommended by the *Emission Limits and Measurement Methods of Exhaust Pollutants from Compression Ignition Engines for Vehicles* (GB17691-2005) and the *Emission Limits and Measurement Methods of Light Vehicle Pollutants (China's Sixth Stage)* (GB18352.6-2016), and meet the requirements of 6b from July 1, 2023. The Project will be opened to traffic in 2025; therefore, the single vehicle emission factors at the operation stage of the Project are determined according to the "6b" standard, as shown in Table 6.1-25.

Table 6.1-25 List of Single Vehicle Emission Factors of Exhaust Pollutants from Motor Vehicles

Project Category		CO	NO_x
6b standard value (mg/km. vehicle)	TM≤1305kg	500	35
	1305kg＜TM≤1760kg	630	45
	1760kg＜TM	740	50

The emission source strength of CO and NO2 of the Project shall be calculated according to the predicted traffic volume and single vehicle emission factors of pollutants in each forecast year, as shown in Table 6.1-26. (NO2=0.88×NOX is taken in this evaluation).

Table 6.1-26 List of Emission Source Strength of Exhaust Pollutants from Motor Vehicles in Different Forecast Years Unit: mg/(s·m)

Route Section \ Year of Prediction		Year 2025		2031		2039	
		CO	NO_2	CO	NO_2	CO	NO_2
Main line		0.0507	0.0071	0.0959	0.0112	0.1656	0.0177
Shuolong Connecting Line	AK0+000~AK2+800	0.0321	0.0071	0.0708	0.0112	0.1301	0.0177
	AK2+800~AK5+423	0.0291	0.0071	0.0638	0.0112	0.1174	0.0177

(4) Impact on acoustic environment

At the operation stage, the noise source mainly comes from the traffic noise generated by motor vehicles running on the road. Traffic noise is related to many factors, such as vehicle speed, traffic flow, vehicle type, road structure, pavement structure, buildings on both sides of the road, terrain and so on. See Table 6.1-27 for the average radiation noise level of various types of vehicles. $\overline{L_{oi}}$

Table 6.1-27 List of Average Radiation Sound Levels of Various Types of Vehicles Unit: dB(A)

Vehicle category	Average radiation sound level	Remarks
Small-sized vehicle	$L_{OS}=12.6+34.73\lg V_s$	Vs: average driving speed of small vehicle
Medium-sized vehicle	$L_{OM}=8.8+40.48\lg V_M$	VM: average driving speed of medium vehicle
Large-sized vehicles	$L_{OL}=22.0+36.32\lg V_L$	VL: average driving speed of large vehicle

According to the above calculation formula, as well as the traffic volume of each road section in each characteristic year, the radiation noise levels of different vehicle types of each road section of the Project in each characteristic year are shown in Table 6.1-28.

Table 6.1-28 List of Radiation Sound Levels of Different Types of Vehicles in Each Road Section of the Project Unit: dB(A)

Prediction Year / Road section and vehicle type			Year 2025		2031		2039	
			Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime
Main line of the Project K1+693~ K11+763		Small-sized vehicle	79.5	79.6	79.4	79.5	79.1	79.4
		Medium-sized vehicle	80.6	80.3	80.9	80.5	81.2	80.8
		Large-sized vehicles	86.4	86.2	86.6	86.4	86.9	86.6
Shuolong Connecting Line	AK0+000~AK2+800	Small-sized vehicle	76.2	76.2	76.1	76.2	75.9	76.1
		Medium-sized vehicle	76.5	76.3	76.8	76.5	77.1	76.7
		Large-sized vehicles	82.8	82.7	83.0	82.8	83.2	82.9
	AK2+800~AK5+423	Small-sized vehicle	76.2	76.2	76.1	76.2	75.9	76.1
		Medium-sized vehicle	76.4	76.3	76.7	76.5	77.1	76.7
		Large-sized vehicles	82.7	82.6	82.9	82.8	83.2	82.9

(5) Solid Waste

Solid waste generated during the operation period mainly refers to domestic garbage generated from the toll station and maintenance work area. The per capita garbage output of fixed personnel is calculated as 1 kg/d, and that of mobile personnel is calculated as 0.25 kg/d. See Table 6.1-29 for the estimated garbage output at the operation stage of the Project.

Table 6.1-29 List of Waste Output in Operation Stage of the Project

S/N	Services Description	Number of persons accommodated by service facilities	Waste Output (t/d)
1	Toll station (built together with the maintenance work area)	Fixed personnel: 30	0.03

(6) Accident Risk

After the Project is put into operation, vehicles transporting toxic or harmful dangerous goods will have an impact on the surface water quality along the line after traffic accidents occur in sensitive sections such as river-cross bridges and tunnels along the line, resulting in great harm to human health, aquatic ecological environment and water environment, as well as environmental risks.

6.1.4.3.3 Summary of Pollution Sources

Table 6.1-30 Summary of Intensity of Main Pollution Sources in Construction Period

Pollution Sources	Pollution Stage	Main Pollution	Source Intensity and Influence
Waste gas	Construction dust	TSP	It has a great adverse impact on the atmospheric environment within 150m of the roadside.
	Dust from mixing station	TSP	It has an adverse impact on the ambient air in the downwind direction of 150m
	Asphalt paver	Asphalt fume	It is mainly produced in the paving process; as the asphalt sets, the effect disappears.
Noise	Noise of construction machinery	Leq	76~98dB(A); the instantaneous sound level of sudden blasting can reach 130dB(A)
Waste water	Domestic sewage produced by construction personnel	SS、COD、BOD	The total output is 8760t; it is used for forest land fertilization after septic tank treatment.
	Production wastewater	SS	Short-term increase of SS in receiving water body
Solid waste	144t of domestic garbage produced by construction personnel		It is collected by the Contractor, and placed in the local sanitary landfill for landfill or other harmless treatment.
	Permanent spoil: 473,000m^3		It is placed in the spoil area, and then the vegetation is restored or greened.

Table 6.1-31 Summary of Intensity of Main Pollution Sources in Operation Period

Pollution Sources	Emissions (t/d)	Annual Emission t/a	Main Pollutants	Generation Amount t/a	Discharge Amount t/a	Disposal Method
Wastewater (total from service facilities)	4.05	1478.25	COD	0.44	0.07	After it is treated to meet the standards for flushing toilets, road cleaning and urban greening in the *Reuse of Urban Recycling Water - Water Quality Standard for Urban Miscellaneous Water Consumption* (GB/T 18920-2002) and *Wastewater Reuse of Highway Service Area - Water Quality* (JT/T 645.1-2016), it can be reused for greening, road cleaning and flushing toilets.
			BOD_5	0.37	0.01	
			SS	0.44	0.1	
			NH_3-N	0.007	0.007	
			Petroleums	0.003	0.001	
Solid waste	0.03	10.95	Mainly domestic waste of service facilities;			
Waste gas	See Table 6.1-26 for details of automobile exhaust CO and NO_2;					
Noise	See Table 6.1-28 for traffic noise;					

6.2 Detian-Shuolong Highway

6.2.1 Overview of the Recommended Scheme

6.2.1.1 Project components

The Project is an upgrading project of Detian – Shuolong section in the upgrading of

Shuolong – Renai Class-II highway. It starts at the entrance of parking lot in Detian Scenic Area and ends at Rentun, Shuolong Community, southeast corner of Shuolong Town. It crosses the Shuolong Connecting Line of Component A at the same level, with a total length of 13.632km.

6.2.1.2 Main technical indexes

See Table 6.2-1 for the main technical and economic indicators and quantities of the Project.

Table 6.2-1 Main Technical and Economic Indicators and Quantities in Recommended Scheme

S/N	Indicator	Unit	Section of Detian – Tourist Center (K0+000 – K9+362.310)	Section of Tourist Center – north end of the Shuolong Medium Bridge (K9+362.310 – K13+632.053)	Total
1	Route length	km	9.362	4.270	13.632
2	Highway Class	Class	Class II (Class III)	Class II	/
3	Design speed	km/h	40（30）	40	/
4	Number of Lanes		Two-way two-lane	Two-way four-lane	/
5	Subgrade width	m	10 (common road section) 7.5 (level 1 water source conservation area) 16 (urban road section)	16 (common road section) 2*8.5 (separated subgrade) 17.5 (urban road section)	/
6	Occupied land	Mu	250.3	170.2	420.5
7	House demolition	m^2	-	-	3528.96
8	Quantities of earthwork and stonework	$1000m^3$	84.615	72.341	156.955
9	Average earthwork and stonework per kilometer	$1000m^3$	9.038	16.942	11.514
10	Drainage works	$1000m^3$	15.84	8.37	24.21
11	Protection	$1000m^2$	21.60	6.82	28.42
12	Pavement	$1000m^2$	81.81	63.23	145.04
13	Culverts	m/set	33	21	54
14	Tunnel	m/Nr.	-	395/1	395/1
15	Level crossing	Nr.	14	9	23
16	Total estimate	RMB 10,000	15510.1747	11512.609	27022.7837
17	Average cost per kilometer	RMB 10,000	1656.7159	2696.1614	1982.3051

6.2.1.3 Project construction scale

Detian – Shuolong Highway has a total length of 13.632km; it is constructed in 2sections: section of Detian – Tourist Center and section of Tourist Center – north end of the Shuolong Medium Bridge. The route from Detian to Tourist Center (K0+000 ~ K9+362.310) is 9.362 km in length and is built as a class II highway with a design speed of 40 km/h and a subgrade width of 10 m. The road section (K3+860 ~ K5+260) near the class I water source conservation area is built as a Class-III highway with a design speed of 30 km/h and original subgrade width (7.5m). At the urban section (K7+050 ~ K7+280), considering the road profile, the road is built as a class II highway with a design speed of 40 km/h, a road width of 16 m, and sidewalks on both sides. At the restricted section (K8+400 ~ K8+700), the road is designed with a speed limit of 30 km/h and a subgrade width of 10 m to avoid large filling and excavation. The section of Tourist Center – north end of the Shuolong Medium Bridge (K9+362.310 – K13+632.053) is 4.270km long; the general road section is of Class-II highway standard, with a design speed of 40km/h and a subgrade width of 16m; the road section with separated subgrade (left line K9+362.310 – K10+155.050, right line YK0+000 – YK1+053.383) refers to the Class-II highway standard, with a design speed of 40km/h and a single subgrade width of 8.5m; the urban road section (K12+520 – K13+632.053) refers to the Class-II highway standard, with a design speed of 40km/h, a road width of 17.5m, and sidewalks on single (inner) side taking into account the urban road sections.

There is no bridge on the whole line, but only one 395m long one-way two-lane tunnel.

The total investment of the Project is RMB 270.227837 million, and the average investment per kilometer is estimated to be RMB 19.823051 million.

6.2.1.4 Forecast of Traffic Volume and Vehicle Type Ratio

(1) Forecast of traffic volume

See Table 6.2-2 for the forecast of traffic volume of the Project based on the Feasibility Study Report.

Table 6.2-2 Traffic Forecast Results unit: pcu/d (equivalent to passenger cars)

Road Section	Forecast Period		
	2023 (the 1st year of operation)	2029 (the 7th year of operation)	2038 (the 15th year of operation)
Section from Detian to the Tourist Center	3541	4574	6068
The tourist center - X532 section	5737	7824	10632
The section of X532 - North Bridge Head of Shuolong Medium Bridge	5635	7688	10446

(2) Structure of Vehicle Types

See Table 6.2-3 for the vehicle type ratio of the Project according to the Feasibility Study Report of the Project.

Table 6.2-3 Vehicle Type Ratio and All-day to Daytime Ratio of Traffic Flow

Year / Vehicle category	Year 2023 (the 1st year after operation)	2029 (the 7th year after operation)	2038 (the 15th year after operation)
Small freight vehicle	5.32%	6.05%	5.30%
Medium freight vehicle	4.60%	5.53%	4.79%
Large freight vehicle	2.13%	4.04%	7.79%
Extra-large freight vehicle	1.31%	2.64%	4.64%
Small Passenger Vehicle	51.50%	53.33%	58.75%
Large Passenger Vehicle	5.84%	6.44%	7.14%
Tractor	27.22%	20.31%	10.54%
Motorcycle	2.08%	1.66%	1.05%

The traffic flow ratio is 80% in daytime and 20% in nighttime (16h in daytime and 8h in nighttime) according to the actual situation.

6.2.1.5 Project construction period

The project is planned to be commenced in October 2021, and be completed and open to traffic in June 2023.

6.2.2 Land Occupation and Demolition of the Project

The Project covers a total area of 420.5 mu, and the land falls in the scope of Shuolong Town of Daxin County, Chongzuo City. The types of land occupied by the Project include cultivated land, forest land, garden plot, waste land, homestead and old roads. The Project involves the demolition of 3528.96 m2.

See Table 6.2-6 for specific land occupation of the Project.

Table 6.2-4 Land Occupation of the Project Unit: mu

Administrative Area	Agricultural Land					Construction Land		Unused land		Total
	Cultivated land		Woodland		Others	Residential land	Transportation	Unused land	Other lands	
	Paddy field	Dry land	Woodland	Shrub land	Grassland	Rural homestead	Existing road	Wasteland	River	
Shuolong Town, Daxin County	19.4	65.7	40.8	81.4	49.8	0.5	149.4	11.2	2.3	420.5

6.2.3 Setting of Earthwork Balance and Temporary Land Use

6.2.3.1 Earthwork Balance of the Project

The earthwork balance accounting results in the *Report of Soil and Water Conservation*

Scheme for Detian – Shuolong Highway Project (the first draft) show that the Project has a total excavation amount of 433,600m3 (including 30,500m3 of stripped topsoil), a total fill amount of 369,400m3 (including 30,500m3 of covered topsoil), no borrows, and permanent spoil of 64,300m3 (transported to the spoil area for stacking). The earthwork is mainly produced in subgrade works area. See Table 6.2-4 for the earthwork balance of the Project.

Table 6.2-5 Balance Table of Earthwork for the Project

Project Zoning	**Excavation**					**Filling**				**Transfer-In**		**Transfer-Out**		**Spoiled earth**	
	Topsoil	**Ordinary soil**	**Earthwork**	**Pavement of existing road**	**Subtotal**	**Topsoil**	**Ordinary soil**	**Earthwork**	**Subtotal**	**Quantity**	**Sources**	**Quantity**	**Destination**	**Subtotal of Spoil**	**Destination**
Subgrade works area	3.01	15.87	23.82	0.48	43.18	3.01	13.95	19.87	36.83	1.6		1.6		6.35	Spoil ground
Bridge works area		0.04			0.04		0.02		0.03					0.02	Spoil ground
Construction access road zone	0.04	0.06			0.1	0.04			0.04			0		0.06	Spoil ground
Construction production and living quarters		0.04			0.04		0.04		0.04						
	3.05	16.01	23.82	0.48	43.36	3.05	14.01	19.87	36.94	1.6		1.6		6.43	

6.2.3.2 Layout of Temporary Works

6.2.3.2.1 Yard planning

The materials required in the Project, such as stone, sand, quicklime, cement, steel and asphalt, shall be purchased in towns and villages near the route, and then transported to the construction site for use by transport services providers.

6.2.3.2.2 Temporary Construction Scheme

It is expected to build 1 concrete mixing station, 1 asphalt mixing station, 1 stone rolling yard and 1 spoil area for the main works of the Project according to the construction scheme in the Project feasibility study report. After the communication and coordination between the Project Designer and the local government, the temporary works of the Project are planned to be concentrated in the left plot of K10+200 (opposite to CNOOC), covering an area of about 60 mu. This plot is a resettlement site planned by the local government, and the land is owned by the residents in Shuolong Community. The land is mainly dry land, which has been purchased and requisitioned by the local government. See 6.2-10 for the satellite diagram of this plot.

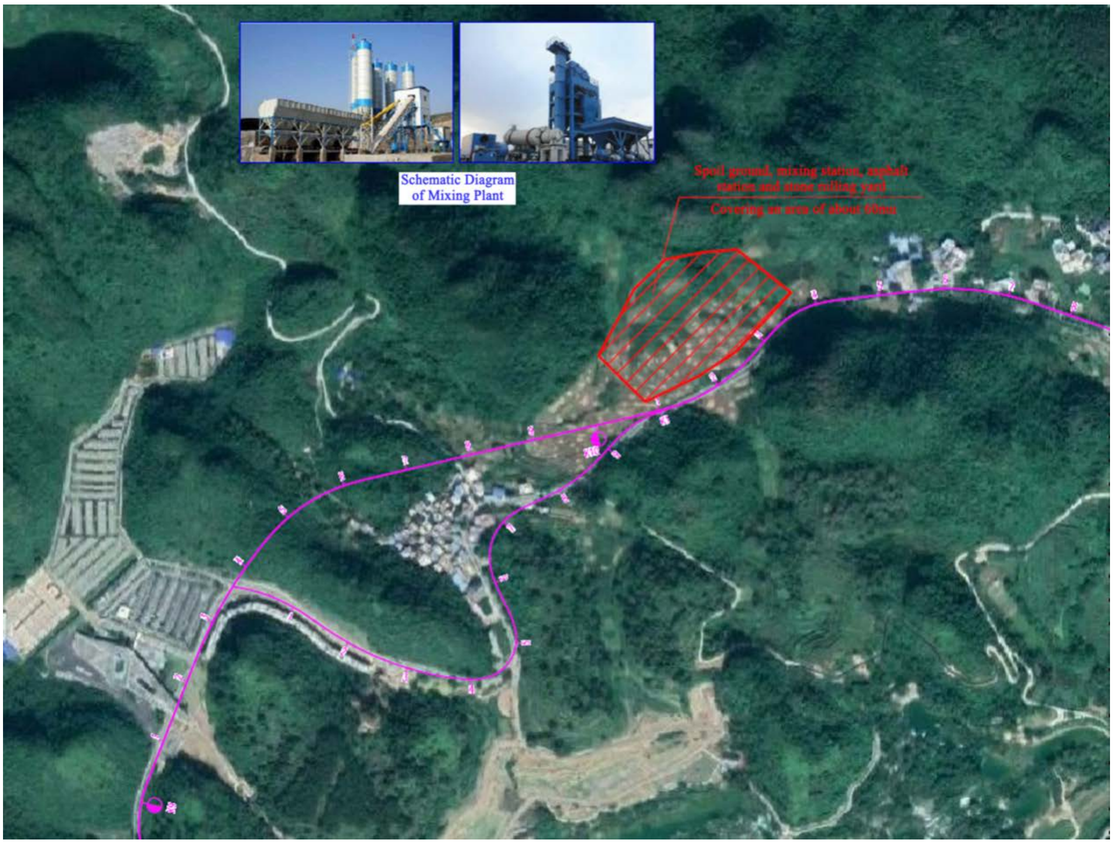


Figure 6.2-1 Plot Location of Comprehensive Yard/Station for Temporary Facilities Preliminarily

Selected by the Employer

(1) Mixing Plant

Asphalt concrete pavement is adopted for the Project, and it is estimated to build 1 concrete mixing station and 1 asphalt mixing station, which will be jointly arranged in the resettlement site of local government for purchasing and storage. The land is located beside the existing highway, which is convenient for material transportation.

The concrete mixing station is provided with concrete mixing station and laboratory. It is estimated to install 2 mixers of 120 type, which are equipped with 8 bins; it is provided with prefabricated house for the operators of the mixing station, concrete truck drivers and some project management personnel. The asphalt mixing station is planned to be equipped with at least 1 automatic metering asphalt concrete mixing station with a capacity of 320t/h and above.

(2) Stone Rolling Yard

Combined with the comparison and selection of material sources, the stones excavated within the line section and the gravels made of tunnel slags are proposed to be utilized in the Project, so as to reduce the engineering cost. The stone rolling yard is also preliminarily arranged in the resettlement site purchased and stored by the local government. The block is located near the exit of Longhong Tunnel, which can effectively shorten the transportation distance of tunnel slag. At the same time, the block is located beside the existing highway, which is convenient for stone transportation.

6.2.3.2.3 Spoil Area

After the excavation and filling of the Project are balanced, the produced 64,300 m3 of permanent spoil will be transported to the special spoil area of the Project for stacking. At present, the Employer has initially selected 1 spoil ground, which is located in the resettlement site purchased and stored by the local government and arranged together with the temporary land for construction. The proposed plot is located beside the existing highway, which is convenient for muck transportation.

6.2.3.2.4 Temporary Storage Yard

Before the subgrade construction of road sections under reconstruction, expansion and new construction of the Project, the topsoil needs to be stripped and temporarily piled up in a centralized way for later land reclamation or ecological restoration. The environmental impacts of temporary dump are mainly temporary land occupation, construction noise, transportation dust, etc. There is a small amount of topsoil produced in the Project, and the balance between excavation and filling can be achieved. There is no temporary storage yard in the Project, and the topsoil produced during subgrade excavation is temporarily stored in the spoil ground, which can be used for backfilling subgrade and roadside slope after the subgrade works is completed.

6.2.3.2.5 Access Road

Most sections of the Project are subject to the reconstruction and expansion of existing roads, and the distance between new road sections and existing roads is not far. Temporary works are located near existing roads, and existing highways along the border and existing rural roads can basically meet the transportation requirements of construction materials of the Project, so the construction temporary access will not be provided.

6.2.4 Engineering Analysis

6.2.4.1 Analysis of Plan Consistency

6.2.4.1.1 Analysis on Conformity with Urban Planning

The Project is mainly located in Daxin County, Chongzuo City, and mainly passes through Shuolong Town. The main line of the Project is a certain distance away from Daxin County, and has not entered the planning areas of counties, so it has no interference with the planning of the counties along the line. The Project is the upgrading project of existing roads, and it is planned to renovate and expand the existing border roads (Detian to Shuolong Section). The local routes are located within the overall planning of Shuolong Town, which is basically consistent with the planned road network in the overall planning of Shuolong Town. See Figure 6.2-2 for the relationship between the Project and the overall planning of Shuolong Town.

Figure 6.2-2 Relationship between the Project and the Master Plan of Shuolong Town

6.2.4.1.2 Analysis on conformity with highway network planning

According to the layout of "west-east road 15" Tieshan Port-Napo (Longlong) in the *Guangxi Provincial Conventional Highway Network Pla*n, this highway is 1068 km long, starting from the mountain pass at the Guangdong-Guangxi border, passing through Gongguan, Tieshan Port, Beihai, Xichang, Xiniujiao, Qinzhou Port, Longmen, Fangcheng Port, Dongxing, Tongzhong, Aidian, Pingxiang, Shuikou, Shuolong, Yuexu, Longbang and Pingmeng, and finally ending at Longlong of Napo at the Yunnan-Guangxi border. It connects 12 counties and cities, 5 Category-1 ports and 8 Category-2 ports along the border, and multiple 4A scenic areas such as Beihai Yintan Beach, Qinzhou Sanniang Bay, and Daxin Detian Transnational Waterfalls. It is a coastal and border corridor connecting Guangdong and Guangxi sea ports and China-Vietnam border ports, and plays important political, economic and national defense roles. The goal of the *Guangxi Provincial Conventional Highway Network Plan* is to build more highways above Class II for the provincial highway network and give priorities to the construction of trunk roads of the Region, Beibu Gulf Economic Zone, and Xijiang Economic Belt, inter-county networked roads, and roads to ports. The local government has included the Shuolong-Detian-Renai Class II Highway Upgrading Works into the local road network development plan.

It is planned to upgrade to the existing Class III border highway (Detian-Shuolong Section) to meet the planning requirements. The Project is Detian-Shuolong Section of the Shuolong-Detian-Renai Class II Highway Upgrading Works, which conforms to the planning of the local government. The Project is located in Daxin County, Chongzuo City. It starts from Detian Scenic Area, Shuolong Town, Daxin County, connects Detian-Renai Class II Highway, extends eastwards along the existing border highway and passes through Aijiang Village and Shuolong Community, and finally reaches the end point near Rentun of Shuolong Community at the southeast corner of Shuolong Town. It crosses the Shuolong Connecting Line of Component A. See Figure 6.2-3 for the relationship between the Project and the *Guangxi Provincial Conventional Highway Network Plan*.

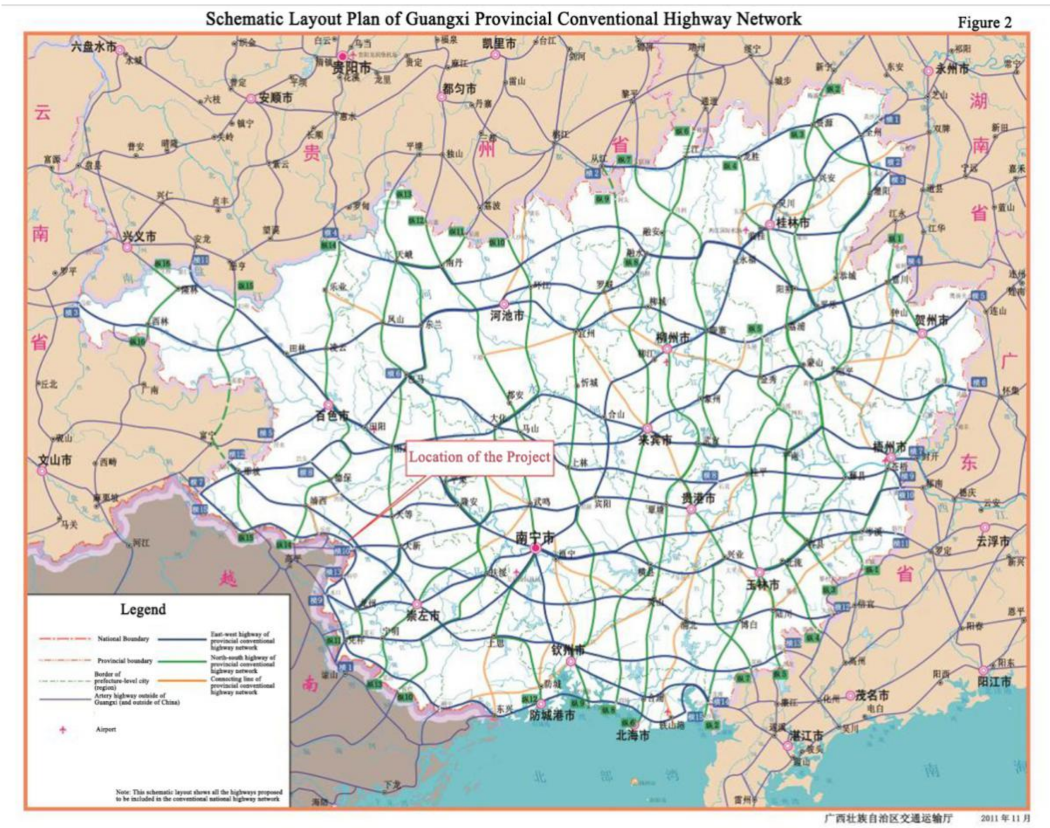


Figure 6.2-3 Location Map of the Project in the Guangxi Provincial Conventional Highway Network Plan

6.2.4.2 Construction Scheme

6.2.4.2.1 Construction Procedure

See Figure 6.2-4 for the construction procedure of the Project.

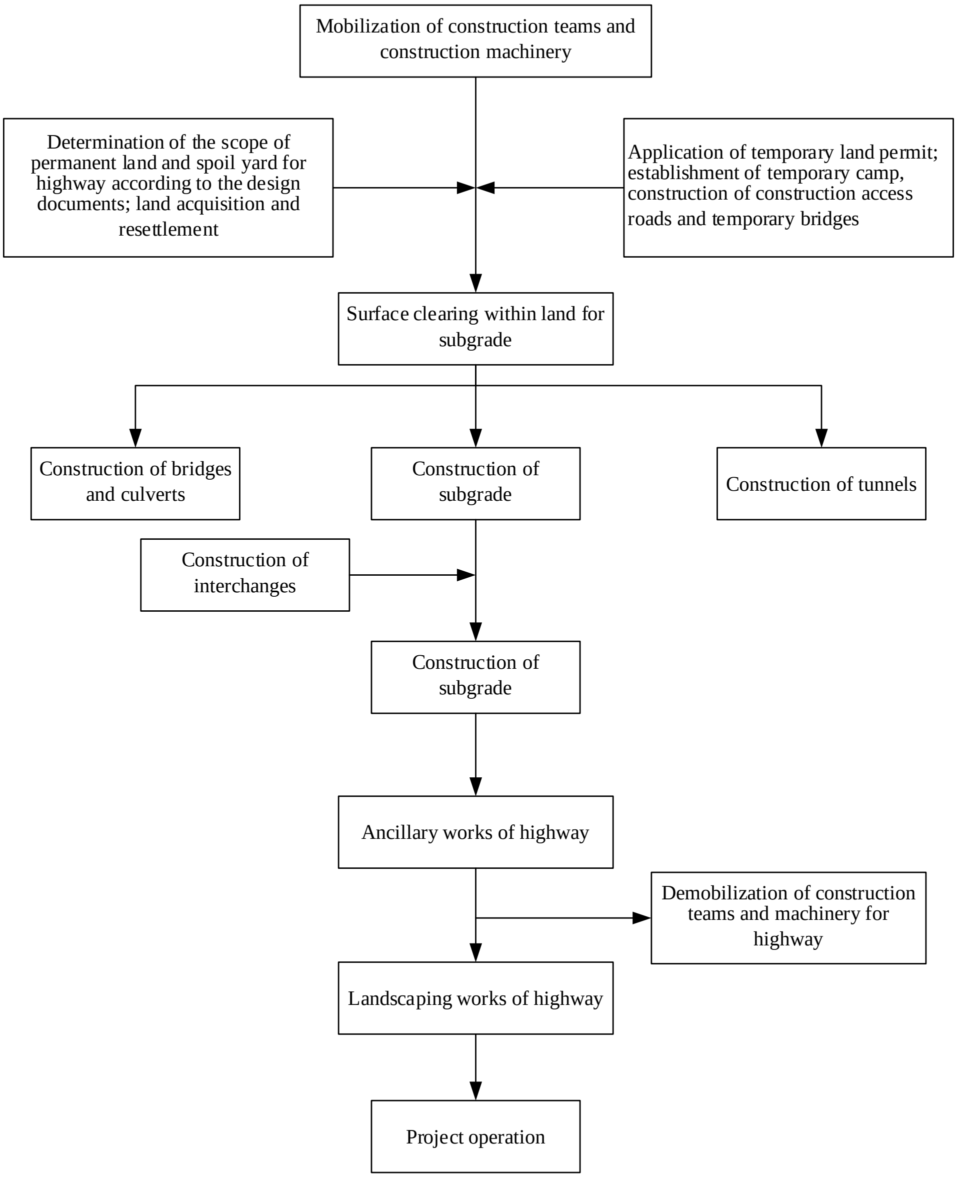


Figure 6.2-4 Schematic Diagram of Construction Process of the Project

6.2.4.2.2 Construction technologies

Main construction process is as follows.

1. Subgrade Clearing Works

In addition to bridge and tunnel sections, the original topsoil (such as planting soil) must be stripped before subgrade filling or excavation, and the thickness is generally about 40~50cm. The topsoil shall be stripped by bulldozers and other construction machinery, and transported by dump trucks to the temporary storage yard, so as to be used for greening or reclamation in the later stage of the project. And the soft soil subgrade shall be treated.

2. Subgrade

Mechanized construction shall be adopted for earthwork of subgrade engineering. Excavators and loaders shall be adopted to cooperate with dump trucks for transportation, bulldozers and graders shall be used for leveling, and road rollers shall be used for compaction. The soil cutting construction can be completely carried out by bulldozer. However, blasting method shall be adopted for rock cutting of high excavation. According to different topographic and geological conditions, different blasting methods shall be adopted, so that the broken rock particles can meet the requirements of clearing, and the earthwork can be removed mechanically.

3. Subgrade Protection and water drainage

In the early stage of subgrade construction, after excavation of culvert foundation, the water flow on both sides of subgrade is often connected through embedded small concrete pipes, and temporary intercepting and drainage ditches are excavated at the cutting slope and the lower slope of subgrade to guide the water flow and prevent the rain from scouring the subgrade. The subgrade surface will be covered with straw or geotextile in rainy season to prevent rain erosion. With the continuation of subgrade works, the culvert foundation will be laid according to the design, and the corresponding circular concrete pipe will be laid (for circular pipe culvert), or the culvert body will be constructed, and the filler on both sides will be backfilled and the reinforced concrete slab will be installed (for slab culvert). At the same time, with the basic formation of subgrade, precast concrete will be used for drainage facilities such as intercepting and drainage ditches, which will be constructed manually by line hanging. According to different design requirements, mortar rubble facing wall or retaining wall will be adopted for subgrade slope toe, and stone masonry and mortar structure will be adopted for framework slope protection.

4. Tunnels

The tunnel works of the project are all constructed by the New Austrian Tunneling Method. The construction method is summarized as the arched roof in advance of wall tunneling; namely, during the excavation of the portal, a small area of rock mass of the upper arch body is excavated first, and the excavated upper arch body is immediately supported and protected; and then the whole portal is excavated and the side wall is protected. The tunnel body is excavated and protected gradually by repeating the above construction method.

When excavating rock mass during construction, since rock mass is the main bearing unit in the tunnel structure system, in order to fully protect rock mass, reduce disturbance to rock mass and avoid excessive damage to its strength, methods such as smooth blasting, presplitting blasting or mechanical excavation shall be adopted.

In the process of supporting and protecting the chamber, anchor bolts, meshes and wet shotcrete shall be used for initial support, and supporting measures such as steel grating, large pipe sheds and small conduits for grouting shall be taken for supplementation; at the same time, in order to improve the mechanical performance of the supporting structure and maintain the stability of the tunnel, the supporting structure of the excavation face shall be enclosed as soon as possible to form a closed cylindrical structure.

5. Pavement works

During construction, the subbase course and base course are paved by pavers in layers, and compacted by rollers; the prime coat oil shall be sprayed by spreaders on each surface course. Pavers are equipped with dump trucks to continuously pave the asphalt mixture, and rollers are used for compaction. The asphalt mixture and cement are provided by the centralized mixing plant.

6. Construction organization for tunnel

(1) Construction General Layout

The general layout of construction mainly includes the site selection of main working face, the layout of spoil area and spoil dumping road, the layout of bulk material stacking yard and material warehouse, the layout of production houses and facilities, etc..

(2) Construction method

a. Construction at the portal: vegetation removal → excavation and protection of the side slope and heading slope of the portal → drainage of the portal.

b. Portal construction: portal construction → open-cut tunnel construction → construction inside the tunnel.

c. Construction of Tunnel Body:

d. Transportation for slag removal: loaders and dump trucks shall be adopted for transportation of slag removed.

e. Support and lining: initial support → bolt-shotcrete support construction → long pipe shed construction → advanced small conduit construction → top and foundation reinforcement of mid-partition.

f. Tunnel lining: formwork erection → steel bar fabrication and installation → concrete pouring.

g. Inverted arch and bottom pavement construction.

h. Construction of tunnel pavement and other ancillary works.

6.2.4.3 Analysis of Environmental Impact Factors

According to the progress of the Project, the environmental impact of the Project is mainly reflected in two stages: construction period and operation period. The environmental impact analysis and identification in two stages are made as follows.

6.2.4.3.1 Construction period

(1) Ecological impacts

See Table 6.2-6 for the ecological impact sources of the main works during construction.

Table 6.2-6 List of Ecological Impact Analysis of Main Works of the Project at Construction Stage

S/N	Project Name		Analysis of Ecological Impacts	Nature and degree of impact
1	Subgrade	Subgrade	Vegetation destruction, farmland occupation, and exposed subgrade cause soil erosion; the wild animals in the land occupation areas may be driven.	The impact is generally irreversible and great.
		Filling	Filling and rolling of vegetation will result in blocking of local natural runoff, and soil erosion is easy to occur.	Vegetation of the slope generated can be restored and the soil erosion can be controlled, but the high-fill section has been greatly affected.
		Excavation	Destroying of landforms and vegetation will easily lead to soil erosion and geological disasters, affecting the growth of vegetation.	There are great hidden dangers of soil and water loss in local deep-cut sections, causing great damage to vegetation.
2	Pavement		Water and soil loss	Medium and controllable impact
3	Tunnel		The vegetation and plants at the tunnel portal are destroyed, the spoil may result in soil erosion, and local geological disasters may occur during construction.	The damage to the tunnel portal is irreversible, but the impact is small and the spoil area can be restored; corresponding measures can be taken to control the geological disasters.
4	Culverts		Soil erosion is easy to occur	Slight and controllable impact

See Table 6.2-7 for ecological impact sources of areas with land occupied by temporary works.

Table 6.2-7 List of Ecological Impact Analysis of Temporary Works of the Project at Construction Stage

S/N	Project Name	Analysis of Ecological Impacts	Nature and degree of impact
1	Construction Road	Vegetation and plants have been destroyed, farmland is occupied, and soil erosion occurs.	Permanent loss of vegetation in permanently occupied areas, restorability of vegetation in temporarily occupied areas, and moderate impact.
2	Spoil Grounds	Vegetation is filled and rolled and soil erosion is easy to occur	After the completion, vegetation can be restored, soil erosion can be controlled and the impact is

S/N	Project Name	Analysis of Ecological Impacts	Nature and degree of impact
			small.
3	Construction camp	The vegetation and plants in the land occupation area are destroyed, and soil erosion is easy to occur.	After the completion, vegetation can be restored, soil erosion can be controlled and the impact is small.
4	Surrounding areas of the tunnel	The vegetation and plants in the land occupation area are destroyed, farmland is occupied, and soil erosion is easy to occur.	After the completion, vegetation can be restored, soil erosion can be controlled and the impact is small.

(2) Impact on water environment

There are pollution sources such as bridges crossing surface water bodies, tunnels crossing mountains, and discharge of production and domestic sewage in construction camps. The specific forms of pollution sources in the Project are as follows:

① The impact of tunnel construction on water environment is mainly manifested in water gushing in tunnel and construction wastewater discharge. One single-way dual-lane short tunnel with a length of 395m shall be set in the Project. Under normal circumstances, the amount of wastewater produced in short tunnel construction is about 100 m3/d.

② Special mixing plants, storage yards, construction machinery, vehicle parking and maintenance areas and living areas are set up in large construction camps. Among them, flushing wastewater will be produced during the production of material mixing plant, containing high-concentration SS and COD; wastewater containing petroleum substances will be produced during equipment washing and maintenance in construction machinery and vehicle parking and maintenance areas; when the storage yard without protection is washed by rain, the rainwater runoff on the road surface of the sand and gravel stacking point mainly consists of sewage containing SS; sewage discharged from the living areas of construction personnel mainly contains COD, BOD5 and N-NH3.

The construction camp is also the main source of sewage in the Project, and the direct discharge of sewage will also have a great adverse impact on the receiving water body; if the construction camp is arranged near the river-crossing bridge, it is more likely to pollute the adjacent water body.

In the Project, if the number of construction workers is 30, the domestic water consumption is 150 L/d per person and the domestic sewage is 80% of water consumption, the domestic sewage discharge of construction personnel is 3.6t/d, and the annual sewage discharge is 1,314t. According to comparison with similar projects, the composition and concentration of domestic sewage discharged from the proposed construction camp in the

Project are shown in Table 6.2-8.

Table 6.2-8 Composition and Concentration of Domestic Sewage in Construction Camp

S/N	Component	Concentration (mg/L)
1	Suspended Substance	100
2	BOD_5	110
3	COD_{Cr}	250
4	NH_3-H	25
5	Animal and vegetable oil	50

④ Impact on drinking water source protection areas

According to the *Plan for Division of Conservation Areas of Centralized Drinking Water Sources in Villages and Towns in Daxin County* and the project route plan. The K0+480~K5+360 section of the Project will pass through the secondary land protection area of Aitun Drinking Water Source Conservation Area in Shuolong Town, and the K9+400~K10+000 section will pass through the secondary land conservation area of Shuolong Community Drinking Water Source Conservation Area in Shuolong Town. Subgrade excavation and filling construction and bridge and tunnel construction in the crossing section may cause an increase in the concentration of suspended solids in the regional water environment, which will have an impact on the water environment at the water intake.

(3) Impact on ambient air

① Construction dust raising

In the project construction stage, the excavation of subgrade, transportation, loading and unloading of road-building materials, concrete mixing, asphalt use and tunnel construction will produce a large amount of dust which will escape into the surrounding atmosphere, and dust pollution may occur in windy days during the stacking of building materials, adversely affecting the atmospheric environment around the construction site and construction road. According to the monitoring results of the construction sites of similar expressway projects without any dust reduction measures, the daily average concentrations of dust at 20m, 150m and 200m downwind the construction site are 13.03mg/m^3, 3.11mg/m^3 and 2.70mg/m^3 respectively.

② Exhaust gas from oil-fired machinery

The construction machinery of the Project mainly includes oil-fired machinery such as excavators, mixers, loaders, road rollers and diesel machines. The oil-fired machinery will produce exhaust gas in the process of operation, and the pollutants discharged mainly include SO_2, CO, NO_X and THC. Since most of the construction machinery is large, the emission coefficient of a single machine is relatively large, but the number of construction machinery is small and such construction machinery is scattered, the pollution is relatively light.

③ Dust raising of concrete mixing station

According to the relevant monitoring data of concrete mixing sites of similar highway projects, for the dust produced by lime-soil mixing plants of highways, the TSP concentrations at 50m, 100m and 150m downwind are 8.90 mg/m^3, 1.65 mg/m^3 and 1.00mg/m^3 respectively.

④ Asphalt fume

Asphalt concrete pavement is used in the Project, asphalt fume pollution will occur in the process of on-site boiling and mixing of asphalt, and a few asphalt fumes will also occur in the process of paving asphalt pavement. The asphalt fume contains pollutants such as total hydrocarbon, total suspended particulates and benzoapyrene, having a certain impact on the air environment.

The asphalt concrete mixing equipment is equipped with an asphalt fume treatment device to collect and purify the asphalt fume uniformly and then discharge it through the exhaust pipe, so as to avoid the unorganized discharge of the asphalt fume as far as possible; in the process of paving asphalt concrete, the ambient air will be affected for a short time, its impact range is small and the duration is short. When paving asphalt, the closed heating and paving devices can be used to reduce the impact on the ambient air and sensitive points of the surrounding environment.

(4) Impact on acoustic environment

Noise during construction mainly comes from the operation of construction machinery and the running of materials transport vehicles. The demolition of buildings is performed by construction machinery such as excavators; large and medium-sized vehicles are mainly adopted for materials transport, and there are many types of construction machinery and equipment for expressways, with high source strength. According to the measured data of common highway construction machinery, the details of pollution source strength are shown in Table 6.2-9.

Table 6.2-9 List of Noise Source Strength of Main Construction Machinery for Highway Works

S/N	Type of Machine	Type	Distance from the measured point to the construction machinery (m)	Maximum sound level Lmax (dB(A))
1	Wheel loader	Type ZL40	5	90
2	Vibrating road roller	Type YZJ10B	5	86
3	Tandem vibratory road roller	Type CC21	5	81
4	Three-wheel roller	/	5	81
5	Tyred roller	Type ZL16	5	76
6	Bulldozer	T140 type	5	86
7	Hydraulic wheel excavator	Type W4-60C	5	84
8	Generator set (2 sets)	Type FKV-75	1	98
9	Impact well drill	Type 22	1	87
10	Concrete mixer	Type JZC350	1	79
11	Paver	SSP220C-5	1	80

Blasting operations may be needed in local tunnel works and sections where rock slopes are excavated. According to relevant data, the instantaneous sound level of sudden blasting can reach 130dB(A), resulting in a great instantaneous impact on the surrounding acoustic environment; therefore, the blasting noise is also the main source of construction noise pollution.

(5) Impact of solid waste

The solid waste of the Project mainly comes from the abandoned earthwork of the Project and the domestic garbage in the construction camp.

There are a large number of abandoned earthworks widely distributed in the Project, mainly from subgrade excavation, replacement in sections with unfavorable geology, bridge pile foundation construction, tunnel excavation and other procedures. The total volume of abandoned earthworks in the Project is 64,300 m^3.

In this evaluation, according to comparison with similar projects, if the number of construction workers is 30 and the per capita domestic garbage output is 1 kg/d, the total domestic garbage output is 30 kg/d and 10.95 t/a, and the total volume of garbage during construction is 16.43t.

6.2.4.3.2 Operation Period

(1) Ecological impacts

After the operation of the Project, obvious ecological effect of corridor will be produced on the roadside, and invasion of alien species will become possible. At the same time, the roadside habitat will be divided, the local habitat will be fragmented and some animal activities will be obstructed. Other adverse effects are mainly reflected in the change of land use pattern around the Project and the consequent change of ecological pattern with the change of traffic environment and the deepening of planning and development activities on both sides of the road.

The impact of the Project on aquatic ecology is mainly reflected in the cross-river section, and the road runoff sewage may pollute the water quality of such section. Under normal circumstances, the bridge deck runoff water of Shuolong Medium Bridge crossing the Guichun River along the highway will not affect the downstream rivers, and will not change the existing water quality category or affect the aquatic organisms in the water body; however, once an accident occurs in the waters across which the bridges span, oil and loaded materials may leak, resulting in pollution of the bridge deck or road surface. After rainfall, rainwater flows into the nearby waters through the highway outlet, which will cause pollution from SS, oil and COD at varying degrees, resulting in pollution on the water quality of the above-mentioned water bodies and aquatic organisms in these water bodies.

(2) Surface water environment

① Runoff sewage generated by rainfall scouring the road surface

The factors affecting the pollution degree of road runoff include rainfall intensity, rainfall duration, traffic flow, interval between two rounds of rainfall, road width, and length of polluted road section. According to the measurement of road runoff pollution in southern China by South China Institute of Environmental Sciences of the Ministry of Environmental Protection, the concentrations of pollutants within one hour at the initial stage of rainfall and at subsequent stages are shown in Table 6.2-10.

Table 6.2-10 Concentrations of Rainwater Pollutants on Road Surface Unit: mg/L

Item	5~20 minutes	20~40 minutes	40~60 minutes	Mean Value
pH Value	7.0~7.8	7.0~7.8	7.0~7.8	7.4
SS(mg/L)	231.42~158.22	185.52~90.36	90.36~18.71	100
COD_{Cr}(mg/L)	7.34~7.30	7.30~4.15	4.15~1.26	5.08
Petroleum (mg/L)	22.30~19.74	19.74~3.12	3.12~0.21	11.25

Note: when the traffic volume and rainfall are known, if the rainfall lasts for 1 hour and the rainfall intensity is 81.6 mm, water samples shall be collected at different times within 1 hour.

② Sewage from transportation service facilities

There are no service areas, toll stations and other transportation service facilities in the Project, and there is no sewage from transportation service facilities.

(3) Ambient air

There is no transportation service facility in the Project. After the Project is put into operation, the automobile exhaust of vehicles travelling on the highway has a certain negative impact on the atmospheric environment on both sides along the route, and the main pollutants from the automobile exhaust are CO and NO_2.

① Formula for Calculating Pollution Source Intensity

The pollution caused by the tail gas emitted by vehicles on the highway can be treated as a line source, and the emission source strength of gaseous pollutants in the tail gas can be calculated according to the calculation formula for line source strength of pollutants emitted by vehicles in the *Specifications for Environmental Impact Assessment of Highways* (JTGB03-2006):

$$Q_j = \sum_{i=1}^{3} 3600^{-1} A_i E_{ij}$$

Where, Q_j— Emission source intensity of type j gaseous pollutant, mg/(s.m);

A_i— Hourly traffic volume of the forecast year for type i vehicle, vehicle/h;

E_{ij} — Single vehicle emission factor of type j emission, type i vehicle in the forecast year, mg/(Vehicle.m).

② Selection of Single Vehicle Emission Factors

The single vehicle emission factor parameters for vehicle pollutants of the Project are those recommended by the *Emission Limits and Measurement Methods of Exhaust Pollutants from Compression Ignition Engines for Vehicles* (GB17691-2005) and the *Emission Limits and Measurement Methods of Light Vehicle Pollutants (China's Sixth Stage)* (GB18352.6-2016). From July 1, 2020, the requirements of phase 6a are met, and from July 1, 2023, the requirements of phase 6b are met. The Project is scheduled to be completed in December 2021, and its initial operation period starts from July 1, 2023, meeting the requirements of 6b. The Project will be put into service in December 2021; therefore, the single vehicle emission factors at the initial operation stage and at the mid-long-term operation stage of the Project are determined according to the "6a" standard and "6b" standard, as shown in Table 6.2-11.

Table 6.2-11 List of Single Vehicle Emission Factors of Exhaust Pollutants from Motor Vehicles

Standard value of Stage VI (mg/km per vehicle)	**Category**	**Level**	**Test quality (TM)/(kg)**	**6a**		**6b**	
				CO	**NO_x**	**CO**	**NO_x**
	Type I Vehicle	—	All	700	60	500	35
	Type II Vehicle	I	TM≤1305kg	700	60	500	35
		II	1305 kg＜TM≤1760 kg	880	75	630	45
		III	1760 kg＜TM	1000	82	740	50

The emission source strength of CO and NO_2 of the Project shall be calculated according to the predicted traffic volume and single vehicle emission factors of pollutants in each forecast year, as shown in Table 6.2-12. (NO_2=0.88×NOX is taken in this evaluation).

Table 6.2-12 List of Emission Source Strength of Exhaust Pollutants from Motor Vehicles in Forecast Years Unit: mg/(s m)

Year of Prediction Route Section	**Year 2023**		**2029**		**2038**	
	CO	**NO_2**	**CO**	**NO_2**	**CO**	**NO_2**
Detian-Tourist Center	0.0273	0.0017	0.0366	0.0023	0.0505	0.0031
From the Tourist Center to the north bank of Shuolong Medium Bridge	0.0439	0.0027	0.0607	0.0037	0.0875	0.0054

(4) Impact on acoustic environment

At the operation stage, the noise source mainly comes from the traffic noise generated by motor vehicles running on the road. Traffic noise is related to many factors, such as vehicle speed, traffic flow, vehicle type, road structure, pavement structure, buildings on both sides of the road, terrain and so on. See Table 6.2-13 for the average radiation noise level of various types of vehicles. $\overline{L_{oi}}$

Table 6.2-13List of Average Radiation Sound Levels of Various Types of Vehicles Unit: dB(A)

Vehicle category	**Average radiation sound level**	**Remarks**
Small-sized vehicle	L_{OS}＝12.6＋34.73lgVs	Vs: average driving speed of small vehicle
Medium-sized vehicle	L_{OM}＝8.8＋40.48lgV_M	VM: average driving speed of medium vehicle
Large-sized vehicles	L_{OL}＝22.0＋36.32lgV_L	VL: average driving speed of large

		vehicle

According to the above calculation formula, as well as the traffic volume of each road section in each characteristic year, the radiation noise levels of different vehicle types of each road section of the Project in each characteristic year are shown in Table 6.2-14.

Table 6.2-14List of Radiation Sound Levels of Different Types of Vehicles in Each Road Section of the Project Unit: dB(A)

Road section and vehicle type \ Prediction Year			Year 2023		2029		2038	
			Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime
Section from Detian to the Tourist Center	General road section	Small-sized vehicle	65.67	65.74	65.61	65.72	65.51	65.68
		Medium-sized vehicle	64.49	64.23	64.64	64.33	64.83	64.46
		Large-sized vehicles	71.97	71.80	72.07	71.86	72.20	71.94
	Class I water source section	Small-sized vehicle	61.26	61.37	61.18	61.34	61.05	61.30
		Medium-sized vehicle	59.59	59.28	59.74	59.39	59.91	59.51
		Large-sized vehicles	67.56	67.34	67.67	67.41	67.79	67.50
	Urban section	Small-sized vehicle	65.42	65.65	65.23	65.58	64.89	65.47
		Medium-sized vehicle	64.93	64.54	65.10	64.69	65.25	64.88
		Large-sized vehicles	72.31	72.03	72.44	72.13	72.57	72.26
	Section restricted by topography	Small-sized vehicle	61.33	61.40	61.27	61.38	61.17	61.34
		Medium-sized vehicle	59.43	59.18	59.59	59.28	59.77	59.40
		Large-sized vehicles	67.43	67.26	67.53	67.32	67.67	67.40
Section from the Tourist Center	General road section	Small-sized vehicle	71.81	71.87	71.77	71.85	71.68	71.82
		Medium-sized vehicle	71.53	71.31	71.67	71.40	71.87	71.52

Road section and vehicle type \ Prediction Year			Year 2023		2029		2038	
			Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime
to the north end of Shuolong Medium Bridge		Large-sized vehicles	78.30	78.16	78.40	78.21	78.54	78.30
	Separation section	Small-sized vehicle	71.68	71.81	71.54	71.77	71.29	71.68
		Medium-sized vehicle	71.88	71.53	72.07	71.68	72.28	71.87
		Large-sized vehicles	78.54	78.31	78.68	78.40	78.85	78.54
	Urban section	Small-sized vehicle	71.81	71.87	71.77	71.85	71.68	71.82
		Medium-sized vehicle	71.53	71.31	71.67	71.40	71.87	71.52
		Large-sized vehicles	78.30	78.16	78.40	78.21	78.54	78.30

(5) Solid Waste

There are no service areas, toll stations and other service facilities in the Project, and no domestic garbage from service facilities. Domestic garbage is mainly garbage randomly discarded by vehicles on the highway, and it is difficult to quantify, so it is planned to assign maintenance workers to clean up regularly.

6.2.4.3.3 Summary of Pollution Sources

Table 6.2-15 Summary of Intensity of Main Pollution Sources in Construction Period

Pollution Sources	Pollution Stage	Main Pollution	Source Intensity and Influence
Waste gas	Construction dust	TSP	It has a great adverse impact on the atmospheric environment within 150m of the roadside.
	Dust from mixing station	TSP	It has an adverse impact on the ambient air in the downwind direction of 150m
	Asphalt paver	Asphalt fume	It is mainly produced in the paving process; as the asphalt sets, the effect disappears.
Noise	Noise of construction machinery	Leq	76~98dB(A); the instantaneous sound level of sudden blasting can reach 130dB(A)
Waste water	Domestic sewage produced by construction personnel	SS、COD、BOD	The total output is 1314 t; it is used for forest land fertilization after septic tank treatment.
	Production wastewater	SS	Short-term increase of SS in receiving water body
Solid waste	16.43t of domestic garbage produced by construction personnel		It is collected by the Contractor, and placed in the local sanitary landfill for landfill or other harmless treatment.
	Permanent spoil: 64,300m3		It is placed in the spoil area, and then the vegetation is restored or greened.

Table 6.2-16 Summary of Intensity of Main Pollution Sources in Operation Period

Pollution Sources	Emissions (t/d)	Annual emission (t/a)	Disposal Method
Waste water	There are no service facilities and no domestic sewage is discharged.		
Solid waste	A small quantity	A small quantity	It is discarded at will by passengers of vehicles traveling on the highway and cleaned regularly by maintenance workers
Waste gas	Automobile exhaust and CO emissions: 0.0273 - 0.0875mg/(s·m), NO2 emissions: 0.0017 - 0.0054 mg/(s·m);		
Noise	Traffic noise: 59.18 - 78.85dB(A)		

6.3 Shuolong Port (Phase II of Shuolong Gate)

6.3.1 Project Overview

6.3.1.1 Phase I Project Overview

Daxin Shuolong Port (upgraded) infrastructure project-Shuolong Port (Shuolong Gate) project is located near the boundary pillar No.845, Guiyue West Road at the border of China and Vietnam, with geographical coordinates of 106°49′23.17″ E and 22°48′59.71″ N. The total investment of the project is RMB 274.5 million, with a total land area of 17,755.88 m^3 and a floor area of 13,767.1 m^3. It mainly includes the construction of gateway, passenger clearance building, inbound and outbound concourse hall, inspection hall with motor vehicle passage, port service center, parking lot, public restroom, duty-free shops, customs supervision facilities, and inspection and quarantine facilities. On April 17, 2017, the Reply on Proposal for Daxin Shuolong Port (Upgrading) Infrastructure Project - Shuolong Port (Shuolong Gate) Project (XFGZ [2017] No. 33) issued by the Development and Reform Bureau of Daxin County was obtained. On May 23, 2017, the Reply on Environmental Impact Report for Daxin Shuolong Port (Upgrading) Infrastructure Project - Shuolong Port (Shuolong Gate) Project (XHGP [2017] No. 7) issued by Daxin County Environmental Protection Bureau was obtained. The Project (Phase I) was commenced in 2018 and the main structure of Phase I works has been completed now. The completed woks are shown in Table 6.3-1.

The passenger clearance building has been built in the Phase I of the Project and the supporting environmental protection works include three-stage septic tank, sewage pipe network, electrostatic oil fume processor, smoke exhaust pipe, medical waste storage room, garbage collection bins and sound proof, noise elimination and vibration reduction measures.

Table 6.3-1 Main Construction Contents of Passenger Clearance Building

Name	Floor	Scope of Works
Passenger clearance building	1F	Hall, souvenir sales area, riverbank support, entry and exit elevator hall, gate business room, fire control room, entry hall, bank, standby room, inspection and control studio, storage room, foreign affairs meeting room, card archive room, emergency treatment room, luggage inspection and monitoring room, quarantine dog captive room, companion animal inspection room, companion animal vaccination room, companion

		animal temporary storage room, current medical X-ray examination room, and medicine bottle equipment storage room, isolation and check-up room, medical disinfection room, interception storage room, sample room, tax collection room, drug dog standby room, explosion-proof room, search room, business acceptance room, drug inspection room, declaration room for passengers and goods, audio-visual printed matter examination room, case examination room, questioning room, diesel generator room, rest area, entry inspection hall, restroom passage, etc.
	2F	Leisure dining bar, commercial sales area, foreign coffee shop, inspection room, duty-free shop, inspection hall, standby room, inspection and control studio, storage room, foreign affairs meeting room, card archive room, emergency treatment room, luggage inspection and monitoring room, quarantine dog captive room, companion animal inspection room, companion animal vaccination room, companion animal temporary storage room, current medical X-ray examination room, and medicine bottle equipment storage room, isolation and check-up room, medical disinfection room, interception storage room, sample room, tax collection room, drug dog standby room, explosion-proof room, search room, business acceptance room, drug inspection room, declaration room for passengers and goods, audio-visual printed matter examination room, case examination room, exit hall, restroom, etc.
	3F	Activity room, internal dining room, library, duty room, internal leisure activity area, lounge, office, conference room, storage room, computer room, monitoring room, etc.

6.3.1.2 Project Components

The Project is Shuolong Port (Shuolong Main Gate) Phase II under Shuolong Port Infrastructure (Upgrading) Project in Daxin County. It functions as an integrated service area, mainly to provide customs clearance and passenger boarding and alighting services, parking of customs passing vehicles and the development of border port tourism services. The planning land area of Phase II is about 18,533.72 ㎡ (about 27.83 mu), with a total floor area of 11,668.03 ㎡, including the Port Service Center, service station, public restroom, ecological parking lot and ancillary road revegetation project, Guichun River revetment landscape park and basement. The total investment is RMB 107,938,400 only.

6.3.1.3 Main Technical Indicators

See Table 6.3-2 for the main technical and economic indicators and quantities of the

Project.

Table 6.3-2 Main Technical and Economic Indicators and Quantities

S/N	Item		Unit	Quantity	Remarks
1	Total planned land area		m^2	18533.72	
2	Building area		m^2	1503.58	
3	Total building area		m^2	11668.03	
3.1	Above-ground gross floor area		m^2	6138.37	
	3.1.1	Port service center	m^2	5664.90	
	3.1.2	Public restroom	m^2	67.32	
	3.1.3	Service station	m^2	60.0	
	3.1.4	Corridor	m^2	326.72	
	3.1.5	1 # staircase	m^2	19.43	
3.2	Underground building area		m^2	5529.66	
4	Building density			21.23	
5	Plot ratio			0.63	
6	Greening rate		%	39.63	
7	Total parking spaces for motor vehicles		No.	283	
7.1	Underground motor vehicle parking spaces		No.	220	Small-sized vehicle
7.2	Underground motor vehicle parking spaces		No.	11	
7.3	Underground motor vehicle charging pile parking spaces		No.	26	
7.4	Ground motor vehicle parking spaces		No.	26	Bus
8	Parking spaces for non-motor vehicles		No.	54	
9	Total investment		RMB 10,000	10793.84	

6.3.1.4 Construction Scale and Content

The land area of Shuolong Port (Shuolong Gate) (Phase II) Project is about 18,533.72 m2, with a total floor area of 11,668.03m2, including port service center, service station, public restroom, ecological parking lot and ancillary revegetation works, Guichun River revetment landscape park and basement parking lot. See Table 6.3-3 for the construction contents of the Project.

Table 6.3-3 List of Main Construction Contents of Shuolong Port (Phase II of Shuolong Gate)

S/N	Item	Scope of Works	Remarks
1	Port service center	It covers an area of about 1030.11m2, with six floors and a total floor area of 5664.90m2. The service center includes the commodity exhibition hall, handling hall, supporting offices, conference rooms, multi-function halls, cafes and dormitories.	
2	Service station	Building Area 60 m2. The service stations mainly provide convenient charging piles, daily necessities and medical supplies purchase services for passengers.	
3	Public restroom	Building Area 67.32 m2. Public restrooms are provided with special toilets for the elderly, the weak, the sick, the disabled and the pregnant.	
4	Ecological parking lot	It will set up 26 motor vehicle parking spaces (large vehicle) and 54 non-motor vehicle parking spaces for waiting for inspection of inbound and outbound vehicles, transfer of inbound and outbound tourists and parking of vehicles of staff.	
5	Revetment landscape park	This project is to build an ecological landscape area with transnational characteristics of the Sino-Vietnamese border, and provide new leisure facilities for tourists from home and abroad. Three functional areas will be built along the revetment: the Youyi Park, Gongrong Park, and Hezuo Park, all of which show the landscape with transnational characteristics of the Sino-Vietnamese border to tourists from home and abroad.	
6	Basement	The basement covers a total area of 5529.66 m2, which is used for passenger car parking service. There are 257 car parking spaces, including 220 mechanical parking spaces, 11 parking spaces for ordinary motor vehicles and 26 parking spaces with charging piles	
7	Roads	6469.0m^2	
8	Hardening of the square	4477.0m^2	
9	Landscape works	4735.0m^2	

6.3.1.5 General Layout Plan of the Project

The land area of Shuolong Port (Shuolong Gate) (Phase II) is about 18533.72 m2. The project area consists of port service center, ecological parking lot, communal toilet and service station from south to north. Provincial Highway S219 passes through the north property boundary. The project layout is regular. See the attached drawings for specific layout plan.

6.3.1.6 Personnel Quota and Working System

After the completion of the Project, 30 employees are proposed for service, with an annual working time of 365 d and a daily working time of 16 h from 6: 00 to 22: 00, with two shifts.

6.3.1.7 Utilities

(1)Water supply

The water used in the Project comes from the existing water supply network at the port, which can provide sufficient water for domestic water of the Project. The main water consumption units of the Project include domestic water consumption of employees, water consumption of passengers and water for greening. With reference to *Code for Design of Building Water Supply and Drainage* (GB50015-2010), the water consumption is shown in Table 6.3-4.

Table 6.3-4 Overview of Water Consumption of the Project

Name	Quantity	Water consumption standard	Daily water consumption (m3)	Annual water consumption (m3)
Domestic water for staff	30 persons	200 (L/d· person)	6	2190
Water consumption of passengers	1000 person/d	5 (L/d· person)	5	1825
Landscaping water	4735.0m^2	1（L/m^2）	4.735	1728
Unpredictable water consumption	——	——	1.5	548
Total	——	——	17.235	6291

(2)Drainage

Rainwater-sewage separation system is adopted in the Project. According to the *Master Plan of Shuolong Town, Daxin County (2007-2025)* (Sewage Works Planning Map), the project area belongs to the pollutant receiving scope of Shuolong Town Sewage Treatment Plant in Daxin County. The Shuolong Town Sewage Treatment Plant in Daxin County has been put into service in October 2015. According to the field investigation, the sewage pipe network has been built in the project site. The domestic sewage of the Project will be discharged to Shuolong Town Wastewater Treatment Plant after being treated by three-stage septic tank, and then discharged into Guichun River after being treated to reach the Level I Class B standard specified in *Discharge Standard of Pollutants for Municipal Wastewater Treatment Plant* (GB18918-2002) and its amendment.

Rainwater ditches are provided around the boundary of the Project to collect rainwater from roads, green spaces and sidewalks and then discharge water into Guichun River.

(3) Heat supply

Solar energy and electricity are used as energy sources of the Project to supply heat, and no boiler will be provided.

(4) Electric power

The Project and Phase I Project share a 1250kVA transformer and a 150kw standby diesel generator.

(5) Firefighting

The fire water supply system shall be designed to meet the standards of fire water supply pipe diameter, fire hydrant spacing, water pressure, flow rate, etc. Each fire station is equipped with self-provided water source, and the fire water supply pipe diameter is not less than 100 mm; the water pressure of the fire hydrant at the far end of the Project shall not be less than 0.10 MPa, and the flow rate shall not be less than 25 l/s. A water supply booster station shall be built in the area with low pipe pressure.

(6) Ventilation

All equipment rooms are equipped with mechanical ventilation system with natural air intake. Equipment room is equipped with mechanical air intake and exhaust system. The air exchange rate in the power transformation and distribution room is 12 times /h, and that in the water pump room, generator room and basement is 6 times/h. All toilets are equipped with mechanical exhaust, and the exhaust air volume is calculated according to the air change rate of 10 times/h.

6.3.1.8 Project Construction Period

The Project is planned to be commenced in December 2021, and be completed February 2023.

6.3.2 Project Analysis

6.3.2.1 Analysis of Plan Consistency

The Project is located in Shuolong Town, Daxin County, Chongzuo City. According to the *Master Plan of Shuolong Town, Daxin County (2007~2025)*, the land for the Project belongs to port land, and part of it is green land. The nature of the land meets relevant planning requirements. See Figure 6.3-1 for the relationship between the Project and the master plan of Shuolong Town.

Figure 6.3-1 Relationship between the Project and the Master Plan of Shuolong Town

6.3.2.2 Construction Scheme

6.2.5.2.1 Construction Procedure

See Figure 6.3-2 for the construction procedure of the Project.

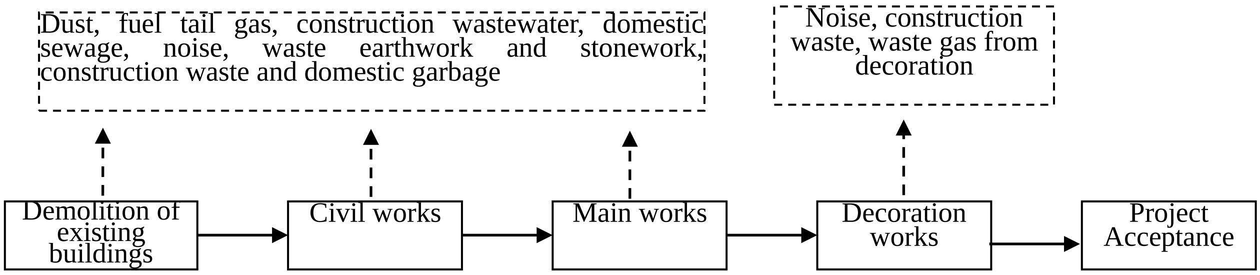


Figure 6.3-2 Construction Procedure and Pollution Yielding Nodes in Construction Period

6.2.5.2.2 Construction technologies

Main construction process is as follows.

(1) Demolition of existing buildings

Demolition of existing buildings on the project site, including joint inspection office buildings, frontier defense office buildings, dormitories and private houses.

(2) Civil works

Earthwork excavation on site, site leveling, pipeline laying, etc.

(3) Main works

The main works includes steel bar, steel-wood works and masonry works of port service center and supporting facilities.

(4) Decoration works

The work in decoration stage includes exterior wall decoration, interior decoration, installation of water and electricity and other supporting facilities.

(5) Project acceptance

Quality acceptance of buildings, environmental protection works and other facilities.

6.3.2.3 Analysis of Environmental Impact Factors

According to the progress of the Project, the environmental impact of the Project is mainly reflected in two stages: construction period and operation period. The environmental impact analysis and identification in two stages are made as follows.

6.2.5.3.1 Construction period

(1) Ecological impacts

The construction of the Project will change the way of land use. The construction process, such as construction site leveling and foundation excavation, will have a certain impact on vegetation, and it will destroy the vegetation within and around the work scope, resulting in increase of bare ground, which is prone to water and soil erosion in case of rain wash.

(2) Impact on water environment

① Construction waste water

During the construction period, the work involving water consumption and drainage is mainly construction of structures, and almost no construction waste water is produced from earthwork. The construction waste water mainly comes from concrete curing, mechanical flushing, site flushing, waste oil from escape, spill, drip or leakage of construction machinery. Ready-mixed concrete is supplied during the construction period, so less waste water is produced during the construction period. The estimated output is about 3m3/d, and the construction period is about 450 days, so the amount of construction waste water produced during the construction period is 1350m3. The main pollutants are COD, SS and petroleum. After being collected by sedimentation tank, the construction waste water is reused for tool washing and as spraying water to reduce dust in the construction site, so as to realize comprehensive utilization.

② Domestic sewage during construction period

During the construction period, there will be about 50 workers, and temporary office buildings and dormitories will be provided on site. Temporary construction camps are provided on site. During the whole construction period, domestic sewage will be generated from the living of construction workers. It is learned that there are about 50 construction workers per day on site. The domestic water consumption during the construction period is calculated as 200 L/ (person·day), and the construction period is about 450 days, so the water consumption is 20 m^3/d, 80% of which is discharged as sewage; the domestic sewage discharge by the construction workers is 12 m^3/d, and the domestic sewage discharge during the whole construction period is 4200 m^3. During the construction period, domestic sewage will be discharged into Shuolong Town Sewage Treatment Plant through municipal sewage pipe network after being treated by septic tank. The production and discharge of domestic sewage during the construction period are shown in Table 6.3-5 below.

Table 6.3-5 Production and Discharge of Domestic Sewage during Construction Period

Category	Item	COD_{Cr}	BOD_5	SS	NH_3-N
Sewage discharge volume 12m^3/d	Generation concentration (mg/L)	300	200	200	30
	Output (kg/d)	3.6	2.4	2.4	0.36
	Treatment measures	Three-level septic tank			
	Emission concentration (mg/L)	200	100	100	20
	Discharge (kg/d)	2.4	1.2	1.2	0.24
	Discharge destination	Shuolong Town Sewage Treatment Plant			

(3) Impact on ambient air

① Dust

Dust generated by demolition, construction of structures on site, in construction site and at the access section of the construction site under the action of wind; dust generated by handling and stacking of building materials, stacking and cleaning of construction waste, and passing vehicles.

The main characteristics of this kind of dust are that the dust is related to meteorological conditions such as wind speed, and also related to the settlement speed of dust particles, and the main influence range is within the close downwind range of the dust point. See Table 6.3-6 below for the variation of dust concentration with distance.

Table 6.3-6 List of Variation of Dust Concentration with Distance, Unit: mg/m3

Distance from dust point	25m	50m	100m	200m
Concentration range	0.38~1.20	0.31~0.99	0.22~0.75	0.19~0.28
Mean Value	0.76	0.65	0.47	0.23

②Fuel tail gas from construction vehicles and machinery

All kinds of construction machinery (such as loaders, excavators, trucks, etc.) mainly use diesel oil as fuel, and the exhaust emission of construction vehicles also pollutes the atmospheric environment in the project area. Harmful substances in exhaust gas mainly include CO, HC, NOx, etc. It will have a temporary impact on the health of people around the project site.

③Waste gas from decoration

Decorative materials such as plywood, coating and paint used in the decoration work contain a certain amount of volatile toxic gases such as formaldehyde, benzene and toluene.

(4) Impact on acoustic environment

During the construction period, construction noise is the main impact factor on acoustic environment, and it mainly comes from construction machinery and transport vehicles. The noise generated by construction machinery is related to the type and quantity of machinery used in construction stage. Loader, excavator, bulldozer, etc. are mainly used for civil works; static pressure pile driver, vibrator, electric saw, electric planer and electric welding machine are mainly used for main works; electric saw, electric hammer, multifunctional woodworking planer, crane, lift, etc. are mainly used for decoration works. When multiple mechanical equipment are operated at the same time, the noise will be superimposed (according to the analogy survey, the added value of the superimposed noise is about 3~8dB(A). See Tables 6.3-7 and 6.3-8 below for specific noise levels of main construction machinery and transportation vehicles.

Table 6.3-7 Noise Level of Main Construction Mechanical Equipment

Construction stage	Sound source	Noise source intensity, dB (A)	Frequency characteristics	Noise duration
Civil works	Loader	90~100	Low/medium frequency	Discontinuity
	Excavator	100	Low/medium frequency	Discontinuity
	Bulldozer	102	Low/medium frequency	Discontinuity
Main works	Static pressure pile driver	85	Low/medium frequency	Discontinuity
	Vibrator	95~100	Medium/high frequency	Discontinuity
	Electric saw, electric dig	90~100	Low/medium frequency	Discontinuity
	Electric welding machine	90	Low/medium frequency	Discontinuity

Decoration Works	Electric saw, electric hammer	85~100	Low/medium frequency	Discontinuity
	Multifunctional woodworking planer	90~95	Low/medium frequency	Discontinuity
	Crane, elevator, etc.	90~100	Low/medium frequency	Discontinuity

Table 6.3-8 List of Noise Level of Various Transport Vehicles in Construction Period

Construction stage	Item	Vehicle type	Noise level dB (A)
Civil works	Outward transport of earth	Large-scale loader	90
Main works	Steel bar, ready-mixed concrete	Concrete tank truck, loader	80~85
Decoration Works	Decorative materials, equipment	Light loader	75

The dominant vibration source during construction comes from pile foundation works. The vibration level at 10m from construction machinery is 75dB (a)~90dB (a), therefore, during construction, the acoustic environment within this range will be affected by the vibration of construction machinery to varying degrees. Especially at night with low background noise, the impact of noise and vibration is more prominent.

(5) Impact of solid waste

① Earthwork and Stonework

The amount of earthwork and stonework produced during the construction period is 14,800 m3. One part of the earthwork and stonework is used for leveling the ground in the south, and the other part is used for greening inside the project site. During the construction period, earthwork and stonework is disposed inside the site, and there is basically no waste earthwork and stonework.

② Construction Waste

Demolition and construction work produce building debris, broken bricks, stones, waste steel bars and other garbage, while house decoration produces decoration waste. About 600t of construction waste is produced in the demolition work. The amount of waste generated from construction of the newly-built buildings per unit floor area is calculated as 25 kg/m2, the total floor area of the Project is about 11,668 m^2, so the construction waste generated from construction of the newly-built building is 292 t. To sum up, the total amount of construction waste generated during the construction period is about 892 t.

③ Domestic Garbage

The number of construction workers is proposed as 50, the daily amount of domestic garbage is calculated as 0.5kg/ person, so the total daily amount of domestic garbage is 25 kg, and the total amount in construction period is 11.3 t.

6.2.5.3.2 Operation Period

(1) Surfacewater environment

Sewage comes from water consumption of employees and passengers, and its main pollution factors are COD, BOD_5, SS and NH_3-N. The water consumption of employees and passengers in the Project is 4015 m^3/a, and the sewage discharge is 80% of the water consumption, so the domestic sewage discharge of the Project is 3212 m^3/a (8.8m^3/d). See Table 6.3-9 below for the production and discharge of domestic sewage of the Project.

Table 6.3-9 Production and Discharge of Domestic Sewage during Operation Period

Category		Item	COD_{Cr}	BOD_5	SS	NH_3-N
Domestic sewage	Sewage discharge 3212m3/a	Generation concentration (mg/L)	300	200	200	30
		Output (t/a)	0.96	0.64	0.64	0.10
		Treatment measures	Three-level septic tank			
		Emission concentration (mg/L)	200	100	100	20
		Discharge (t/a)	0.64	0.32	0.32	0.06
		Discharge destination	It is discharged into Shuolong Town Sewage Treatment Plant through municipal sewage pipe network			

(2) Ambient air

The exhaust gas of the Project mainly from automobile exhaust in parking lots, stench from communal toilets and garbage collection points, and exhaust gas from standby diesel generators.

① Vehicle exhaust

The Project is a port project, and the vehicles passing by are basically light vehicles (gasoline-fueled vehicles). Automobile exhaust mainly refers to the exhaust emission of the automobile at idle speed and slow speed (≤5km/h) when the automobile is driving in the project site, including exhaust of exhaust pipe, leakage of crankcase, leakage of fuel system such as oil tank and carburetor. The main pollution factors of automobile exhaust are CO, NOx, hydrocarbons, etc.

② Stench

One communal toilet is provided in the east of the project site, and one male/female restroom is provided on 1F-6F of the port service center. The communal toilets in the Project are built based on Class I water-flush toilet specified in *Hygienic Standard for Communal Toilet in City Municipality* (GB/T17217-1998), and the emission concentration of H2S and NH_3 are 0.01 mg/m^3 and 0.3 mg/m^3, respectively. The exhaust gas (H_2S and NH3) in the restroom mainly comes from feces accumulated in the closet pan, urine accumulated in the urinal and urine scale attached hereto. The output and concentration of H_2S and NH_3 are related to sanitary conditions, ventilation conditions, temperature and humidity in toilets. The output of exhaust gas in toilets can be reduced through daily cleaning, and the exhaust gas is discharged to the outside for unorganized emission through the exhaust fans.

The domestic garbage in the Project has high organic content, so it is easy to decay and decompose, resulting in bad smell and other negative environmental impacts. If the domestic garbage is not properly treated, it is easy to rot and deteriorate to produce malodorous gas, which is a mixture of multi-component and low-concentration chemicals, among which the main components are ammonia, hydrogen sulfide, methyl mercaptan, trimethylamine and other aliphatic substances. The domestic garbage shall be classified and stored in garbage bins, and treated every day.

③ Exhaust gas of standby generator

The standby diesel generator of the Project has a short service time, and is only used in case of power failure. The exhaust gas produced by fuel of diesel generator contains dust, SO_2, NOx, CO, HC and other atmospheric pollutants. Compared with similar projects, the emission concentration of pollutants in fuel waste gas of diesel generator set can reach the China III emission limit in Table 2 of Limits and Measurement Methods for Exhaust

Pollutants from Diesel Engines of Non-road Mobile Machinery (China III, IV) (GB 20891-2014). The fuel waste gas of the generator set produces less pollutants, which are led to the roof of the main building through a dedicated gas exhaust pipe.

(3) Impact on acoustic environment

During the operation period, the noise is the traffic noise from vehicles passing by; noise from passengers and business activities; equipment noise produced by the operation of mechanical equipment for ventilation system, water supply, firefighting and air draft and exhaust.

① Noise from vehicles passing by

After the Project is completed, traffic noise will be produced when vehicles pass by. The noise produced by motor vehicles is related to the vehicle type and driving speed. According to the analogy survey, the noise source intensity of motor vehicles is 60~75dB(A). Measures, such as driving at low speed, no honking, sound barriers and greening shall be taken.

② Domestic noise

The level of noise from passengers and business activities is generally 60~70dB(A). Domestic noise is characterized by low intensity, discontinuity and irregularity.

③ Equipment noise

After the Project is completed, the mechanical equipment used in the firefighting facilities and ventilation system will produce certain noise. The main noise sources come from standby diesel generator, fan and water pump, and the noise source intensity of mechanical equipment is 65~95dB(A). Characteristics of noise sources are listed in Table 6.3-10 below.

Table 6.3-10 Characteristics of Noise Sources

Noise source	Sound pressure level [dB(A)]	Nature
Standby diesel generator	90~95	Aerodynamic force
Water pump	80~90	Mechanical/aerodynamic force
Fan	65~70	Mechanical force

(4) Solid waste

The solid waste of the Project is mainly the domestic garbage from dining of staffs and passengers. There are 50 staffs in the Project who do not live in the site. If the daily amount of domestic garbage produced by one person is calculated as 0.5 kg, the amount of domestic garbage from staffs is 25 kg/d, i.e. 9 t/a. The passenger turnover volume of the Project is 1 million people/year, and the garbage output for one time by one person is calculated as 0.1 kg, so the domestic garbage output by passengers is 274 kg/d, i.e. 100 t/a. Therefore, the output of domestic garbage in the Project is 299kg/d, i.e. 109t/a. Domestic garbage shall be collected in a unified way, packed in black plastic bags, placed in a covered trash can, and transported away by the sanitation department every day.

6.1.4.3.3 Summary of Pollution Sources

See Tables 6.3-11 and 6.3-12 for the summary of intensity of pollution sources during construction period and operation period.

Table 6.3-11 Summary of Intensity of Main Pollution Sources in Construction Period

Pollution Sources	Pollution Stage	Main Pollution	Source Intensity and Influence
Waste gas	Construction dust	TSP	It has a great adverse impact on the atmospheric environment within 150m of surrounding area.
	Exhaust gas from construction vehicles	CO、NO_2	It has an adverse impact on the ambient air in the downwind direction of 150m
	Decoration waste gas	Formaldehyde, benzene and toluene	It is mainly produced in the decoration process; as the decoration is completed, the impact disappears.
Noise	Noise of construction machinery	Leq	76~98dB(A); the instantaneous sound level of sudden blasting can reach 130dB(A)
Waste water	Domestic sewage produced by construction personnel	SS、COD、BOD	The output is 4200t; it is discharged into the sewage treatment plant after being treated by septic tank.
	Production wastewater	SS	Short-term increase of SS in receiving water body
Solid waste	11.3t of domestic garbage produced by construction personnel		It is collected by the Contractor, who entrusts the local sanitation department to treat it.

Table 6.3-12 Summary of Intensity of Main Pollution Sources in Operation Period

Pollution Sources	Emissions (t/d)	Annual Emission t/a	Main Pollutants	Generation Amount t/a	Discharge Amount t/a	Disposal Method
Waste water	8.8	3212	COD	0.96	0.64	After being treated by septic tank, it is discharged into Shuolong Town Sewage Treatment Plant through municipal sewage pipe network
			BOD_5	0.64	0.32	
			SS	0.64	0.32	
			NH_3-N	0.10	0.06	
Solid waste	0.299	109	Mainly domestic waste of service facilities;			
Waste gas	Automobile exhaust, odor of restroom and domestic garbage collection point, and exhaust gas of standby diesel generator					
Noise	Traffic noise: 64.45 - 78.58 dB(A)					

6.4. Overview of Detian (Daxin)-Huashan (Ningming) Highway (Shuolong-Tianxi Section) Project

In the recommended scheme for the Detian (Daxin)–Huashan (Ningming) Highway (Shuolong–Tianxi Section), Route K starts from the vicinity of Bami, southeast of Shuolong Town, Daxin County, and is located near the main entrance to the Shuolong Port. It can connect the planned Detian–Shuolong Highway through the existing bridge. The route runs from north to south, passing through Shuolong Town, Kanxu Township, and Baoxu Township within Daxin County, Zhubu Township and Xiangshui Town within Longzhou County, and Tingliang Township within Ningming County, and ends at Tianxi Interchange Exit of Nanning-Friendship Pass Expressway in Tingliang Township, Ningming County. The route is 84.171 km in length and is constructed in three phases. The Phase II works is constructed as a Class-I highway with a design speed of 60 km/h and a subgrade width of 22.5 m. From the design starting point to 105 m towards Shuolong Town, and from the starting point to about 250m towards the Yanying border region residents trade point, the road section of a total length of about 355 m connects Components C and A, being associated to the Project.

The EIA Report of the Detian (Daxin)–Huashan (Ningming) Highway (Shuolong–Tianxi Section) was approved by the Environmental Protection Department of Guangxi Zhuang Autonomous Region in November 2018 (CHH [2018] No.10). According to the *Notice on Printing and Distributing the List of Major Changes of Construction Projects in Some Industries in Environmental Impact Assessment Management* (HB [2015] No. 52) issued by the former Ministry of Environmental Protection, compared with the EIA stage, the construction site and production process proposed in the project construction drawing design scheme shall be subject to major changes, and according to the *Environmental Impact Assessment Law of the People's Republic of China* (revised in 2016), the environmental impact assessment documents of construction projects must be re-submitted for approval. After consulting Chongzuo Ecological Environment Bureau, Guangxi Xingchong Infrastructure Investment Co., Ltd., the Employer, has entrusted Guangxi Transportation Science and Technology Group Co., Ltd. to carry out environmental impact assessment (re-submission for approval) of K0+000~K58+650 of Detian (Daxin)–Huashan (Ningming) Highway (Shuolong–Tianxi Section). At present, the new environmental impact assessment report of the Project is being prepared.

7 Survey and Assessment of Current Environmental Conditions

The survey content of environmental conditions of the Project is mainly extracted from the conclusions about the survey and assessment of environmental conditions in the *Environmental Impact Report of Wuzhou (Longyanzui) – Shuolong Highway (Chongzuo – Jingxi Expressway to Shuolong Port Section)* of Component A, the *Environmental Impact Report of Detian-Shuolong Highway* of Component B, and the *Environmental Impact Report of Daxin Shuolong Port (Upgrading) Infrastructure Project - Shuolong Port (Shuolong Gate) Project* of Component C, and a supplementary survey has been conducted according to the characteristics of the Project. See Appendix 1 for the specific survey content. The Section K0+000~K0+400 of Detian (Daxin)-Huashan (Ningming) Highway (Shuolong-Tianxi Section) Project is connected with Component A and Component C. The environmentally sensitive targets of this section have been included in Component A and Component C, and the survey content of environmental conditions of this project will not listed separately in this chapter.

7.1 Environmental Protection Objectives

7.1.1 Component A – Wuzhou (Longyanzui)-Shuolong Expressway (Chongzuo–Jingxi Expressway to Shuolong Port Section)

7.1.1.1 Acoustic Environmental Protection Objects

There are 12 acoustic and atmospheric environmental protection targets within the scope of assessment along the proposed highway, including 8 sensitive points along the mainline (2 schools and 6 villages) and 4 sensitive points along Shuolong Connecting Line (villages). Refer to Table 7.1-1 for details.

Table 7.1-1 List of Acoustic Environmental Sensitive Points along the Project

S/N	Center Chainage	Description of Sensitive Points	Location Relation with the Project			Form and height difference relative to subgrade /m	Angle of road-side houses to the road	Number of households/persons within the assessment scope		Characteristics of surrounding environment and investigation on drinking water sources of villagers	Measures	Photo
			Orientation	Distance from the highway (m)				Cat. 4a zone	Cat. 2 zone			
				Boundary	Center line							
I. Sensitive points along the main line												
1	K4+700~K4+900	Buli	Left side of the road	141.5	148	Bridge -20	Parallel	/	42/208	The proposed highway passes through the north side of the village in the form of separated bridge. There is a certain elevation difference between the village and the highway. The houses are mainly of brick-concre	The noise level and the quality of the spring water are within the allowed standards, so no measures are required.	

										te structures with 1-3 stories and equipped with aluminum alloy glass windows, part of the houses are of brick-tile structures. Existing environmental noise sources: social activities and traffic. Drinking water source of villagers: mountain spring water.		
2	K5+070~K5+100	Xuanjie teaching school	Left side of the road	82.5	89	Bridge -20	Vertical	/	13 persons	The proposed highway passes through the north side of the school in the form of a separated bridge. There is a	The noise level and the quality of the spring water are within the allowed standards, so no measures	

										certain elevation difference between the sensitive point and the highway. The school is composed of a two-story building with aluminum alloy glass windows, and both teachers and students do not live in the school. Existing environmental noise sources: social activities and traffic; drinking water source: mountain spring water.	are required.	

3	K5+400~K5+460	Buguo	Left side of the road	11	17.5	Bridge -15	Skew	9/45	15/70	The proposed highway passes through the north side of the village in the form of a separated bridge. There is a certain elevation difference between the sensitive point and the highway. The houses in the village are mainly of brick-concrete structures with 1-3 stories and equipped with aluminum alloy glass windows. Existing environmental noise sources: social	The noise level and the quality of the spring water are within the allowed standards, so no measures are required.	

										activities and traffic; drinking water source of villagers: mountain spring water.		
4	K5+200~K5+450	Datun	Left side of the road	140.5	147	Bridge -13	Parallel	/	60/284	The proposed highway passes through the north side of the village in the form of bridge. There is certain elevation difference between the sensitive point and the highway. The houses in the village are mainly of brick-concrete structures with 1-3 stories and equipped with aluminum	The noise level and the quality of the spring water are within the allowed standards, so no measures are required.	

										alloy glass windows. Existing environmental noise sources: social activities and traffic; drinking water source of villagers: mountain spring water.		
5	K5+750~K5+900	Dunli	Right side of the road	167	180	Subgrade -10	Slightly skew	/	45/214	The proposed highway passes through the south side of the village in the form of subgrade. There is certain elevation difference between the sensitive point and the highway. The houses in the village are mainly of	The noise level and the quality of the spring water are within the allowed standards, so no measures are required.	

										brick-concrete structures with 1-3 stories and equipped with aluminum alloy glass windows. Existing environmental noise sources: social activities and traffic; drinking water source of villagers: mountain spring water.		
6	Yixian Village Primary School	K11+880~K11+900	Left side of the road	24	60	Subgrade -12	Vertical	/	9 persons	The proposed highway passes through the west side of the school in the form of a subgrade. There is a certain elevation difference between the	The noise level and the quality of the spring water are within the allowed standards, so no measures are required.	

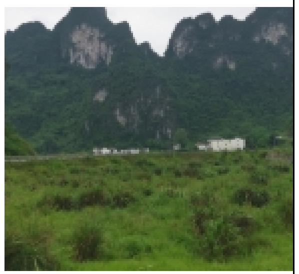
										sensitive point and the highway. The school is composed of a two-story building with aluminum alloy glass windows, and both teachers and students do not live in the school. Existing environmental noise sources: social activities and traffic; drinking water source: mountain spring water.		

7	Guitun	K11+900~K12+050	Left side of the road	79	92	Bridge-13.5	Parallel	/	55/270	The proposed highway passes through the west side of the village in the form of bridge. There is certain elevation difference between the sensitive point and the highway. The houses in the village are mainly of brick-concrete structures with 1-3 stories and equipped with aluminum alloy glass windows. Existing environmental noise sources: social activities and traffic;	The noise level and the quality of the spring water are within the allowed standards, so no measures are required.	

										drinking water source of villagers: mountain spring water.		
8	Bangtun	AK0+100~AK0+250	Right side of the road	13	26	Subgrade -7	Skew	6/30	50/235	The proposed highway passes through the south side of the village in the form of subgrade. There is certain elevation difference between the sensitive point and the highway. The houses in the village are mainly of brick-concrete structures with 1-3 stories and equipped with aluminum alloy glass windows.	Install ventilated sound insulation windows with the installation capacity of 20 m2	

										Existing environmental noise sources: social activities and traffic; drinking water source of villagers: mountain spring water.		
II. Sensitive points along the connecting line												
1	Sanjiadiantun	AK1+780~AK1+820	Left side of the road	82	95	Subgrade -3	Skew	/	3/15	The proposed highway passes through the west side of the village in the form of subgrade. There is certain elevation difference between the sensitive point and the highway. The houses in the village are mainly of brick-concre	Aluminum alloy glass windows have been installed at this sensitive point to meet the requirements of noise reduction, so it is not needed to take additional noise prevention	

										te structures with 2 stories and equipped with aluminum alloy glass windows. Existing environmental noise sources: social activities and traffic; drinking water source of villagers: mountain spring water.	measures	
2	Waitun	AK2+600~AK2+700	Right side of the road	113	129	Subgrade -2	Vertical	10/40	11/45	The proposed highway passes through the east side of the village. There is certain elevation difference between the sensitive point and the highway.	The noise level and the quality of the spring water are within the allowed standards, so no measures are required.	

										The houses in the village are mainly of brick-concrete structures with 1-3 stories and equipped with aluminum alloy glass windows. Existing environmental noise sources: social activities and traffic; drinking water source of villagers: mountain spring water.		
3	Longmei	AK2+950~AK3+150	Right side of the road	166	179	Subgrade -5	Parallel	2/8	18/60	The proposed highway passes through the east side of the village. There is certain elevation	The noise level and the quality of the spring water are within the allowed standards, so no	

										difference between the sensitive point and the highway. The houses in the village are mainly of brick-concrete structures with 1-3 stories and equipped with aluminum alloy glass windows. Existing environmental noise sources: social activities and traffic; drinking water source of villagers: mountain spring water.	measures are required.	

4	Rentun	AK5+020~AK5+180	Right side of the road	1	7.4	Subgrade	Parallel	3/15	27/137	The proposed highway passes through the east side of the village in the form of subgrade. There is certain elevation difference between the sensitive point and the highway. The houses in the village are mainly of brick-concrete structures with 1-3 stories and equipped with aluminum alloy glass windows. Existing environmental noise sources: social activities; drinking	Install ventilated sound insulation windows with the installation capacity of 90 m2	

										water source of villagers: mountain spring water.		

7.1.1.2 Surface Water Environmental Protection Objects

The water environmental protection targets within the assessment scope of the Project mainly include: surface water bodies such as Baidou River, Xialei River and Guichun River crossed by the highway; one township-level drinking water source protection area adjacent to the highway (drinking water source protection area in Shuolong Town, Daxin County). See Table 7.1-2 and Table 7.1-3 for the relationship between main surface water environmental protection objects and the route.

Table 7.1-2 List of Main Surface Water Environmental Protection Objects of the Project

S/N	Main Surface Water Bodies	Relation with the Route	Investigation on Centralized Drinking Water Source Conservation Area	Measures
1	Baidou River	ZK5+165/YK5+187 Buxuan Major Bridge 20/19×30m prestressed concrete T-girder	There is no drinking water source conservation area at the bridge, and there is no centralized water intake downstream of the bridge.	1. For the construction of river-crossing major bridge, the operation sequence of pile foundation shall be reasonably arranged, and construction in flood periods and the fish spawning peak period shall be avoided; steel cofferdams shall be built in the dry season of rivers; adopt advanced technology to shorten the operation time. 2. Provide warning signs such as speed limit, no overtaking, and no dropping. 3. Provide reinforced crash barriers and warning signs.
2		ZK6+960/YK6+950 Dunli Major Bridge 28/19×20m prestressed concrete T-girder		
3		ZK8+795/YK8+815 Longkalang Super Viaduct 31/32×40m prestressed concrete T-girder		
4	Xialei River	ZK12+075/YK12+117 Bangtun Major Bridge 3×40m prestressed concrete T-girder		
5	Guichun River	AZK5+353/AYK5+337 Shuolong Guichun River Major Bridge 3×30m prestressed concrete small box girder		

Table 7.1-3 List of Main Surface Water and Drinking Water Source Protection Areas along the Route

S/N	Description of water source	Level	Water Intake	Relation with the line	Passing through water source protection areas or not
1	Drinking Water Source Protection Area in Shuolong Town, Daxin County	Centralized in the township (approved)	The water intake is located in Yuejin Canal, providing drinking water for Shuolong Community.	The proposed highway passes through the downstream boundary of the water intake, and the minimum distance is about 95m from AK1+900~AK3+510 to Class II protection area and 690m to the Class I protection area.	The route is adjacent to the water source protection area and does not pass through the protection area. This section is constructed in the form of tunnel.

7.1.1.3 Groundwater Environmental Protection Objects

According to the data investigation and consultation, no centralized groundwater source is involved within the assessment scope of the gas station for the Project. The Project does not cross any centralized drinking water source conservation area of groundwater. Groundwater is generally dispersed and used as water source by surrounding residents, and the amount of exploitation is small. The starting point of the project passes through the Bukan Water Source Class I and Class II Protection Areas in Liliang Village, Fuxin Town. Tiandeng People's Government agreed to relocate the entire Bukan water source area (in Liliang Village, Fuxin Town according to the *Reply of Tiandeng People's Government on Adjusting the Bukan Water Source in Liliang Village, Fuxin Town, Tiandeng County* (TDH [2019] No.134), and the relocation procedure is currently in progress. After relocation, the Project does not involve crossing the scope of Bukan water source protection zone.

7.1.1.4 Ecological Environmental Protection Objects

Two ecologically sensitive areas are located within the assessment scope, namely Xialei Nature Reserve and Huashan Scenic Area, and the overlapping area of these two areas is located at AK3+600~AK4+600. There are no other ecologically sensitive areas.

Within the assessment scope, there are 3 species of Class II wild plants under national protection, namely, buerretiodendron hsienmu, Cibotium barometz and Zenia insignis; 4 species of plants under protection of Guangxi Autonomous Region, namely, Acampe rigida, Cymbidium bicolor, Cheirostylis chinensis and Spiranthes sinensis. 7 species of ancient trees such as Radermachera sinica, Dimocarpus longan, Ficus virens Aiton and Litchi chinensis, totaling 10 (Nr.); 14 species of Class II animals under national protection such as

Hoplobatrachus rugulosus, Accipiter virgatus and Lophura nycthemera; 58 species of animals under protection of Guangxi Autonomous Region, such as Rana guentheri, Bungarus fasciatus, Pycnonotus jocosus and Callosciurus erythraeus. The Project mainly occupies the activity and foraging areas of protected animal and does not affect the concentrated habitats of protected animal; the Project occupies 15.7hm2 of key public welfare forests.

Table 7.1-4 Ecological Environmental Protection Objects

<table>
<tr><th colspan="7">Ecologically sensitive area</th></tr>
<tr><th>S/N</th><th colspan="2">Sensitive Objects</th><th>Level</th><th>Main Protected Objects</th><th>Location Relation Between the Route and the Protection Area</th><th>Management Requirement</th></tr>
<tr><td>1</td><td colspan="2">Xialei Nature Reserve in Guangxi</td><td>Autonomous region level</td><td>Northern tropical karst forest ecosystem and rare and endangered species such as François's Langur, Assamese Macaque, Burretiodendron hsienmu, Cycas miquelii and Orchid</td><td>The sections at K7+885~K10+715 and AK3+600~AK4+600 pass through the experimental area of the Nature Reserve, with a total length of 3.83km</td><td>Special assessment for the Project shall be carried out according to the management requirements of the State and Guangxi Autonomous Region on nature reserves, and it shall be approved by the administrative department.</td></tr>
<tr><td>2</td><td colspan="2">Huashan National Scenic Area in Guangxi</td><td>National Level</td><td>A large number of cliff mural landscapes of the ancient Zhuang nationality</td><td>The sections at K11+500~K12+263 and AK0+000~AK5+416 pass through the Class II protection area of the Scenic Area, with a total length of 6.179km</td><td>Other formalities may be handled according to law after the plan is approved by the construction administrative department at or above the county level according to the management authority of construction projects</td></tr>
<tr><th colspan="7">Protected plants and ancient trees</th></tr>
<tr><th>S/N</th><th colspan="2">Sensitive Objects</th><th>Chainage</th><th>Relationship with road reserve boundary (m)</th><th>Total number/area (species/clusters)</th><th>Content or level of protection</th></tr>
<tr><td>1</td><td rowspan="3">Protected plants</td><td rowspan="3">Excentrodendron tonkinese</td><td>K4+700</td><td>80m RHS of Buli Tunnel</td><td>8/0</td><td rowspan="3">National Level II</td></tr>
<tr><td>2</td><td>K8+900</td><td>70m LHS of Longkalang Super Major Bridge</td><td>7/0</td></tr>
<tr><td>3</td><td>K9+250</td><td>160m LHS of Longkalang</td><td>1/0</td></tr>
</table>

				Super Major Bridge		
4			K9+400	210m on the right side of Longkalang Super Major Bridge	1/0	
5			K9+880	180 m to the left side of Longdong No.1 Tunnel	3/0	
6			K9+900	320 m to the right side of Longdong No.1 Tunnel	1/0	
7			K10+375	Upper right of Longdong No.2 Tunnel	7/0	
8		Zenia insignis Chun	K8+700	270m on the right side of Longkalang Super Major Bridge	8/0	
9			K9+400	50m LHS of the route	1/0	
10			K10+330	40 m to the left of Longdong No.2 Tunnel	2/0	
11		Cibotium barometz	AK3+930	10 m to the right of Shuolong Tunnel	6/0	
12			AK4+390	55 m to the right side of Shuolong Tunnel	2/0	
13		Acampe rigida	K9+900	120 m to the right side of Longdong No.1 Tunnel	3/0	Guangxi Zhuang Autonomous Region Level
14		Cymbidium bicolor Lindl	K10+053	90 m to the left side of Longdong No.1 Tunnel	8/0	
15		Cheirostylis chinensis	K9+100	190m LHS of Longkalang Super Major Bridge	2/0	
16		Spiranthes sinensis	AK3+930	10 m to the right of Shuolong Tunnel	5/0	
17	Ancient tree	Radermachera sinica	K4+570	35m LHS of Buli Tunnel	1/0	Class III
18		Dimocarpus longan	K10+050	58m LHS of Longdong	3/0	Ancient tree

				Tunnel		
19		Ficus lacor	AK0+580	In the occupied area	1/1	Class III
20		Dimocarpus longan	AK4+980	6m RHS of the connecting line	1/0	Class III
21		Litchi chinensis	AK5+010	6m RHS of the connecting line	1/0	Class III
22		Litchi chinensis	AK5+010	35m on the right side of the Connecting Line	2/0	Class III
23		Ficus lacor	AK5+000	65m on the right side of the Connecting Line	1/0	Class III
Protected animals						
1	Protected animals		The Project mainly occupies the activity and foraging areas of protected animal and does not affect the concentrated habitats of protected animal		14 species of Class II animals under national protection: Hoplobatrachus rugulosus, Gekko gecko, Lophura nycthemera, Centropus bengalensis, Centropus sinensis, Aviceda leuphotes, Accipiter trivirgatus, Accipiter virgatus, Milvus migrans, Spilornis cheela, Glaucidium brodiei, Glaucidium cuculoides, Falco tinnunculus;58 species of animals under protection of Guangxi Autonomous Region, such as Rana guentheri, Bungarus fasciatus, Pycnonotus jocosus and Callosciurus erythraeus	Class I and II under national protection; animals under protection of Guangxi Autonomous Region
Key public welfare forest						
1	Key public welfare forest		The area of public welfare forest damaged by construction in Tiandeng		Water conservation forest	Key public welfare forests

		County is about 4.88hm2		under protection of Guangxi Autonomous Region
2		The area of public welfare forest damaged by construction in Daxin County is about 10.82hm2	Water conservation forest	
Cultivated land				
1	Basic farmland	Affected areas along the whole route	22.67hm^2	Cultivated land

7.1.2 Component B - Detian-Shuolong Highway

7.1.2.1 Atmospheric and Acoustic Environment Protection Objects

There are 12 acoustic environmental protection objects within the assessment scope along the proposed highway, including 1 school and 11 villages. Refer to Table 7.1-5 for details.

Table 7.1-5 List of Sensitive Points of Acoustic and Atmospheric Environment along the Project

S/N	Description of Sensitive Points	Center Chainage	Location Relation with the Project		Number of households/persons	Characteristics of surrounding environment and investigation on drinking water sources of villagers	Main Measures	Photo
			Orientation	Distance m (centerline/boundary)				
1	Detian	K0+000	RHS	69/60	63/274	It is located at the foot of the mountain at the entrance of Detian Waterfall Scenic Area; the houses are mainly brick-concrete buildings with 2 - 3 floors, and some 5 - 6 houses near the entrance of the scenic area are used as tourist hotels, all of which are	The noise level and the quality of the spring water are within the allowed standards, so no measures are required.	

S/N	Description of Sensitive Points	Center Chainage	Location Relation with the Project		Number of households/persons	Characteristics of surrounding environment and investigation on drinking water sources of villagers	Main Measures	Photo
			Orientation	Distance m (centerline/boundary)				
						equipped with aluminum alloy glass windows. Drinking water source of villagers: mountain spring water.		
2	Liudeng	K1+900~K2+060	LHS	8/0	16/65	It is located at the foot of the mountain on the north side of the existing highway along the border; the houses are mainly brick-concrete buildings with	The noise of 4 households exceeds the standard, and 40m^2 of windows are replaced by the	

S/N	Description of Sensitive Points	Center Chainage	Location Relation with the Project		Number of households/persons	Characteristics of surrounding environment and investigation on drinking water sources of villagers	Main Measures	Photo
			Orientation	Distance m (centerline/boundary)				
						3 floors, and some houses along the road are used as tourist inns, all of which are equipped with aluminum alloy glass windows. Drinking water source of villagers: mountain spring water.	ventilation and sound proof windows	

S/N	Description of Sensitive Points	Center Chainage	Location Relation with the Project		Number of households/persons	Characteristics of surrounding environment and investigation on drinking water sources of villagers	Main Measures	Photo
			Orientation	Distance m (centerline/boundary)				
3	Aijiang Forest Farm	K3+000~K3+500	LHS	15/6	21/120	It is located at the foot of the mountain on the north side of the existing highway along the border; the houses are mainly brick-concrete buildings with 2 - 3 floors, all of which are equipped with aluminum alloy glass windows. Drinking water source of villagers: mountain	The noise level and the quality of the spring water are within the allowed standards, so no measures are required.	

S/N	Description of Sensitive Points	Center Chainage	Location Relation with the Project		Number of households/persons	Characteristics of surrounding environment and investigation on drinking water sources of villagers	Main Measures	Photo
			Orientation	Distance m (centerline/boundary)				
						spring water.		
4	Aitun	K5+500~K5+700	Both sides	7/0	54/211	It is located in the relatively gentle zone beside the river bank on the south side of the existing highway along the border. Some residents built houses on the roadside to serve as shops, restaurants and hotels. These houses are mainly brick-concrete buildings with	The noise of 5 households exceeds the standard, and 50m2 of windows are replaced by the ventilation and sound proof windows	

S/N	Description of Sensitive Points	Center Chainage	Location Relation with the Project		Number of households/persons	Characteristics of surrounding environment and investigation on drinking water sources of villagers	Main Measures	Photo
			Orientation	Distance m (centerline/boundary)				
						2 - 3 floors, and a few old houses are of brick and tile structure. All buildings are equipped with aluminum alloy glass windows, and most of the old houses are equipped with wooden windows. Drinking water source of villagers: mountain spring water.		

S/N	Description of Sensitive Points	Center Chainage	Location Relation with the Project		Number of households/persons	Characteristics of surrounding environment and investigation on drinking water sources of villagers	Main Measures	Photo
			Orientation	Distance m (centerline/boundary)				
5	Bagan	K5+900~K6+000	LHS	25/18	76/272	It is located at the foot of the mountain on the east side of the existing highway along the border; the houses are mainly brick-concrete buildings with 2 - 3 floors, and a few old houses are of brick and tile structures; all buildings are equipped with aluminum alloy glass	The noise of 3 households exceeds the standard, and 30m^2 of windows are replaced by the ventilation and sound proof windows	

S/N	Description of Sensitive Points	Center Chainage	Location Relation with the Project		Number of households/persons	Characteristics of surrounding environment and investigation on drinking water sources of villagers	Main Measures	Photo
			Orientation	Distance m (centerline/boundary)				
						windows, and most of the old houses are equipped with wooden windows. Drinking water source of villagers: mountain spring water.		
6	Aijiang Village Primary School	K6+100	RHS	135/125	/	The school consists of two teaching buildings, each with 2 floors; one building has 4 classrooms for primary school students and	The noise level and the quality of the spring water are within the allowed standards, so no	

S/N	Description of Sensitive Points	Center Chainage	Location Relation with the Project		Number of households/persons	Characteristics of surrounding environment and investigation on drinking water sources of villagers	Main Measures	Photo
			Orientation	Distance m (centerline/boundary)				
						another building has 6 classrooms, serving as Detian Kindergarten. There is 1 primary school teacher, 5 kindergarten teachers and 100 students. All buildings are equipped with aluminum alloy glass windows. None of the teachers and students live in school. Their drinking	measures are required.	

S/N	Description of Sensitive Points	Center Chainage	Location Relation with the Project		Number of households/persons	Characteristics of surrounding environment and investigation on drinking water sources of villagers	Main Measures	Photo
			Orientation	Distance m (centerline/boundary)				
						water is the mountain spring water.		
7	Longjian	K6+700~K6+800	Both sides	7/0	46/161	It is located on both sides of the existing highway along the border. Some residents built 3 - 6 houses on the roadside to serve as shops, restaurants and tourism inns. These houses are mainly brick-concrete buildings with 2 - 3 floors,	The noise of 7 households exceeds the standard, and 70m^2 of windows are replaced by the ventilation and sound proof windows	

S/N	Description of Sensitive Points	Center Chainage	Location Relation with the Project		Number of households/persons	Characteristics of surrounding environment and investigation on drinking water sources of villagers	Main Measures	Photo
			Orientation	Distance m (centerline/boundary)				
						and a few old houses are of brick and tile structure. All buildings are equipped with aluminum alloy glass windows, and most of the old houses are equipped with wooden windows. Drinking water source of villagers: mountain spring water.		

S/N	Description of Sensitive Points	Center Chainage	Location Relation with the Project		Number of households/persons	Characteristics of surrounding environment and investigation on drinking water sources of villagers	Main Measures	Photo
			Orientation	Distance m (centerline/boundary)				
8	Wanlong	K6+900~K7+100	Both sides	8/0	90/327	It is located on both sides of the existing highway along the border. Some residents built 3 - 6 houses on the roadside to serve as shops, restaurants and tourism inns. These houses are mainly brick-concrete buildings with 2 - 3 floors, and a few old houses are of brick and tile	The noise of 8 households exceeds the standard, and $80m^2$ of windows are replaced by the ventilation and sound proof windows	

S/N	Description of Sensitive Points	Center Chainage	Location Relation with the Project		Number of households/persons	Characteristics of surrounding environment and investigation on drinking water sources of villagers	Main Measures	Photo
			Orientation	Distance m (centerline/boundary)				
						structure. All buildings are equipped with aluminum alloy glass windows, and most of the old houses are equipped with wooden windows. Drinking water source of villagers: mountain spring water.		

S/N	**Description of Sensitive Points**	**Center Chainage**	**Location Relation with the Project**		**Number of households/persons**	**Characteristics of surrounding environment and investigation on drinking water sources of villagers**	**Main Measures**	**Photo**
			Orientation	**Distance m (centerline/boundary)**				
9	Longhong	K9+700	RHS	36/25	80/313	It is located on both sides of the existing highway along the border. Some residents built 3 - 6 houses on the roadside to serve as shops, restaurants and tourism inns. These houses are mainly brick-concrete buildings with 2 - 3 floors, all of which are equipped with aluminum	The noise of 2 households exceeds the standard, and 20m^2 of windows are replaced by the ventilation and sound proof windows	

S/N	Description of Sensitive Points	Center Chainage	Location Relation with the Project		Number of households/persons	Characteristics of surrounding environment and investigation on drinking water sources of villagers	Main Measures	Photo
			Orientation	Distance m (centerline/boundary)				
						alloy glass windows. Villagers' drinking water is the tap water supplied by villages and towns.		
10	Gutun	K10+400~K11+200	Both sides	12/2	88/323	It is located on both sides of the existing highway along the border. Some residents built 3 - 6 houses on the roadside to serve as shops, restaurants and tourism inns.	The noise of 16 households exceeds the standard, and 160m^2 of windows are replaced by the ventilation	

S/N	Description of Sensitive Points	Center Chainage	Location Relation with the Project		Number of households/persons	Characteristics of surrounding environment and investigation on drinking water sources of villagers	Main Measures	Photo
			Orientation	Distance m (centerline/boundary)				
						These houses are mainly brick-concrete buildings with 2 - 3 floors, all of which are equipped with aluminum alloy glass windows. Villagers' drinking water is the tap water supplied by villages and towns.	and sound proof windows	

S/N	Description of Sensitive Points	Center Chainage	Location Relation with the Project		Number of households/persons	Characteristics of surrounding environment and investigation on drinking water sources of villagers	Main Measures	Photo
			Orientation	Distance m (centerline/boundary)				
11	Shuolong Community	K12+300~K13+100	LHS	10/0	295/1040	It is located on the north side of the existing highway along the border, in the center of Shuolong Town. There are many shops, restaurants and hotels near the main streets of the town, and one middle school and one primary school in the center of the town. The residential	The noise of 13 households exceeds the standard, and 130m^2 of windows are replaced by the ventilation and sound proof windows	

S/N	Description of Sensitive Points	Center Chainage	Location Relation with the Project		Number of households/persons	Characteristics of surrounding environment and investigation on drinking water sources of villagers	Main Measures	Photo
			Orientation	Distance m (centerline/boundary)				
						houses in the town are mainly brick-concrete buildings with 2 - 3 floors, and the teaching buildings in schools are with 4 - 5 floors, all of which are equipped with aluminum alloy glass windows. Their drinking water is the tap water supplied by villages and		

S/N	Description of Sensitive Points	Center Chainage	Location Relation with the Project		Number of households/persons	Characteristics of surrounding environment and investigation on drinking water sources of villagers	Main Measures	Photo
			Orientation	Distance m (centerline/boundary)				
						towns.		
12	Rentun	K13+200~K13+400	LHS	65/55	36/118	It is located at the foot of the mountain about 200m east of the edge of Shuolong Town; the houses are mainly brick-concrete buildings with 2 - 3 floors, all of which are equipped with aluminum alloy glass windows. Villagers' drinking water	The noise of 5 households exceeds the standard, and 50m^2 of windows are replaced by the ventilation and sound proof windows	

S/N	Description of Sensitive Points	Center Chainage	Location Relation with the Project		Number of households/persons	Characteristics of surrounding environment and investigation on drinking water sources of villagers	Main Measures	Photo
			Orientation	Distance m (centerline/boundary)				
						is the tap water supplied by villages and towns.		

7.1.2.2 Water Environmental Protection Targets

The water environmental protection objectives within the evaluation scope of the Project are mainly: Guichun River crossed by the highway and two township-level drinking water source protection areas adjacent to the highway. See Table 7.1-6 and Table 7.1-7 for the relationship between main surface water environmental protection objects and the route.

Table 7.1-6 List of Main Surface Water Environmental Protection Objects of the Project

S/N	Main Surface Water Bodies	Relation with the Route	Investigation on Centralized Drinking Water Source Conservation Area	Main Measures
1	Guichun River	It is located on the south side of the route, where K0+000~K5+500 is adjacent to the river, and no bridge is set to cross the water body.	It is planned to set up the Aitun Drinking Water Source Protection Area in Shuolong Town on the river, and the planned water intake is located at K5+000	Temporary drainage ditches and sedimentation tanks shall be provided for the construction of the section near the river, to prevent that the bare surface is washed by rain and flows into Guichun River, so as to avoid affecting the water quality

Table 7.1-7 List of Main Surface Water Environmental Protection Objects along the Project

S/N	Description of water source	Level	Water Intake	Relation with the line	Passing through water source protection areas or not	Main Measures
1	Aitun water source in Shuolong Town, Daxin County	Centralized in the township (approved)	The water intake is located near Aitun Dam of Guichun River, which is the planned water source.	Highway section K0+460~K5+360 passes through the Grade II conservation area of the Aitun Drinking Water Source Conservation Area in Shuolong Town, where section K3+980~K5+110 is adjacent to the Grade-I conservation area of this water source conservation area.	The route passes through the water source protection area, of which 1.13km is adjacent to the Class I protection area, and this section is planned to be used along the whole line	Road runoff collection system is set on the river side of K3+900~ K5+300; an oil isolation and sedimentation tank is set outside K5+300 water source protection area to lead to the downstream of Aitun Dam for discharge; signs of speed limit, no overtaking, in and out, and water source are arranged on both sides of K0+200 and K5+300.

S/N	Description of water source	Level	Water Intake	Relation with the line	Passing through water source protection areas or not	Main Measures
2	Community water source area in Shuolong Town, Daxin County	Centralized in the township (approved)	The water intake is located in Yuejin Canal, providing drinking water for Shuolong Community.	Highway K9+400~K10+000 of the Project passes through the Grade-II conservation area of Shuolong Community Water Source Conservation Area in Shuolong Town, and the layout of section K10+000~K11+400 shall be adjacent to the Grade-II conservation area of this water source conservation area.	The route crosses the water source protection area with a crossing length of 600m, of which the tunnel section is about 300m and the subgrade section is about 300m.	Corrugated steel crash barriers are set at the river side of K7+500~K8+100; speed limit traffic signs are set at K7+500~K8+100; water source entry and exit signs are set at both ends of K9+400~K10+000

7.1.2.3 Ecological Environmental Protection Objects

There are only two ecologically sensitive areas within the assessment scope, namely Xialei Autonomous Region Nature Reserve and Huashan Scenic Area in Guangxi.

The results of the field survey within the evaluation scope are as follows: there are 3 species of national Class II protected plants, including 4 species of excentrodendron tonkinese, 7 clusters of cymbidium bicolor lindl, and 9 clusters of cibotium barometz; there are 2 ancient trees (banyan tree and litchi tree); there are 3 species of national Class II protected animals (hoplobatrachus rugulosus, glaucidium cuculoides and centropus sinensis) and 21 species autonomous region-level protected animals, such as bufo melanostictus, naja atra, pycnonotusjocosus and callosciurus erythraeus. The project mainly occupies the activity and foraging habitats of protected animals, which do not involve their concentrated habitats; it occupies 1.08hm2 of key non-commercial forest.

Table 7.1-8 Ecological Environmental Protection Objects

Ecologically sensitive area						Measures
S/N	Sensitive Objects	Level	Main Protected Objects	Location Relation Between the Route and the Protection Area	Management Requirement	

1	Xialei Nature Reserve in Guangxi	Autonomous region level	Northern tropical karst forest ecosystem and rare and endangered species such as François's Langur, Assamese Macaque, Burretiodendron hsienmu, Cycas miquelii and Orchid	Crossing is not involved, and the nearest distance is about 700m.	The experimental area can be used for scientific experiments, teaching practice, visit and domestication, cultivate rare animals and plants and other activities	Crossing is not involved; it is prohibited to arrange the temporary sites in protected areas
2	Huashan National Scenic Area in Guangxi	National Level	A large number of cliff mural landscapes of the ancient Zhuang nationality	The Project is located in the scenic area in the whole line.	Other formalities may be handled according to law after the plan is approved by the construction administrative department at or above the county level according to the management authority of construction projects	Coordinate landscape greening with scenic area; strengthen the management of construction; accept the supervision of scenic area management office

Protected animals, plants and ancient trees

S/N	**Sensitive Objects**		**Chainage**	**Relationship with road reserve boundary (m)**	**Total number/area (species/clusters)**	**Content or level of protection**	**Main Measures**
1	Protected plants	Excentrodendron tonkinese	K13+050	15 m on the right	2/0	National Level II	In-situ conservation
2		Excentrodendron tonkinese	K13+600	50m on the left	2/0	National Level II	In-situ conservation
3		Cymbidium bicolor Lindl	K13+050	15 m on the right	2/0	National Level II	In-situ conservation
4		Cymbidium bicolor Lindl	K11+150	2m on the left	5/5	National Level II	Optimize the design as far as possible to avoid them; if it is impossible to avoid them, report it to the forestry department for the

							approval of transplant
5		Cibotium barometz	K9+400	290m on the right	2/0	National Level II	In-situ conservation
6		Cibotium barometz	K5+360	45m on the left	2/0	National Level II	In-situ conservation
7	Ancient tree	Ficus microcarpa Linn. f.	K11+150	Adjacent to the left side	1/1	Class III	Optimize the design as far as possible to avoid them; if it is impossible to avoid them, report it to the forestry department for the approval of transplant
8		Litchi chinensis	K12+560	20m on the right	1/0	Class III	In-situ conservation
Protected animals							
1	Protected animals		The Project mainly occupies the activity and foraging areas of protected animal and does not affect the concentrated habitats of protected animal		There are 3 species of national Class II protected animals (hoplobatrachus rugulosus, glaucidium cuculoides and centropus sinensis) and 21 species autonomous region-level protected animals, such as bufo melanostictus, naja atra, pycnonotusjocosus and callosciurus erythraeus.	National Class II and autonomous region-level protected animals	Strengthen the management of construction personnel; ban on hunting; set up bridges and culverts
Key public welfare forest							
1	Key public welfare forest		The crossing length of subgrade in Daxin		Water conservation	Key public	Optimize the design to

		County is about 3700m, covering an area of about 1.08hm2	forest	welfare forest	reduce the occupation, take measures of "compensating every piece of land occupied" in case of occupation

7.1.3 Component C - Shuolong Port (Phase II of Shuolong Gate)

7.1.3.1 Atmospheric and Acoustic Environment Protection Objects

One Acoustic Environment within the Assessment Scope of the Proposed Project Refer to Table 7.1-9 for details.

Table 7.1-9 List of Sensitive Points of Acoustic and Atmospheric Environment along the Project

S/N	Description of Sensitive Points	Location Relation with the Project		Number of households/persons	Characteristics of surrounding environment and investigation on drinking water sources of villagers	Photo
		Orientation	Distance (m)			
1	Shuolong town residential area	East	5	5/20	The houses are mainly brick-concrete buildings with 2 floors, all of which are equipped with aluminum alloy glass windows. Villagers' drinking water is the tap water.	

7.1.3.2 Water Environmental Protection Objects

The water environmental protection objects within the assessment scope of the Project mainly include: Guichun River on the north side of the Project and 1 township-level drinking water source protection area near the Project. See Table 7.1-10 and Table 7.1-11 for the relationship between main surface water environmental protection objects and the route.

Table 7.1-10 List of Main Surface Water Environmental Protection Objects of the Project

S/N	Main Surface Water Bodies	Location Relation with the Project	Investigation on Centralized Drinking Water Source Conservation Area	Main Measures
1	Guichun River	30m north of plant boundary	It is planned to set up Aitun drinking water source protection zone in Shuolong Town at 6.5km upstream of the river	Temporary drainage ditches and sedimentation tanks shall be provided for the construction, to prevent that the bare surface is washed by rain and flows into Guichun River, so as to avoid affecting the water quality.

Table 7.1-11 List of Main Surface Water Environmental Protection Objects along the Project

S/N	Protection Objects	Orientation Opposite to Plant Boundary	Distance from the Project	Type
1	Community water source area in Shuolong Town, Daxin County	Northwest	The project is about 1000m away from the land area of the Class II protection zone	Drinking water source conservation area

7.1.3.3 Ecological Environmental Protection Objects

There are only two ecologically sensitive areas within the assessment scope, namely Xialei Autonomous Region Nature Reserve and Huashan Scenic Area in Guangxi.

The results of the field survey within the assessment scope are as follows: there are 3 kinds of national key protected wild plants, including 4 pieces of Excentrodendron tonkinese (national class II protected plant), 7 clusters of Cymbidium bicolor (national class II protected plant), and 9 clusters of Cibotium barometz (national class II protected plant); there are 2 ancient trees (Ficus microcarpa and lychee tree); there are 3 kinds of national Class II protected animals (Hoplobatrachus rugulosus, Glaucidium brodiei and Centropus sinensis) and 21 kinds of protected animals at autonomous region level, such as Duttaphrynus melanostictus, Naja atra, Pycnonotus jocosus and Callosciurus erythraeus; the activity and foraging habitats of protected animals are mainly occupied, and no concentrated habitat of protected animals is involved.

Table 7.1-12 Ecological Environmental Protection Objects

Ecologically sensitive area						Measures
S/N	**Sensitive Objects**	**Level**	**Main Protected Objects**	**Location Relation Between the Route and the Protection Area**	**Management Requirement**	
1	Xialei Nature Reserve in Guangxi	Autonomous region level	Northern tropical karst forest ecosystem and rare and endangered species such as François's Langur, Assamese Macaque, Burretiodendron hsienmu, Cycas miquelii and Orchid	Crossing is not involved, and the nearest distance is about 1000m.	The experimental area can be used for scientific experiments, teaching practice, visit and domestication, cultivate rare animals and plants and other activities	Crossing is not involved; it is prohibited to arrange the temporary sites in protected areas
2	Huashan National Scenic Area in Guangxi	National Level	A large number of cliff mural landscapes of the ancient Zhuang nationality	The Project is located in the scenic area.	Other formalities may be handled according to law after the plan is approved by the construction administrative department at or above the county level according to the management authority of construction projects	Coordinate landscape greening with scenic area; strengthen the management of construction; accept the supervision of scenic area management office

7.2 Survey of Ecological Environmental Status

7.2.1 Wuzhou (Longyanzui) – Shuolong Highway (Chongzuo – Jingxi Expressway to Shuolong Port Section)

(1) The sections K7+885~K10+715 and AK3+600~AK4+600 of the proposed highway pass through the experimental area of the Xialei Autonomous Region Nature Reserve, with a total length of 3.83km, with the nearest distance to the core area being 3.33km, and that to the buffer area being about 2.905km. The protection objects are the northern tropical karst forest ecosystem, Trachypithecus francoisi, Excentrodendron hsienmu and other rare and endangered wild animals and plants.

(2) Sections K11+500~K12+263 and AK0+000~AK5+416 pass through the Class II Reserve of the Huashan National Scenic Area, with a total length of 6.179km, and the

protection objects are Huashan Mural and Detian Waterfall, etc.

(3) According to the *Ecological Function Zoning of Guangxi Zhuang Autonomous Region (2008)*, the Project is located in the ecological regulation function zone → biodiversity conservation function zone → biodiversity conservation function zone for karst mountains of southwest Guangxi. The main ecological function of this area is biodiversity conservation. There are 9 regional nature reserves in this area, with large northern tropical limestone seasonal rainforests, rich in karst biodiversity and rare species, being the important species repositories in the northern tropical karst area of China and the biodiversity distribution centers with international significance, being of great significance to the global biodiversity conservation. The Project occupies about 4.42hm2 of key public welfare forests at autonomous region level and 22.67hm2 of cultivated land.

(4) Three kinds of national Class II key protected wild plants have been found within the assessment scope: there are 28 pieces of Excentrodendron tonkinese, with two of them located above the Longdong Tunnel, involving no occupation; there are 11 pieces of Zenia insignis, with two of them located above the Longdong Tunnel, involving no occupation; there are 8 pieces of Cibotium barometz, located above the Longdong Tunnel, involving no occupation; 4 kinds of key protected wild plants in Guangxi have been found within the assessment scope, including 3 pieces of Acampe rigida, 8 pieces of Cymbidium bicolor, 2 pieces of Cheirostylis chinensis Rolfe and 5 pieces of Spiranthes sinensis, all of which are not in the occupied area. Within the assessment scope, there are 14 kinds of national Class II protected animals such as Hoplobatrachus rugulosus, Accipiter virgatus and Lophura nycthemera. Within the assessment scope, there are 58 kinds of protected animals at the autonomous region level such as Hylarana guentheri, Bungarus fasciatus, Pycnonotus jocosus and Callosciurus erythraeus; the activity and foraging habitats of protected animals are mainly occupied, and no concentrated habitat of protected animals is involved;

(5) There are no "three grounds" and migration routes for fish in the waters of the assessment area, fish are of common species, and no protected aquatic organisms at the national level and the autonomous region level are found.

7.2.2 Detian-Shuolong Highway

(1) Within the project assessment scope, there are two important ecologically sensitive areas: Xialei Autonomous Region Nature Reserve and Huashan National Scenic Area in Guangxi. The Project does not pass through the Xialei Autonomous Region Nature Reserve

in Guangxi, with the nearest distance to the reserve of about 700 m; the whole line of the Project is located in the Huashan Scenic Area, and it does not pass through or involve any special-grade or Level I conservation area.

(2) Three kinds of national Class II key protected plants have been found in the project assessment area, including 9 clusters of Cibotium barometz, 7 clusters of Cymbidium bicolor and 4 pieces of Excentrodendron tonkinese, and all of them are located outside the project area, involving no occupation. Two ancient trees have been found in and around the project assessment area, all of which are at Class III, including one Ficus microcarpa and one lychee tree; the Ficus microcarpa is close to the outside the left subgrade of the existing highway at K11+150; the lychee tree is located 20m to the right of K12+560. The Project occupies 1.08m^2 of key public welfare forests, with the vegetation types including subtropical forests and rocky mountain secondary forests; the dominant species mainly include Pinus massoniana, Cunninghamia lanceolata, Liquidambar formosana, Macaranga denticulata, Trema tomentosa, Alangium chinense, Melastoma candidum, Leucaena leucocephala, and Mallotus barbatus; the key public welfare forests occupied mainly fall into the water conservation forests.

(3) There are 3 kinds of national Class II key protected wild animals in the assessment area, including 2 kinds of birds (Glaucidium brodiei and Centropus sinensis) and 1 kind of amphibian (Hoplobatrachus rugulosus); there are 21 kinds of key protected wild animals in Guangxi, including 3 kinds of amphibians (Duttaphrynus melanostictus, Fejervarya multistriata, and Microhyla ornata), 4 kinds of reptiles (Calotes versicolor, Elaphe radiata, Ptyas mucosus, and Naja atra), 2 kinds of mammals (Callosciurus erythraeus and Tupaia belangeri), and 12 kinds of birds (Pericrocotus flammeus, Dicrurus macrocercus, Pycnonotus jocosus, Pycnonotus sinensis, Lanius schach, Urocissa erythrorhyncha, Turdus merula, Garrulax canorus, Orthotomus sutorius, Phylloscopus inornatus, Phylloscopus proregulus, and Parus major); no concentrated distribution area or important habitat of protected animals is involved.

(4) There are no "three grounds" and migration routes for fish in the waters of the assessment area, fish are of common species, and no protected aquatic organisms at the national level and the autonomous region level are found.

7.2.3 Shuolong Port (Phase II of Shuolong Gate)

The Project is located in an area with frequent human activities, no special ecologically-sensitive area, no distribution of rare and endangered animals and plants, and relatively simple biodiversity; in this area, the plants are mainly common low shrubs, and animals are mainly common birds, frogs and insects. The current status of ecological environment quality in the assessment area is general.

7.3 Survey of Current Status of Surface Water Environment

7.3.1 Wuzhou (Longyanzui) – Shuolong Highway (Chongzuo – Jingxi Expressway to Shuolong Port Section)

In this assessment, the monitoring objects of surface water environment status are represented by the Xialei River and the Guichun River, which are large surface water bodies crossed by the Project. According to the *Environmental Quality Status Bulletin of Chongzuo City in 2019*, the water quality of the Detian Section of the Guichun River meets Class I water quality criteria and that of the Nongxin Section of the Xialei River meets Class III water quality criteria specified in the *Environmental Quality Standards for Surface Water* (GB 3838-2002). The water environment in the project area is up to standards.

For the assessment, totally three monitoring sections are set up in the Baidou River, the Xialei River and the Guichun River. The monitoring results show that eight indexes of water body assessment factors, namely pH value, DO, BOD5, permanganate index, chemical oxygen demand, petroleum, ammonia nitrogen and total phosphorus, in the three water quality monitoring sections of river reaches under assessment of the Baidou River, the Xialei River and the Guichun River all meet Class III criteria specified in the *Environmental Quality Standards for Surface Water* (GB 3838-2002), and SS meets Class III criteria specified in the *Quality Standards for Surface Water Resources* (SL63-94). These indicate a good environmental quality of surface water along the project area.

7.3.2 Detian-Shuolong Highway

The local sections of the Project are close to the Guichun River. According to the *Environmental Quality Status Bulletin of Chongzuo City in 2018* published online by Chongzuo Ecological Environment Bureau, the water quality of the Detian Section of the Guichun River meets Class I water quality criteria and that of Xinli Section meets Class II water quality criteria specified in the *Environmental Quality Standards for Surface Water* (GB 3838-2002). The water environment in the project area is up to standards.

The Project crosses two drinking water sources. Sampling analysis has been made at the water intakes of the water sources crossed in this EIA. Eight indexes of water quality assessment factors of Aitun and Yuejin Canal water intakes of Guichun River, namely pH value, DO, BOD5, permanganate index, chemical oxygen demand, petroleum, ammonia nitrogen and total phosphorus, all meet Class II criteria specified in the *Environmental Quality Standards for Surface Water*, and SS meets Class II criteria specified in the *Quality Standards for Surface Water Resources*. These indicate a good environmental quality of surface water along the project area.

7.3.3 Shuolong Port (Phase II of Shuolong Gate)

During the operation period of the Project, domestic sewage will be discharged to the Guichun River after being treated in Shuolong Town Sewage Treatment Plant. According to the *Water Function Zoning of Chongzuo City*, the Guichun River falls into a Class III water area in terms of water quality, and Class III water quality criteria specified in the *Environmental Quality Standards for Surface Water* (GB 3838-2002) shall be followed. According to the *Environmental Quality Status for Water of Chongzuo City in 2019*, the water quality of the Detian Section of the Guichun River meets Class III water quality criteria specified in the *Environmental Quality Standards for Surface Water* (GB 3838-2002).

7.4 Survey of Current Status of Groundwater Environment

In this assessment, one monitoring point is set at the water intake of Bukan water source in Liliang Village, Fuxin Town. The monitoring results show that the water quality monitoring indexes of the water intake of Bukan water source in Liliang Village, Fuxin Town, such as pH value, total hardness, oxygen consumption, ammonia nitrogen, total dissolved solids, nitrate, nitrite, manganese and iron, all meet Class III water quality criteria in the *Quality Standard for Groundwater* (GB/T 14848-2017). The total coliforms exceed the requirements of Class III criteria, with the maximum excess multiple of 55.67, which is caused by the reason that groundwater may be affected by the random discharge of domestic sewage from villages or nearby livestock farms.

7.5 Survey of Acoustic Environmental Status

7.5.1 Wuzhou (Longyanzui) – Shuolong Highway (Chongzuo – Jingxi Expressway to Shuolong Port Section)

The industrial development along the Project is relatively lagging behind according to the field survey, and the industrial pattern mainly composed of agriculture and forestry production is basically formed at present. The main noise pollution sources along the line include: traffic noise of existing classified highways (provincial highway S326, county road 522, border highways, etc.), traffic noise of village roads, and production and living noise of residents along the line.

Six representative sensitive points (2 schools and 4 residential areas) are selected for noise monitoring in the assessment. The monitoring results show that: among the six representative sensitive points of acoustic environment within the assessment scope, the daytime acoustic environment of the first floor and the third floor in the first row of Bangtun sensitive point near the existing county road 532 can meet the requirements of Class 4a criteria in the *Environmental Quality Standard for Noise*, and the nighttime acoustic environment exceeds the requirements of Class 4a criteria, with the maximum excess of 14.3dB(A); the daytime and nighttime acoustic environment of the monitoring points of Bangtun at the side of the Project can meet the requirements of Class 2 criteria in the *Environmental Quality Standard for Noise*; the daytime and nighttime acoustic environment of the other five sensitive points can meet the requirements of Class 2 criteria in the *Environmental Quality Standard for Noise*.

The existing situation of the border highway crossing the ending point of the Project in the selected area is monitored. The monitoring results show that the corresponding standard of Class 2 area in the *Environmental Quality Standard for Noise* (GB 3096-2008) can be met at 43m from the highway centerline in the daytime and the corresponding standard of Class 4a area in the *Environmental Quality Standard for Noise* (GB 3096-2008) can be met at 16m from the highway centerline in the daytime; the corresponding standards of Class 2 area can be reached at 78m from the highway centerline at night, and the corresponding standards of Class 4a area in the *Environmental Quality Standard for Noise* (GB 3096-2008) can be reached at 19m from the highway centerline in the daytime.

7.5.2 Detian-Shuolong Highway

The industrial development along the Project is relatively lagging behind according to the field survey, and the industrial pattern mainly composed of agriculture and forestry production, and tourism development is basically formed at present. The main noise pollution sources along the line include: traffic noise of existing border highways and traffic noise of village roads, as well as production and living noise of residents along the line, etc.

Four representative sensitive points, such as Liudeng, Aijiang Village Primary School, Gutun and Shuolong Town Primary School, are selected for status monitoring of acoustic environment in the assessment. The monitoring results show that the daytime and nighttime acoustic environment of the four representative sensitive points of acoustic environment within the assessment scope can meet the requirements of Class 2 criteria in the Environmental Quality Standards for Noise.

7.5.3 Shuolong Port (Phase II of Shuolong Gate)

According to the Master Plan of Shuolong Town, Daxin County (2007-2025)(Environmental Protection Planning Map), the Project is located in the function area of Class 2 acoustic environment. According to the monitoring data in the Daxin Shuolong Port (Upgrading) Infrastructure Project - Shuolong Port (Shuolong Gate) Project, the acoustic environment quality at the plant boundary in the east, south, west and north of the project plot meets Class 2 criteria in the *Environmental Quality Standard for Noise* (GB3096-2008).

7.6 Survey of Atmospheric Environmental Status

The Guangxi Chongzuo Border Connectivity Improvement Project is located in Tiandeng County and Daxin County. According to the monitoring data of the Automatic Ambient Air Monitoring Station of Tiandeng County, in 2019, six indexes, namely SO_2, NO_2, PM_{10}, $PM_{2.5}$, O_3-8h and CO-24h, in Tiandeng County all reached Class II criteria in the *Ambient Air Quality Standard* (GB3095-2012); the ambient air quality in Tiandeng County was good and up to standards; according to the monitoring data of the Automatic Ambient Air Monitoring Station of Daxin County, in 2018, the annual average and 24-hour average 98th percentile concentration of SO2 and NO2 met the requirements of Class II criteria in the

Ambient Air Quality Standard (GB3095-2012); the annual average and 24-hour average 95th percentile concentration of PM10 met the requirements of Class II criteria in the *Ambient Air Quality Standard* (GB3095-2012); the 24-hour average 95th percentile concentration of CO and the maximum 8-hour average 90th percentile concentration on a day of O3 all met the requirements of Class II criteria in the *Ambient Air Quality Standard* (GB3095-2012); the annual average and 24-hour average 95th percentile concentration of PM2.5 exceeded the requirements of Class II criteria in the *Ambient Air Quality Standard* (GB3095-2012), with the frequency of exceeding the standard being 6.03% and the excess multiple being 0.05. Therefore, the ambient air quality of Daxin County where the Project is located was not up to standard.

8 Predictions and Assessments on Environmental Impacts

8.1 Ecological Impact Forecast

8.1.1 Assessment of Environmental Impact of Chongzuo-Jingxi Expressway to Shuolong Port Section

8.1.1.1 Impact Analysis of Ecological Sensitive Areas

8.1.1.1.1 Impact Analysis of Guangxi Xialei Nature Reserve

This chapter is mainly excerpted from the *Evaluation Report on the Impact of Wuzhou (Longyanzui) - Shuolong Expressway (Chongzuo-Jingxi Expressway to Shuolong Port Section) on Xialei Autonomous Region Nature Reserve in Guangxi* (hereinafter referred to as the "Demonstration Report") issued by Guangxi Forest Inventory & Planning Institute, which was approved by Department of Forestry of Guangxi Zhuang Autonomous Region on June 19, 2020 (see Attachment 11).

8.1.1.1.1.1 Main Works in Xialei Nature Reserve

The recommended alternative (K route) of the highway main route (chainage:K7+885~K10+715) passes through the experimental area of the Nature Reserve in the form of the tunnel (Longchanglang tunnel) + roadbed + bridge (Longchanglang super major bridge) + tunnel (Longdong tunnel), with a length of 2830 m in the reserve. The route's closest distance to the buffer zone is about 2905 m, and its closest distance to the core area is 3330 m.

AK3+600~AK4+600 section passes through the experimental area of the Nature Reserve in the form of a tunnel (Shuolong tunnel), with a distance through the reserve of 1000 m. The section's closest distance to the buffer zone is about 2958 m, and its closest distance to the core area is 3655 m.

8.1.1.1.1.2 Regulation Compliance Analysis of Project Site Selection

For the highway passes through Guangxi Xialei Autonomous Region Nature Reserve, the laws and regulations applicable mainly include *Regulations of the People's Republic of China on Nature Reserves*. The analysis results on the highway's compliance with relevant laws and regulations are shown in Table 8.1-1.

Table 8.1-1 Analysis on Compliance of Highway Construction with Related Laws and Regulations

S/N	Relevant provisions	Project design scheme and status	Compliance analysis
1	Article 32 It is prohibited to build any production facilities in the core/buffer zones of nature reserves.	The highway's main route is about 2905 m from the buffer zone in the minimum and 3330 m from the core area in the minimum; the highway's connecting route is about 2958 m from the buffer zone in the minimum and 3655 m from the core area in the minimum.	Conformed
2	Article 32 No production facility that pollutes the environment, destroys resources or landscapes may be	This Project is not a pollution-type construction project. During the operation period, service facilities such as toll stations (built in conjunction with the	Strengthen the landscape protection and

	constructed in the experimental area of a nature reserve.	maintenance work area) are not in Xialei Nature Reserve, and have little impact on the environment of Xialei Nature Reserve. The highway passes through the experimental area of Xialei Nature Reserve, and mainly passes through the areas with good vegetation through bridges and tunnels. The project construction has a slight impact on the ecosystem, landscape and main protection targets in Xialei Nature Reserve, has a minor impact on the biological communities, habitats and stakeholder groups of Xialei Nature Reserve, and has a moderate impact on biosecurity, species and population in Xialei Nature Reserve. Under the premise of taking effective protection measures and restoration measures and coordinating the relationship with the stakeholder groups, the overall impact of the Project on Xialei Nature Reserve is small and kept within an acceptable level.	compliance after restoration
3	Article 26 It is prohibited to carry out activities such as felling, grazing, hunting, fishing, medicinal picking, reclamation, burning waste, mining, quarrying, sand fishing, etc. in nature reserves; however, unless otherwise provided by laws and administrative regulations.	The project will not set up temporary works such as borrow pit, spoil ground, temporary stock yard, and construction camp in Xialei Nature Reserve.	Conformed

After the comparative analysis, the Project complies with the relevant requirements in the *Regulations of the People's Republic of China on Nature Reserves*.

8.1.1.1.1.3 Feasibility Analysis on Avoidance from the Nature Reserve

According to the *Overall Planning of Xialei Autonomous Region Nature Reserve in Guangxi* (2017-2026) and its approval documents, Xialei Nature Reserve is longitidually distributed from north to south, with a planned area of about 27305.2 hm2.

If the highway avoids this ecological-sensitive area, its route can only be shifted to the north of Daxin County.

The proposed Wuzhou (Longyanzui) to Shuolong Highway (Chongzuo - Jingxi Expressway to Shuolong Port section) is located in Tiandeng County and Daxin County of Chongzuo City. It is a component of the Wuzhou (Longyanzui) to Shuolong Expressway, one of the 7 east-west expressways in *Expressway Network Planning of Guangxi (2018~2030)*, and is also one of the 9 new corridors leading to areas beyond the border. According to the route, the Project is an extension from the end of Longan-Shuolong Expressway. It is a direct high-grade highway connecting Chongzuo City, Daxin County, Tiandeng County and Nanning City with the Shuolong Port, a national-level port at China-Vietnam border. If the Project is moved to the north, away from Shuolong Port, the route will be located in a remote mountainous area, far away from Shuolong Town and the Port. In that case, the expressway will have little economic radiance on Shuolong Town, Daxin County, and lost its significance in the original planning and routing.

On the whole, moving the route to avoid Xialei Nature Reserve is not feasible from the perspective of construction significance. Therefore, the route cannot be moved to avoid Xialei Nature Reserve.

8.1.1.1.1.4. Impact Analysis of Nature Reserve

According to the *Assessment Report on Environmental Impact of Wuzhou (Longyanzui)– Shuolong Highway (Chongzuo–Jingxi Expressway to Shuolong Port Section) on Xialei Region-Level Nature Reserve in Guangxi* prepared by Guangxi Forest Inventory & Planning Institute, the quantitative results show that the impact of the proposed highway on the ecological system and landscape, biological community and habitat, and main protected objects of Xialei Nature Reserve are relatively small, and the impact on the species and populations of Xialei Nature Reserve and the biosafety of the nature reserve is moderate impact. The proposed highway construction has some negative impacts on Xialei Nature Reserve, which are mainly as follows: the connectivity of habitat is affected to some extent, thereby leading to the impact on the migration, dispersion and reproduction of important species; invasive plants spread further, and the accessibility of the nature reserve is improved, which leads to an increase in the management cost and difficulty of the nature reserve. On the premise of actively taking protection and restoration measures, properly coordinating the relationship with relevant interest groups can alleviate the impact of the proposed highway on the nature reserve.

8.1.1.1.2 Analysis of Impact on Huashan National Scenic Area in Guangxi

This chapter is mainly excerpted from the *Evaluation Report on Landscape Impact of Wuzhou (Longyanzui) - Shuolong Highway (Chongzuo-Jingxi Expressway to Shuolong Port Section) Crossing Huashan Scenic Area* prepared by Guangxi Urban-rural Planning Design Institute. The demonstration report was approved by Department of Forestry of Guangxi Zhuang Autonomous Region on May 25, 2020 (see Annex 10).

8.1.1.1.2.1 Spatial Relationship Between Line and Huashan Scenic Area

According to the *Master Plan for Huashan Scenic Area (1994 Edition),* Huashan Scenic Area is divided into five scenic spots (Chongzuo Scenic Spot, Ningming Scenic Spot, Longzhou Scenic Spot, Daxin Scenic Spot, Pingxiang Scenic Spot) and fifteen small scenic spots (Huashan Rock Art, Shangjin Boat Street, Mingshi Landscape, Detian Waterfall, Chongzuo Stone Forest, Panlong Monkeys, Donglang Banian Forest, Nongjin Scroll, Youyin Watchtower, etc.), and six nature reserves.

The total length of the proposed highway main line (K-line) K11+500-K12+263 and connecting line (A-line) AK0+000-AK5+423 crossing the Class II protection zone of Guangxi Huashan Scenic Area in the form of bridge, tunnel and subgrade is about 6.179 km. The main scenic spots on both sides of the proposed highway are Duxiu Peak and Yuejin Channel, with the minimum distances of 500 m and 690 m respectively, and both of them are Class III tourist attractions. The project is far from the Class I tourist attractions and special-class tourist attractions.

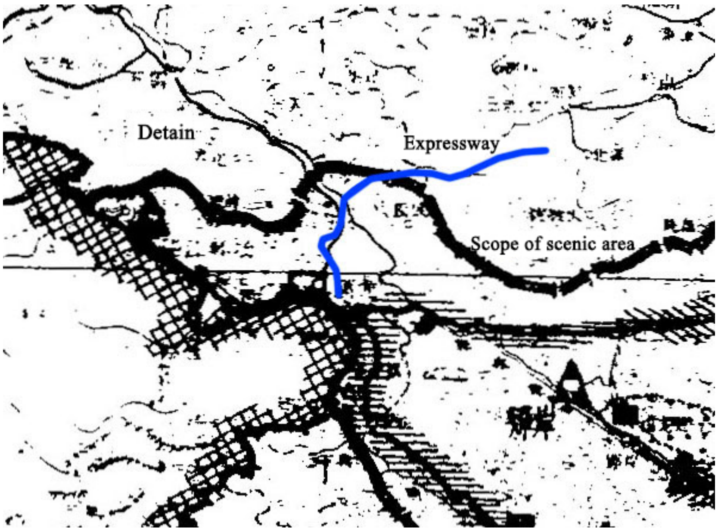


Figure 8.1-1 Relationship Between Proposed Highway and Scenic Area Scope of Master Plan (1994 Edition)1

8.1.1.1.2.2 Analysis on Compliance with Laws and Regulations and Coordination of Overall Planning

The laws and regulations related to the proposed highway in Huashan National Scenic Area in Guangxi mainly include *Regulations on Scenic Areas*, *Regulations on Administration of Scenic Areas in Guangxi Zhuang Autonomous Region* and *Notice on Strengthening Environmental Impact Assessment for Highway Planning and Construction* (HF [2007] No. 184). See Table 8.1-2 for the analysis of compliance of the proposed highway with relevant laws and regulations.

Table 8.1-2 Analysis Results of Compliance of Route of Proposed Highway Recommended Alternative with Relevant Laws and Regulations

S/N	Relevant provisions	Design Scheme and Current Situation of Proposed Project	Compliance Results
1	According to Article 28 of the *Regulations on Scenic Areas*, to build cable cars, ropeways and other major construction works in national scenic areas, the site selection scheme of the project shall be submitted to the construction authority of the people's government of the province or autonomous region and the scenic area authority of the people's government of the municipality directly under the Central Government for approval.	The proposed highway passes through the Class III protection zone of Huashan National Scenic Area in Guangxi, with the route approved by Department of Forestry of Guangxi Zhuang Autonomous Region (see Attachment 10)	Conformed
2	According to Article 28 of the *Regulations on Scenic Areas*, those who engage in construction activities outside the scope prohibited by Articles 26 and 27 of the Regulations in the scenic area shall go through the examination and approval procedures in accordance with the provisions of relevant laws and regulations upon examination by the management organization of the scenic area.	The proposed highway passes through the Class III protection zone of Huashan National Scenic Area in Guangxi, with the route approved by Department of Forestry of Guangxi Zhuang Autonomous Region (see Attachment 10)	Conformed
3	According to (HF [2007] No. 184), the new highway project shall avoid crossing the environmentally sensitive areas that need special protection according to law such	Due to engineering conditions, route planning and natural factors, the proposed highway needs to cross the	Conformed

S/N	Relevant provisions	Design Scheme and Current Situation of Proposed Project	Compliance Results
	as the core scenic spots of the scenic area. If it is necessary to cross the area outside the core scenic spots of the scenic area due to engineering conditions and natural factors, the Contractor shall obtain prior consent of the relevant authorities.	area outside the core scenic spot of Huashan National Scenic Area. The route has been approved by the Department of Forestry of Guangxi Zhuang Autonomous Region (see Attachment 10)	
4	According to Article 23 of the *Regulations on Administration of Scenic Areas in Guangxi Zhuang Autonomous Region*, in the scenic areas and their peripheral protected zones, it is not allowed to violate the planning to carry out construction of projects and facilities that are not concerned with the landscape and sightseeing or destroy the landscape or hinder sightseeing. Entertainment, accommodation, living and large-scale engineering facilities shall not be built in the scenic spots with concentrated landscape and attractions and the nature reserve in the scenic area.	The route of the Project passes through the Class II protection zone of Huashan Scenic Area. The scenic area along the line is classified as a general scenic spot, free from special-class scenic spots, Class I scenic spots and other important scenic spots. The route is far away from the core scenic spot and not within the visual range of the core scenic spot.	Conformed

It can be seen from Table 8.1-2 that the proposed highway meets the relevant requirements of *Regulations on Scenic Areas*, *Regulations on Administration of Scenic Areas in Guangxi Zhuang Autonomous Region* and *Notice on Strengthening Environmental Impact Assessment for Highway Planning and Construction* (HF [2007] No. 184).

8.1.1.1.2.3 Analysis of impact on landscape

1. Impact on Landscape Resource on Both Sides of Proposed Highway

The closer the landscape is to the landscape viewer, the higher the visibility and clarity of the landscape is. Similarly, the closer the expressway is to landscape resource, the greater the possible impact on the landscape is. Huashan Scenic Area belongs to subtropical karst landform. Featured by beautiful landform and relatively small size, it belongs to medium and micro landscape. Generally speaking, the farthest sight distance for people to view medium and micro landscape is no more than 1500 m, of which the best landscape distance shall be within 300 m. There are two scenic spots within 1500 m on both sides of the proposed highway, that is, Duxiu Peak and Yuejin Channel, and both of them belong to Class III scenic spots, with a distance from the Project of 500 m and 690 m respectively. There are no scenic spots within 300 m. In order to maximize the protection on Duxiu Peak and Yuejin Channe, the proposed highway must be protected during construction to avoid damage to the building itself. Besides, it is proposed to plant landscape trees on both sides of the highway for visual isolation.

To sum up, no core scenic spots are involved on both sides of the proposed highway (the sight distance between medium and micro landscapes), and the two scenic spots involved, Duxiu Peak and Yuejin Channel, belong to Class III scenic spots. Under corresponding measures, there is little impact on the landscape resource of Huashan Scenic Area.

2. Impact of the Line on Class I Protection Zone (Core Scenic Spot)

According to the *Master Plan for Huashan Scenic Area* (1994 Edition), three special scenic spots (namely Huashan Rock Art, Detian Waterfall, Panlong Monkeys) and their visual range, all the Class I scenic spots, Longrui, Longgang, Longhu, Luobai, Encheng and Laituan Rare Animal and Plant Resources Nature Reserves are classified as Class I protection areas.

The Project does not cross the Class I protection areas, so it has no impact on the Class I protection areas under 1994 Edition.

8.1.1.1.2.4 Impact of the Line on Primitiveness of Landscape Resources in Huashan Scenic Area

The primitiveness of landscape resources in Huashan Scenic Area mainly includes the primitiveness of topography and natural vegetation.

1. Primitiveness of Topography

The spatial landscape of Huashan Scenic Area is based on the development of typical colorful tropical karst landforms, which are mainly composed of karst landforms such as peak clusters and depressions, valleys, peaks and valleys, and basins, and is also featured by criss-crossed river networks and water systems, forming a wonderful landscape.

The construction of Chongzuo-Jingxi Expressway to Shuolong Port Expressway will have an impact on the current topography, which is mainly reflected in the destroy of the original surface configuration caused by mountain blasting and valley filling in the case of crossing natural mountains and valleys. The new line shall avoid areas with steep slopes and adopt bridges and tunnels to reduce the impact on topography.

Figure 8.1-2 Photos of Landform Along the Line

2. Primitiveness of Natural Vegetation

The proposed highway will occupy land and cause irreversible vegetation destruction. In addition, during the construction period, transport vehicles and personnel access will also cause vegetation destruction. The current situation investigation shows that the ecological environment on both sides of the proposed highway mainly consists of bushes, scrub-grasslands, and artificially cultivated saccharum officinarum, Zea mays, Oryza sativa, etc. The adverse impact of the implementation of the Project on plants is generally mild, and is mainly reflected as follows:

① Temporary land occupation in the project area causes vegetation destruction and death to some plants, resulting in certain biomass loss and local population density reduction. Part of the biomass loss caused by project construction can be compensated by highway greening. Neither disappearance of regional vegetation types nor reduction of biodiversity in the assessment area will occur;

② With the nature of land occupied by road changed, the area of regional green space is reduced and the spatial distribution is changed, which leads to the weakening or loss of the environmental control ability of the original green space;

③ Earthwork is required in highway construction. The vegetation destruction of fill and cut sections is caused by filling and cutting by construction machinery, transport vehicles and construction personnel activities, which is devastating. However, after construction, the vegetation on both sides of the highway will be restored to the type before being destructed, and it can be basically restored within 2-3 years after completion.

To sum up, the project construction will inevitably cause some damage to the vegetation along the line. The interference to the vegetation can be minimized through planning, design and compensation restoration. The project construction has little impact on the local vegetation.

8.1.1.1.2.5 Impact of the Line on Integrity of Landscape Resources in Huashan Scenic Area

The integrity of landscape resources is an important principle of landscape protection in scenic areas. The impact of Chongzuo-Jingxi Expressway to Shuolong Port Expressway on the landscape integrity of Huashan Scenic Area mainly lies in the division of scenic spots by the line and destruction of landscape dependent environment.

Huashan Scenic Area is formed by a number of interconnected scenic spots. From the existing distribution of scenic spots, the route selection of Chongzuo-Jingxi Expressway to Shuolong Port Expressway has avoided the scenic spot intensive areas, which has little impact on the integrity of scenic spots.

8.1.1.1.2.6 The line greatly improves the sightseeing conditions of scenic spots and promotes the development of tourism

The construction of proposed highway will improve the external traffic conditions of Shuolong and Detian Waterfall, greatly promoting the development of tourism. The building of the Project is the necessary infrastructure construction to serve the establishment of Sino-Vietnamese Detian·Ban Gioc International Tourism Cooperation Zone and the creation of Detian Waterfall scenic spot as a national 5A-level scenic spot. For the Sino-Vietnamese Detian·Ban Gioc International Tourism Cooperation

Zone, it is required to speed up the construction and improvement of scenic spots in the scenic area and surrounding service facilities, further improve the functional orientation of each zone, and effectively improve the number and level of scenic roads and tourist footpaths.

The construction of the project will speed up the development of tourism in Daxin county. The construction of the Project will create efficient, safe and convenient transportation conditions for tourists getting off Chongzuo - Jingxi Expressway and going to Shuolong Town and Detian Waterfall, making the development and construction of tourism economy in Daxin County more quickly and smoothly.

8.1.1.1.2.7 Conclusions

To sum up, there are few scenic spots on both sides of the proposed highway, free from the Class I protection areas, Class I scenic spots and special scenic spots. The terrain along the line is featured by small topography change. In spite of the inevitable vegetation destruction along the line during construction, the interference to the vegetation will be minimized through planning, design and compensation restoration. The line has little impact on the landform and vegetation primitiveness of Huashan Scenic Area. The line passing through the periphery of scenic spot intensive area has little impact on the integrity of scenic spots and improves the accessibility of scenic area.

8.1.1.2 Assessment on Impact of the Project on Terrestrial Plants and Vegetation

8.1.1.2.1 Impact on Plants and Vegetation During Construction Period

According to the plan and profile of the main design recommendation scheme, the high-fill deep-cut sections are counted according to the filling height of more than 20 m and the cutting depth of more than 30 m. The Project does not involve high-fill deep-cut sections, but the land occupation and tunnel construction will impose a certain impact on regional plants and vegetation in the construction process, as follows:

1. Analysis of Vegetation Types for Project Land Occupation

The total length of the project is 17.679, and the land area is 2004.96 mu, and permanent LA occurs in subgrade works area, bridge works area, tunnel works area and facilities area along the line, with a land area of 1391.96 mu. Temporary land occupation occurs in spoil area, temporary dump, construction, production and living areas and construction access road, with an area of 613 mu.

According to the field investigation, the land occupied by the project is mainly scrub-grasslands and crops, mainly including farmland crops and planted forests, and the natural secondary vegetation occupied by the proposed highway is mainly seasonal rainforest vegetation.

For the routing of the Project, it has been considered to route along the slope toe and wasteland as far as possible to reduce the occupation of cultivated land, economic forest and well-developed forest vegetation. At the same time, the occupation of regional vegetation is greatly reduced through the setting of bridges and tunnels, especially long tunnels crossing large mountains and elevated bridges crossing valleys.

2. Analysis of Impact on Vegetation

(1) Both permanent land occupation and temporary land occupation will affect the vegetation by removal of the surface vegetation. Permanent land occupation changes the way of land use, resulting in loss of ecological functions of the original vegetation. It is a direct and irreversible impact. Temporary land occupation leads to the death of the original vegetation by the removal of surface vegetation and the accumulation of materials and spoil, resulting in the loss of vegetation biomass, but the original appearance can be gradually restored after vegetation restoration. The vegetation biomass loss in the assessment area caused by the project construction is shown in the following chapters.

(2) From the importance of vegetation occupied, the Project mainly occupies farmland crops, planted forests and economic forests, and the natural vegetation occupied is mainly evergreen broad-leaved forests, shrubs and scrub-grasslands. The plants occupied by the project are mainly cultivated species, which have little impact on the plant species diversity in the assessment area. In addition, vegetation of land permanently occupied can be compensated to a certain extent by greening of the Project itself.

The vegetation of land temporarily occupied can be gradually restored through measures such as land greening in the later period;

(3) The recommended route of the Project has a total length of 17.679 km. Among which, the mainline is 12.263 km long, with a total of 5.1125 km bridges and 3.6455 km tunnels, with a bridge-tunnel ratio of 71.4%. The Shuolong connecting line is 5.416 km long, with a total of 98.5 m bridges and 1.43 km tunnels, with a bridge-tunnel ratio of 28.22%. From the engineering point of view, the construction scheme with the minimum impact on the vegetation in the assessment area is adopted. In the case of crossing the valley, bridges are used to reduce the vegetation occupation or interference area of the project land occupation area, and also avoid the vegetation damage arising from high fill. In the case of crossing large independent mountain or continuous mountains, tunnels are adopted, and these mountain sections where the line passes are mostly areas with good development of natural vegetation in the assessment area. Tunnel engineering avoids large-scale excavation of mountain, reducing the occupation of vegetation and providing protection on the continuity of vegetation.

To sum up, the land occupation and construction of the Project will inevitably cause some damage to the vegetation in the assessment area. However, the area along the line is the area with frequent human development activities, and the vegetation occupied is mainly artificially cultivated. The involving natural vegetation occupied is dominant by shrubs, and in the mountain where natural vegetation is continuously distributed, viaducts and tunnels have been set up for the Project to reduce the interference to vegetation.

Therefore, the project construction has little impact on the plant species diversity in the assessment area, and will not lead to the reduced plant species diversity in the assessment area. Through highway greening and vegetation restoration of temporary land occupation in the later period, the adverse impact of highway construction on the vegetation in the assessment area can be reduced.

3. Estimation and Compensation of Biomass Loss

It is necessary to occupy the original vegetation in the project construction, which leads to the loss of vegetation biomass. As the biomass lost in temporary land occupation can be basically compensated by ecological restoration, the assessment only estimates the biomass lost in permanent land occupation. For details of biomass loss in the permanently occupied area of the proposed highway, see Table 8.1-3.

Table 8.1-3 Schedule of Biomass Loss for Permanent Land Occupation of the Project

Floor area Type	Representative Species	Biomass Per Unit Area (t/hm^2)	Floor Area of the Project (hm^2)	Amount of Biomass Loss (t)
Paddy field	Oryza sativa (double cropping)	10.69	15.53	166.02
Dry land	Saccharum officinarum, etc.	22.4	21.47	480.93
Economic forest	Litchi chinensis, etc.	29.87	1.82	54.36
Forest Land	Liquidambar formosana, etc.	49.58	10.68	529.51
	Eucalyptus urophylla, etc.	61.6	8.74	538.38
Shrubland	Cipadessa baccifera, etc.	9.35	14.56	136.14
Shrub-grassland	Miscanthus sinensis Anderss, Neyraudia reynaudiana, etc.	5.4	24.27	131.06
Total				2036.40

The project area is located in the subtropical humid monsoon climate zone with good rainfall and temperature conditions and stable natural environment, which is suitable for plant growth. Permanent land occupation can be compensated to a certain extent by greening of slopes, central medians and highway communities, while temporary land occupation is temporary and can be compensated to a great extent by vegetation restoration after occupation.

4. Analysis of Impact on Protected Plants

(1) Impact on Protected Plants

Within the scope of assessment, there are about 12 nos. Excentrodendron tonkinese, a national Class II protected plant, and 29 nos. Zenia insignis Chun, national Class II protected plants found, which are more than 50 m (excluding tunnel) away from the land requisition area of the line and barely affected by the Project.

No protected plants are found in the occupied area of the project, and the two protected plant communities found in field investigation are close to the construction area of the line. As long as proper preventive and protective measures are taken during the construction period, the impact is generally not significant. However, the assessment area is an area where Zenia insignis Chun and Excentrodendron tonkinese are widely distributed in Guangxi Autonomous Region, some of which may be distributed near the construction area. Therefore, before the implementation of the Project, the Contractor shall, in conjunction with the local forestry department, conduct a detailed investigation on the protected plants in the adjacent occupied areas in the assessment area, protect the protected plants by hanging plates near the construction area and take protective measures of iron fences if necessary.

(2) Impact on Ancient and Famous Trees

According to the field investigation, there are a total of 10 ancient trees at 7 locations, among which 4 ancient trees are more than 40 m away from the boundary of land requisition of the Project. As long as proper preventive and protective measures are taken during the construction period, the impact is generally not significant.

According to the investigation, there are 5 ancient trees located within 40m from the boundary line of land requisition of the Project, which are 1 Radermachera sinica, 1 Dimocarpus longan, 3 ancient Litchi chinensis and 1 Ficus lacor in occupied area. The impact analysis is shown in Table 8.1-3. If the Project is constructed according to the current recommended scheme, the Ficus lacor will have to be transplanted. Therefore, during the project construction design, it is necessary to carefully compare and select the topographical, geomorphological and geological environment and other issues from multiple aspects around the ancient trees, consider comprehensively, and give priority to the lateral detail translation design of the project line on the premise of meeting the project construction, so as to bypass the growth impact range of the 6 ancient trees.

Table 8.1-4 List of Impact Analysis of Ancient Trees Located within the Boundary Line of Land Acquisition

S/N	Chinese name	Chainage	Coordinates	Quantity/occupied area (Nr.)	Impact analysis
1	Ficus lacor	AK0+580	N 22°51'8.47" E 106°49'37.75" H：292m	1/0	Optimize the design as far as possible to avoid them; if it is impossible to avoid them, report it to the forestry department for the approval of transplant
2	Radermachera sinica	35m LHS of K4+570	N22°52'39.51" E106°53'23.55" H：503m	1/0	In-situ protection shall be carried out, and enclosure measures shall be taken for protected plants and old trees close to each other to reduce the impact of project construction on protected plants and old trees.
3	Dimocarpus longan	6m RHS of AK4+980	N22°49'7.46" E106°49'38.22" H:291m	1/0	
4	Litchi	6m RHS	N22°49'6.47"	1/0	

S/N	Chinese name	Chainage	Coordinates	Quantity/occupied area (Nr.)	Impact analysis
	chinensis	of AK5+010	E106°49'38.18" H:291m		
5	Litchi chinensis	35m RHS of AK5+010	N22°48'55.98" E106°49'49.83" H:292m	2/0	

8.1.1.2.2 Impact of Operation Period on Plant Resources

(1) Analysis of Impact on Plant Community Succession

Highway construction leads to the change of the original land use mode. Due to the unique soil, water and terrain conditions, the restored roadside slope vegetation remains in the stage of grass or scrub-grasslands for a long time, which reduces the normal succession speed of vegetation, and then has a certain adverse impact on the continuity of regional vegetation. Because the project has a very high bridge-tunnel ratio (The mainline reaches 71.4%, and the branch line is 28.22%), the adverse impact is reduced to a certain extent.

At the same time, according to the investigation of roadside slope vegetation status of Nanning-Guilin Expressway, which has been in operation for many years, highway construction has an impact on vegetation in the occupied area, but has little impact on vegetation outside the occupied area; After years of management and protection, compared with the surrounding natural vegetation, the roadside slope vegetation has a higher coverage rate and thrives; Although the vegetation of highway roadside slope basically keeps the stage of scrub-grasslands in the early and medium stage of operation, with roadside slope greening plants as the main species and low species diversity, after the medium stage of operation, the surrounding natural vegetation can gradually enter the highway roadside slope, and the vegetation of highway roadside slope gradually changes from planted vegetation to natural vegetation, which is in the positive succession of vegetation.

However, the environmental conditions of the project region are similar to those of Nanning-Guilin Expressway, so the greening scope of the highway itself and the vegetation of temporary land will also show a trend of changing from planted vegetation to natural vegetation with the continuation of operation time and the gradual reduction of human interference, which is in the positive succession of vegetation.

(2) Analysis of Impact of Pollutant Discharge on Growth and Development of Plants along the Road

Vehicle exhaust and dust raising may exert a certain adverse effect on the growth and development of plants in the highway nature strip and its nearby areas. By analogy investigation of Nanning-Guilin Expressway, a lot of dust accumulates on the leaf surface of plants nearby the highway nature strip and shoulder, but such plants grow normally, so no obvious adverse effect is found.

In addition, in the section of agricultural production area where the highway passes, the exhaust emission of operating vehicles has certain influence on the growth and pollination of some crops on both sides, and then affects the crop yield and quality, but this influence decreases with the increase of distance, and the influence range is generally within 50m on both sides away from the highway boundary.

(3) Analysis of Impact of Alien Species on Local Ecosystem

According to the field investigation, seven invasive species in the assessment area were classified as invasive alien species, including Eupatorium odoratum, Dysphania ambrosioides, Amaranthus spinosus, Lantana camara, Bidens pilosa, Parthenium hysterophorus and Conyza canadensis. Bidens pilosa and Eupatorium odoratum form dominant communities along some roads. Most of the other invasive species appear in the assessment scope in sporadic distribution form.

The corridor effect during and after the project construction may cause the distribution range of existing alien species along the line to expand, and the project construction will form bare land. If local species are not used for greening in time, alien species in local regions may invade and gradually form a single dominant plant community, which will adversely affect local species. At the same time, the leading ecological function along the project region is provided by agricultural products, while the local region is protected by water conservation and biodiversity. Invasion of alien species will reduce the community species diversity, alleviate the normal succession of the community, and have certain adverse effects on the continuous enhancement and exertion of the community ecological function.

Targeted measures shall be taken to prevent the alien species from obviously expanding the distribution scope and further aggravating biological invasion caused by the construction of this project. In particular, prevention efforts shall be mainly strengthened for those passing through the concentrated distribution areas of protected plants and key public welfare forest sections.

Generally speaking, because the vegetation in the project assessment area is mainly cultivated plants such as agriculture and planted forests, the project assessment area is not a biodiversity sensitive region. As long as the protective measures are taken during construction and operation period, the possibility of large-scale biological invasion caused by the project implementation is small.

8.1.1.3 Assessment of Impact of the Project on Terrestrial Vertebrates

8.1.1.3.1 Analysis of Impact Factors

According to the present situation of terrestrial vertebrates, as well as the topography, climate, vegetation and other characteristics in the affected region of the project, combined with the project characteristics, the impact factors and ways of the project affecting terrestrial vertebrates are analyzed, as shown in the following table:

Table 8.1-5 List of Impact Factors of Project on Animals

Impact Period	Impact Factor		Major Impact Objects	Affecting Manner	Impact Property	Impact extent
Construction Period	Temporary land occupation		All groups	Occupy habitat	Temporary	Smaller
	Construction noise		Birds, mammals	Scare and drive	Temporary	Smaller
	Construction waste water Domestic sewage produced by construction personnel		Amphibians, forest-water model reptiles, wading birds	Pollute and deteriorate habitat	Temporary	Smaller
	Construction dust		Birds, mammals	Pollute, deteriorate habitat, drive	Temporary	Smaller
	Activities of construction personnel	Human interference	Birds, mammals	Scare and drive	Temporary	Smaller
		Human killing	Species with economic value	Individual death, quantity reduction	Temporary	Relatively serious
	Domestic garbage produced by construction personnel		All groups	Pollute and deteriorate habitat	Temporary	Smaller
Operation period	Permanent land occupation of the project		All groups	Occupy habitat	Permanent	General
	Vehicle impact and crushing		Birds	Individual death, quantity reduction	Permanent	Relatively serious
	Vehicle driving noise		Birds, mammals	Drive	Temporary	Smaller
	Nighttime lighting		Nocturnal birds and bats	Affect the flight route	Permanent	Smaller
	Obstruct the channel		Reptiles, mammals	Obstruct animal channels and affect gene exchange	Permanent	Smaller

8.1.1.3.2 Impact on Animals during Construction Period

(1) Impact of Construction Land Occupation on Animal Habitat

The common terrestrial wild animals along the project are mainly forest-water and shrub-rock model reptiles and birds, among which are mainly small songbirds and small mammals. The land occupation impact range of terrestrial animals in the assessment area is mainly concentrated in hilly and mountainous regions, and the vegetation is mainly broad-leaved forest. It is characterized by temporary land occupation of the project, such as temporary occupation of animal habitat in construction camp, temporary stockyard and slag yard. This reduces the habitat of wild animals, limits the activity region and foraging range of some terrestrial animals, and thus has a certain impact on the survival of terrestrial animals. However, due to the small scale of the project, and after the construction is completed, the animal habitat will be restored after the temporary land occupation for vegetation restoration, and the animals originally living in these habitats can return to their original habitat. The impact extent is small.

(2) Impact of Construction Noise on Animals

In the process of expressway construction, the construction machinery will produce certain noise, which may scare the wild animals near the construction region and make them move away from the construction region, which will have a certain impact on their foraging activities. However, due to the migration ability of animals, especially birds and mammals, and the similar habitats near the construction region, wild animals can temporarily move from the original habitat to live in similar habitats far away from the construction region; And these adverse effects will disappear with the completion of construction. Therefore, the degree of this impact is not great.

(3) Impact of Construction Wastewater and Domestic Sewage Produced by Construction Personnel on Animals

Construction activities will produce some wastewater, and the activities of construction personnel will also produce a certain amount of domestic sewage. If the wastewater and domestic sewage are discharged to nearby water areas, such as Xiaohei River and its tributaries, ponds, etc., they will have adverse effects on animals living in the water area. These adverse effects are mainly manifested in polluting the water areas and degrading the habitats of these animals. The affected animals are mainly amphibians, forest-water model reptiles and wading birds in birds. After the construction, the discharge of the sewage will stop, and the water body has a certain self-purification ability to restore the water quality to its original state, so this influence is temporary. Because the water area in the assessment area is small, there are not many kinds and numbers of animals living in these environments, and the influence is small. In addition, after adopting appropriate prevention and control measures, this kind of influence can be avoided.

(4) Impact of Construction Dust Raising on Animals

During construction, construction machinery and vehicles will produce a certain amount of dust. Dust will deteriorate the habitat of animals and keep them away from the construction scope. Birds and mammals are mainly affected. Since there are many similar habitats near the construction region, the impact will disappear after the construction, so the impact extent is also small.

(5) Impact of Construction Personnel's Activities on Animals

A. Interference from human activities

Construction activities will certainly introduce a large number of human activities. Wild animals are usually very afraid of human beings. Human activities will scare and drive away animals. The affected groups are mainly birds and mammals with more sensitive senses. This impact extent is small and temporary, and can be alleviated by appropriate measures.

B. Impact of human killing on animals

Among the terrestrial animals distributed in the assessment area, some species with economic value (see the following table for details) may be hunted and killed by construction personnel, which will cause individual animal death, reduce the number and have a greater impact extent. This kind of influence can be avoided if appropriate protective measures are taken.

Table 8.1-6 List of Economically Valuable Animals in the Assessment Area

Group	Order/Family/Species	Main Habitat			Protection	Occurrence Time	Economic value
		Arbor Forest	Cultivated Land and Village	Water area			
Batrachia	Bufo melanostictus	√	√		Autonomous region level	Summer	Can be used as medicine
	Hylarana guentheri		√	√	Autonomous region level	Summer	The meat tastes delicious
	Odorrana schmackeri	√				Summer	The meat tastes delicious
	Hoplobatrachus rugulosus	√	√	√	National class II	Summer	The meat tastes delicious
Reptile	Gekko gecko	√			National class II	Summer	Can be used as medicine and has high economic value
	Bungarus multicinctus	√			Autonomous region level	Summer	Can be used as medicine and has high economic value
	Naja atra	√	√		Autonomous region level	Summer	Can be used as medicine and has high economic value
	Elaphe	√	√	√		Summer	The meat tastes delicious
	Orthriophis taeniurus	√	√	√		Summer	The meat tastes delicious
	Zaocys dhumnades	√	√	√	Autonomous region level	Summer	The meat tastes delicious
Birds	Francolinus pintadeanus	√	√			Annual	The meat tastes delicious
	Bambusicola thoracica	√			Autonomous region level	Annual	The meat tastes delicious
	Lophura nycthemera	√	√		National Level II	Annual	The meat tastes delicious
	Phasianus colchicus	√	√		Autonomous region level	Annual	The meat tastes delicious
	Streptopelia chinensis	√	√			Annual	The meat tastes delicious
	Streptopelia orientalis	√	√			Annual	The meat tastes delicious
	Centropus bengalensis	√	√		National Level II	Summer	Can be used as medicine and has high

							economic value
	Centropus sinensis	√	√		National Level II	Annual	Can be used as medicine and has high economic value
	Gallinula chloropus		√	√	Autonomous region level	Annual	The meat tastes delicious
	Zosterops japonicus	√				Annual	Traditional caged birds with certain economic value
	Garrulax canorus	√	√		Autonomous region level	Annual	Traditional caged birds with certain economic value
	Leiothrix lutea (Scopoli)	√			Autonomous region level	Annual	Traditional caged birds with certain economic value
	Acridotheres cristatellus	√	√		Autonomous region level	Annual	Traditional caged birds with certain economic value
Mammalia	Mustela sibirica	√	√	√	Autonomous region level	Annual	Fur has certain economic value
	Melogale moschata	√	√		Autonomous region level	Annual	The meat tastes delicious
	Paguma larvata	√			Autonomous region level	Annual	The meat tastes delicious
	Sus scrofa	√	√			Annual	The meat tastes delicious
	Muntiacus muntjak	√			Autonomous region level	Annual	The meat tastes delicious
	Rhizomys pruinosus	√	√			Annual	The meat tastes delicious
	Rhizomys sinensis Gray	√	√		Autonomous region level	Annual	The meat tastes delicious

(6) Impact of Domestic Garbage Produced by Construction Personnel on Animals

During the construction process, the construction personnel will produce a certain amount of domestic garbage. If these domestic wastes are not properly disposed of, random stacking will have a certain impact on animals. On the one hand, the accumulation of garbage will deteriorate the habitat of animals and cause some animals to stay away from the construction region; On the other hand, domestic garbage will attract insects, etc., which will provide food sources for some insectivorous animals and increase their number, mainly including some species of birds that are suitable for living with people, such as passer montanus, and insectivores and rodents in mammals, which will lead to certain changes in animal community structure near construction camps and domestic garbage dumps. Due to the small scale of construction, this kind of impact extent is not great, and this kind of influence will disappear after construction.

The above analysis shows that the construction of this project has little impact on wildlife and the impact time is short. Some impacts can be avoided or alleviated by reasonable measures, and these impacts will be weakened or even disappear with the completion of construction.

8.1.1.3.3 Impact on Animal Diversity during the Operation Period

(1) Permanent Land Occupation of the Project

This project occupies a certain area of animal habitat in the reserve, mainly broad-leaved forest and cultivated land, and occupies a certain area of habitat for wild animals living in wood land environment, which makes their habitat compressed to a certain extent. This project is an expressway engineering, which mainly covers the piers of subgrade and viaduct, etc., which will have a certain degree of impact on animals.

(2) Vehicle Impact and Crushing

After the project is completed and put into operation, high-speed vehicles will impact or crush animals crossing the highway. As viaducts and tunnels are mainly used in this project, amphibians, reptiles and beasts can pass under the bridge or above the tunnel, and birds are mainly affected. The impact of birds crossing the highway will cause individual death, and the number of birds is reduced, which has a great impact extent, so certain measures shall be taken to avoid or alleviate it.

(3) Vehicle Driving Noise

When the expressway is running, the noise of vehicles and horns will cause adverse effects on animals, which is mainly manifested as driving away, which makes animals afraid to approach the highway. However, because animals have certain adaptability to long-term stable and harmless noise, the impact will gradually be weakened or even disappear after the project runs for a period of time. This impact extent is small and temporary.

(4) Obstructing Effect of the Line on Animals

After the expressway is completed, it will cut off the habitat of animals, which will have a certain obstructing effect on animals and hinder the gene exchange of animals. The data show that medium-sized herbivores generally need more than 500m of habitat corridors. Because the line is mainly viaduct and tunnel, the bridge-tunnel ratio is high (The mainline is up to 71.4%, and the branch is 28.22%), and the recommended route mileage is 17.679 km (including 12.263km for mainline and 5.416km for connecting line). The mainline has 5.1125 km of bridges and 3.6455 km of tunnels, and amphibians, reptiles and mammals can pass under the bridge or above the tunnel. This influence is small.

8.1.1.3.4 Impact on Key Protected and Rare and Endangered Wild Animals

Among the 177 species of terrestrial vertebrates in the assessment area, there are 14 species listed in the List of Wild Animals under Special State Protection in China, all of which are national Class II protected animals; There are 58 species listed in the List of Wild Animals under Special Protection of Guangxi Zhuang Autonomous Region. There are 23 species listed in the Red List of China's Vertebrates, including 1 critically endangered species, 6 endangered species, 5 vulnerable species and 11 near threatened species. There are 16 species listed in the appendices of Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), including 1 species in Appendix II and 1 species in Appendix III.

See Table 8.1-7 for the major impacts of the project on the key protected animals distributed in the assessment area.

Table 8.1-7 List of Major Impacts of Project on Key Protected Animals

Bridge type	Protection Level	CITES	CRDB	Main Distribution				Occurrence Time	Major Impact
				Zone A	Zone B	Zone C	Region D		
1 Hoplobatrachus rugulosus	National class II		EN		√		√	Summer	Construction wastewater pollutes the habitat. Killed by construction personnel. The habitat is occupied by project land occupation.
2 Gekko gecko	National class II		CR				√	Summer	Killed by construction personnel. The habitat is occupied by project land occupation.
3 Lophura nycthemera	National class II		LC	√			√	Annual	Driven away by construction noise and human activities. Killed by construction personnel. The habitat is occupied by project land occupation.
4 Centropus bengalensis	National class II		LC		√		√	Summer	Driven away by construction noise and human activities. Killed by construction personnel. The habitat is

Bridge type	Protection Level	CITES	CRDB	Main Distribution				Occurrence Time	Major Impact
				Zone A	Zone B	Zone C	Region D		
									occupied by project land occupation. Vehicle impact.
5 Centropus sinensis	National class II		LC		√		√	Annual	Driven away by construction noise and human activities. Killed by construction personnel. The habitat is occupied by project land occupation. Vehicle impact.
6 Aviceda leuphotes	National class II	Appendix II	LC				√	Annual	Driven away by construction noise and human activities. The habitat is occupied by project land occupation. Vehicle impact.
7 Accipiter trivirgatus	National class II	Appendix II	NT	√			√	Annual	Driven away by construction noise and human activities. The habitat is occupied by project land occupation. Vehicle impact.
8 Accipiter virgatus	National class II	Appendix II	LC	√			√	Annual	Driven away by construction noise and human activities. The habitat is occupied by project land occupation. Vehicle impact.
9 Elanus caeruleus	National class II	Appendix II	NT				√	Annual	Driven away by construction noise and human activities. The habitat is occupied by project land occupation.
10 Milvus migrans	National	Appendix	LC	√	√	√	√	Annual	Driven away by

Bridge type	Protection Level	CITES	CRDB	Main Distribution				Occurrence Time	Major Impact
				Zone A	Zone B	Zone C	Region D		
	class II	II							construction noise and human activities. The habitat is occupied by project land occupation.
11 Spilornis cheela	National class II	Appendix II	NT	√			√	Annual	Driven away by construction noise and human activities. The habitat is occupied by project land occupation.
12 Glaucidium cuculoides	National class II	Appendix II	LC	√			√	Annual	Driven away by construction noise and human activities. The habitat is occupied by project land occupation. Vehicle impact. Nighttime lighting interferes with flight.
13 Glaucidium cuculoides	National class II	Appendix II	LC	√			√	Annual	Driven away by construction noise and human activities. The habitat is occupied by project land occupation. Vehicle impact. Nighttime lighting interferes with flight.
14 Falco tinnunculus	National class II	Appendix II	LC	√	√		√	Annual	Driven away by construction noise and human activities. Vehicle impact. The habitat is occupied by project land occupation.
15 P. mucosus	Autonomous region level	Appendix II	EN	√			√	Summer	Construction wastewater pollutes the habitat. The

Bridge type	Protection Level	CITES	CRDB	Main Distribution				Occurrence Time	Major Impact
				Zone A	Zone B	Zone C	Region D		
									habitat is occupied by project land occupation.
16 Bungarus multicinctus	Autonomous region level		EN	√			√	Summer	Construction wastewater pollutes the habitat. The habitat is occupied by project land occupation.
17 Elaphe taeniura	Autonomous region level		EN	√			√	Summer	Construction wastewater pollutes the habitat. The habitat is occupied by project land occupation.
18 Elaphe			EN	√	√		√	Summer	Construction wastewater pollutes the habitat. Killed by construction personnel. The habitat is occupied by project land occupation.
19 Orthriophis taeniurus			EN	√	√		√	Summer	Construction wastewater pollutes the habitat. Killed by construction personnel. The habitat is occupied by project land occupation.
20 Naja atra	Autonomous region level	Appendix II	VU	√			√	Summer	Construction wastewater pollutes the habitat. Killed by construction personnel. The habitat is occupied by project land occupation.
21 Garrulax	Autonomous	Appendix	LC	√	√		√	Annual	Driven away by

Bridge type	Protection Level	CITES	CRDB	Main Distribution				Occurrence Time	Major Impact
				Zone A	Zone B	Zone C	Region D		
canorus	region level	II							construction noise and human activities. Killed by construction personnel. The habitat is occupied by project land occupation.
22 Leiothrix lutea (Scopoli)	Autonomous region level	Appendix II	LC	√			√	Annual	Driven away by construction noise and human activities. Killed by construction personnel. The habitat is occupied by project land occupation.
23 Scandentia	Autonomous region level	Appendix II	LC	√			√	Annual	Driven away by construction noise and human activities. The habitat is occupied by project land occupation.
24 Prionailurus bengalensis	Autonomous region level	Appendix II	VU	√	√		√	Annual	Driven away by construction noise and human activities. The habitat is occupied by project land occupation.
25 Paguma larvata	Autonomous region level	Appendix III	NT	√			√	Annual	Driven away by construction noise and human activities. Killed by construction personnel. The habitat is occupied by project land occupation.
26 Bufo melanostictus	Autonomous region level		LC	√	√		√	Summer	Construction wastewater pollutes the habitat. Killed by construction personnel. The habitat is

Bridge type	Protection Level	CITES	CRDB	Main Distribution				Occurrence Time	Major Impact
				Zone A	Zone B	Zone C	Region D		
									occupied by project land occupation.
27 Hylarana guentheri	Autonomous region level		LC			√		Summer	Construction wastewater pollutes the habitat. Killed by construction personnel. The habitat is occupied by project land occupation.
28 Fejervarya limnocharis	Autonomous region level		LC		√	√	√	Summer	Construction wastewater pollutes the habitat. The habitat is occupied by project land occupation.
29 Polypedates megacephalus	Autonomous region level		LC	√	√		√	Summer	Construction wastewater pollutes the habitat. The habitat is occupied by project land occupation.
30 Microhyla ornata	Autonomous region level		LC		√	√	√	Summer	Construction wastewater pollutes the habitat. The habitat is occupied by project land occupation.
31 Microhyla pulchra	Autonomous region level		LC		√	√	√	Summer	Construction wastewater pollutes the habitat. The habitat is occupied by project land occupation.
32 C. versicolor	Autonomous region level		LC	√			√	Summer	The habitat is occupied by project land occupation.
33 Ramphotyphlop	Autonomous region level		DD	√	√		√	Summer	The habitat is occupied by

Bridge type	Protection Level	CITES	CRDB	Main Distribution				Occurrence Time	Major Impact
				Zone A	Zone B	Zone C	Region D		
s braminus									project land occupation.
34 Pareas margaritophorus	Autonomous region level		NT	√	√		√	Summer	The habitat is occupied by project land occupation.
35 Elaphe mandarinus			VU	√			√	Summer	Construction wastewater pollutes the habitat. The habitat is occupied by project land occupation.
36 Enhydris plumbea			VU		√	√		Summer	Construction wastewater pollutes the habitat. The habitat is occupied by project land occupation.
37 Ptyas korros			VU	√			√	Summer	Construction wastewater pollutes the habitat. The habitat is occupied by project land occupation.
38 Zaocys dhumnades	Autonomous region level		VU	√	√	√	√	Summer	Construction wastewater pollutes the habitat. Killed by construction personnel. The habitat is occupied by project land occupation.
39 Francolinus pintadeanus			NT	√	√		√	Annual	Driven away by construction noise and human activities. Killed by construction personnel. The habitat is occupied by project land occupation. Vehicle impact.

Bridge type	Protection Level	CITES	CRDB	Main Distribution				Occurrence Time	Major Impact
				Zone A	Zone B	Zone C	Region D		
40 Bambusicola thoracica	Autonomous region level		LC	√			√	Annual	Driven away by construction noise and human activities. Killed by construction personnel. The habitat is occupied by project land occupation. Vehicle impact.
41 Phasianus colchicus	Autonomous region level		LC	√	√		√	Annual	Driven away by construction noise and human activities. Killed by construction personnel. The habitat is occupied by project land occupation. Vehicle impact.
42 Cuculus micropterus	Autonomous region level		LC	√	√		√	Summer	Driven away by construction noise and human activities. Vehicle impact. The habitat is occupied by project land occupation.
43 Cacomantis merulinus	Autonomous region level		LC	√			√	Summer	Driven away by construction noise and human activities. Vehicle impact. The habitat is occupied by project land occupation.
44 Surniculus lugubris	Autonomous region level		LC	√			√	Summer	Driven away by construction noise and human activities. Vehicle impact. The habitat is occupied by project land occupation.
45 Amaurornis phoenicurus	Autonomous region level		LC		√	√	√	Annual	Driven away by construction noise

Bridge type	Protection Level	CITES	CRDB	Main Distribution				Occurrence Time	Major Impact
				Zone A	Zone B	Zone C	Region D		
									and human activities. The habitat is occupied by project land occupation.
46 Gallinula chloropus	Autonomous region level		LC			√		Annual	Driven away by construction noise and human activities. Killed by construction personnel. The habitat is occupied by project land occupation.
47 Ardeola bacchus	Autonomous region level		LC	√	√	√	√	Annual	Driven away by construction noise and human activities. Vehicle impact. The habitat is occupied by project land occupation.
48 Upupa epops	Autonomous region level		LC	√	√		√	Annual	Driven away by construction noise and human activities. Vehicle impact. The habitat is occupied by project land occupation.
49 Eurystomus orientalis	Autonomous region level		LC	√			√	Annual	Driven away by construction noise and human activities. The habitat is occupied by project land occupation.
50 Halcyon smyrnensis	Autonomous region level		LC		√	√	√	Annual	Driven away by construction noise and human activities. The habitat is occupied by project land occupation.
51 Megalaima	Autonomous		LC	√			√	Annual	Driven away by

Bridge type	Protection Level	CITES	CRDB	Main Distribution				Occurrence Time	Major Impact
				Zone A	Zone B	Zone C	Region D		
virens	region level								construction noise and human activities. The habitat is occupied by project land occupation.
52 Psilopogon asiaticus	Autonomous region level		DD	√			√	Annual	Driven away by construction noise and human activities. The habitat is occupied by project land occupation.
53 Oriolus chinensis	Autonomous region level		LC	√	√		√	Summer	Driven away by construction noise and human activities. The habitat is occupied by project land occupation.
54 Pericrocotus roseus	Autonomous region level		LC	√			√	Summer	Driven away by construction noise and human activities. The habitat is occupied by project land occupation.
55 Dicrurus macrocercus	Autonomous region level		LC	√	√	√	√	Summer	Driven away by construction noise and human activities. Vehicle impact. The habitat is occupied by project land occupation.
56 Dicrurus leucophaeus	Autonomous region level		LC	√	√		√	Spring, Summer	Driven away by construction noise and human activities. Vehicle impact. The habitat is occupied by project land occupation.
57 Dicrurus hottentottus	Autonomous region level		LC	√	√		√	Summer	Driven away by construction noise

Bridge type	Protection Level	CITES	CRDB	Main Distribution				Occurrence Time	Major Impact
				Zone A	Zone B	Zone C	Region D		
									and human activities. Vehicle impact. The habitat is occupied by project land occupation.
58 Terpsiphone paradisi			NT	√			√	Summer	Driven away by construction noise and human activities. The habitat is occupied by project land occupation.
59 Lanius schach	Autonomous region level		LC	√	√		√	Annual	Driven away by construction noise and human activities. Vehicle impact. The habitat is occupied by project land occupation.
60 Urocissa erythrorhyncha	Autonomous region level		LC	√			√	Annual	Driven away by construction noise and human activities. Vehicle impact. The habitat is occupied by project land occupation.
61 Dendrocitta formosae	Autonomous region level		LC	√			√	Annual	Driven away by construction noise and human activities. Vehicle impact. The habitat is occupied by project land occupation.
62 Parus major	Autonomous region level		LC	√	√		√	Annual	Driven away by construction noise and human activities. The habitat is occupied by project land occupation.
63 Orthotomus	Autonomous		LC	√	√		√	Annual	Driven away by

Bridge type	Protection Level	CITES	CRDB	Main Distribution				Occurrence Time	Major Impact
				Zone A	Zone B	Zone C	Region D		
sutorius	region level								construction noise and human activities. The habitat is occupied by project land occupation.
64 Pycnonotus aurigaster	Autonomous region level		LC	√	√		√	Annual	Driven away by construction noise and human activities. Vehicle impact. The habitat is occupied by project land occupation.
65 Pycnonotus sinensis	Autonomous region level		LC	√	√		√	Annual	Driven away by construction noise and human activities. Vehicle impact. The habitat is occupied by project land occupation.
66 Pycnonotusjocosus	Autonomous region level		LC	√	√		√	Annual	Driven away by construction noise and human activities. Vehicle impact. The habitat is occupied by project land occupation.
67 Hypsipetes mcclellandii	Autonomous region level		LC	√			√	Annual	Driven away by construction noise and human activities. Vehicle impact. The habitat is occupied by project land occupation.
68 Phylloscopus proregulus	Autonomous region level		LC	√			√	Winter	Driven away by construction noise and human activities. The habitat is occupied by project land occupation.

Bridge type	Protection Level	CITES	CRDB	Main Distribution				Occurrence Time	Major Impact
				Zone A	Zone B	Zone C	Region D		
69 Phylloscopus calciatilis			NT	√			√	Annual	Driven away by construction noise and human activities. The habitat is occupied by project land occupation.
70 Tesia cyaniventer	Autonomous region level		LC	√			√	Annual	Driven away by construction noise and human activities. The habitat is occupied by project land occupation.
71 Pomatorhinus ruficollis	Autonomous region level		LC	√			√	Annual	Driven away by construction noise and human activities. Vehicle impact. The habitat is occupied by project land occupation.
72 Garrulax sannio	Autonomous region level		LC	√	√		√	Annual	Driven away by construction noise and human activities. Vehicle impact. The habitat is occupied by project land occupation.
73 Garrulax chinensis	Autonomous region level		LC	√			√	Annual	Driven away by construction noise and human activities. Vehicle impact. The habitat is occupied by project land occupation.
74 Acridotheres cristatellus	Autonomous region level		LC	√	√		√	Annual	Driven away by construction noise and human activities. Killed by construction personnel. Vehicle impact. The habitat is

Bridge type	Protection Level	CITES	CRDB	Main Distribution				Occurrence Time	Major Impact
				Zone A	Zone B	Zone C	Region D		
									occupied by project land occupation.
75 Turdus merula	Autonomous region level		LC	√	√		√	Annual	Driven away by construction noise and human activities. Vehicle impact. The habitat is occupied by project land occupation.
76 Turdus dissimilis			NT	√	√		√	Annual	Driven away by construction noise and human activities. Vehicle impact. The habitat is occupied by project land occupation.
77 Melophus lathami	Autonomous region level		LC	√	√		√	Annual	Driven away by construction noise and human activities. The habitat is occupied by project land occupation.
78 Mustela sibirica	Autonomous region level		LC	√	√		√	Annual	Driven away by construction noise and human activities. Killed by construction personnel. The habitat is occupied by project land occupation.
79 Melogale moschata	Autonomous region level		NT	√			√	Annual	Driven away by construction noise and human activities. Killed by construction personnel. The habitat is occupied by project land occupation.
80 Muntiacus muntjak	Autonomous region level		NT	√			√	Annual	Driven away by construction noise

Bridge type	Protection Level	CITES	CRDB	Main Distribution				Occurrence Time	Major Impact
				Zone A	Zone B	Zone C	Region D		
									and human activities. Killed by construction personnel. The habitat is occupied by project land occupation.
81 Rhizomys sinensis Gray	Autonomous region level		LC	√	√		√	Annual	Driven away by construction noise and human activities. Killed by construction personnel. The habitat is occupied by project land occupation.

Note: For the classification system of amphibians, refer to Colored Atlas of Chinese Amphibians and Their Distributions Sichuan Science and Technology Press, Fei Liang, 2012; For the classification system of reptiles, refer to A Revised Taxonomy for Chinese Reptiles Biodiversity, Cai Bo, Wang Yuezhao et al., 2015 (03); For the classification system of birds, refer to A Checklist on the Classification and Distribution of the Birds of China (Third Edition) Science Press, Zheng Guangmei, 2017; Refer to China's Mammal Diversity (2nd Edition), Biodiversity, Jiang Zhigang et al., 2017(08) for the classification system of beasts. Protection level: I~ national class I protected animals, II~ national class II protected animals; Autonomous region level: key protected terrestrial wild animals in Guangxi Zhuang Autonomous Region; CITES Convention on International Trade in Endangered Species of Wild Fauna and Flora: I~ Appendix I, II~ Appendix II, III ~ Appendix III; levels of threatened species in CRDB: CR— critically endangered, EN—endangered, VU— vulnerable, NT— near threatened, LC— least concerned, DD— data deficiency. In the main distribution, zone A: K1+100 ~ K4+200, K9+200~ K11+500 section; zone B: the starting point of the line ~K1+100, K4+200~K9+200, K11+500~LK5+300 section; zone C: K12+0 ~ K12+100, LK5+300~ the ending point section of the line; zone D: in the section where the line crosses the experimental area of Xialei Reserve; it is close to one side of the core area and buffer area of the reserve.

8.1.1.4 Analysis of Impact of Project on Aquatic Organisms

8.1.1.4.1 Construction period

1. Analysis of Impact on Zooplankton and Phytoplankton

The discharge of domestic sewage and garbage in the construction camp, oily sewage produced by mechanical repair of construction machinery and oil spill during work will inevitably pollute the water quality to a certain extent, resulting in the changes in the composition and dominance of plankton species.

The bridge operation field is adjacent to the water body, and the construction materials may enter the water body due to improper storage or being scoured by heavy rain; Exposed earth and stone after pavement excavation, spoil and waste slag of the project, and pavement runoff formed by rain scour will also enter the water body, which will lead to turbidity of the water body and destroy the growth environment of plankton. In the process of bridge erection, the excavation of bridge foundation disturbs local water body, resulting in turbid water quality, the concentration of suspended solids in water will increase, and plankton will reduce biomass in the construction region due to the change of water quality.

After the construction, with the dilution and self-purification of the water body, the water quality is gradually improved, and the plankton can basically recover to the level before the construction.

2. Impact on Benthos

During the construction period, the water quality of the river has decreased due to various reasons, and it is suitable for the species inhabiting the cleaner water body. Pollution will inevitably cause the influence of such species. However, aquatic benthos along the route are also distributed in similar environments in other nearby areas. From the perspective of species protection, the construction of the project has little impact on these species.

3. Impact on fish

The field investigation shows that the water areas in the project region are mainly common fish. The impact of major bridge construction on the water environment is mainly manifested by the increase of suspended solids concentration in the water body, and the concentration of petroleum substances in the water body will also increase under the condition of improper treatment or management. The primary productivity is reduced mainly by affecting photosynthesis such as algae in the water body, which leads to the decrease of bait, which has a certain impact on fish. The impact of the project on fish is limited to the construction region and does not affect the protection of fish species resources.

8.1.1.4.2 Operation period

Pollutants (mainly SS and petroleum) produced by automobile exhaust and pavement materials may enter rivers along with road-region runoff formed by natural rainfall, and then affect aquatic organisms. In the project design, corresponding project measures have been adopted according to different geological conditions, and the road-region runoff is collected into natural ditches through side drains and drainage ditches. The pollutant of low concentration would have its concentration further reduced through natural degradation by natural water body and would not change current status of the water quality. Therefore, it has minor impact on aquatic organisms.

Sewage from the toll station (built together with the maintenance work area) will be recycled after being collected and processed to the standard, so it basically has no impact on aquatic organisms.

8.1.1.5 Analysis of Ecological Impacts on Agriculture and Forestry

Temporary land occupied by the highway engineering can basically restore its original production function after second ploughing or restoration. Generally, there is no great impact. Transformation of agricultural land into construction land in permanent land occupation by the highway will result in loss of agricultural and forestry production functions on the original land. Therefore, the impact of highway engineering on agricultural and forestry land resources is mainly represented at permanent land occupation areas. For changes in agricultural and forestry land in the assessment area due to the permanent occupation of agricultural and forestry land by the Project, refer to the following table.

Table 8.1-8 Changes in Agricultural and Forestry Land in Assessment Area Due to Permanent Occupation of Agricultural and Forestry Land by Project

Area affected	Cultivated land			Plantation Land			Woodland		
	On-hand Quantity (hm^2)	Project Occupation (hm^2)	Reduction Ratio (%)	On-hand Quantity (hm^2)	Project Occupation (hm^2)	Reduction Ratio (%)	On-hand Quantity (hm^2)	Project Occupation (hm^2)	Reduction Ratio (%)
Total within the evaluation scope	456.06	33	7.24	9.75	1.82	18.67	119.9	19.42	16.20

It can be seen from Table 8.1~-7: From the perspective of cultivated land occupation, the cultivated land along the line will be reduced by 7.24% after project implementation, with a small ratio of occupation. In the next stage, we shall put more effort to protection and restoration of protection; from the perspective of plantation land occupation, the plantation land along the line will be reduced by 18.67% after project implementation. Appropriate compensation shall be given; from the perspective of wood land occupation, the wood land along the line will be reduced by 16.20% after project implementation. In general, the highway has no great impact on the wood land.

On the whole, the implementation of the Project will not cause any major adverse impact on the pattern of agricultural land in counties.

8.1.1.6 Analysis of Impact on Occupation of Key Public Welfare Forests

Key public welfare forests occupied by the Project consist of about 3.12hm2 ecological public welfare forests in Tiandeng County and about 1.3hm2 ecological public welfare forests in Daxin County.

Key public welfare forests occupied are dominated by bush, dominant species mainly including cipadessa baccifera, pterolobium punctatum, alchornea trewioides and desmos chinensis. Key public welfare forests occupied mainly consist of national defense forests and soil and water conservation forests. They are all national class II public welfare forests and contain no class I public welfare forests.

In sections of key public welfare forests under project occupation, public welfare forests are occupied in subgrade form, which causes a certain fragmentation impact on ecological public welfare forests; crossing public welfare forests in tunnel form would not have significant impact on forest integrity and vegetation continuity. In addition, project occupation is mainly in belt form, and does not involve large-area destruction, and greening and other water and soil conservation measures will be timely taken after project completion. Therefore, project construction would not cause a large area of water and soil loss.

On the whole, the Project occupies a relatively small proportion of the area of key public welfare forests compared with that in counties along the line, would not impair the continued performance of its dominant ecological function, and has no great impact on its overall ecological service capacity. In addition, a site survey on ecological public welfare forests through which the Project goes shows distribution of the same vegetation type similar or superior to that on the structure of key public welfare forests to be occupied near the forests. With "occupation and supplementation", the ecological service capacity of regional key public welfare forests would not change greatly.

8.1.1.7 Ecological Impact Analysis of Tunnel Works

8.1.1.7.1 Vegetation at Construction Area of Tunnel Works and Impact Analysis

Bush is mainly occupied at the tunnel entrance and exit at the construction area of tunnel works in the Project, a portion of economic forests and scrub-grassland also occupied.

The results of the vegetation status survey show the vegetation affected by project construction at the portal has a wide distribution in the area. Affected species mainly consist of common or widely distributed species at local areas, such as pterolobium punctatum, cipadessa baccifera, sageretia thea and cratoxylum cochinchinense. Protective plants, such as excentrodendron tonkinese and zenia insignis, are occupied at local areas. The quantity of lost plants is limited. The population quantity is basically not affected in areas. Regional plant species diversity is not affected. The impact of project tunnel works on vegetation is mainly represented by occupation of a small amount of vegetation. With no significant or sensitive vegetation type occupied, the impact is not great.

8.1.1.7.2 Impact Analysis on Vegetation on Tunnel Top

The analysis shows that tunnel works along the Project are of good geological conditions and stable bedrock; construction of tunnel works may cause a small volume of the maximum water yield.

In case of a great volume of water yield in the early period of construction, the water content of surrounding soil may give a temporary reduction, but it has no great impact on the water content of thin layer soil on the ground. If the construction process of tunneling while supporting is adopted, underground water yield will be gradually controlled following the effect of the intercepting measure, and affected water content of soil will be gradually restored in general.

The vegetation on tunnel top mainly consists of the bush, tropical bamboo forest, economic forest and scrub-grassland, with a few monsoon forests distributed at local areas. Affected species generally use soil groundwater within 10m below the ground, and are insensitive to minor changes in deep groundwater. By analogy with tunnels of the existing expressway from Nanning to Youyiguan, the tunnel works have no great impact on animals and plant above during operation.

The Project is dominated by subtropical monsoon climate, with abundant rainfall, a season both called rainy season and hot season, and annual average precipitation of 1267.5~1479.2mm. Atmospheric rainfall is the main source for plant growth and to the water content of thin layer soil. The Project has no impact on the meteorological and climatic environment, for example, atmospheric rainfall, effectively securing stable source of plant water required for ecological purpose and water consumption for normal growth of plants.

Overall, the Project has minor impact on the vegetation on tunnel top. There is little possibility of vegetation withering on tunnel top due to groundwater leakage.

8.1.1.7.3 Impact Analysis of Waste Slag in Tunnel

Slags from the tunnel are delivered to nearby spoil ground for stacking. From the results of the survey on current status of the environment around the portal, improper slag disposal and slab rejection near the portal or at will during construction will occupy or temporarily occupy a large area of cultivated land, thus intensifying the shortage of local cultivated land. With a great amount of stonework, occupied cultivated land is hard to undergo second ploughing in general, which will put more pressure to protection of regional cultivated land and cause impact on regional agricultural production.

8.1.1.8 Analysis on Environment Rationality of Borrow Area, Spoil Ground and Temporary Stock Yard

According to the Report on Soil and Water Conservation Scheme of Wuzhou (Longyanzui) - Shuolong Highway (Chongzuo - Jingxi Expressway to Shuolong Port Section) (November 2019) and the Feasibility Study Report of Wuzhou (Longyanzui) - Shuolong Highway (Chongzuo - Jingxi Expressway to Shuolong Port Section) Project (November 2020): the Project is provided with 3 spoil grounds, 3 temporary stock yards (set in the three spoil grounds) and 2 centralized large-scale production and living areas. The quantity of permanent spoil in the Project is 355,000 m3 (transported to the spoil grounds for stacking).

8.1.1.8.1 Environmental Impact Analysis of Spoil Ground

1. There are 3 spoil grounds initially proposed, whose locations are not statutory sensitive areas or objects, protected flora and fauna and important habitats, but mainly occupy the wood land, with a portion of non-irrigated land and plantation land occupied. From the perspective of land occupation, the locations of the spoil grounds are basically feasible.

2. Spoil grounds and transport routes are away from schools, hospitals and other special sensitive areas. Most of these areas are available through farm roads, so not many access roads for construction are to be built. Spoil grounds and transport routes have minor noise and dust impacts.

3. Attention should be paid to avoiding occupying cultivated land in location selection for spoil grounds. However, a portion of the proposed spoil grounds involves occupation of non-irrigated land. The Project is dominated by mountainous areas with a little cultivated land, and most of depressions suitable for spoiling slags have been made into cultivated land. Therefore, occupation of cultivated land by slags is inevitable. It is proposed in the assessment to reduce the impact by layout improvement and second ploughing in the next stage.

8.1.1.8.2 Rationality Analysis of Temporary Stock Yard Setting

Three temporary earth yards are proposed, which are far away from villages, schools and other sensitive targets within 100m, without occupying basic cultivated land and with short transport routes, getting rid of high-yield cultivated land and natural vegetation as far as possible and which are located at non-irrigated land, orchard and open forest land as possible. Therefore, the location is basically reasonable. It is recommended to further improve the layout, occupy no basic cultivated land, occupy as less wood land as possible and make the plan of second ploughing and vegetation restoration.

8.1.1.8.3 Site Selection Principle of Spoil Ground and Temporary Stock Yard

From the perspective of environmental protection, spoil grounds and temporary stock yards of the Project shall follow the site selection principle and requirement below:

1. Borrow areas shall be located at low hills as possible; spoil grounds and temporary pile yards shall be in valley or gentle slope type as possible. The spoil ground with small upstream catchment area is not a big gully and easy to be protected. The surrounding of spoil grounds and temporary stock yards is free of collapse, landslide and other natural disasters.

2. Spoil grounds and temporary stock yards shall get rid of centrally distributed habitats of protected flora and fauna or well developed natural vegetation, and areas with special social concern (such as, concentrated villages and towns, hospitals and schools). There is no village or important utility within the

impact area of spoil grounds, especially downstream areas.

3. Without the consent of the competent authority, spoil areas, borrow areas and temporary stock yards shall not be in areas prohibited by laws and regulations, such as nature reserves, geological parks, famous scenic sites, culture relic protection site, drinking water source protection area, danger areas of collapse and landslide and susceptible areas of debris flow.

4. Spoil areas, borrow areas and temporary stock yards shall not be in urban and township planning areas or visible range of famous scenic sites. Spoil areas and borrow areas shall not be within the visible range of the highway as possible.

5. Spoil grounds and temporary stock yards are not allowed to be located at rivers and reservoirs along the line or below the highest flood line of the river.

6. Spoil grounds, borrow areas and temporary stockyards shall not be set up in basic cultivated land, high-yield cultivated land, specialty cultivated land and mineral resources distribution areas and other important resource areas; occupation of woodland and irrigated land shall be avoided as far as possible, and occupation of non-irrigated land shall be minimized as far as possible; priority shall be given to hillside land, wasteland, abandoned land or unavailable land.

7. The haul distance of borrows and spoils shall be minimized and existing access roads shall be used for transportation as possible; transport passage do not go through sensitive areas, such as urban areas, concentrated residential areas, schools and hospitals.

8.1.1.8.4 Rationality of Site Selection for Construction Production and Living Areas

1. Site selection

There are two large construction, production and living areas preliminarily proposed for the Project, among which the No.1 construction, production and living area is planned to use the maintenance work area along the line, and it is located on the right side of K5+800 (west of Dunlitun); the No.2 construction, production and living area is located on the left side of AK0+300 (south of Bangtun). The current land types are wasteland and dry land.

According to the locations of the construction, production and living areas preliminarily selected by the Employer, there are two restrictive factors for the site selection, one is that they are located in the Huashan Scenic Area, and the other is that they are close to the residential sensitive spots.

2. Analysis on the restrictions of Huashan Scenic Area

Affected by the project route, the Employer preliminarily determined that the No.2 construction, production and living area would be located in the Huashan Scenic Area, which is delineated in a wide range, covering almost the whole Shuolong Town of Daxin County. K11+500~K12+263 and AK0+000~AK5+423 of the proposed project pass through the Class II Reserve of the Huashan National Scenic Area, with a total crossing length of 6.179 km, and the construction mileage of the sections is long.

If the No.2 construction, production and living area is set outside the scenic area, it is far away from the construction section, which is not conducive to the project construction. To sum up, the construction and living areas for K11+500~K12+263 and AK0+000~AK5+423 will inevitably need to be located within the scenic area.

According to the conclusion made in the *Landscape Impact Assessment Report of Wuzhou (Longyanzui) - Shuolong Highway (Chongzuo - Jingxi Expressway to Shuolong Port Section) Crossing Huashan Scenic Area*, there are few scenic spots on both sides of Wuzhou (Longyanzui) - Shuolong Highway (Chongzuo - Jingxi Expressway to Shuolong Port Section) and no class I conservation areas, class II scenic spots or special scenic spots are involved. The terrain changes little along the Project. Although certain damages will inevitably be caused to the vegetation along the Project during construction, the disturbance to vegetation can be minimized through appropriate planning design and compensatory restoration. The Project will have little impact on the original nature of the landform and vegetation in Huashan Scenic Area. The line will pass through the Scenic Area only along the periphery of the zone of concentrated scenic spots and so will have little impact on integrity of the scenic spots. On the other hand, the Project will improve the accessibility of the Scenic Area. Temporary land occupation in the project area causes vegetation destruction and death to some plants, resulting in certain biomass loss and local population density reduction. Part of the biomass loss caused by project construction can be compensated by highway greening. Neither disappearance of regional vegetation types nor reduction of biodiversity in the assessment area will occur. To sum up, the project construction will inevitably cause some damage to the vegetation along the line. The interference to the vegetation can be minimized through planning design and compensation restoration. The project construction has little impact on the local vegetation.

3. The site is close to the residential sensitive spots

There are two large construction, production and living areas preliminarily proposed, among which the No.1 construction, production and living area is planned to use the maintenance work area along the line; it is located 120 m west of Dunli and close to sensitive targets, and the noise, dust and asphalt waste gas generated in the construction, production and living area will have a certain impact on Dunli. The No.2 construction, production and living area is located 25m south of Bangtun; it is close to sensitive targets, and the noise and dust generated in the construction, production and living area will have a certain impact on Bangtun. Therefore, according to the requirements of this assessment, the concrete mixing station and asphalt mixing station in the construction, production and living area of the Project shall be as far away from residential areas as possible when selecting and arranging the site.

To sum up, the No.2 construction, production and living area of the Project will inevitably need to be located within the scenic area, and the crossing subject has been approved by the competent authorities of the scenic area; Because the No.1 and No.2 construction, production and living areas of the Project are close to the residential sensitive spots, in order to avoid affecting sensitive targets, the following site selection requirements are put forward for the construction, production and living areas in this EIA:

(1) Rent local houses or use houses acquired and demolished for the highway as construction camps and management rooms during the construction period of the Project as possible.

(2) It shall not be located within the range of the catchment area of the water body with the function of drinking water. Sewage cannot be discharged to the vicinity of the water intake of surface water body or groundwater with the function of domestic drinking water.

(3) Without the consent of the competent authority, it shall not be in areas prohibited by laws and regulations such as nature reserves, geological parks, famous scenic sites, basic cultivated land protection areas, culture relic protection sites and drinking water source protection areas.

(4) It shall not be set up in basic cultivated land, high-yield cultivated land, specialty cultivated land and mineral resources distribution areas and other important resource areas; occupation of wood land and irrigated land shall be avoided as far as possible, and occupation of non-irrigated land shall be minimized as far as possible, priority shall be given to hillside land, wasteland, abandoned land or unavailable land;

(5) The domestic sewage generated shall be treated by sewage treatment facilities before discharged. The effluent quality shall meet the requirements of the Grade I standard limit in the *Integrated Wastewater Discharge Standard*. Feces in the centralized living area can be used as cultivated land fertilizer through composting. It is strictly prohibited to allow them to overflow or discharge them into rivers without treatment.

(6) According to the *Design Specifications of Highway Environmental Protectio*n (JTG B04-2010), the asphalt mixing station should not be less than 300m to the environmental sensitive point, and shall be located on the windward side of the protected object in the wind direction of the least frequency in local construction season.

(7) According to the *Design Specifications of Highway Environmental Protection* (JTG B04-2010), the aggregate and other mixture mixing station should not be less than 200m to the environmental sensitive point, and shall be located on the windward side of the protected object in the wind direction of the least frequency in local construction season.

Based on the above, the degree of environmental impact of the construction camp is in relation to the site selection to a great extent. Reasonable site selection of the construction camp will greatly reduce its environmental impact. In general, the construction camp has minor environmental impact only if we strictly follow the requirement for site selection proposed in the report and implement measures regarding environmental protection.

8.1.1.9 Impact Analysis on Ecological Function Zoning

According to the *Ecological Function Zoning of Guangxi Zhuang Autonomous Region*, the project area is overall located in a biodiversity conservation function zone in karst mountain areas of southwest Guangxi.

When selecting the route of the proposed highway, the route shown in the recommended scheme has gotten rid of centrally distributed areas of flora and fauna, core areas and buffer areas of natural reserves as possible. Project route is basically along the old route with frequent human activities and high development intensity, and mainly goes through cultivated land and a portion of hillside edges. When it is inevitable to pass through hillside areas, the subgrade is generally replaced with the tunnel, which minimizes vegetation destruction and separation of wild animals. In the Project, bridges and tunnels along the main line and branch line account for 71.4% and 28.22% respectively. From the engineering perspective, the construction scheme with minimum impact on the vegetation in the assessment area is adopted to protect vegetation continuity.

The implementation of the proposed project will not lead to the extinction of affected species and have minor impact on the diversity of local species. However, attention shall be paid to improvement of the spread speed and increase of the distribution area of foreign species by the effect of highway passages, to minimize adverse impacts on local species.

Project implementation will require occupying a certain amount of vegetation, which will damage water and soil conservation function of original vegetation. A combined method of engineering and vegetation protection will be adopted for the highway to carry out active water and soil conservation treatment at affected areas. The implementation of the greening works of the proposed highway and vegetation restoration measures at the temporarily occupied land will play a certain role in water and soil conservation and realize ecological compensation to some extent.

On the whole, it is in line with the property requirement of the construction project by the ecological function zoning.

8.1.2 Ecological Impact Assessment for Detian-Shuolong Highway

8.1.2.1 Impact Analysis of Ecological Sensitive Areas

As the project route does not cross Xialei Nature Reserve, it has little impact on the reserve. The whole route of the Project is located in Huashan Scenic Area, and the Project belongs to the Detian-Shuolong Section in the upgrading project of Shuolong-Detian-Renai Class II Highway. The impact of the Project on Huashan Scenic Area is mainly taken from the *Report for Landscape Impact Assessment of Shuolong-Detian-Renai Class II Highway Upgrading Project in Daxin County Passing* *through Huashan Scenic Area* compiled by Guangxi Urban-rural Planning Design Institute.

8.1.2.1.1 Spatial Relationship Between the Line and Huashan Scenic Area

According to the 94 Edition, Huashan Scenic Area is divided into five scenic areas (Chongzuo Scenic Area, Ningming Scenic Area, Longzhou Scenic Area, Daxin Scenic Area, Pingxiang Scenic Area) and fifteen small scenic spots (Huashan Rock Art, Shangjin Boat Street, Mingshi Landscape, Detian Waterfall, Chongzuo Stone Forest, Panlong Monkeys, Donglang Banian Forest, Nongjin Scroll, Youyin Watchtower, etc.), and six nature reserves.

The line mainly crosses the scenic areas in the form of tunnels, bridges and roadbeds, and is mainly located in Daxin Scenic Area, with a length of about 18km.

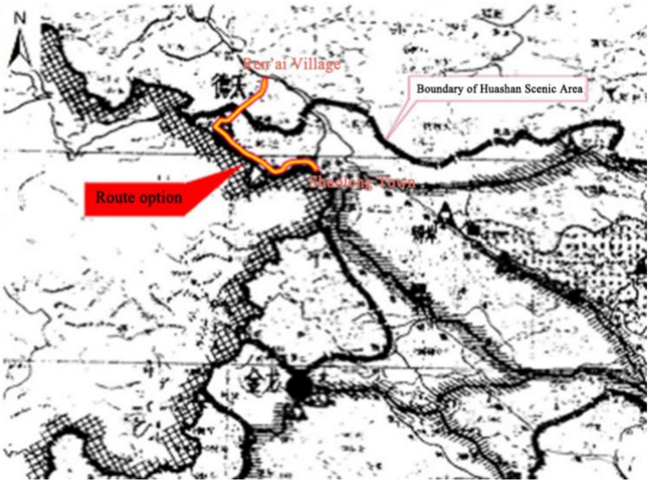


Figure 8.1-1 Relationship Between the Line and Scenic Area Scope of the Master Plan (1994 Edition)

8.1.2.1.2 Relationship between the Line and the Core Spot of Huashan Scenic Area

The Master Plan for Huashan Scenic Area (94 Edition) classifies three special scenic spots, Huashan Rock Art, Detian Waterfall, Panlong Monkeys as three special scenic spots and their visual range, and all the first-class scenic spots, such as Longrui, Longgang, Longhu, Luobai, Encheng and Laituan Rare Animal and Plant Resources Nature Reserves as the Class I protection zone. The Project does not cross the Class I protection zone.

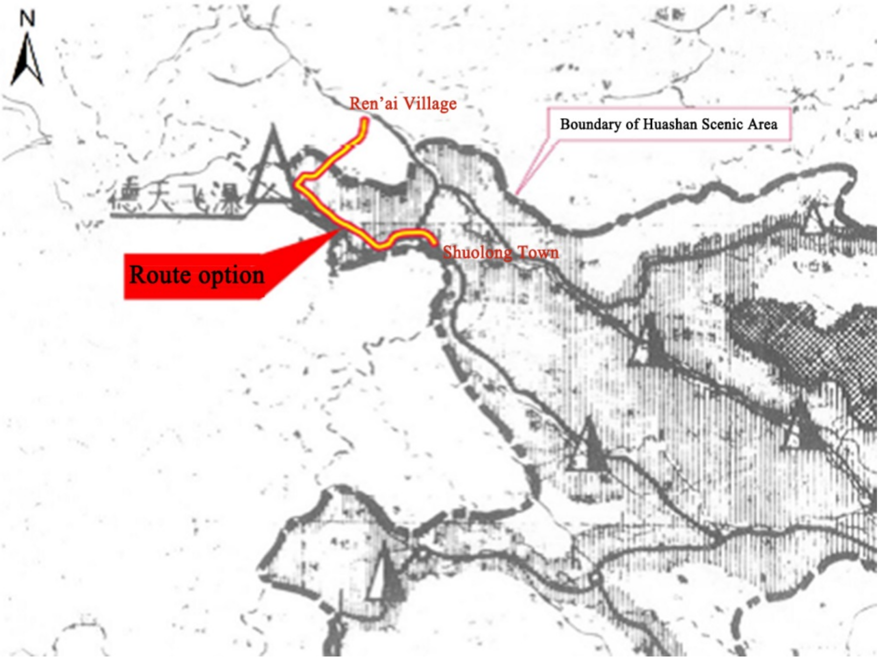


Figure 8.1-2 Relationship Between the Line and the Master Plan (1994 Edition)

8.1.2.1.3 Identification of Landscape Impact along the Line

(1) Scenic spots along the line

Shuolong-Detian-Renai Class-II highway runs through Huashan Scenic Area from east to west, and the line is close to Guichun River, with beautiful scenery along the river. In addition, there are many scenic spots along the route, including 9 scenic spots such as Duxiu Peak, Lvdaoxingyun, Zhuangjia Ancient Village, Shuolong Underground Great Wall, Guichun River, Detian Fort, No.53 Boundary Pillar, Detian Waterfall and Jingbian Town. See Table 8.1-9 and Figure 8.1-5 for scenic spots along the line.

Table 8.1-9 Landscape List on Both Sides of the Line

Category	Scenic name	Level	Straight-line distance from the line
Natural	Lvdaoxingyun	Class I	10 m
	Detian Waterfall	Special level	800m
	Guichun River	Class III	10 m
Humanities	Sino-Vietnamese No.53 old boundary pillar	Class I	1,000 m
	Detian Yinpanshan Fort	Class III	1,000 m
	Jingbian Town	Class I	1,000 m
	Shuolong Underground Great Wall	Class III	600m
	Zhuangjia Ancient Village	Class II	10 m
	Duxiu Peak	Class III	10 m

Figure 8.1-3 Distribution of Scenic Spots along the Line

(2) Identification of the affected scenic spots

In order to scientifically identify the scenic spots affected by the route, multi-factor comprehensive superposition calculation is adopted to determine the scenic spots affected by the route.

① Selection of factors

Four factors are selected as influencing factors: scenic spot class, scenic spot type, distance from the line and building volume (landscape environment). The full score of each factor is determined to be 100 points, and the scores of scenic spots are determined to be 100 points, 80 points, 60 points, 40 points and 20 points respectively from the special class to Class IV. Scenic spots are divided into natural scenic spots and cultural scenic spots. The natural scenic spots are more fragile than the cultural scenic spots, with 100 points determined for natural attractions and 50 points determined for human attractions. For the distance from the line, 100 points, 80 points, 60 points, 40 points and 20 points from near to far are determined. For the building volume (landscape environment), 100 points, 80 points, 60 points, 40 points and 20 points are determined according to the size or area from large to small. Higher score means greater impact.

② Determination of weight

Scenic spot class, scenic spot type, distance from the line, and building volume (landscape environment) have different degrees of impact recognition. According to the analytic hierarchy process, the weight of each factor is determined, and the importance order of these four factors is distance from the line, building volume (landscape environment), scenic spot type and scenic spot class. The weights are determined to be 0.5, 0.2, 0.2 and 0.1, respectively, and those with scores above 60 are affected scenic spots.

Table 8.1-10 Multi-factor Comprehensive Superposition Calculation Table

Scenic name	Straight-line distance from the line		Building volume (landscape environment)		Landscape type		Scenic spot class		Total Score
	Points	Weight	Points	Weight	Points	Weight	Points	Weight	
Lvdaoxingyun	100	0.5	100	0.2	100	0.1	80	0.1	88
Detian Waterfall	40	0.5	80	0.2	100	0.1	100	0.1	56
Guichun River	100	0.5	100	0.2	100	0.1	40	0.1	84
Sino-Vietnamese No.53 old boundary pillar	20	0.5	20	0.2	50	0.1	80	0.1	27
Detian Yinpanshan Fort	20	0.5	20	0.2	50	0.1	40	0.1	23
Jingbian Town	20	0.5	20	0.2	50	0.1	80	0.1	27

Shuolong Underground Great Wall	60	0.5	20	0.2	50	0.1	40	0.1	43
Zhuangjia Ancient Village	100	0.5	40	0.2	50	0.1	60	0.1	69
Duxiu Peak	100	0.5	40	0.2	50	0.1	40	0.1	67

③Affected scenic spots

After multi-factor comprehensive superposition calculation, the scenic spots with scores above 60 are Guichun River, Lvdaoxingyun, Duxiu Peak and Zhuangjia Ancient Village.

Guichun River and Lvdaoxingyun are natural landscapes with fragile ecological environment. Therefore, the main scenic spots affected by the upgrading project are Guichun River and Lvdaoxingyun. Lvdaoxingyun is located on Guichun River, and only Guichun River is subject to assessment of scenic spot impact.

Duxiufeng and Zhuangjia Ancient Village are human landscapes, will a few tourists at present. In addition, the building is very small, but it is about 10 meters away from the upgrading project. The line must be protected during the construction to avoid damage to the scenic spots. The lines at the two scenic spots are reconstructed and expanded. After operation, the distance between Duxiufeng and Zhuangjia Ancient Village changes very little, so the impact is small.

(3) Topography and natural vegetation along the line

From east to west, along the Shuolong-Detian-Renai Class-II Highway, there are mainly relatively flat valleys and undulating peaks; there are many strange karst cliffs and peaks along the line; most of the mountains and hills are rocky mountains, and the typical forest vegetation in karst areas with strong originality is preserved, with rich species and high ornamental value. Therefore, topography and natural vegetation along the line are also one of the contents of landscape impact assessment.

(5) Influence of road construction on scenic spots

The upgrading project is more convenient for tourists to visit various scenic spots. Shuolong-Detian-Renai Class-II highway runs through Huashan Scenic Area from east to west, and the line is close to Guichun River, with beautiful scenery along the river. In addition, there are many scenic spots along the route, including 9 scenic spots such as Duxiu Peak, Lvdaoxingyun, Zhuangjia Ancient Village, Shuolong Underground Great Wall, Guichun River, Detian Fort, No.53 Boundary Pillar, Detian Waterfall and Jingbian Town. Through the upgrading project, the Class-I highway (tourist avenue) from Shuolong to Tianxi can be well connected, improving the road tour system of the whole scenic spot.

8.1.2.1.4 Influence of the Line on the Scenic along the Line

(1) Influence on the natural landscape along Guichun River

Guichun River is an important landscape corridor and an important viewing route in Huashan

Scenic Area, so the visibility on Guichun River shall be reduced as much as possible. This report focuses on assessing the impact of the route on the landscape from the visibility between the route and Guichun River.

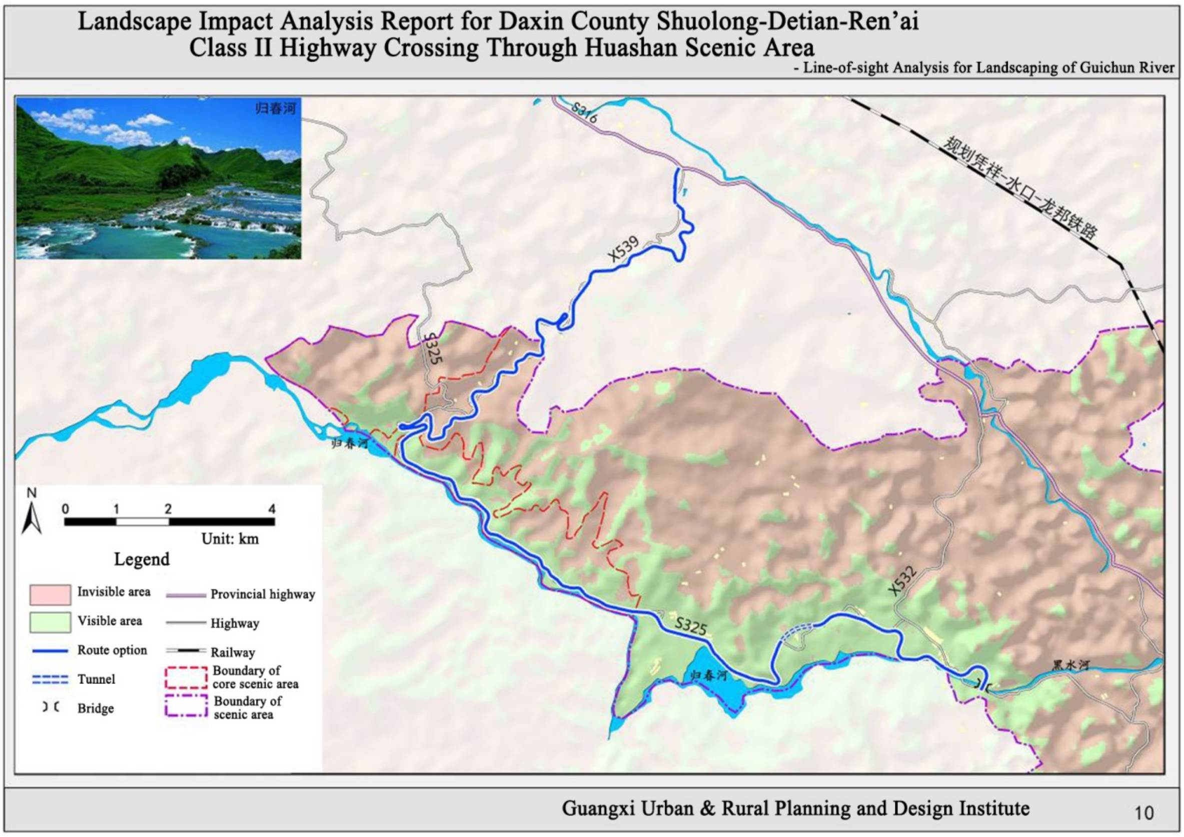


Figure 8.1-4 Landscape Sight Analysis Diagram

With the characteristics of tropical karst landscape in the scenic spot, when visiting along Guichun River, only the front slopes, cliffs, plains and valleys are visible, so the slopes, cut walls, valleys and basins along the river are visible areas, while the hilltops and back slopes are invisible areas. Using the three-dimensional simulation technology of ARCGIS software, the visual range of people visiting Zuojiang River is simulated, and the landscape visibility of the study area is analyzed. As shown in the figure, the pink indicates invisible areas and the green indicates visible areas. According to the analysis, when tourists visit Guichun River, most of the line is visible.

Due to the limitation of terrain conditions, the route at the Lvdaoxingyun will remain as it is with no expansion or alteration, having no influence on the landscape.

(2) Influence of the line on the humanistic scenic

Two scenic spots, Duxiu Peak and Zhuangjia Ancient Village, are located about 10 meters away from the side of the line, so they must be protected during the construction to avoid damage to the building itself. In the scenic spot, the line is visible to it, but since the line is reconstructed and expanded, the distance of Duxiu Peak changes very little after operation, so the impact is small. In order to protect Duxiu Peak and Zhuangjia Ancient Villages to the maximum extent, more trees shall be planted on both sides of the road for visual isolation.

8.1.2.1.5 Influence of the Line on the Primitiveness of the Landscape Resources in Huashan Scenic Area

The primitiveness of landscape resources in Huashan Scenic Area mainly includes the primitiveness of topography and natural vegetation.

(1) Primitiveness of topography

The spatial landscape of Huashan Scenic Area is based on the development of typical colorful tropical karst landforms, which are mainly composed of karst landforms such as peak clusters and depressions, valleys, peaks and valleys, and basins, and is also featured by criss-crossed river networks and water systems, forming a wonderful landscape.

The impact of line construction on the current topography is mainly reflected in the destruction of the original surface form caused by splitting mountains and filling valleys when crossing natural mountains and valleys. However, most of the areas of the line are laid out according to the original line, so it has little impact on the topography.

The newly built line shall avoid areas with large slopes to reduce the impact on topography and landform.

(2) Primitiveness of natural vegetation

The upgrading project will occupy land and cause irreversible vegetation destruction. In addition, during the construction period, transport vehicles and personnel mobility will also cause vegetation destruction. The current situation investigation shows that the ecological environment on both sides of the highway mainly consists of bushes, scrub-grasslands, and artificially cultivated Saccharum, Zea mays, Oryza sativa, etc. The adverse impact of the implementation of the Project on plants is generally mild, and is mainly reflected as follows:

① Temporary land occupation in the project area causes vegetation destruction and death to some plants, resulting in certain biomass loss and local population density reduction. Part of the biomass loss caused by project construction can be compensated by highway greening. Neither disappearance of regional vegetation types nor reduction of biodiversity in the assessment area will occur;

② With the nature of land occupied by road changed, the area of regional green space is reduced and the spatial distribution is changed, which leads to the weakening or loss of the environmental control ability of the original green space;

③ Earthwork is required in highway construction. The vegetation destruction of fill and cut sections is caused by filling and cutting by construction machinery, transport vehicles and construction personnel activities, and the destruction is devastating. However, after construction, the vegetation on both sides of the highway will be restored as per the type before destruction, and it can be basically restored within 2-3 years after completion.

To sum up, the project construction will inevitably cause some damage to the vegetation along the line. The interference to the vegetation can be minimized through planning, design and compensation restoration. The project construction has little impact on the local vegetation.

8.1.2.1.6 Impact of the Line on Primitiveness of Landscape Resources in Huashan Scenic Area

The integrity of landscape resources is an important principle of landscape protection in scenic spots. The impact of the upgrading project on the landscape integrity of Huashan Scenic Area mainly includes the division of scenic spots by the line and destruction of landscape dependent environment.

Huashan Scenic Area is formed by many interrelated scenic spots. From the distribution of existing scenic spots, except the Aijiang-Detian section close to Guichun River that has a certain impact on the existing scenic spots, the rest sections of the line avoid the scenic spot-intensive areas, and have little impact on the integrity of scenic spots.

8.1.2.1.7 Positive Impacts

The road traffic planning of Huashan Master Plan (94 edition) mentioned that there are different classes of roads for internal traffic, with high pavement rate. The line circuitous in peaks, valleys, depressions and depressions, connecting most towns and villages in four counties and one city, with strange peaks and strange rocks, pastoral scenery and beautiful landscape along the line. Most of the route in Longzhou and Daxin county is both land transportation and highway gallery. Zuojiang River and its tributaries Mingjiang River, Lijiang River and Pinger River run through Chongzuo, Longzhou, Ningming and Pingxiang City, and the landscape along the river stretches, serving as water transportation and water gallery. Such an external and internal land and water transportation network provides a very favorable condition for the scenic spot. However, some of the roads are paved with sand and gravel, some are machine-made dirt roads, and the road from Sukhlong to Dudian Waterfall is not yet open, which is not conducive to tourism.

The upgrading project improves the traffic from Shuolong to Detian Waterfall, and strengthens the connection between Detian and S316 Provincial Highway, so the Project will greatly promote the development of tourism.

The construction of the Project is a necessary infrastructure construction, which serves to create the Sino-Vietnamese Detian·Ban Gioc International Tourism Cooperation Zone and makes Detian Waterfall Scenic Spot be a national 5A-level scenic spot. For the Sino-Vietnamese Detian·Ban Gioc International Tourism Cooperation Zone, it is required to speed up the construction and improvement of scenic spots in the scenic area and surrounding service facilities, further improve the functional orientation of each zone, and effectively improve the number and level of scenic roads and tourist footpaths. The upgrading project is an important measure, which strengthens communication with Vietnam, strives for consensus on tourism cooperation zone project, and urges Vietnam side to formulate cooperation zone (Vietnam) planning and scenic spot management mechanism as soon as possible.

The construction of the project will speed up the development of tourism in Daxin county. The construction of the Project will create efficient, safe and convenient transportation conditions for tourists getting off Hepu-Napo Expressway and going to Detian Waterfall, making the development and construction of tourism economy in Daxin County more quick and smooth.

Shuolong Town-Detian-Renai Class II Highway can promote the development and building of scenic spots along the routes, such as Lvdaoxingyun, Jingbian Fort, Old Kapok Scenic Area, Yinpanshan Fort, etc., enhance the links between scenic spots, and greatly promote the development of local tourism industry.

8.1.2.1.8 Summary of Impact Analysis

When tourists visit Guichun River, most of the line is visible. The terrain along the line is featured by small topography change. In spite of the inevitable vegetation destruction along the line during construction, the interference to the vegetation will be minimized through planning, design and compensation restoration, so the line has little impact on the landform and vegetation primitiveness of Huashan Scenic Area. The line passes through the periphery of the scenic spot concentration area, so it has little influence on the integrity of scenic spots and improves the sightseeing conditions of scenic spots.

8.1.2.2 Evaluation on Impact of the Project on Terrestrial Plants and Vegetation

8.1.2.2.1 Impact on Plants and Vegetation Construction Period

It is an existing road upgrading and reconstruction project and serves the local tourism industry, with long-term human interference along it. The agricultural lands and urban residential areas within the assessment occupy about 52.59%, with a generally high proportion. The total length of the Project is only 13.632km. The forest vegetation coverage rate within the assessment is 18.35%, but there is a relatively high proportion of artificial forest vegetation. Natural forests mainly include a small number of secondary forests and secondary shrub forests, while there is a relatively small proportion of natural forests.

1. Analysis of Vegetation Types for Project Land Occupation

The total length of the Project is 13.632km, with a permanent land occupation of 28.03hm2. It is an existing road upgrading and reconstruction project and serves the local tourism industry. The project routes are mainly based on existing highways, with local sections straightened and a small number of new routes. The original routes are mainly widened. There is long-term human disturbance along the Project. The agricultural lands, construction lands and road reserves occupy about 52.18%, while the wood lands occupy only 33.42%.

According to the field investigation, the land occupied by the project is mainly scrub-grasslands and crops, mainly including cultivated land crops and planted forests. The natural secondary vegetation occupied by the proposed highway is mainly subtropical monsoon forest vegetation and stone mountain secondary shrubs.

2. Analysis of Impact on Vegetation

(1) Both permanent land occupation and temporary land occupation will affect the vegetation by removal of the surface vegetation. Permanent land occupation changes the way of land use, resulting in loss of ecological functions of the original vegetation. It is a direct and irreversible impact. Temporary land occupation leads to the death of the original vegetation by the removal of surface vegetation and the accumulation of materials and spoil, resulting in the loss of vegetation biomass, but the original appearance can be gradually restored after vegetation restoration.

(2) Judging from the importance of occupied vegetation, the Project mainly occupies shelter forests on both sides of original roads as well as a small number of secondary forests and shrub-grass lands. All the plant species are common species in the area and are occupied in a small area, which has no impact on plant species diversity in the assessment area; in addition, the vegetation for the permanent land occupation can be compensated to a certain extent by the project landscaping and the vegetation for the temporary land occupation can be gradually restored by measures such as later land landscaping.

(3) It is an existing road upgrading and reconstruction project, with long-term human interference along it. Most of the project land occupation includes agricultural lands, construction lands and road reserves. There is a small proportion of vegetation in the occupied lands and most vegetation is protection trees beside the current highway, mainly Acacia confusa Merr., Bauhinia purpurea Linn. and some Melia azedarach Linn.; additionally, a small number of secondary natural forests and shrub-grass lands.

In summary, the project land occupation and construction behavior will inevitably cause some damage to the vegetation in the evaluation area. The natural vegetation occupied along the Project mainly includes artificial forests and scrub-grass lands. There is a small quantity of new permanent land occupation, with a short distance. The construction has no impact on the plant species diversity in the evaluation area, which will not lead to the reduction of plant species diversity in the evaluation area. The adverse impact of highway construction on the vegetation in the evaluation area can be reduced through highway landscaping and later vegetation restoration for temporary land.

3. Estimation and Compensation of Biomass Loss

The biomass loss caused by the construction of the Project occurs in the original vegetation on both sides of roads,as well as also in a tunnel entrance at both ends of the tunnel (K9+375 ~ K9+770). According to the vegetation type map interpreted by remote sensing satellite pictures and field survey, the total biomass of vegetation in the evaluation area is about 25337.9t, of which the forest vegetation accounts for 76.9%, the shrub-grass land accounts for 15. 3% and the economic forest and cultivated land (irrigated land and non-irrigated land) account for 7.8%.

The vegetation along the original road will be occupied by the construction of the Project. It is estimated that the biomass reduction caused by the permanent occupation of the Project will be 1112.51 t, accounting for 4.39% of the total biomass in the assessment area. All the plant species occupied by road sections along the project are common species in the area and are widely distributed.

There is the real-time occupation of the surface vegetation around the route in a small quantity and the landscaping around the route in the later period will make up for most of the lost biomass. Therefore, the Project will not cause a great loss to the surrounding organisms, and will not affect the balance of the original ecosystem within the evaluation scope.

(1) Impact on Protected Plants

3 kinds of national class II protected plants are found within the evaluation scope, including about 4 Excentrodendron tonkinese, 7 Cymbidium bicolor Lindl and 9 Cibotium barometz, with 5 Cymbidium bicolor Lindl at 2m on the left side of K11+80 attached to 1 class III ancient tree-Ficus microcarpa Linn. f. Because it is located on the current road side, if the road section will be widened from the center line to both sides in the expansion scheme, the tree with 5 Cymbidium bicolor Lindl will have to be transplanted. In addition, the protected plants close to the project route include 2 Cymbidium bicolor Lindl located at 15m on the right side of K13+50, and 2 Excentrodendron tonkinese located at 15m on the right side of K13+50 respectively. There is a certain distance between the rest of the protected plants and the project land boundary. The project construction has little impact on them.

It is a reconstruction and expansion project. Most road sections are widened on the basis of the original highways, with the pavement being widened by 3~9 meters. For the above protected plants that are close to the route, before construction, these protected plants shall be enclosed and signs shall be set up. For 5 Cymbidium bicolor Lindl attached to Ficus microcarpa Linn. f. at 2m on the left side of K11+80, it is recommended to optimize the design, and move the reconstruction and expansion project to the right side of the road to avoid the attached Ficus microcarpa Linn. f. In case of unavoidable occupation due to special construction reasons, these protected plants must be transplanted to avoid direct damage to these protected plants as much as possible. For the protected plants far away from the route, as long as the preventive measures are taken during the construction period and the circulation and education for construction personnel are properly carried out, the construction activities will have little impact on them.

Because some areas in the evaluation area, where trees (Excentrodendron tonkinese, Cibotium barometz and Cymbidium bicolor Lindl) are located by large quantity, are distributed near the construction area, before the project implementation, the Contractor shall, in conjunction with the local forestry department, conduct a detailed investigation on the protected plants in the adjacent occupied areas in the evaluation area, protect the protected plants by hanging plates near the construction area and take protective measures of iron fences if necessary.

(2) Impact on Ancient and Famous Trees

It is found that there are 2 ancient trees in the evaluation area by the field investigation, one of which was Ficus microcarpa Linn. f. located beside the existing highway on the left side of K11+150. The section where the ancient tree is located is the reconstruction and expansion section. It is planned to widen the existing highway from 7 meters to 16 meters. If in the reconstruction and expansion project, roads are widened from the center of the existing highway to both sides, the ancient tree is in the occupied area and needs to be demolished. It is suggested that in the preliminary design of the next stage, the roads shall be widened to the right side, the location of the ancient tree shall be avoided and it shall be protected by the enclosure. In this case, preventive and protective measures shall be taken during the construction period to avoid the impact of the reconstruction and expansion project.

Another ancient tree in the evaluation area is Litchi chinensis at 20m on the right side of K12+560. The section where the ancient tree is located is the reconstruction and expansion section. The current highway is widened from 7 meters to 17.5 meters. The ancient tree is located at 20m on the current roadside and is outside the pavement of the reconstruction and expansion project. As long as the ancient tree is properly protected and the circulation and education are carried out for the construction personnel, the construction activities will have little impact on it.

If the project is constructed according to the current recommended scheme, 1 ancient tree will have to be transplanted. Therefore, during the construction design of the project, it is necessary to carefully compare the topography, geomorphology, geological environment and other issues near the ancient tree. Through overall consideration, on the premise that the project construction meets the requirements, priority shall be given to the horizontal translation design for the project route, so as to avoid the growth impact range of 1 ancient tree.

Table 8.1-11 Analysis on Impact of Ancient Trees in the Project Area

Chinese name	Chainage	Coordinates	Quantity/occupied area (Nr.)	Spatial Relationship with the Highway	Impact analysis
Ficus microcarpa Linn. f.	K11+150	E106°48'32.00" N 22°49'31.88"	1/1	Near the current road side, as per the reconstruction and expansion scheme, the ancient tree is located within the expansion scope of the project.	In the next stage, the construction scheme is designed and optimized to avoid the ancient trees as much as possible and they shall be protected; if transplanting is necessary, it shall be submitted to the local forestry department for scientific and reasonable

Chinese name	Chainage	Coordinates	Quantity/occupied area (Nr.)	Spatial Relationship with the Highway	Impact analysis
					transplanting under the guidance.

8.1.2.2.2 Impact on Plant Resources during Operation Period

(1) Impact on plant community succession

Highway construction changes the original land use mode. Due to unique soil, water and topography conditions, the restored slope vegetation has been shrubs and grasses for a long time, greatly reducing the normal succession speed of vegetation, thus having certain adverse impacts on the continuity of vegetation in the area. However, because artificial vegetation is mainly located in the occupied area, it has little impact on the natural succession of natural vegetation in the area. Moreover, there are good rainfall and heat conditions in the project area which is suitable for plant growth. The speed of vegetation restoration in the temporary occupation area is relatively fast. The loss of vegetation biomass caused by construction occupation will be compensated to a certain extent.

(2) Analysis of impact of pollutant discharge on growth and development of plants along the route

Vehicle exhaust and dust raising may exert a certain adverse effect on the growth and development of plants in the highway nature strip and its nearby areas. A lot of dust accumulates on the leaf surface of plants of the highway planted strips and road shoulder nearby, but such plants grow normally, so no obvious adverse effect is found. Because the soil and dust left around the road during the construction period will flow towards the road surface due to the impact of rainwater, there is relatively much dust around the road at the beginning of the operation period. With the continuous cleaning of the pavement and the restoration of the surface vegetation of the temporary land occupation around the road, the dust generated on the pavement will be gradually decreased. With the increase of time, the impact of dust on the plants around the road will become less and less.

(3) Impact of Alien Species on Local Ecosystem

The project construction behavior and the corridor effect after completion may cause the expanded distribution of exotic species along the route and the project construction land will form a bare land. If the local species are not afforested in time, the alien species may be invaded locally and a single dominant plant community will be gradually formed, which is unfavorable to the protection of local species. After the completion of the highway, it will serve as a corridor for some alien species, providing the possibility of spread for seeds and plants along the highway. If alien species can be adapted to the disturbed environment better than local species, they will gradually form a local dominant single community through the occupation of the ecological environment or secretion of allelopathic substances, which will gradually lead to a decrease in the distribution and population quantity of sensitive or fragile local species, even their disappearance in the local area, thus forming ecological invasion. It will have many adverse impacts such as a decrease in regional species diversity.

In order to avoid the invasion of alien plants with a single advantage, the vegetation of planted strips shall be restored in time during the project construction period. Before alien species invade the local area, the vegetation on both sides of the road will be restored first through artificial vegetation restoration measures. When the artificial vegetation grows stably, with a high density, it will be more difficult for exotic species to compete for space and sunlight in this vegetation and it will be difficult to form invasive species.

8.1.2.3 Evaluation on Impact of the Project on Terrestrial Vertebrates

8.1.2.3.1 Impact on Animals during Construction Period

The impact on wild animals during the construction period of the Project is mainly reflected in the impact of construction noise on animals and the occupation of a small number of habitats.

(1) Impact on the Ecological Environment

Temporary land occupation of the project reduces the habitat of wild animals, and blocks the movement area, migration route and foraging range of some wild animals, thus having a certain impact on the survival of wild animals. However, it is mainly an existing road expansion project, which mainly occupies the vegetation on both sides of the original road. The project construction has little impact on the original vegetation types in the evaluation area and the same ecological environment around it is widely distributed. Animals affected by the project construction are easier to find new habitats, so it will not cause a great impact on wild animals.

(2) Impact on amphibious animals

Amphibious protected animals within the evaluation scope of the Project include one national Class II protected animal, Hoplobatrachus rugulosus, and three amphibious animals in Guangxi key protected areas, including Fejervarya limnocharis, Bufo melanostictus and Microhyla ornata, of which Fejervarya limnocharis is the most widely distributed.

Amphibious animals mainly inhabit rivers, canals and irrigated lands along the highway, and some amphibious animals may be crushed by passing project vehicles during highway construction. All the exposed surface caused by subgrade excavation, disturbance of river banks caused by bridge construction, and stacked temporary spoil into water body by rainwater scouring may lead to the turbidity of construction water area, and the ecological environment of nearby amphibious animals will be affected. In addition, if construction is carried out at night, construction lighting will also affect the foraging of amphibious animals.

During the construction period, the occupation of subgrade and construction behavior may have a certain impact on the ecological environment of protected animals. It is a reconstruction and expansion project. Most of the road sections are widened on the basis of the existing pavement. The project occupies a small area and is mostly located on both sides of the existing road. Affected by the current highway occupation and operation, most amphibious animals in the evaluation area have moved to undisturbed areas far away from the highway except for a small number of amphibious animals living in roadside cultivated lands under the human settlement environment. Therefore, the construction of the Project has little impact on the individual number and population of amphibious animals in the evaluation area.

(3) Impact on reptiles

There are 4 reptiles in the area where the project is located, namely, C. versicolor, E. radiata, P. mucosus and Naja atra, which are protected wild animals at the autonomous district level.

It is a reconstruction and expansion project. Most of the road sections are widened on the basis of the existing pavement and the construction activities are mostly carried out on both sides of the existing roads. Affected by the current highway occupation and operation, the sensitive reptiles in the evaluation area have moved to undisturbed areas far away from the highway. The construction activities such as subgrade excavation of the project have relatively little impact on reptiles.

The impact on reptiles during the construction period of the Project mainly comes from the disturbance caused by tunnel blasting and the hunting from construction personnel. After the reasonable arrangement of blasting time, avoidance of the disturbance of wild animals caused by blasting in the morning and at night, strengthening of circulation, education, supervision and management of construction personnel, and prohibition of hunting of wild animals, the project has little impact on reptiles in the evaluation area during the construction period.

(4) Impact on birds

There are 2 kinds of national Class II key protected birds in the area where the project is located, namely, Glaucidium cuculoides and Centropus sinensis. There are 12 key protected birds in Guangxi Autonomous Region, namely, Pericrocotus flammeus, Pycnonotusjocosus, Pycnonotus sinensis, Lanius schach, Dicrurus macrocercus, Urocissa erythrorhyncha, Turdus merula, Garrulax canorus, Orthotomus sutorius, Phylloscopus inornatus, Phylloscopus proregulus, Parus major.

Centropus sinensis and Glaucidium cuculoides are common species, which often inhabit shrubs along the route. During the construction period, there is some damage to the ecological environment of scrubs and woodlands, but due to their strong adaptability to the environment and mobility, the project construction has little impact on these two protected birds.

Most of the other protected birds are songbirds. According to the field investigation, it is not the main distribution area or movement area for protected animals along the project and the natural concentrated habitat of the above-mentioned protected birds is not found in the evaluation area. Within the evaluation scope, songbirds mainly move for food. The ecosystem along the project is not unique to the area and such ecological environments are widely distributed in the area. The number of ecological environments actually occupied by the reconstruction and expansion project is limited. Affected species can find a suitable alternative ecological environment in the area by the active movement for survival, with little impact on ecological environment occupation.

Generally speaking, most of the important habitats and breeding grounds of protected birds in the evaluation area are wood lands with less human interference and birds mainly move for food in other areas of the evaluation area. No natural concentrated habitat of the above-mentioned protected birds has been found in the evaluation area. The impact on birds during construction is mainly reflected in the increase of human activities along the route, the vibration caused by subgrade excavation, and the scare and interference caused by construction machinery noise. However, these birds can avoid the impact of construction on their habitats and foraging by migration and flying. Due to the interference of construction, these birds may migrate to neighboring areas and stay away from the construction area, so the construction will not bring obvious adverse impacts on birds.

(5) Impact on mammals

There are 2 kinds of wild protected mammals in the evaluation area, namely, Callosciurus erythraeus and Tupaia belangeri.

The impact of construction on mammals is mainly reflected in the destruction of the ecological environment where animals inhabit and forage, including the destruction of vegetation in the construction area, which changes the evaluation area and its surrounding environment. The affected mammals will migrate to nearby areas with little interference. It is a reconstruction and expansion project. The reconstruction and expansion are mainly carried out along the existing highways. Human activities are frequent in the area, and the protected mammals along the project have migrated to areas with good mountain vegetation and little human interference due to human activities. Therefore, highway construction has no direct impact on the protected mammals.

(6) Summary

The impact on wild animals during the construction period is inevitable and inescapable, but it only involves in the construction area. It is a reconstruction and expansion project. The construction activities are mainly concentrated in certain areas on both sides of the existing highways. There are a large number of human settlements and ecological environments of cultivated land distributed along the existing highways. Human activities are frequent along the highways. The affected wild animals along the highways have migrated to areas far away from human activities and they mainly move for food in the evaluation area. The project construction has little impact on them. Under the measures, such as the strengthening of the education and supervision of construction personnel, prohibition of hunting of wild animals, and reasonable arrangement of tunnel blasting time, the reconstruction and expansion project has little impact on the wild animals in the evaluation area.

8.1.2.3.2 Impact on Terrestrial Animals during Operation Period

(1) Analysis of impact on a barrier of animals

The project is mainly reconstructed and expanded on the basis of the original highway. The original highway construction has separated and blocked the original ecological environment and living activities of amphibious animals and reptiles along the route. Amphibious animals and reptiles along the route have migrated to the side far away from the highway. The reconstruction and expansion of the Project have little impact on the barrier of surrounding animals. In addition, a certain number of culverts are set at the locations where the highway passes through cultivated land ditches and gullies. These facilities have a certain animal passage function, which can slow down the barrier impact of the highway.

(2) Impact of pollutant discharge on animals

After the highway is upgraded and renovated, there is certain increased traffic flow and the noise, waste gas and road runoff generated during the operation will cause certain pollution to the living environment of roadside animals. Traffic noise, vehicle lights, etc. will have certain adverse impacts on animals perching and reproduction, causing some animals to avoid roadside areas when they choose ecological environments and set up nests, resulting in a decrease in animal species and quantity within the evaluation scope. The impact is related to animal species and their habits.

(3) Impact of traffic operation on animals

At the beginning of highway operation, animals died across the highway. However, the original highway has been in operation for many years and wild animals along the highway are gradually familiar with the highway crossing through culverts. The number and probability of wild animals killed by traffic have been greatly reduced. In the reconstruction and expansion of the Project, the culverts set at cultivated land ditches of the original highway are still retained and have little impact on wild animals along the route.

8.1.2.4 Analysis on Impact of the Project on Aquatic Organisms

8.1.2.4.1 Impact on Aquatic Organisms during Construction Period

In the Project, sections of K0+400 ~ K5+500, K7+100 ~ K8+400, K11+900 ~ K13+700 are adjacent to the Guichun River. The operation site in the section near the river reach, the construction materials may enter the water body due to improper storage or heavy rain erosion. The exposed earth and rock after road excavation and the project spoil and dregs will also enter the water body due to road surface runoff formed under rainwater scouring, which will lead to the turbidity of the water body and affect the growth environment of some plankton and benthos. The construction will have a certain impact on aquatic organisms in the short term, but the construction management can be standardized, the stacking of the construction earthwork and surplus materials can be avoided on the river bank, and the debris flow buffer land can be set on the ground near the river reach where water and soil may be converged into the river, which can avoid more impacts on rivers and further reduce the impact of the project construction on aquatic organisms.

The field investigation shows that there are no stable scale "three ground" of fish spawning, feeding and wintering, no fish migration channel and aquatic germplasm conservation zone, and no national and Guangxi key protected fish or local endemic fish. The impact of the project on fish is only short-term in the construction area, so it does not affect the protection of fish species resources. To sum up, after certain preventive and protective measures are taken, the construction of the Poject has little impact on aquatic organisms.

8.1.2.4.2 Impact on Aquatic Organisms during Operation Period

During the operation of the project, pollutants (mainly SS and petroleum) generated by automobile exhaust and pavement materials may enter the river reach around the project due to the initial surface runoff formed by natural rainfall, thus affecting the aquatic organisms therein. According to different geological conditions, the corresponding rainwater drainage engineering measures are adopted for the sections in the engineering design, and the runoff in the road area is gathered to the natural ditches by the side ditches and drainage ditches. At the beginning of the pavement, the concentration of rainwater will be further reduced after biological, physical and chemical natural degradation such as dilution, precipitation and oxidation of the natural water body, which will not change the current water quality status, so it has little impact on aquatic organisms.

8.1.2.5 Analysis of Ecological Impacts on Agriculture and Forestry

Temporary land occupation by the highway engineering can basically restore its original production function after second ploughing or restoration. Generally, there is no great impact. Transformation of agricultural land into construction land in permanent land occupation by the highway will result in loss of agriculture and forestry production functions on the original land. Therefore, the impact of highway engineering on agricultural and forestry land resources is mainly represented in permanent land occupation areas. For changes in agricultural and forestry land in the evaluation area due to the permanent occupation by the Project, refer to the table below.

Table 8.1-12 Changes in Agricultural and Forestry Land in Assessment Area Due to Permanent Occupation of Agricultural and Forestry Land by Project

Area affected	Cultivated land			Grassland			Woodland		
	On-hand	Project	Reduction	On-hand	Project	Reduction	On-hand	Project	Reduction

	Quantity (hm²)	Occupation (hm²)	Ratio (%)	Quantity (hm²)	Occupation (hm²)	Ratio (%)	Quantity (hm²)	Occupation (hm²)	Ratio (%)
Total within the evaluation scope	1033.48	5.67	0.55	14.27	3.32	23.26	513.97	8.15	1.58

It can be seen from Table 8.1-11 that, from the perspective of cultivated land occupation, the cultivated lands along the route will be reduced by 0.55% after the project implementation and can be restored by the measure of "one occupation and one compensation" (the cultivated land occupation scheme of a construction project corresponds to a supplementary cultivated land scheme); from the perspective of grassland occupation, the grasslands along the route will be reduced by 23.26% after the project implementation, and appropriate compensation shall be made; from the perspective of wood land occupation, the wood lands along the route will be reduced by 1.58% after the project implementation, with a small proportion, which has little impact on wood lands. On the whole, the implementation of the Project will not cause any major adverse impact on the pattern of agricultural land in counties.

8.1.2.6 Analysis of Impact on Occupation of Key Public Welfare Forests

The whole project is located in Daxin County. The project occupies 1.08m2 of key non-commercial forests, with the vegetation types of the key non-commercial forests occupied including subtropical forests and rocky mountain secondary forests; the dominant species being From.Pinus massoniana, From.Cunninghamia lanceolata, Form. Liquidambar formosana, Form. Macaranga denticulata, Trema tomentosa, Alangium chinense, and Melastoma candidum, Leucaena leucocephala, and Mallotus japonicus, etc.; the types of the key non-commercial forests occupied are mainly of the water conservation forest.

It is a reconstruction and expansion project. The occupied key ecological public welfare forests are mainly involved in the existing highway pavement widening and slope engineering occupation. The occupied public welfare forests are small in area and located beside the existing highway. It will not affect the division of ecological public welfare forests in the area and has little impact on the integrity and vegetation continuity of public welfare forests.

On the whole, the Project occupies a relatively small proportion of the area of key public welfare forests compared with that in Daxin country, would not impair the continued performance of its dominant ecological function, and has no great impact on its overall ecological service capacity. In addition, a field investigation on ecological public welfare forests through which the Project goes shows the distribution of the same vegetation type similar or superior to that on the structure of key public welfare forests to be occupied near the forests. With "one occupation and one supplementation" measure, the ecological service capacity of regional key public welfare forests would not change greatly.

8.1.2.7 Ecological Impact Analysis of Tunnel Works

8.1.2.7.1 Vegetation in Construction Area of Tunnel Works and Impact Analysis

In the Project, one Longhong Tunnel is set up at K9+375 ~ K9+770. According to the investigation results of vegetation status, the natural shrub forest is mainly distributed at the entrance of the tunnel, with the main common plant species such as Cipadessa cinerascens, Rhus chinensis Mill., Macaranga denticulata and Phyllostachys. Form. Miscanthus floridulus is mainly distributed on the bottom of the tunnel entrance and some sclerophyllous broad-leaved tree species on the top. There are some secondary natural forests at the tunnel entrance, mainly with the common plant species such as Macaranga denticulata, From.Pinus massoniana on the top of tunnel entrance, and Bambusa chungii McClureand a small amount of shrubs on the bottom. These plants are common and widely distributed in the local area, and not involved in the rare and endangered protected species. The project construction has little impact on population number and has no impact on species diversity. The tunnel works does not involve sensitive protected vegetation types and has little impact on the vegetation in the area.

Figure 8.1-5 Project Tunnel Entrance (Left) and Exit (Right)

8.1.2.7.2 Impact Analysis on Vegetation on Tunnel Top

The area where the tunnel passes through is limestone mountain. It is originally composed of limestone and the surface is dry and short of water for a long time. The real-time construction project has little impact on the water content of the tunnel top and surrounding soil layers. It has little impact on the vegetation on the top of the tunnel entrance and nearby the entrance.

Because the limestone mountain plant species survive in the long-term water-deficient environment, plants in these areas have evolved a survival mechanism for the local water-deficient environment. These plants can absorb a large amount of water from the air and the ground during the rainy season and store the water in the roots, stems, leaves and other organs in the plants. In the dry season, the water stored in these plant organs can be used in the dry weather. Therefore, in the long-term natural selection and self-evolution, the survival mechanism for plants in these areas occurs for the local dry rock environment.

The tunnel construction of the project will not affect the plants in these areas.

Generally speaking, the project has little impact on the vegetation on the top of the tunnel and it is unlikely that the vegetation on the top will wither due to the lack of water on the surface caused by the project construction.

8.1.2.7.3 Impact Analysis of Muck from Tunnel

The tunnel length of the Poject is short, and most of the muck excavated from the tunnel can be used for subgrade filling. If a small amount of waste muck remains, it shall be disposed of in an appropriate spoil area. If part of the waste muck is improperly disposed of, e.g. the muck will be abandoned locally or randomly from the vicinity of the tunnel entrance during the construction, the waste muck will occupy or temporarily occupy part of the irrigated grassland vegetation. It will have a certain impact on the local vegetation. During the construction, the waste muck shall be fully utilized as far as possible according to the construction material demands of road sections and the tunnel muck situation, so as to reduce the impact on local vegetation.

8.1.2.8 Environmental Rationality Analysis of Temporary Site

8.2.1.8.1 Restrictive Factors of Temporary Site Selection

Huashan Scenic Area is delineated in a wide range, covering almost the whole Shuolong Town of Daxin County. The scenic area takes the national border as the south border near Shuolong Town, and the existing border highways are basically laid along the north bank of Guichun River, facing Vietnam across the river on the south side of the national border. However, the Project is intended to upgrade the existing border highways, which belongs to the reconstruction and expansion project. Affected by the layout of the existing border highways, the whole line of the Project is located in the scenic area. For highway linear projects, temporary facilities such as construction, production and living areas, temporary stock yards and spoil grounds shall be set up near the main works to provide services. The Project is to upgrade the existing border highways, the local sections on the south side of the highways are close to the national border, and the south side of Huashan Scenic Area is bounded by the national border. The scenic area has a large north-south span, and the depth of 1.5~5.3 km from the national border to the north belongs to the scenic area. If the temporary site needs to be located outside the scenic area: to the south, it will enter the boundary of Vietnam, which is obviously not feasible; to the north, the site needs to be located in an area 1.5 ~ 5.3 km away from the highway, which is not conducive to the project construction; to the east and west, it will enter Xialei Nature Reserve, causing greater damage to the natural ecosystem. To sum up, it is inevitable that the temporary site should be located within the scenic area.

According to the conclusion made in the *Report for Landscape Impact Assessment of Shuolong-Detian-Renai Class II Highway Upgrading Project in Daxin County Passing through*

Huashan Scenic Area (hereinafter referred to as "Crossing Subject"), although certain damages will inevitably be caused to the vegetation along the Project during construction, the disturbance to vegetation can be minimized through appropriate planning design and compensatory restoration. The Project will have little impact on the original nature of the landform and vegetation in Huashan Scenic Area. The line will pass through the Scenic Area only along the periphery of the zone of concentrated scenic spots and so will have little impact on integrity of the scenic spots. On the other hand, the Project will improve the sightseeing conditions of scenic spots. Environmental response measures for construction site in the "Crossing Subject": During highway construction, the centralized treatment of waste and the unified discharge of sewage shall be properly done in the construction sites (including the areas of the Contractor, the Supervisor, etc.). In addition, during the camp construction, the damage to the original natural environment shall be minimized, and the original state shall be restored after completion and demolition.

To sum up, the temporary sites of the Project are inevitably located within the scenic area, and the crossing subject has been approved by the competent authorities of the scenic area. In the EIA, the following site selection requirements are put forward for temporary sites:

(1) Temporary sites are forbidden to be located in Xialei Nature Reserve, Aitun Water Source Conservation Area in Shuolong Town and Shuolong Community Water Source Conservation Area in Shuolong Town; Similarly, these sites are prohibited from being located in special and class I conservation areas, and are not allowed to occupy scenic spots at all levels in the scenic area.

(2) Temporary sites shall be located in wasteland instead of mountainous areas with rich vegetation as far as possible to reduce the damage to vegetation.

The preparation and evaluation of the soil and water conservation scheme of the Project shall be improved, and the vegetation and engineering measures in the water and soil conservation scheme shall be implemented during the construction to reduce the impact of soil erosion.

(3) Land acquisition procedures shall be handled in accordance with the relevant regulations, and the compensation measures for cultivated land and forest land by relevant competent departments shall be implemented.

(4) Sewage from construction, production and living areas shall be reused as far as possible after unified treatment, and the rest shall be used for irrigation of nearby farmland; it is recommended that all the production wastewater after treatment be reused and not discharged; oil-bearing substances in wastewater from production areas shall be collected by special collection system and then entrusted to qualified units for disposal, and it is forbidden to discharge or discard them at will; domestic garbage shall be collected and handed over to the local sanitation department for unified transportation and disposal, and shall not be discarded at will.

(5) Engineering and vegetation measures shall be implemented in the spoil grounds and temporary stock yards in strict accordance with the soil and water conservation scheme approved by the relevant competent departments, and no spoil and topsoil shall be piled up without permission to reduce the impact of water and soil loss.

8.1.2.8.2 Rationality of Site Selection for Spoil Ground and Temporary Stock Yard

(1) Site selection

For the Project, the total cut of is 433,600 m^3, the total fill is 369,400 m3, and the spoil is 64,300 m3. At present, the Employer has preliminarily determined that there is one spoil ground without any temporary stock yard. The spoil ground is planned to be located in the resettlement site (north of CNOOC) reserved by Shuolong Town Government on the north side of the existing highway and on the east side of Longhong Tunnel Exit. This resettlement land covers an area of 60 mu and currently has wasteland and dry land. The owner of the land is Longhongtun villagers in Shuolong Community.

According to the locations of the spoil grounds preliminarily selected by the Employer, there are two restrictive factors for the site selection, one is that they are located in the Huashan Scenic Area, and the other is that they are located in the Level II Community Water Source Conservation Area of Shuolong Town.

(2) Analysis on the restrictions of water source area

According to the demarcation scheme of community water source conservation areas in Shuolong Town, Daxin County, the Level II water source conservation area is bounded by the existing highway in the south. The spoil grounds preliminarily selected by the Employer are located in the resettlement site (in the farmland on the north side of the existing highway and on the east side of Longhongtun) reserved by the local government and within the Level II Community Water Source Conservation Area of Shuolong Town.

This plot is the resettlement land reserved by Shuolong Town Government. In the overall planning of Shuolong Town, the plot belongs to the spare land for development and has been reserved by the local government. It can be seen that the water source area of Shuolong Community in Shuolong Town conflicts with the overall planning of Shuolong Town, and the water source area restricts the development of Shuolong Town. After consulting the local government, it is known that the government is organizing to adjust the scope of water source area, and the resettlement sites reserved by the government will not belong to the scope of the water source conservation area after adjustment.

The source of the water source conservation area is taken from Guichun River and supplied to Shuolong Community Water Source Plant via Yuejin Canal. The water intake of the canal is located near Guichun River in the Old Kapok Scenic Area, with an elevation of about +325 m. The canal passes through mountains and is connected to Shuolong Community Water Source Plant on the north side of

Shuolong Community. Yuejin Canal is mostly located in the mountain, with a few exposed to the surface at the intersections with local roads. The elevation of the canal is mostly above +320 m, while the elevation of the spoil grounds proposed for the Project is about +295~300 m, which is lower than that of the canal. The proposed spoil grounds are located at the foot of the mountain where the canal is located, and have no water conservancy connection with the canal. Therefore, although the sites are set within the water source area, they have no water conservancy connection with the water source area and will not affect the water quality of the canal.

In summary, there is no water conservancy connection between the local resettlement site where the spoil grounds will be located and the water source area, and the plot of the water source area belongs to the spare land for development in the master plan of Shuolong Town, which restricts the development of Shuolong Town to a certain extent. In order to solve the restrictive factors of the water source area, the local government has planned to adjust its scope. However, the time for adjusting the scope of the water source area is uncertain. Therefore, this Assessment suggests that the local government shall promote the adjustment of the water source area as soon as possible during the project construction. If the spare land is already outside the water source area during the construction, the site selection of the spoil grounds is reasonable; If not, it is suggested to select another site for the spoil grounds.

(3) Analysis on the restrictions of the scenic area

Affected by the project route, the sites are located in Huashan Scenic Area according to the Employer's preliminary site selection and EIA recommendations. Combined with "8.2.1.8.1 Restrictive Factors of Temporary Site Selection", the spoil grounds will inevitably be located in the scenic area, but no special conservation areas, class I conservation areas or scenic spots at all levels are involved. According to the conclusion made in the *Report for Landscape Impact Assessment of Shuolong-Detian-Renai Class II Highway Upgrading Project in Daxin County Passing through Huashan Scenic Area*, although certain damages will inevitably be caused to the vegetation along the Project during construction, the disturbance to vegetation can be minimized through appropriate planning design and compensatory restoration. The Project will have little impact on the original nature of the landform and vegetation in Huashan Scenic Area. Therefore, although the spoil grounds of the Project will be inevitably located in Huashan Scenic Area, the impact can be effectively reduced by taking compensation and restoration measures.

To sum up, affected by the route direction, it is inevitable that spoil ground will be located in the Huashan Scenic Area. Through the demonstration and analysis of the crossing subject, the Project has little impact on the Huashan Scenic Area after the compensation and restoration measures are taken, and the crossing subject has been approved by the competent authorities. The selected site of spoil ground is located in the water source area, but it is not in the catchment area of the water source area. There is no water conservancy connection with the water source area, which has little impact on the water quality of the water source area, and the local government is adjusting the location of the water source area. After adjustment, the site does not involve the water source area, and the site selection is basically reasonable.

8.1.2.8.3 Rationality of Site Selection for Construction Production and Living Areas

(1) Site selection

At present, one mixing station and one stone rolling yard are planned to be set as temporary construction, production and living facilities of the Project. The construction, production and living areas are planned to be located in the resettlement site (north of CNOOC) reserved by Shuolong Town Government on the north side of the existing highway and on the east side of Longhong Tunnel Exit. This resettlement land covers an area of 60 mu and currently has wasteland and dry land. The owner of the land is Longhongtun villagers in Shuolong Community.

According to the locations of the construction, production and living areas preliminarily selected by the Employer, there are two restrictive factors for the site selection, one is that they are located in the Huashan Scenic Area, and the other is that they are located in the Level II Community Water Source Conservation Area of Shuolong Town.

(2) Analysis on the restrictions of water source area

According to the demarcation scheme of community water source conservation areas in Shuolong Town, Daxin County, the Level II water source conservation area is bounded by the existing highway in the south. The construction, production and living areas preliminarily selected by the Employer are located in the resettlement site (in the farmland on the north side of the existing highway, east of Longhongtun) reserved by the local government and within the Level II Community Water Source Conservation Area of Shuolong Town.

This plot is the resettlement land reserved by Shuolong Town Government. In the overall planning of Shuolong Town, the plot belongs to the spare land for development and has been reserved by the local government. It can be seen that the water source area of Shuolong Community in Shuolong Town conflicts with the overall planning of Shuolong Town, and the water source area restricts the development of Shuolong Town. After consulting the local government, it is known that the government is organizing to adjust the scope of water source area, and the resettlement sites reserved by the government will not belong to the scope of the water source conservation area after adjustment.

The source of the water source conservation area is taken from Guichun River and supplied to Shuolong Community Water Source Plant via Yuejin Canal. The water intake of the canal is located near Guichun River in the Old Kapok Scenic Area, with an elevation of about +325 m. The canal passes through mountains and is connected to Shuolong Community Water Source Plant on the north side of Shuolong Community. Yuejin Canal is mostly located in the mountain, with a few exposed to the surface at the intersections with local roads. The elevation of the canal is mostly above +320 m, while the elevation of the construction, production and living areas proposed for the Project is about +295~300 m, which is lower than that of the canal. The proposed construction, production and living areas are located at the foot of the mountain where the canal is located, and have no water conservancy connection with the canal. Therefore, although the sites are set within the water source area, they have no water conservancy connection with the water source area and will not affect the water quality of the canal.

In summary, there is no water conservancy connection between the local resettlement site where the construction, production and living areas will be located and the water source area, and the plot of the water source area belongs to the spare land for development in the master plan of Shuolong Town, which restricts the development of Shuolong Town to a certain extent. In order to solve the restrictive factors of the water source area, the local government has planned to adjust its scope. However, the time for adjusting the scope of the water source area is uncertain. Therefore, this Assessment suggests that the local government shall promote the adjustment of the water source area as soon as possible during the project construction. If the spare land is already outside the water source area during the construction, the site selection of the construction, production and living areas is reasonable; If not, it is suggested to select another site for the construction, production and living areas.

(3) Analysis on the restrictions of the scenic area

Affected by the project route, the Employer preliminarily determined that the site would be located in Huashan Scenic Area. According to "Restrictive Factors of Temporary Site Selection of 8.1.2.1", due to the restriction of project route layout, the site of the construction and production areas will be inevitably located in the scenic area, but no special conservation areas, class I conservation areas or scenic spots at all levels are involved. Combined with the environmental response measures of the construction site in the crossing subject, in the process of highway construction, a large amount of construction waste, domestic waste and sewage will be generated in the construction sites (including the areas of the Contractor, the Supervisor, etc.). Therefore, centralized treatment of waste and unified discharge of sewage shall be properly done. In addition, during the camp construction, the damage to the original natural environment shall be minimized, and the original state shall be restored after completion and demolition.

To sum up, affected by the route direction, it is inevitable that construction, production and living areas will be located in the Huashan Scenic Area. Through the demonstration and analysis of the crossing subject, the Project has little impact on the Huashan Scenic Area after the compensation and restoration measures are taken, and the crossing subject has been approved by the competent authorities. The selected site of construction, production and living areas is located in the water source area, but it is not in the catchment area of the water source area. There is no water conservancy connection with the water source area, which has little impact on the water quality of the water source area, and the local government is adjusting the location of the water source area. After adjustment, the site does not involve the water source area, and the site selection is basically reasonable.

8.1.3 Ecological Impact Assessment of Shuolong Port (Phase II of Shuolong Gate)

As the project route does not cross Xialei Nature Reserve, it has little impact on the reserve. The Project is located in the landscape coordination area of Huashan Scenic Area. The construction of the Project coordinates with the landscape of Huashan Scenic Area, and does not damage the scenic area landscape. The construction is helpful to improve the supporting infrastructure of the scenic area, and the construction during the construction period will cause certain damage to the site in the scenic area. After the project is completed, the project landscape will enhance the beauty of Huashan Scenic Area.

With the excavation of the construction site, the existing vegetation will be lost due to the construction, most of the biological individuals will be removed, and a few individuals will be transplanted, which will cause the destruction of the original landform, reduce or lose the water and soil conservation function of the original landform, and increase water and soil loss. The current project land occupation includes wood land and a small amount of non-irrigated land. The land occupation of the Project is planned as port construction land. After the construction project occupies, the current land occupation changes from non-irrigated land and wood land to port construction land, which changes the regional ecosystem.

The land occupied by the project mainly consists of wood land and non-irrigated land ecosystems. Ecologically, they are "producers", and when the port is established, the vegetation in the permanently occupied area of the Project will disappear completely. However, as the Project occupies a small area, the original vegetation form in this area is single, the natural vegetation is common in the local area, and the artificial vegetation is wood land and crops, the loss of biomass reduced by the construction can be compensated by greening. The construction will not reduce the ecological diversity of regional species, and has little impact on regional natural vegetation and no obvious impact on regional ecology. The permanent land occupation of the proposed project needs to occupy the original vegetation, resulting in the loss of vegetation biomass. The Project will occupy permanent land and lose a certain amount of biomass. After the project is completed, greening will be carried out with an area of 4,735 m², which will maximize the biomass of the nature strip and make up for some of the biomass loss caused by the construction. Generally speaking, the land occupation of the Project loses a certain amount of biomass, but the amount is small, which has a slight impact on the regional ecosystem.

Most of the land occupied by the Project is developed non-irrigated land, wood land, etc. Human production and living activities are frequent, and the common animals are rodents such as voles. In addition, there are some common reptiles, amphibians, birds and other species, which are rarely seen in this land. In general, terrestrial animals will gradually move to the surrounding areas with the construction of the Project, so the construction has little impact on them.

The Project does not occupy basic cultivated land, and the agricultural production land within the occupied area is small. According to the field investigation, most of the agricultural farming areas occupied by the Project are non-irrigated land, and there is basically no commercial crops. Changing the original land use mode of the land after the construction has a certain impact on agricultural production, but the impact is limited.

In summary, under the condition of strictly implementing the above ecological environment protection measures, the construction has no obvious disturbance to the regional ecological system and has little impact on the surrounding ecological environment.

8.2 Prediction and Assessment of Impact on Water Environment

8.2.1 Assessment of Water Environmental Impact of Chongzuo-Jingxi Expressway to Shuolong Port Section

8.2.1.1 Analysis of Surface Water Environment Impact during Construction Period

8.2.1.1.1 Bridge Construction Impact Analysis

(1) Setting of bridges across surface water bodies

The surface water systems along the Project route mainly consist of Baidou River, Xialei River and Guichun River. There are 5 bridges across the rivers along the Project and the conditions of the surface water bodies are shown in Table 8.2-1.

Table 8.2-1 List of Surface Water Bodies Crossed by Main River Crossing Bridges of the Project

S/N	Chainage	River or bridge name	Bridge length /m	Crossed River/River Width	Water Pier/Pier Group	Water Quality Standard	Main Functions of Crossed Water Body
1	K4+820~K5+428	Buxuan Major Bridge	607	Baidou River/5~10m	0	Class III	Irrigation
2	K6+763~K7+129	Dunli Major Bridge	366	Baidou River/5~10m	0	Class III	Irrigation
3	K8+181~K9+208	Longkalang Super Major Bridge	1027	Baidou River/5~10m	0	Class III	Irrigation
4	K11+697~K12+243	Bangtun Major Bridge	547	Xialei River/30~40m	2 groups (3 No.)	Class III	Irrigation
5	AK5+227~AK5+383	Shuolong Guichun River Major Bridge	106	Guichun River/30~50m	2 groups (5 No.)	Class III	Irrigation

Table 8.2-1 shows 2 water bodies among all water bodies crossed by the highway are involved with underwater piper construction, namely Bangtun Major Bridge at K11+697~K12+243 and Shuolong Guichun River Major Bridge at AK5+227~AK5+383; the water bodies crossed by other bridges have shallow water surface, and are just crossed,

involved with no underground pipe foundation construction. Surface water bodies crossed by bridges along the Project are as follows:

(2) Impact of underwater pier construction:

For the construction of underwater piers of the river-crossing bridges, "steel cofferdam + circulation bored pile" is generally adopted. Reasonably arrange the operation sequence of the pile foundation of the river-crossing bridge to avoid the flood period of the river; steel cofferdams shall be built in the dry season, and advanced technology shall be adopted to shorten the construction period. All cofferdams shall be completed and the working face shall be cleaned up before the flood season comes.

At the initial stage of construction, the steel casing is used for cofferdam. As the submerged construction of cofferdam will partially disturb the water bottom, it will cause the increase of silt and other suspended solids in the water. According to the monitoring data of similar projects in China, the SS concentration increase is obvious (above 80mg/L) within 100m range at the downstream of the cofferdam construction site, but the impact gradually decreases with the increase of distance; the SS concentration increase is less than 4.13mg/L beyond 1km from the construction site; upon the completion of cofferdam construction, the impact will soon disappear. However, the drilling stage construction is carried out in the cofferdam, thus causing little impact on the water outside the cofferdam.

Moreover, the potential pollutants that bring the biggest impact on the water during the construction of bored piles are drilling residue and slurry for retaining wall. The drilling slurry can be recycled and resued. However, random discharge of drilling residue will cause silting up of the water, resulting in a large increase in total suspended solids (SS) and total dissolved solids (DS) in the water, which will greatly increase the turbidity of the water and lead to a decrease in water quality.

(3) For bridges without underground pile foundation construction, the pollution of suspended matters to crossed water bodies during construction is mainly sourced from cleaning and transportation of abandoned earthwork not in time after earthwork excavation on the bank side and leading to increased concentration of suspended matters that enter the water body. In addition, pier construction near both banks of the water body will produce a certain amount of drilling slag. If discarded to the water body at will, the slag will cause water blockage, water quality deterioration and pollution within a certain time and a certain range of waters.

(4) During bridge construction, the residual oil in the process of oil leakage of construction machinery and equipment and mechanical repair may cause oil pollution to the

water body, and the water insolubility property of oil substances bring long the pollution time and wide the influence range. During the construction of bridges, regular cleaning shall be carried out to maintain machinery and equipment, and certain prevention and management measures shall be taken for oil leakage from construction machinery to avoid oil pollution to water quality of the water body.

(5) If the construction materials stacked in the construction site (such as asphalt, oil, some powdery materials, etc.) are not properly kept or washed into the water body by heavy rain, they will cause water pollution; if the powdery materials are not strictly shielded or covered up, dust will rise in case of wind, thus polluting the water body; if the height of the materials stacking site is lower than the water level in the wet season, in the rainstorm season, the materials may be submerged or washed into the water body by rainwater, thus causing water pollution; residual substances from abandoned building materials storage yard will also cause water pollution when they enter the water body along with surface runoff.

(5) If the domestic sewage generated by construction personnel is directly discharged into the crossed water body, it will cause the organic matter and other indexes of the water body to exceed the standard and affect the water quality.

(6) Solid wastes, for example, bridge construction wastes that are piled up separately without being collected centrally may enter the water body and cause pollution.

(7) During the construction of the bridge superstructure of the Project, the main water environment pollutants are concrete blocks falling during cantilever concrete pouring and curing, and the discharged concrete curing wastewater, which have certain influence on the water quality of surface water along the Project. By hanging the dense mesh for buildings, the influence of wind blowing on the pouring concrete of the upper structure can be reduced, and the situation where the concrete falls into the water body can be reduced. Moreover, such influence is temporary and can be eliminated soon after the construction is completed.

8.2.1.1.2 Impact of Domestic Sewage from Construction Living Area on Water Environment

The number of the construction camps and construction personnel is determined by the quantity of works in the subcontracted sections. Now the Project is under the feasibility study stage. At that time, the specific position and number of the construction camps have not been determined yet. In combination with the report on the water and soil conservation scheme and by analogy with projects of the same type, 2 construction areas are set in the Project, and 100 construction personnel are allocated to each construction area. It is estimated that the daily output of sewage is 24t/d and the annual output of sewage is 8760t/a.

Domestic sewage from the construction living areas mainly consists of the sewage and fecal sewage produced by construction personnel' dining and washing. The sewage, failing to meet grade I standard indicated in the *Integrated Wastewater Discharge Standard* (GB8978-1996_, will cause water environment pollution if directly discharged to nearby surface water body and agricultural irrigation system. It is proposed to build the oil separation tank outside of the dining room in the construction living area. Wastewater from dining room is discharged into septic tank together with toilet flushing water and washing water after oil trap treatment for collection and treatment, and then is used for fertilizing the forest land around the construction living area, and the septic tank is periodically cleaned and used for fertilizing the forest land. It has minor impact on surrounding environment of surface water.

8.2.1.1.3 Impact of Construction Production Wastewater on Water Environment

The construction camp includes the special mixing yard, storage yard, parking and maintenance area of construction machinery, vehicles, living areas, etc. Among them, the material mixing station will produce a considerable amount of wastewater during the process of mixing concrete and making prefabricated components, mainly in the form of the flushing wastewater produced by the concrete drum mixer and charging bucket. The discharge of the production wastewater has the characteristics of high concentration of suspended solids, small water volume, intermittent centralized discharge and the like, and the effluent contains SS with high concentration and high chemical oxygen demand. According to relevant data, the amount of wastewater generated by each flushing of concrete drum mixer and charging bucket is about 0.5m3, the SS concentration of the wastewater can reach 3000 ~ 5000mg/L, and the pH value is about 12, far exceeding the requirements of the Grade I standard limit of the *Integrated Wastewater Discharge Standard* (GB8978-1996). However, wastewater containing petroleum substances will be generated during equipment flushing and maintenance in the parking and maintenance area of construction machinery and vehicles. Under the condition that the storage yard is washed by rainwater without sufficient protection, the sewage properties, mainly SS-containing sewage, vary with different storage materials.

Therefore, the production wastewater from the construction camp shall not be directly discharged into the surrounding surface water body. The production wastewater shall be treated with deoiling and sedimentation, and shall be reused as much as possible after treatment. After strictly implementing various management and protection measures, the production sewage during the construction period will not pose obvious impacts on the water environment of the surrounding surface water body.

8.2.1.1.4 Impacts of Tunnel Construction on Water Environment

In the process of tunnel construction, wet rock drilling is mostly used. In the process of drilling, high-pressure water will be used to wet dust to make it flow out as magma. At the same time, spraying water will be used in the blasting process to prevent dust generated by blasting operation from affecting the environment.

The above construction process will produce mud wastewater. If it is allowed to be discharged without being collected and treated, it will cause different degrees of pollution to surface rivers or irrigated lands near the entrance and exit. In addition, tunnel construction may also obstruct the groundwater to a certain extent or cause the groundwater to gush out, and affect the nearby water environment.

In general, about 200~300m^3/d, 200m^3/d and 100m^3/d recycling sewage will be produced during construction of long, medium and short tunnels along the Project respectively. A recycling can be completed in one working day. During the tunnel construction period, the main pollutants in the production wastewater are suspended solids. If it is directly discharged into the water body without treatment, the concentration of suspended solids in the water body will increase, which will have certain adverse effects on the water quality of rivers and streams. Generally, the concentration value of SS is between 800 and 10000mg/L, and the composition is relatively simple. Impurities such as mud can be removed after sedimentation treatment. The mud deposited at the bottom will be removed regularly, and the supernatant will be recycled and reused for spraying water in the site to reduce dust. Thus the impact on the surrounding environment is little. During the construction period, sedimentation tanks, reservoirs and other facilities shall be set up according to different tunnel wastewater outputs, and the wastewater shall be reused or discharged after treatment, and must not be directly discharged.

8.2.1.1.5 Impact of Non-point Source Loss from Rainfall

During the construction of the proposed highway, there is a large area of the bare surface caused by excavation, which will result in a large amount of water and soil loss to the water body of surrounding water ditch under the condition of heavy rainfall, thus posing an adverse effect to the surrounding water environment. Therefore, attention shall be paid to the protection of the bare surface during construction. According to the soil and water conservation plan of the Project, soil woven bags shall be used for retaining around the topsoil accumulation area during the construction of the Project, and temporary interception and drainage ditches shall be excavated on the subgrade slope to block and drain rainwater in time. After these measures are taken, surface runoff can be reduced, and the amount of non-point source loss under heavy rainfall will also be reduced, thus reducing the impact on the surrounding water environment.

8.2.1.2 Analysis on Surface Water Environment Impact during Operation Period

The water environment impact during project operation is mainly represented by pavement runoff and sewage discharge from traffic service facilities.

8.2.1.2.1 Impact Analysis of Pavement Runoff on Water Environment

The water quality and concentration of the pavement rainwater is related to the rainfall, rainfall time, traffic flow and air pollution degree. Due to the strong randomness and contingency of various factors, the concentration of typical pavement rainwater pollutants is also difficult to determine. According to the research results of the South China Institute of Environmental Sciences of the Ministry of Ecology and Environment on the pavement runoff pollution in the southern region, there are more suspended solids and oil substances in the rainwater within 30 min from the beginning of rainfall to the initial formation of runoff, and after 30 min, with the extension of rainfall time, the concentration of pollutants decreases rapidly. Generally speaking, the average concentration of pollutants in rainfall runoff remains at a relatively low level.

In the Project, side ditches are used to collect pavement runoff and discharge it to the water body along the route. The side ditches intercept the runoff formed by precipitation on the pavement and subgrade slope, thus avoiding the phenomenon of rainwater overflow and the scouring of cultivated land along the route by rainwater runoff. According to engineering analysis, the pollutants in pavement runoff are mainly COD, SS and petroleum substances, and the concentration of pollutants is relatively high in the initial formation stage. However, with the increase of rainfall duration, the concentration of pollutants in runoff decreases rapidly. Generally speaking, the average concentration of pollutants in runoff remains at a relatively low level.

At the beginning of rainfall, after pavement runoff is diluted by rainfall and adsorbed by slope, the pollutant concentration can basically meet the requirements of the Grade I standard limit specified in the *Integrated Standard for Wastewater Discharge* (GB8978-1996) when the pavement runoff reaches the surrounding water. After the pavement runoff enters the surrounding water from the side ditches and rainwater pipe outlets of the highway, it will cause an instantaneous increase in the concentration of pollutants in a small local range near the runoff inflow point. However, with the turbulent mixing of the water, the pollutants will be quickly mixed evenly on the whole section, thus its contribution to the increase in the pollutant concentration in the receiving water is very little, which will basically not affecting the water quality along the route.

8.2.1.2.2 Impact Analysis on Sewage Discharge from Highway Traffic Services

(1) Calculation of Sewage Volume from Services

Traffic facilities along the entire project are a toll station, a maintenance work area (built together with the toll station). For the volume and destination of sewage discharge from traffic facilities as indicated by the engineering analysis, see Table 8.2-2; for the amount of pollutants, see Table 8.2-3.

Table 8.2-2 Volume and Destination of Sewage Discharge from Project Traffic Services

Management Facility Description	Chainage (location)	Surrounding Description	Nearby Water Body/Distance	Sewage output (t/d)	Sewage Treatment Facility and Scale	Discharge destination
Toll station (built	K5+800~K6+100	The site is surrounded	Baidou River/70m	4.05	The toll station (built together with the	Reuse and no external

together with the maintenance work area)		by the wood land and non-irrigated land, without surface water distribution			maintenance work area) is provided with a set of MBR sewage treatment system with the capacity of 6m3/d. The sewage discharged meets the standard for toilet flushing, road cleaning and urban greening indicated in the *Reuse of Recycling Water for Urban– Water Quality Standard for Non-portable Urban Use* (GB/T18920-2002) and *Reuse of Recycling Water for Highway Service Area—Water Quality* (JT/T645.1-2016).	discharge

Table 8.2-3 Amount of Major Pollutants from Project Traffic Services before and after Sewage Treatment

Services Description	Sewage Discharge Volume (t/a)		Pollutant Amount (t/a)				
			SS	COD	BOD_5	NH3-H	Petroleums
Toll station (built together with the maintenance work area)	1478.25	Before Treatment	0.44	0.44	0.37	0.007	0.003
		After Treatment	0.1	0.07	0.01	0.007	0.001

Project traffic services produce 1478.25t/a sewage in total. After treatment by the sewage treatment facilities, the total discharge of major pollutants is as follows: about 0.1t/a SS, about 0.07t/a COD, about 0.01t/a BOD_5, about 0.007t/a ammonia-nitrogen and about 0.001t/a petroleum. Although the toll station (built together with the maintenance work area) discharges a small amount of sewage and total pollutants, direct discharge without treatment will also bring adverse impact to surrounding water environment, especially water bodies around the toll station and maintenance work area and in Xialei Nature Reserve 1km downstream of the Baidou River. Therefore, the wastewater from the rest area, toll station and maintenance work area of the Project can be reused and not be discharged outside after being treated by the sewage treatment facilities to the standard for toilet flushing and urban greening indicated in the *Reuse of Recycling Water for Urban– Water Quality Standard for Non-portable Urban Use* (GB/T18920-2002) and *Reuse of Recycling Water for Highway*

Service Area—Water Quality (JT/T645.1-2016).

(2) Analysis on Reuse Feasibility of Sewage from Services

The toll station and maintenance work area produce about 4.05m^3/d wastewater. Pollutant concentration in the wastewater is as follows: 300mg/L(COD), 250mg/L (BOD_5), 300mg/L (SS), 2mg/L (petroleum) and 5mg/L (ammonia-nitrogen). Wastewater from the toll station, maintenance work area is proposed to be treated by a set of MBR sewage treatment system with the capacity of 6m3/d to the *Reuse of Recycling Water for Urban– Water Quality Standard for Non-portable Urban Use* (GB/T18920-2002) and *Reuse of Recycling Water for Highway Service Area—Water Quality* (JT/T645.1-2016), and then reused for greening, road cleaning and toilet flushing.

① Process feasibility

Analogy is made with the application of recycled water recycling facilities in Lingli Service Area Reconstruction and Expansion Project, a sub-project of the Reconstruction and Expansion Project for Liuzhou (Luzhai County) - Nanning Section of Quanzhou-Nanning Expressway in the assessment. The Lingli Service Area Reconstruction and Expansion Project is located in Lingli Town, Qingxiu District, Nanning City. The split MBR method is adopted in Lingli Service Area and its treatment process is "modified A2/O process + MBR membrane modules + chlorine dioxide disinfection". The membrane modules used are tubular type (PVDF material), and the treatment scale is 120 m^3/(d·spot). The project was started on July 30, 2015, and passed the special completion acceptance of environmental protection by the Environmental Protection Department of Guangxi Zhuang Autonomous Region on January 16, 2017. According to the *Investigation Report on Completion Acceptance of Environmental Protection for Lingli Service Area Reconstruction and Expansion Project* (submitted for approval), the Guangxi traffic environmental monitoring central station conducted an on-site sampling of the water after treatment by the sewage treatment facilities at the south and north sides of Lingli Service Area from October 12, 2016 to October 14, 2016. The monitoring and analysis results are shown in Table 8.2-4.

Table 8.2-4 Monitoring and Analysis Results for Quality of Water after Treatment by Sewage Treatment Facilities in Lingli Service Area

Setting of Sampling Spots	pH Value	Total dissolved solids (mg/L)	BOD_5(mg/L)	Ammonia-nitrogen (mg/L)	Anionic surfactant (mg/L)	Dissolved Oxygen (mg/L)	TC (Nr./L)
Influent quality	6.5~9	400~600	40~140	40~140	/	/	300
Monitoring average value of treated	6.5	327	8.5	8.71	0.16	1.9	1

effluent in the south side							
Monitoring average value of treated effluent in the north side	6.5	346	7.3	7.31	0.13	2.3	1
The Reuse of Recycling Water for Urban– Water Quality Standard for Non-portable Urban Use (GB/T18920-2002)	6~9	1000	10	10	1	1	3

It can be seen from the above table that the monitoring values of all monitoring factors (pH, total dissolved solids, BOD5, ammonia nitrogen, anionic surfactant, dissolved oxygen and total coliform group) of the reused water after treatment in Lingli Service Area meet the requirements of flushing test and urban greening water quality standard in the *Reuse of Recycling Water for Urban– Water Quality Standard for Non-portable Urban Use* (GB/T18920-2002). The wastewater in the toll stations and maintenance work areas of the Project is mainly domestic sewage produced by service facility management personnel and floating personnel, and its water quality is the same as that of the wastewater produced in Lingli Service Area. Therefore, the wastewater in the toll stations and maintenance work areas of the Project is planned to be treated with the MBR treatment system (modified A2/O process+ MBR membrane modules + chlorine dioxide disinfection). It can meet the requirements of water quality standards for flushing test, road cleaning and urban greening in the *Reuse of Recycling Water for Urban– Water Quality Standard for Non-portable Urban Use* (GB/T18920-2002), and is feasible in respect of the processing technology.

② Treatment Scale and Reuse Feasibility

The greening area of the toll stations and maintenance work areas of the proposed project is about 17,000m2, and when the greening water consumption is taken as 2.5L/m2.d, the greening water consumption will be 42.5m^3/d. The wastewater generated in the toll stations and maintenance work areas of the Project can be reused without being discharged.

In summary, the wastewater from project services (namely the toll station and maintenance work area) is reused for greening, road cleaning and toilet flushing and not discharged outside after being treated by MBR sewage treatment system to the *Reuse of Recycling Water for Urban– Water Quality Standard for Non-portable Urban Use* (GB/T18920-2002) and *Reuse of Recycling Water for Highway Service Area—Water Quality*

(JT/T645.1-2016). Therefore, it has minor impact on surrounding water environment.

8.2.1.2.3 Impact on Hydrological Elements

Bridge works mainly cross water in the Project. The Xialei River with the full width of 30~40m flows under the Bangtun Major Bridge. The axis of the bridge location is oblique with the flow direction. Piers are unavailable in the main riverbed, while underwater piers are available in the auxiliary riverbed. Piers are located at the boundary of auxiliary riverbed. The Guichun River with the full width of 30~50m is under the Guichun River Major Bridge. The axis of the bridge location is oblique with the flow direction. Piers are unavailable in the main riverbed, while underwater piers are available in the auxiliary riverbed. Piers are located at the boundary of auxiliary riverbed.

In the above 2 bridges with underwater piers, piers are located in the auxiliary riverbed, occupying small water area and having minor impact on the water form in rivers, runoff conditions, hydraulic conditions and changes in dredging.

8.2.1.2.4 Analysis on Surface Water Environment Impact from Tunnel Works

In tunnel works (closed area), it is impossible to naturally clean the pavement through rainfall, which results in sediment accumulation on the pavement for a long time. When the pavement is subject to manual cleaning, the pollutant concentration of pavement runoff is much higher than that of common pavement runoff. The reconnaissance shows that the tunnel entrance and exit proposed by the Project are mainly surrounded with mountain streams, gullies and other distributed surface water bodies. If the runoff from manual pavement cleaning in the tunnel works is directly discharged without treatment, it will have great adverse impact on the quality of the receiving water environment within a short time. Measures shall be taken especially in long tunnel works, to control the adverse impact.

8.2.1.3 Impact Analysis on Drinking Water Source Conservation Areas

The water source in Shuolong Town Community is the Yuejin Canal, which is located in the ridge in the east of the proposed highway. The proposed highway is about 95m and 690m to the secondary and primary protection areas of the water source in Shuolong Town respectively. The section is built in the tunnel form, making no hydraulic connection with protections areas of the water source in Shuolong Town. Therefore, project construction has minor impact on the water source in Shuolong Town.

8.2.1.4 Impact Analysis on Decentralized Drinking Water in Villages along the Line

The field investigation shows that most of residents living in villages along the proposed highway take the water from mountain streams or wells as the water source in a decentralized manner. Decentralized water points of mountain streams are far away from the highway, while decentralized well water is taken from closed motor-pumped wells or wells dug in the residents' yards. Therefore, highway construction would not have direct adverse impact on decentralized water points of mountain streams and wells. However, construction such as excavation and filling of the subgrade may damage related decentralized drinking water facilities and water pipelines, so relevant preliminary investigation work shall be carried out in details, and protection or compensation schemes shall be made for possible impacts.

8.2.2 Ecological Impact Assessment for Detian-Shuolong Highway

8.2.2.1 Analysis of Surface Water Environment Impact during Construction

8.2.2.1.1 Construction Impact Analysis of Sections along the River

Guichun River is the main surface water system along the route of the Project. There is no bridge and no river-crossing section, but K0+000~K5+500 is close to Guichun River.

During the construction period, the impact of construction of sections along the river on water environment is mainly reflected in the following aspects:

(1) During construction of sections along the river, the residual oil in the process of oil leakage of construction machinery and equipment and mechanical repair may cause oil pollution to the water body, and the water insolubility property of oil substances brings long the pollution time and widens the influence range. During construction of sections along the river, cleaning shall be carried out regularly, machinery and equipment shall be maintained regularly, and certain prevention and management measures shall be taken for oil leakage from construction machinery to avoid oil pollution to the water body.

(2) If the construction materials stacked in the construction site (such as asphalt, oil, some powdery materials, etc.) are not properly kept or washed into the water body by heavy rain, they will cause water pollution; if the powdery materials are not strictly shielded or covered up, dust will rise in case of wind, thus polluting the water body; if the height of the materials stacking site is lower than the water level in the wet season, in the rainstorm season, the materials may be submerged or washed into the water body by rainwater, thus causing water pollution; residual substances from construction waste storage yard will also cause

water pollution when they enter the water body along with surface runoff.

(3) If the domestic sewage from the construction workers is directly discharged into the water body, it will cause the organic matter and other indexes of the water body to exceed the standard and affect the water quality.

(4) Solid wastes such as construction wastes from construction of sections along the river that are piled up separately without being collected centrally may enter the water body and cause pollution.

The following measures are recommended to avoid the adverse impact of the construction of sections along the river on the water quality of Guichun River: construction material stacking area is not provided in this area; before construction, build temporary intercepting and drainage ditches and sedimentation tanks. Construction wastewater and rainwater runoff are reused after sedimentation to reduce dust as much as possible, and not discharged at will; do not carry out road excavation and pavement construction in rainy season as far as possible, and backfill and compact the excavated surface in time to reduce the impact of water and soil loss; strengthen management, carry out civilized construction education for construction workers, and randomly discarding construction waste and domestic garbage into water bodies is prohibited; strengthen equipment maintenance to avoid leakage. After taking the above measures, the construction of sections along the river will have little impact on the water quality of Guichun River.

8.2.2.1.2 Impact of Domestic Sewage in Construction Living Area on Water Environment

The maximum number of construction personnel during the construction period is calculated as 30. It is estimated that the daily output of sewage is 3.6t/d and the annual output of sewage is 1314t/a. Domestic sewage in the construction camp mainly includes fecal sewage and cleaning and washing water. If directly discharged into surface water and agricultural irrigation system, it will cause pollution to the water environment.

8.2.2.1.3 Impact of Construction Production Wastewater on Water Environment

The construction camp includes the special mixing yard, storage yard, parking and maintenance area of construction machinery, vehicles, living areas, etc. Among them, the material mixing station will produce a considerable amount of wastewater during the process of mixing concrete and making prefabricated components, mainly in the form of the flushing wastewater produced by the concrete drum mixer and charging bucket. The discharge of the production wastewater has the characteristics of high concentration of suspended solids, small water volume, intermittent centralized discharge and the like, and the effluent contains SS with high concentration and high chemical oxygen demand. According to relevant data, the amount of wastewater generated by each flushing of concrete drum mixer and charging bucket is about 0.5m3, the SS concentration of the wastewater can reach 3000 ~ 5000mg/L, and the pH value is about 12, far exceeding the requirements of the Grade I standard limit of the *Integrated Wastewater Discharge Standard*. However, wastewater containing petroleum substances will be generated during equipment flushing and maintenance in the parking and maintenance area of construction machinery and vehicles. Under the condition that the storage yard is washed by rainwater without sufficient protection, the sewage properties, mainly SS-containing sewage, vary with different storage materials.

Therefore, the production wastewater from the construction camp shall not be directly discharged into the surrounding surface water body. The production wastewater shall be treated with deoiling and sedimentation, and shall be reused as much as possible after treatment. After strictly implementing various management and protection measures, the production sewage during the construction period will not pose obvious impacts on the water environment of the surrounding surface water body.

8.2.2.1.4 Impacts of Tunnel Construction on Water Environment

In the process of tunnel construction, wet rock drilling is mostly used. In the process of drilling, high-pressure water will be used to wet dust to make it flow out as magma. At the same time, spraying water will be used in the blasting process to prevent dust generated by blasting operation from affecting the environment.

The above construction process will produce mud wastewater. If it is allowed to be discharged without being collected and treated, it will cause different degrees of pollution to surface rivers or irrigated lands near the entrance and exit. In addition, tunnel construction may also obstruct the groundwater to a certain extent or cause the groundwater to gush out, and affect the nearby water environment.

Under normal circumstances, the amount of wastewater generated from adit construction cycles is about 100m3/d, and one cycle can be completed in one working day. During the tunnel construction period, the main pollutants in the production wastewater are suspended solids. If it is directly discharged into the water body without treatment, the concentration of suspended solids in the water body will increase, which will have certain adverse effects on the water quality of rivers and streams. Generally, the concentration value of SS is between 800 and 10000mg/L, and the composition is relatively simple. Impurities such as mud can be removed after sedimentation treatment. The mud deposited at the bottom will be removed regularly, and the supernatant will be recycled and reused for spraying water in the site to reduce dust. Thus the impact on the surrounding environment is little. During the construction period, sedimentation tanks, reservoirs and other facilities shall be set up according to different tunnel wastewater outputs, and the wastewater shall be reused or discharged after treatment, and must not be directly discharged.

8.2.2.1.5 Impact of Non-point Source Loss from Rainfall

During the construction of the proposed highway, there is a large area of the bare surface caused by excavation, which will result in a large amount of water and soil loss to the surrounding Jinggou water body under the condition of heavy rainfall, thus posing an adverse effect to the surrounding water environment. Therefore, attention shall be paid to the protection of the bare surface during construction. According to the soil and water conservation plan of the Project, soil woven bags shall be used for retaining around the topsoil accumulation area during the construction of the Project, and temporary interception and drainage ditches shall be excavated on the subgrade slope to block and drain rainwater in time. After these measures are taken, surface runoff can be reduced, and the amount of non-point source loss under heavy rainfall will also be reduced, thus reducing the impact on the surrounding water environment.

8.2.2.2 Impact Analysis on Surface Water Environment during Operation Period

8.2.2.2.1 Analysis on Impact of Sewage Discharge from Highway Auxiliary Facilities

There are no service areas, rest areas and toll stations along the route of the Project, and no domestic sewage from service facilities is discharged.

8.2.2.2.2 Impact Analysis of Pavement Runoff on Water Environment

The water quality and concentration of the pavement rainwater is related to the rainfall, rainfall time, traffic flow and air pollution degree. Due to the strong randomness and contingency of various factors, the concentration of typical pavement rainwater pollutants is also difficult to determine. According to the research results of the South China Institute of Environmental Sciences of State Environmental Protection Administration on the pavement runoff pollution in the southern region, there are more suspended solids and oil substances in the rainwater within 30 min from the beginning of rainfall to the initial formation of runoff, and after 30 min, with the extension of rainfall time, the concentration of pollutants decreases rapidly. Generally speaking, the average concentration of pollutants in rainfall runoff remains at a relatively low level. See Table 4.6-5 for the concentration of pollutants in rainfall runoff.

In the Project, side ditches are used to collect pavement runoff and discharge it to the water body along the route. The side ditches intercept the runoff formed by precipitation on the pavement and subgrade slope, thus avoiding the phenomenon of rainwater overflow and the scouring of cultivated land along the route by rainwater runoff. According to engineering analysis, the pollutants in pavement runoff are mainly COD, SS and petroleum substances, and the concentration of pollutants is relatively high in the initial formation stage. However, with the increase of rainfall duration, the concentration of pollutants in runoff decreases rapidly. Generally speaking, the average concentration of pollutants in runoff remains at a relatively low level.

At the beginning of rainfall, after pavement runoff is diluted by precipitation and adsorbed by slope, the pollutant concentration can basically meet the requirements of the Grade I standard limit of the *Integrated Wastewater Discharge Standard* (GB8978-1996) when the pavement runoff reaches the surrounding water body. After the pavement runoff enters the surrounding water body from the side ditches and rain pipe outlets of the highway, it will cause an instantaneous increase in the concentration of pollutants in a local small range near the runoff inflow point, but with the turbulent mixing of the water body, the pollutants will be quickly mixed evenly on the whole section, thus its contribution to the increase in the concentration of pollutants in the receiving water body is very small, which will basically not affecting the water quality along the route.

8.2.2.2.3 Impact on Hydrological Elements

There are no bridges and water-related works in the Project, so there is basically no influence on the shape of river water area, runoff conditions, water conservancy conditions and scouring and silting changes.

8.2.2.3 Impact Analysis on Drinking Water Source Conservation Areas

8.2.2.3.1 Resolution of Legal Restrictions on Crossing Drinking Water Source Conservation Areas by the Project

1. Resolution of Restriction Factors for Project Crossing Aitun Water Source Conservation Area in Shuolong Town

The Project belongs to the Detian-Shuolong Section of the Detian-Renai Highway with about 4.9km of chainages of K0+460 ~ K5+360 passing through the land area of the Class II Aitun Water Source Conservation Area in Shuolong Town. Daxin County Transportation Bureau solicited opinions from Daxin County Environmental Protection Bureau on the water source crossing issue, and the Daxin Environmental Protection Bureau replied with *Opinions on Detian-Renai Highway Crossing Class II Aitun Land Water Source Conservation Area in Shuolong Town and Class II Baxing Land Water Source Conservation Area in Xialei Town* (see Attachment 7 for details), agreeing in principle that the Project can cross the Class II Aitun Land Water Source Conservation Area in Shuolong Town.

2. Resolution of Restriction Factors for Project Crossing Shuolong Town Community Water Source Conservation Area

The highway section of chainages of K9+400 ~ K10+000 with a length of about 600m passes through the land area of the Class II Aitun Water Source Conservation Area in Shuolong Town. Daxin County Transportation Bureau solicited opinions from Daxin County Environmental Protection Bureau on the water source crossing issue, and the Daxin Environmental Protection Bureau replied with *Opinions on Detian-Shuolong Highway Crossing Shuolong Town Community Class II Land Water Source Conservation Area* (see Attachment 7 for details), agreeing in principle that the Project can cross the Shuolong Town Community Class II Land Water Source Conservation Area.

8.2.2.3.2 Impact Analysis of Aitun Drinking Water Source Conservation Area in Shuolong Town

1. Spatial relationship

Highway section of chainages K0+200 ~ K5+300 with a length of about 5.1km passes through the land area of the Class II Aitun Water Source Conservation Area in Shuolong Town. Most of the crossing sections are located at the upper reaches of the water intake of Guichun River in Aitun, of which about 1.13km of K3+980 ~ K5+110 is close to the Class I Aitun Land Water Source Conservation Area. The highway section crosses the water source conservation area in the form of subgrade. See Figure 3-2 for the location relationship diagram between the Project route and the Aitun Drinking Water Source Conservation Area in

Shuolong Town.

2. Construction Impact Analysis

(1) Impact analysis of excavation and filling construction

The Project is a reconstruction and extension project, of which, about 1.13km of K3+980~K5+110 is close to the Class I Aitun Land Water Source Conservation Area in Shuolong Town. To mitigate the impact, this section is to be reconstructed with no change to the original alignment and subgrade width of the existing road; considering that the construction machinery may cause damage to the pavement, which will call for replacement of the pavement material, no subgrade works is involved, and other sections crossing the Class II conservation area are basically routed along the existing border highway. The pavement of the existing 7.5m border highway is proposed to be widened to 10m, which does not involve high-filled and deep-cut sections, with smaller quantities compared to a new construction project, and controllable impact on the water quality of the water source during the normal construction period under the measures of strengthening construction management, prohibiting the disposal of earthwork and stonework of subgrade excavation and building materials to the riverbed, etc. However, due to the small distance between the crossing section and Guichun River, the exposed surface formed by the construction and the randomly piled spoil and construction materials are easy to form mud-containing sewage entering the surface water body when scoured by rainwater, thus polluting the water quality of the water intake planned in the downstream. Therefore, the sludge-containing water formed by rainwater during subgrade excavation and filling construction of the sections across the water source conservation area will pose adverse effects on the water intake and water environment of Guichun River. After adopting the environmental protection measures proposed in "9.2.2.3 Environmental Protection Measures for Drinking Water Source Conservation Areas", the impact of engineering construction on the water quality of the Aitun Drinking Water Source Conservation Area in Shuolong Town can be minimized.

(2) Impact analysis of construction production and domestic wastewater and construction camp

According to the *Water Pollution Prevention and Control Law of the People's Republic of China* (revised in 2017) and relevant requirements for drinking water source protection, the Assessment requires that temporary sites such as construction production and living areas and construction camps shall not be set up within the Aitun Drinking Water Source Conservation Area in Shuolong Town, and shall be set far away from the catchment area of water intake waters, so as to avoid the pollution of the drinking water source conservation area of Guichun

River caused by construction production and domestic wastewater. Construction production and domestic sewage are prohibited from being discharged into the Guichun River reach within the drinking water source conservation area.

3. Impact Analysis during Operation Period

(1) Impact analysis of pavement rainwater runoff

Under the non-emergency condition, the pavement runoff sewage discharge can be basically close to the discharge standards stipulated by the State, and with the continuation of rainfall, the concentration of pollutants in pavement rainwater runoff will decrease, and the adverse impact on the surface water environment will gradually decrease accordingly, thus the pavement runoff will not have great adverse impact on the water environment of water source conservation area.

(2) Impact analysis of highway service management facilities

According to Article 64: It is prohibited to set sewage outlets in drinking water source conservation areas; Article 66: It is prohibited to construct, reconstruct or extend construction projects that discharge pollutants in Class II drinking water source conservation areas; For the completed construction projects that discharge pollutants, the people's governments at or above the county level shall order to dismantle or close them in the *Water Pollution Prevention and Control Law of the People's Republic of China* (2017). The Project does not set up service areas, rest areas, maintenance stations and other service facilities within the Aitun Drinking Water Source Conservation Area in Shuolong Town, thus meeting the requirements of the above legal provisions.

(3) Risk analysis of dangerous goods transportation accidents

After the Project is put into operation, the adverse impact on the water environment of the Aitun Drinking Water Source Conservation Area in Shuolong Town is mainly the adverse impact of pollutants entering the water body on the drinking water environment in the case of dangerous goods transportation accidents on the sections crossing the water source. The highway under the Project mainly serves as the tourist highway from Shuolong Town to Detian Waterfall, where the vehicles are mainly private cars and tour buses, and there are basically no dangerous goods transportation vehicles. Moreover, due to this section is on the border, the design speed is reduced to 40km/h in the Project Feasibility Study Scheme. At the same time, several traffic police smuggling inspection posts are set up on this section, which greatly limits the speed of this section. Based on the above factors, the occurrence of dangerous goods transportation accidents in this section is few. The more likely risk accidents occur in the situation where private cars run out of control and rush into the river bank due to long-distance fatigue driving of the cars. However, a border protective fence has been set up near the river bank to further control the runaway vehicles from falling into the Guichun River.

8.2.2.3.3 Impact Analysis on Shuolong Town Community Water Source Conservation Area

1. Spatial relationship

The highway section of chainages K9+400 ~ K10+000 with a length of about 600m passes through the Class II Shuolong Town Community Water Source Conservation Area, and the section of K10+000 ~ K11+400 with a length of about 1.4km is close to the periphery of the Class II land water source conservation area; the crossing section is located upstream of the water intake. The highway section crosses the water source conservation area by the form of tunnel and subgrade, of which the total length of tunnel sections is 300m and that of the subgrade sections is 300m. See Figure 8 for the location relationship diagram between the Project route and the Shuolong Town Community Water Source Conservation Area.

2. Construction Impact Analysis

(1) Impact analysis of tunnel construction on water environment

The tunnels cross the Class II water source conservation area, but the water source conservation area is of river type. The water intake on Yuejin Channel of its water source is located in Guichun River beside the Detian Old Kapok Scenic Area, and there is no water conservancy relationship between its water source and the mountain in the crossing section. Therefore, wastewater and groundwater inflow into the tunnels during tunnel construction have little influence on the water source.

(2) Impact analysis of subgrade excavation and filling construction

The works are located in the subgrade sections of 300m in total within the Shuolong Town Community Water Source Conservation Area, and are located in cultivated land without high-fill deep-cut section. The exposed surface formed by excavation and filling construction, as well as the spoil and construction materials piled up at will, are easy to form mud-containing sewage entering the surface water body when scoured by rainwater; however, because Yuejin Channel in the water area of the water source is a relatively closed channel, which, in the crossing section of the works, is mainly located in the mountain on the north side of the Project route and there is no close water conservancy relationship between Yuejin Channel and the surrounding streams, so it is unlikely that the mud-containing water formed by rainwater during the subgrade excavation and filling construction of the section crossing water source conservation area will affect the water quality of the Yuejin Channel.

(4) Impact analysis of construction production and domestic wastewater and construction

camp

According to the *Water Pollution Prevention and Control Law of the People's Republic of China* (revised in 2017) and relevant requirements for drinking water source protection, the Assessment requires that temporary sites such as bridge prefabrication yards, construction production and living areas and construction camps shall not be set up within the Shuolong Town Community Water Source Conservation Area, and shall be set far away from the runoff paths of Yuejin Channel, so as to avoid the pollution of Shuolong Town Community Water Source Conservation Area caused by construction production and domestic wastewater. Construction production and domestic sewage are prohibited from being discharged into Shuolong Town Community Water Source Conservation Area.

3. Impact Analysis during Operation Period

(1) Impact analysis of pavement rainwater runoff

Under the non-emergency condition, the pavement runoff sewage discharge can be basically close to the discharge standards stipulated by the State, and with the continuation of rainfall, the concentration of pollutants in pavement rainwater runoff will decrease, and the adverse impact on the surface water environment will gradually decrease accordingly. Moreover, Yuejin Channel is a relatively closed channel with little water conservancy relationship with the surrounding streams, thus the pavement runoff will not have great adverse impact on the water environment of the water source conservation area.

(2) Impact analysis of highway service management facilities

According to Article 64: It is prohibited to set sewage outlets in drinking water source conservation areas; Article 66: It is prohibited to construct, reconstruct or extend construction projects that discharge pollutants in Class II drinking water source conservation areas; For the completed construction projects that discharge pollutants, the people's governments at or above the county level shall order to dismantle or close them in the Water Pollution Prevention and Control Law of the People's Republic of China (2017). The Project does not set up service areas, rest areas, maintenance stations and other facilities within the Shuolong Town Community Water Source Conservation Area, thus meeting the requirements of the above legal provisions.

(3) Risk analysis of dangerous goods transportation accidents

After the Project is put into operation, the adverse impact on the water environment of the Shuolong Town Community Water Source Conservation Area is mainly the adverse impact of pollutants entering the water body on the drinking water environment in the case of dangerous goods transportation accidents on the crossing sections. The highway under the

Project mainly serves as the tourist highway from Shuolong Town to Detian Waterfall, where the vehicles are mainly private cars and tour buses, and there are basically no dangerous goods transportation vehicles. Moreover, the Yuejin Channel in the water area of the Shuolong Town community water source is a relatively closed channel, and most of the Yuejin Channel in the crossing section of the works is located in the mountain and has little water conservancy relationship with the surrounding environment, thus the leaked pollutants in the crossing section of the Project are difficult to enter the channel and pollute the water quality of the Shuolong Town Community Water Source Conservation Area.

8.2.3 Water Environment Impact Assessment of Shuolong Port (Phase II of Shuolong Gate)

8.2.3.1 Analysis of Surface Water Environment Impact during Construction Period

8.2.2.1.1 Impact of Domestic Sewage in Construction Living Area on Water Environment

The output of domestic sewage during the construction period is 12 m3/d, and the domestic sewage discharge rate during the whole construction period is 5400 m3. The domestic sewage during construction period will be discharged into Shuolong Sewage Treatment Plant after being treated by the septic tank. Therefore, the domestic sewage during the construction period has little impact on the environment.

8.2.2.1.2 Impact of Construction Wastewater on Water Environment

There are dedicated storage yard, construction machinery, vehicle parking spaces and living area, etc. in the construction camp; wastewater containing petroleum substances will be produced from washing of construction machinery and vehicles; when the storage yard is washed by rain and lacks protection, sewage will be produced, and the properties of sewage are different depending on different storage materials. It is mainly sewage containing SS. The production wastewater from the construction camp shall not be directly discharged into the surrounding surface water body. The production wastewater shall be treated with deoiling and sedimentation, and shall be reused as much as possible after treatment. After strictly implementing various management and protection measures, the production sewage during the construction period will not pose obvious impacts on the water environment of the surrounding surface water body.

8.2.3.2 Analysis on Surface Water Environment Impact during Operation Period

The wastewater of the Project is mainly domestic wastewater. The domestic sewage treated by the three-stage septic tank in the Project meets the requirements of Class III standard (COD≤500mg/L, BOD5≤300mg/L, SS≤400mg/L, oil and grease ≤100mg/L, anionic surfactant ≤50mg/L) of *Integrated Wastewater Discharge Standard* (GB 8978-1996). The treated domestic sewage of the Project meeting standard will be discharged into Shuolong Town Wastewater Treatment Plant, and will be discharged to Guichun River after being treated to meet Level I Class B standard of Discharge Standard of Pollutants for Municipal Wastewater Treatment Plant (GB18918-2002) and its amendment.

Shuolong Sewage Treatment Plant was put into use in October 2015. The Sewage Treatment Plant uses a multi-stage composite moving bed bio-membrane reactor treatment process, and it treats 1,000 tons of sewage every day. Multi-stage composite moving bed bio-membrane reactor is a new high-efficiency reactor between activated sludge process and fixed bio-membrane process. The filler with large specific surface area in the reactor moves freely in the water due to stirring. When sewage continuously passes through the reactor with moving filler, bio-membrane grows on the filler, and microorganisms on the bio-membrane multiply. Heterotrophic and autotrophic microorganisms utilize C, N and P in the water for metabolism, thus playing a role in purifying sewage. The water discharge of the Project is 8.8 t/d, accounting for 0.9% of the sewage treatment capacity of Shuolong Town. The current water supply in Shuolong Town is 600t/d, and the water discharge is calculated as 80% of its water supply, so the water discharge of the residents in Shuolong Town is 480t/d. Therefore, Shuolong Sewage Treatment Plant can still receive the comprehensive sewage produced by the Project. The project is located within the pollutant receiving scope of Shuolong Town Sewage Treatment Works. After field survey, the municipal sewage pipe network has been built, so it is feasible to introduce domestic wastewater into Shuolong Town Sewage Treatment Works for treatment. Comprehensive sewage has little impact on Guichun River after being treated by Shuolong Town Wastewater Treatment Plant.

8.3 Prediction and Assessment of Noise Impact

8.3.1 Prediction and Assessment of Noise Impact during Construction

8.3.1.1 Analysis of Noise Sources in Different Stages of Construction Period

The proposed project site has a complex terrain. Although there are no high-fill and deep-cut sections, lots of tunnels are required, resulting in a large amount of earth-rock excavation and filling. For this purpose, many construction machinery and transport vehicles are to be used, and the construction activities may have a big interference impact on the acoustic environment along the project route.

The main noise sources in the construction period are the noise generated by construction machinery and the radiation noise from transport vehicles. The noise impact is temporary; however, due to long construction period of the proposed project and lots of construction machinery, the noise is generally loud and irregular, and it may cause a large noise disturbance to the villages nearby and other acoustic environment sensitive points if no control measures are taken. The process of expressway construction is generally divided into three stages: foundation construction, pavement construction and traffic engineering construction.

(1) Foundation construction

This is the longest stage during which the largest number of construction machinery is used and the noise intensity is the highest. It includes foundation treatment, subgrade leveling, earth excavation and filling, layer-by-layer compaction, etc. The main construction machinery used in this stage are excavators, bulldozers, rollers, and graders.

(2) Pavement construction

This follows the subgrade construction. A major part of it is to spread asphalt along the Line. The main construction machinery used in this stage is heavy-duty asphalt spreader. Some results of noise monitoring of expressways in China indicate that the highway construction noise generated in this stage is smaller than that of the subgrade construction stage, and the sensitive points 50m away from the roadside are less affected.

(3) Bridge erection

The bridge construction can be synchronized with the subgrade construction, including the construction of pile foundation at lower part and the construction of box girders at upper part. Bridges use bored pile foundation. The main machinery generating noise in the construction of pile foundation in the lower part is drill and pile driver, whilst that in the construction of box girders in the upper part is crane.

(4) Traffic engineering construction

The major part of it is to install the traffic and communication facilities on the expressway and improve the signs and marker lines. Large construction machinery is hardly used in this stage, so the noise has a much less impact.

The above stages are all accompanied by the radiation noise brought by the vehicles for transportation of construction materials. It is inevitable to choose some existing roads near sensitive points as the roads for vehicles to transport construction materials. The radiation noise produced by these vehicles may have a certain impact on the acoustic environment sensitive points along the Line. See Table 8.3-1 for the main construction machinery in each construction stage.

Table 8.3-1 Construction Machinery Used in Different Construction Stages

Construction stage	**Main Section**	**Construction Machinery**
Subgrade construction	Subgrade sections along the Line	Bulldozer, excavator, loader, grader, vibratory roller, smooth wheel roller
Pavement construction	Whole route	Asphalt mixers, loaders, scrapers, graders, asphalt pavers, vibrating rollers, smooth wheel rollers
Bridge construction	Bridge sections	Drilling machine, pile driver, crane, transport vehicle
Traffic engineering construction	Whole route	Electric drill, electric saw, cutter

According to the above analysis and the construction features, the noise source distribution of the Project is as follows:

① Road rollers, bulldozers, graders and other road construction machinery are mainly distributed within the road reserve;

② Pile drivers and loaders are concentrated at bridges and grade separation;

③ Mixers are mainly centralized in the mixing station;

④ Excavators and loaders are mainly centralized in the spoil yard;

⑤ Dump trucks are concentrated on the access roads between spoil areas and highways, and between mixing plants, bridges and grade separations.

8.3.1.2 Prediction of Noise Impact of Construction Machinery

The noise from construction machinery is predicted and calculated in the mode represented by the following formula:

$$L_i = L_0 - 20\lg(r_i/r_O) - \Delta L$$

Where: L_i - represents the noise level of r_i m from noise source, dB(A);

L_0 - represents the noise level of r_0 m from noise source, dB (A);

ΔL represents the noise attenuation attributed to other factors, dB(A).

The results of the noise at different distances from construction machinery as prediction in the above mode are listed in Table 8.3-2.

Table 8.3-2 Predicted Attenuation of Noise Level of Main Construction Machinery at Different Distances Unit: dB(A)

Type of Machine	Type	Distance from measuring point, m	Maximum sound level, dB	10 m	30 m	50 m	80 m	100 m	150 m	200 m	250 m	300 m
Wheel loader	ZL40	5	90	84.0	74.4	70.0	65.9	64.0	60.5	58.0	56.0	54.4
Wheel loader	ZL50	5	90	84.0	74.4	70.0	65.9	64.0	60.5	58.0	56.0	54.4
Grader	PY160A	5	90	84.0	74.4	70.0	65.9	64.0	60.5	58.0	56.0	54.4
Vibrating road roller	YZJ10B	5	86	80.0	70.4	66.0	61.9	60.0	56.5	54.0	52.0	50.4
Double-wheel and double-vibrator roller	CC21	5	81	75.0	65.4	61.0	56.9	55.0	51.5	49.0	47.0	45.4
Three-wheel roller	/	5	81	75.0	65.4	61.0	56.9	55.0	51.5	49.0	47.0	45.4
Tyred roller	Z116	5	76	70.0	60.4	56.0	51.9	50.0	46.5	44.0	42.0	40.4
Bulldozer	T140	5	86	80.0	70.4	66.0	61.9	60.0	56.5	54.0	52.0	50.4
Hydraulic wheel excavator	W4-60C	5	84	78.0	68.4	64.0	59.9	58.0	54.5	52.0	50.0	48.4
Paver (UK)	Fifond311 ABG CO	5	82	76.0	66.4	62.0	57.9	56.0	52.5	50.0	48.0	46.4

Type of Machine	Type	Distance from measuring point, m	Maximum sound level, dB	10 m	30 m	50 m	80 m	100 m	150 m	200 m	250 m	300 m
Paver (Germany)	VOGELE	5	87	81.0	71.4	67.0	62.9	61.0	57.5	55.0	53.0	51.4
Pile driver	/	5	85	79.0	69.4	65.0	60.9	59.0	55.5	53.0	51.0	49.4
Generator set (2 sets)	FKV-75	1	98	78.0	68.5	64.0	59.9	58.0	54.5	52.0	50.0	48.5
Impact well drill	22	1	87	67.0	57.5	53.0	48.9	47.0	43.5	41.0	39.0	37.5
Conical drum reversing concrete mixer	JZC350	1	79	59.0	49.5	45.0	40.9	39.0	35.5	33.0	31.0	29.5

Note: The noise level at a distance of 5m is measured value, and others are predicted values which may be slightly different from the reality.

8.3.1.3 Analysis of Noise Impact of Construction Machinery

(1) During the operation of a single machine, the daytime noise at a distance of 50m from the construction machine reaches the standard (70dB(A)) specified in the *Emission Standard of Environment Noise for Boundary of Construction Site*, and the nighttime noise at a distance of 284m from the construction machinery reaches the standard (55dB(A)).

(2) The operation mode of the construction machinery to be used in the Project is mobile operation. The construction machinery is approximately considered as the point sources located at the center line of the highway, 20m away from the construction site boundary. The duration of construction is considered on the assumption of continuous operation under the same load in the daytime and nighttime. The noise impact at the construction site boundary in different construction stages as is predicted on the assumed scenario of simultaneous operation of construction machinery, taking into consideration the features of different construction stages, is shown in Table 8.3-3.

Table 8.3-3 Noise Level at Construction Site Boundary in Different Construction Stages Unit: dB(A)

Construction stage	Typical combination of machines under simultaneous operation	Predicted value at construction site	Daytime		Nighttime	
			Standard value	Compliance	Standard value	Compliance

		boundary				
Bill of quantities of relocation	Excavator × 1, grader × 1	78.9	70	+8.9	55	+23.9
Excavation for subgrade	Excavator × 1, loader × 1	78.9	70	+8.9	55	+23.9
Filling for subgrade	Bulldozer × 1, roller × 1	76.9	70	+6.9	55	+21.9
Bridge construction	Pile driver × 1, drill × 1	73.2	70	+3.2	55	+18.2
Road paving	Spreader × 1, roller × 1	77.5	70	+7.5	55	+22.5

The prediction results show that: the noise generated by loaders in the process of demolition & relocation and subgrade excavation has the greatest impact, and the daytime noise level at the construction site boundary is about 8.9dB(A) higher than the daytime noise limit specified in the *Emission Standard of Environment Noise for Boundary of Construction Site* (GB12523-2011), and the nighttime noise level is about 23.9dB(A) higher than the nighttime noise limit; the daytime noise level at the construction site boundary in the process of subgrade filling is about 6.9dB(A) higher than the daytime noise limit specified in the *Emission Standard of Environment Noise for Boundary of Construction Site* (GB12523-2011), and the nighttime noise level is about 21.9dB(A) higher than the nighttime noise limit; the daytime noise level at the construction site boundary in the process of construction of bridge pile foundation is about 3.2dB(A) higher than the daytime noise limit specified in the *Emission Standard of Environment Noise for Boundary of Construction Sit*e (GB12523-2011), and the nighttime noise level is about 18.2dB(A) higher than the nighttime noise limit; the daytime noise level at the construction site boundary in the process of road paving is about 7.5dB(A) higher than the daytime noise limit specified in the *Emission Standard of Environment Noise for Boundary of Construction Site* (GB12523-2011), and the nighttime noise level is about 22.5dB(A) higher than the nighttime noise limit.

8.3.1.4 Analysis of Noise Impact on Sensitive Points during Construction

The acoustic sensitive points of the Project are mainly affected by the construction noise of subgrade sections. The construction stage includes subgrade excavation, subgrade filling and road paving. In view of the combination of construction machines to be used in each construction stage as given in table 8.3-3, the predicted sound level at different types of acoustic environment sensitive points along the Line in different construction stages is shown in Table 8.3-4. The ground on both sides of the construction area of the Project is mostly covered by green belts and farmlands. In order to loosen the surface, the ground effect correction is considered for the construction noise propagation. An attenuation of 5.0dB(A) caused by the shelter from a row of densely-distributed buildings is considered for a row of prediction points near the proposed highway behind those buildings.

Table 8.3-4 Predicted Value of Sound Level at Acoustic Environment Sensitive Points during Construction Unit: dB(A)

Type of sensitive point	Typical distance from the center of construction area (m)	Excavation for subgrade	Filling for subgrade	Road paving	Daytime standard	Nighttime Standard	Daytime Excess	Nighttime Excess
Sensitive point close to highway	40	71.9	69.9	70.5	70	55	+1.9	+16.9
Sensitive point sheltered by a building separating it from a highway	50	65.4	62.4	63.0	60	50	+5.4	+15.4
Sensitive point that has some distance from a highway but is sheltered by nothing	50	69.4	67.4	68.0	70	55	Up to standard	+14.4
	100	60.9	58.9	59.5	60	50	+0.9	+10.9
	150	54.9	52.9	53.5	60	50	Up to standard	+4.9

According to the prediction results, as to the sensitive points close to the highway construction site boundary for which Class 4a standardS are implemented, the daytime noise during construction is 1.9 dB(A) higher than standard, and the nighttime noise is 16.9dB(A) higher than standard. At the sensitive points for which Class 2 standards are implemented, where there is shelter from a row of buildings in front of them, the daytime and nighttime noise is 5.4dB(A) and 15.4dB(A) higher than standard respectively; where there is no shelter from buildings in front of them, the daytime and nighttime noise at a distance of 100m from the center line of the highway is 0.9dB(A) (max.) and 10.9dB(A) (max.) higher than standard respectively; and, the daytime noise at a distance of 150m from the center line of the highway is up to standard, and the nighttime noise is 4.9dB(A) (max.) higher than standard.

Construction is carried out for a certain period. The construction noise impact will end with the completion of construction. In general, the environmental impact of construction noise is acceptable on the premise of construction enclosure and construction prohibition at night.

8.3.1.5 Impact Analysis of Tunnel Construction Noise on Sensitive Points

There are 7 tunnels in Component A, 1 tunnel in Component B and no tunnels in Component C, and blasting operations may be required. According to the relevant data, the sudden instantaneous sound level in the blasting can reach 130dB(A), which can greatly changes the surrounding acoustic environment and frighten the nearby people. The blasting impact range is a radius of 500m from the blasting hole. The investigation finds that there are 3 sensitive targets (Bulitun, Longruntun, Rentun and Longhong) within a 500m radius of the tunnel. The Project may bring a great instantaneous impact to them, but the impact is temporary. The adverse impact will disappear when the blasting operation is completed.

8.3.1.6 Analysis on Impact of Blasting Vibration in Tunnel

When blasting operation is made in tunnel, the explosive energy is mainly consumed in the rock, which can lead to the ground vibration. This kind of ground vibration spreads from the blasting center to the surrounding area, and when its intensity is large enough, it will destroy the ground buildings. The prediction method of blasting vibration, various impacts caused by blasting vibration and prevention measures are analyzed below.

(1) Safe distance of vibration

In China, it is recommended that the impact degree of blasting vibration on buildings is calculated as per the following formula (Wang Weide, Prediction of Vibration Impact of Metro Blasting Construction on Buildings [j]. Railway Occupational Safety Health & Environmental Protection, 1998, 25 (3); 1551-153):

$$R = \left(\frac{K}{V}\right)^{1/\alpha} Q^{1/3}$$

Where, R is the blasting safety distance (m);

Q is the charge for one blasting, calculated at the maximum charge of 210 kg;

V is the vibration velocity (cm/s);

K and α are the coefficients related to blasting point and bedrock characteristics, as shown in Table 8.3-5.

Table 8.3-5 K and α of Lithologic Character in Blasting Area

Lithology	K	α
Hard rock layer	50~150	1.3~1.5
Medium hardness rock	150~250	1.5~1.8
Soft Rock	250~350	1.8~2.0

According to the *Safety Regulations for Blasting* (GB6772-2014), different allowable safety vibration velocity standards are proposed for various types of buildings (structures), as shown in Table 8.3-6.

Table 8.3-6 Allowable Standards for Safety of Various Buildings (Structures)

S/N	Category of protected object	Allowable Safety Vibration Velocity (cm/s)		
		f≤10Hz	10Hz＜f≤50Hz	f＞50Hz
1	Loess cave, adobe building and stone house	0.15~0.45	0.45~0.9	0.9~1.5
2	Civil building	1.5~2.0	2.0~2.5	2.5~3.0
3	Industrial and commercial buildings	2.5~3.5	3.5~4.5	4.2~5.0
4	Ancient building and historic site	0.1~0.2	0.2~0.3	0.3~0.5

The blasting vibration propagation distance is also different under different rock conditions. The lithology of the mountain where Longdong Tunnel and Shuolong Tunnel are located is hard~medium hard clastic rock, and the values of K and a are 150 and 1.5 respectively. The blasting vibration frequency is 20~100Hz, and the main frequency is 36Hz. It can be seen from Table 8.1-18 that the allowable safe particle vibration velocity for general civil buildings is 2.0~2.5, while that for adobe buildings is 0.45~0.9 cm/s at this frequency. By bringing this coefficient into the formula, the safety distance of blasting vibration for general civil buildings is 91~106m, and that for adobe buildings is 180~286m.

According to the investigation, there are 3 sensitive points (Longruntun, Rentun and Longhongtun) within 500m around the tunnel, and the nearest sensitive point to the tunnel is Longhong (about 50m to the right of the exit of Longhong Tunnel), and the blasting vibration of Longhong Tunnel in Component B has certain impact on Longhongtun. The blasting vibration of Longdong Tunnel and Shuolong Tunnel in Component A has little impact on general civil buildings, and the distance between roughcast houses and tunnels is within the safe distance range.

(2) Prediction of vibration intensity at nearby sensitive points

Predication mode of vibration intensity:

$$V = K\left(\frac{Q^m}{R}\right)^\alpha$$

Where: V is the particle vibration velocity (cm/s);

Q is the maximum single-segment charge, calculated at the maximum charge of 210 kg;

R is the distance (m) from measuring point (or protected point) to blasting;

m is the charge indicator, taking 1/3;

K is the parameter related to geological condition and other factors, see Table 8.1-17 for values;

α is the attenuation index related to rock property, see Table 8.1-17 for values.

According to the investigation, there are three sensitive points distributed within 500m of Longdong Tunnel and Shuolong Tunnel of the Project. The prediction of vibration intensity of tunnel blasting on surrounding sensitive points is shown in the following table.

Table 8.3-7 Prediction of Vibration Intensity of Tunnel Blasting on Sensitive Points

Description of Sensitive Points	**Longruntun**	**Rentun**	**Longhongtun**
Distance from the tunnel (m)	290m (LHS of Longdong Tunnel)	100 (RHS of Shuolong Tunnel)	50 (Longhong Tunnel)
Vibration velocity (cm/s)	0.44	2.17	4.34

It can be seen from the above table that the vibration velocity of tunnel blasting to sensitive points within 500 m is 0.44~4.34 cm/s. Compared with Table 8.1-18, the vibration velocity at Longruntun is lower than the allowable safe vibration velocity for general civil buildings, and the vibration velocity is within the allowable safe vibration velocity range for roughcast houses. The blasting of Longdong Tunnel has little impact on the safety of nearby sensitive houses in Longruntun. The vibration velocity at sensitive points in Rentun and Longhongtun is higher than the allowable safe vibration velocity for general civil buildings and higher than the allowable safe vibration velocity range for roughcast houses. The blasting of Shuolong Tunnel and Longhong Tunnel has certain impact on nearby sensitive points in Rentun and Longhongtun. It can be seen from the above analysis, the blasting vibration velocity is affected by factors such as one-time charge and geological conditions. When the engineering geological conditions are determined, the charge for blasting directly affects the vibration intensity and the safety distance. Therefore, the Assessment suggests adopting the current mature millisecond blasting technology, reducing the one-time blasting charge, selecting reasonable blasting parameters, millisecond delay intervals and other measures to reduce the vibration impact of blasting.

8.3.2 Prediction and Assessment of Acoustic Environment Impact during Operation

8.3.2.1 Traffic Noise Prediction Calculation Model

The road noise prediction model recommended in the *Technical Guidelines For Noise Impact Assessment* (HJ2.4-2009) is adopted.

1. Calculation of Environmental Noise Level

$$L_{Aeq环} = 10\lg\left[10^{0.1L_{Aeq交}} + 10^{0.1L_{Aeq背}}\right]$$

Wherein: -Environmental noise value of forecast point, dB; $L_{Aeq环}$

$L_{Aeq交}$ -Road traffic noise value of forecast point, dB;

$L_{Aeq背}$ -Background noise value of forecast point, dB;

2. Calculation of road traffic noise level

$$L_{Aeq}(h)i = \left(\overline{L_{OE}}\right)_i + 10\lg\frac{N_i}{TV_i} + 10\lg\left(\frac{7.5}{r}\right) + 10\lg\left(\frac{\psi_1+\psi_2}{\pi}\right) + \Delta L - 16$$

Where: - refers to the hourly equivalent sound level of Type i vehicles, which are usually classified into three types (light-duty, medium-duty and heavy-duty), dB; $L_{Aeq}(h)i$

$\overline{(L_{oE})_i}$ - refers to the average radiation noise level of this type of vehicles at the reference point (at a distance of 7.5m), dB;

N_i - refers to the hourly traffic volume of this type of vehicles, vehicle/h;

T - refers to the time to calculate the equivalent sound level, T=1h;

V_i -Average running speed of vehicles of type i, km/h;

ψ_1, ψ_2 - refers to the angle from the prediction point to both ends of the limited-length road section, radian;

ΔL - refers to the correction attributed to other factors, dB;

$$\Delta L = \Delta L_{坡度} + \Delta L_{路面} + \Delta L_{其他}$$

ΔL **Pavement** - refers to the correction attributed to pavement material of highway, dB;

ΔL **Grade** - refers to the correction of the longitudinal grade of highway, dB;

ΔL **Others** - refers to corrections for air absorption attenuation, ground effect attenuation, attenuation in transmission path, acoustic reflection, etc.;

The equivalent sound level of total traffic volume is expressed as follows:

$$L_{Aeq(T)} = 10\lg\left[10^{0.1L_{Aeq大}} + 10^{0.1L_{Aeq中}} + 10^{0.1L_{Aeq小}}\right]$$

$L_{Aeq(T)}$ - refers to the hourly equivalent sound level of road traffic noise, dB;

(II) Determination of calculation parameters

1. Running speed

This is the reference formula for speed calculation:

$$v_i = k_1 u_i + k_2 + \frac{1}{k_3 u_i + k_4}$$

$$u_i = vol(\eta_i + m_i(1 - \eta_i))$$

Wherein: v_i-The estimated speed of type i vehicle, km/h; when designed speed is lower than 120km/h, then for this type of vehicle, the estimated speed is decreased in proportion;

u_i - refers to the equivalent number of this type of vehicles; η_i - refers to the ratio of this type of vehicles;

vol - refers to the traffic volume of a single lane, vehicle/h; m_i - refers to the weighting coefficient of other two types of vehicles, vehicle/h.

K_1, K_2, K_3 and K_4 are coefficients, as shown in Table 8.3-8.

Vehicles are classified into three types: light-duty, medium-duty and heavy-duty. The classification standard is described in Table 8.3-9. The vehicle type ratio shall be determined from the traffic volume survey results provided in the preliminary design of the Project.

Table 8.3-8 Coefficient of Calculation Formula for Vehicle Speed

Vehicle category	k_1	k_2	k_3	k_4	m_i
Small-sized vehicle	－0.061748	149.65	－0.000023696	－0.02099	1.2102
Medium-sized vehicle	－0.057537	149.38	－0.000016390	－0.01245	0.8044
Large-sized vehicles	－0.051900	149.39	－0.000014202	－0.01254	0.70957

Table 8.3-9 Vehicle Type Classification Standard

Vehicle category	Total mass of vehicle
Small vehicle (s)	<3.5t
Medium vehicle (m)	3.5t~12t
Large vehicle (L)	≥12t

2. Radiation noise level of single vehicle when driving

(1) The average radiation noise level (dB(A)) of Type i vehicle at the reference point (at a distance of 7.5m) is calculated as follows: L_{oi}

Light-duty vehicle: LoEL＝12.6+34.73lgVL

Medium-duty vehicle: LoEM＝8.8+40.48lgVM

Heavy-duty vehicle: LoEH＝22.0+36.32lgVH

Where: L, M and H on the bottom right corner - refer to light-duty, medium-duty and heavy-duty vehicles respectively.

Vi - Average running speed of vehicles of this type, km/h.

(2) Longitudinal grade correction

The longitudinal grade correction (ΔL) of highway can be calculated according to the following formula:

Heavy-duty vehicle: ΔLgrade=98×β dB(A)

Medium-duty vehicle: ΔLgrade=73×β dB(A)

Light-duty vehicle: ΔLgrade=50×β dB(A)

Where: β - refers to the longitudinal grade of highway, %.

(3) Pavement correction

The correction for traffic noise source intensity (△Lpavement) attributed to highway pavement takes the value given in Table 8.3-10.

Table 8.3-10 Correction △Lpavement for Conventional Pavement

Pavement type	Corrected value of different running speeds km/h		
	30	40	≥50
Asphalt concrete	0	0	0
rainwater inlet cement concrete	1.0	1.5	2.0

The proposed main line and connecting line both have asphalt concrete pavement, so △Lpavement takes the value of 0.

3. Calculation of attenuation attributed to distance (△Ldistance)

$$\Delta L_{距离} = 10\lg\frac{r_0}{r}$$

r - refers to the distance from the center line of the equivalent lane to the receiving point, m;

$$r = \sqrt{r_1 \cdot r_2}$$

Where: r1 - refers to the distance from the receiving (prediction) point to the driving center line of the near-side lane, m;

r2 - refers to the distance from the receiving (prediction) point to the driving center line of the far-side lane, m.

r_o- refers to the distance from the center line of the equivalent lane to the reference point, ro=7.5m.

4. Calculation of traffic noise correction attributed to limited-length road section

$$\Delta L_{有限路段} = 10\lg\left(\frac{\psi_1 + \psi_2}{\pi}\right)$$

ψ_1,ψ_2 - refers to the angle from the prediction point to both ends of the limited-length road section, radian (See Figure 8.3-1).

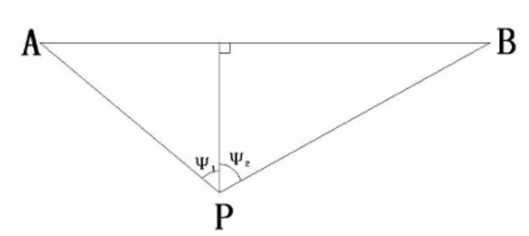


Figure 8.3-1 Function of Correction for Limited-length Road Section (A & B refer to road sections and P refers to prediction point)

5. Calculation of attenuation attributed to sound wave propagation

(1) Attenuation attributed to obstacle

① Calculation of attenuation value of sound barrier (Abar)

Infinite sound barrier can be calculated as the following formula:

$$A_{bar} = \begin{cases} 10\lg\left[\dfrac{3\pi\sqrt{1-t^2}}{4arc\cdot tg\sqrt{\dfrac{(1-t)}{(1+t)}}}\right], t=\dfrac{40f\delta}{3c}\le 1dB \\ 10\lg\left[\dfrac{3\pi\sqrt{t^2-1}}{2\ln(t+\sqrt{t^2-1})}\right], t=\dfrac{40f\delta}{3c}> 1dB \end{cases}$$

F - acoustic frequency, Hz; δ - acoustic path difference, m; c - sound velocity, m/s.

During the assessment of road construction project, attenuation value of sound barrier calculated by means of sound wave frequency of 500Hz can be employed as approximate attenuation value of acoustic level A.

Calculation of limited sound barrier:

Abar is still calculated by the above formula.

Then, it is corrected as indicated in Figure 8.3-2. The corrected A_{bar} depends on the shielding angle β/θ.

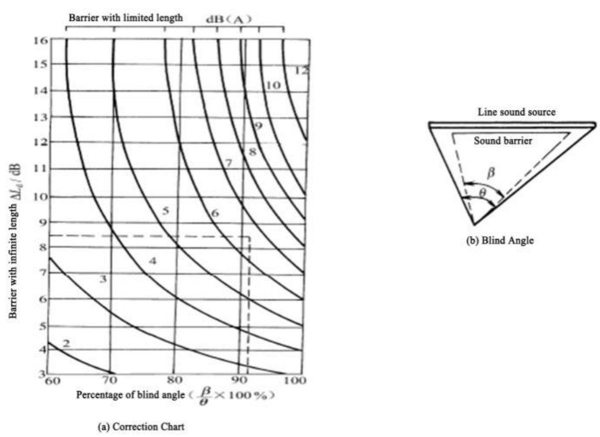


Figure 8.3-2 Correction Figure for Limited Sound Barrier and Line Sound Source

Transmission and reflection correction volume of sound barrier can be calculated by reference to HJ/T90.

② Calculation of attenuation value in sound shadow regions at both sides of high embankment or low cutting

The attenuation value (Abar) in sound shadow regions at both sides of high embankment or low cutting is the additional attenuation value caused by forecast point in sound shadow regions at both sides of high embankment or low cutting.

When the prediction point is in the sound immission zone, Abar is equal to 0. When the prediction point is in the sound shadow zone, Abar depends on the sound path difference δ.

Calculate δ as per Figure 8.3-3, δ=a+b-c. Then, check the table for Abar.

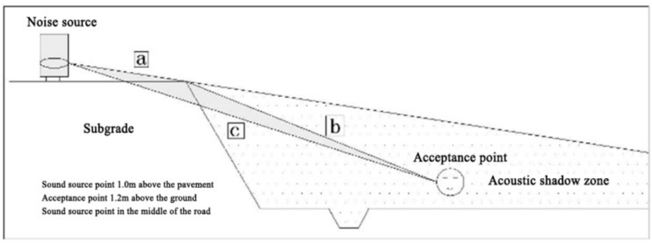


Figure 8.3-3 Schematic Diagram of Calculation of Sound Path Difference δ

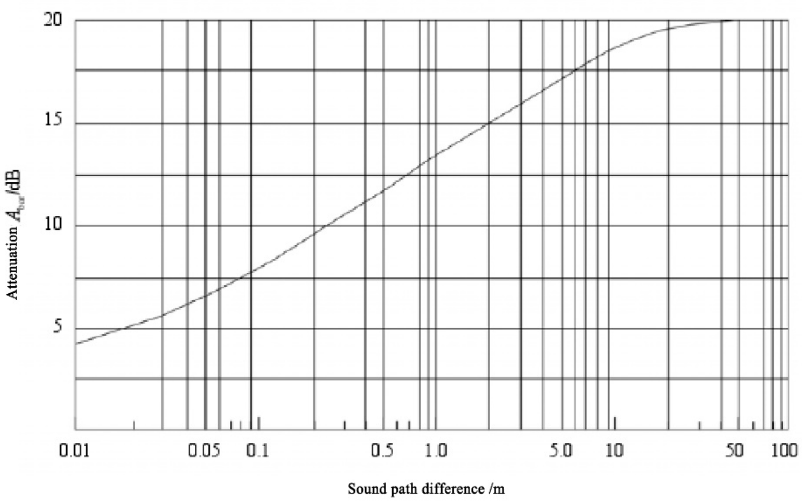


Figure 8.3-4 Relation Curve of Noise Attenuation Abar and Sound Path Difference δ (f=500HZ)

③ Estimated value of additional attenuation value of rural houses

The attenuation value of rural houses can be calculated by reference to Appendix A of GB/T17247.2. In sound shadow zone of first row of houses along the highway can be approximately calculated as per Figure 8.3-5 and Table 8.3-11.

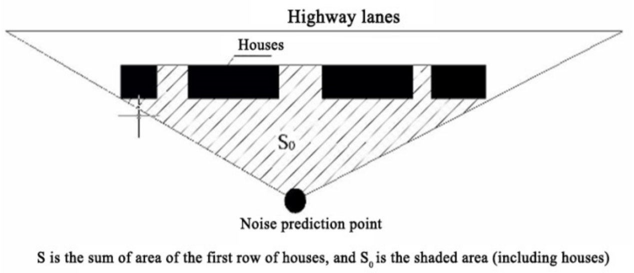


Figure 8.3-5 Schematic Diagram for Noise Reduction Value Estimation of Rural Houses

Table 8.3-11 Estimated Value of Additional Attenuation Volume of Noise from Rural Houses

S/S_0	A_{bar}
40%~60%	3 dB(A)
70%~90%	5 dB(A)
Every row of houses added later	1.5, maximum attenuation ≤ 10dB(A)

(2) Attenuations Aatm, Agr & Amisc

① Attenuation attributed to air absorption (Aatm)

The attenuation attributed to air absorption is calculated by the following formula:

$$A_{atm} = \frac{a(r - r_0)}{1000}$$

Where: A is a function of temperature, humidity and acoustic frequency.

② Ground effect attenuation (Agr)

The ground can be divided into several types:

a) Solid ground, including pavement, water surface, ice surface and compacted ground.

b) Loose ground, including the ground covered by grass or other plants and the ground suitable for plant growth, such as farmland.

c) Mixed ground, composed of solid ground and loose ground.

When the sound wave propagates over the loose ground or the mixed ground dominated by loose ground, the octave band attenuation attributed to the ground effect can be calculated by the following formula on the premise that only sound level A is calculated at the prediction point.

$$A_{gr} = 4.8 - (\frac{2h_m}{r})[17 + \frac{300}{r}]$$

Where: r refers to the distance from sound source to prediction point, m;

hm (hm= F/r, where F is area expressed by m2, and R is expressed by m) refers to the height of the propagation path above the ground, m.

If the calculated Agr is a negative value, it can be replaced by "0". In other cases, it can be calculated as per GB/T17247.2.

6. Selection of noise background value

The Project is a new highway. At the measuring points for background noise monitoring, the highest value of two-day monitoring results is directly used as the background noise value. At the prediction points without environmental background noise monitoring, the available environmental background noise monitoring results obtained from the place which is at a close distance and has similar features are approximately

used as the environmental background value.

8.3.2.2 Prediction and Analysis of Traffic Noise Impact

(1) Prediction results of highway traffic noise contribution value

On the basis of the predicted traffic volume of the Project, the attenuation of traffic noise contribution value of the main line and connecting line of the proposed highway with the distance is predicted. The prediction results are shown in Table 8.3-12 and Table 8.3-14.

Table 8.3-12 Traffic Noise Contribution Value of Main Line of the Project

Distance from highway centerline (m)	Year 2025		2031		2039	
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime
20	64.4	61.4	67.5	64.4	70.4	67.4
30	60.5	57.5	63.6	60.5	66.5	63.5
40	58.5	55.5	61.6	58.5	64.5	61.4
50	57.1	54.1	60.2	57.1	63.1	60.1
60	56.1	53.1	59.2	56.1	62.1	59.0
70	55.3	52.2	58.4	55.2	61.2	58.2
80	54.6	51.5	57.7	54.5	60.5	57.5
90	53.9	50.9	57.0	53.9	59.9	56.9
100	53.4	50.4	56.5	53.4	59.3	56.3
110	52.9	49.9	56.0	52.9	58.8	55.8
120	52.4	49.4	55.5	52.4	58.4	55.4
130	52.0	49.0	55.1	52.0	58.0	55.0
140	51.6	48.6	54.7	51.6	57.6	54.6

Distance from highway centerline (m)	Year 2025		2031		2039	
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime
150	51.3	48.2	54.4	51.2	57.2	54.2
160	50.9	47.9	54.0	50.9	56.9	53.9
170	50.6	47.6	53.7	50.6	56.6	53.5
180	50.3	47.3	53.4	50.3	56.3	53.2
190	50.0	47.0	53.1	50.0	56.0	53.0
200	49.7	46.7	52.8	49.7	55.7	52.7
220	49.2	46.2	52.3	49.2	55.2	52.2
240	48.7	45.7	51.8	48.7	54.7	51.7
260	48.3	45.3	51.4	48.3	54.2	51.2
280	47.9	44.9	51.0	47.9	53.8	50.8
300	47.5	44.5	50.6	47.5	53.4	50.4

Table 8.3-13 Traffic Noise Contribution Value of Shuolong Connecting Line (AK0+000~AK2+800)

Distance from highway centerline (m)	Year 2025		2031		2039	
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime
20	59.8	56.7	63.7	60.6	66.7	63.6
30	56.0	52.8	59.8	56.8	65.8	59.8
40	54.0	50.8	57.8	54.8	60.8	57.8
50	52.6	49.4	56.5	53.4	59.5	56.4
60	51.6	48.4	55.4	52.4	58.4	55.4
70	50.8	47.6	54.6	51.5	57.6	54.6
80	50.0	46.9	53.9	50.8	56.9	53.8
90	49.4	46.2	53.3	50.2	56.3	53.2
100	48.9	45.7	52.7	49.6	55.7	52.7
110	48.4	45.2	52.2	49.1	55.2	52.2
120	47.9	44.8	51.8	48.7	54.8	51.7
130	47.5	44.3	51.3	48.3	54.4	51.3
140	47.1	43.9	51.0	47.9	54.0	50.9
150	46.8	43.6	50.6	47.5	53.6	50.6
160	46.4	43.2	50.2	47.2	53.3	50.2
170	46.1	42.9	49.9	46.9	52.9	49.9
180	45.8	42.6	49.6	46.6	52.6	49.6

Distance from highway centerline (m)	Year 2025		2031		2039	
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime
190	45.5	42.3	49.3	46.3	52.4	49.3
200	45.2	42.1	49.1	46.0	52.1	49.0
210	45.0	41.8	48.8	45.7	51.8	48.8
220	44.7	41.5	48.6	45.5	51.6	48.5
230	44.5	41.3	48.3	45.2	51.3	48.3
240	44.2	41.1	48.1	45.0	51.1	48.0
250	44.0	40.8	47.8	44.8	50.8	47.8

Table 8.3-14 Traffic Noise Contribution Value of Shuolong Connecting Line (AK2+800~AK5+410)

Distance from highway centerline (m)	Year 2025		2031		2039	
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime
20	59.4	56.4	63.2	60.2	66.3	63.2
30	55.5	52.5	59.4	56.4	62.4	59.3
40	53.5	50.5	57.3	54.4	60.4	57.3
50	52.2	49.2	56.0	53.0	59.0	56.0
60	51.1	48.1	55.0	52.0	58.0	54.9
70	50.3	47.3	54.1	51.1	57.2	54.1
80	49.6	46.6	53.4	50.4	56.4	53.4
90	49.0	46.0	52.8	49.8	55.8	52.8
100	48.4	45.4	52.2	49.2	55.3	52.2
110	47.9	44.9	51.7	48.8	54.8	51.7
120	47.5	44.4	51.3	48.3	54.3	51.3
130	47.0	44.0	50.9	47.9	53.9	50.8
140	46.7	43.6	50.5	47.5	53.5	50.5
150	46.3	43.3	50.1	47.1	53.2	50.1
160	46.0	42.9	49.8	46.8	52.8	49.8
170	45.6	42.6	49.5	46.5	52.5	49.4
180	45.3	42.3	49.2	46.2	52.2	49.1
190	45.0	42.0	48.9	45.9	51.9	48.8
200	44.8	41.8	48.6	45.6	51.6	48.6
210	59.4	56.4	63.2	60.2	51.4	48.3
220	55.5	52.5	59.4	56.4	51.1	48.0

Distance from highway centerline (m)	Year 2025		2031		2039	
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime
230	53.5	50.5	57.3	54.4	50.9	47.8
240	52.2	49.2	56.0	53.0	50.6	47.6
250	51.1	48.1	55.0	52.0	50.4	47.4

(2) Determination of traffic noise protection distance

According to the predicted traffic noise contribution values in Table 8.3-12 to Table 8.3-14, the minimum distance for the traffic noise of the main line and connecting line in the Project to meet the standards of Class 4a and Class 2 in the *Environmental Quality Standard for Noise* is estimated as shown in Table 8.3-15.

Table 8.3-15 Distance for Traffic Noise of the Project to Reach the Standard

Item	Road Section	Forecast Period	Period	Standard Category	Standard value dB(A)	Distance from highway centerline (m)	Standard Category	Standard value dB(A)	Distance from highway centerline (m)
Wuzhou (Longyanzui)-Shuolong Expressway (Chongzuo–Jingxi Expressway to Shuolong Port Section)	Main line	Year 2025	Daytime	Class 4a	70	/	Class II	60	33
			Nighttime		55	38		50	108
		2031	Daytime		70	/		60	49
			Nighttime		55	73		50	190
		2039	Daytime		70	19		60	88
			Nighttime		55	130		50	340
	Shuolong Connecting Line AK0+000~AK2+500	Year 2025	Daytime	Class 4a	70	/	Class II	60	/
			Nighttime		55	24		50	46
		2031	Daytime		70	/		60	29
			Nighttime		55	39		50	93

Item	**Road Section**	**Forecast Period**	**Period**	**Standard Category**	**Standard value dB(A)**	**Distance from highway centerline (m)**	**Standard Category**	**Standard value dB(A)**	**Distance from highway centerline (m)**
		2039	Daytime		70	/		60	46
			Nighttime		55	58		50	167
	Shuolong Connecting Line AK2+500~AK5+410	Year 2025	Daytime	Class 4a	70	/	Class II	60	/
			Nighttime		55	24		50	38
		2031	Daytime		70	/		60	28
			Nighttime		55	37		50	87
		2039	Daytime		70	/		60	44
			Nighttime		55	59		50	153

Note: “ - "means “within the boundary”.

(3) Analysis of traffic noise prediction results

① Mainline

According to the prediction results, the distance for the proposed main line to reach the standard in the long-term operation is as follows:

The distance for the traffic noise contribution value to reach Class 4a standard in the *Environmental Quality Standard for Noise* is 19m from both sides of the highway centerline in the daytime, and 130m from both sides of the highway centerline in the nighttime. The distance for the traffic noise contribution value to reach Class 2 standard is 88m from both sides of the highway centerline in the daytime, and 340m from both sides of the highway centerline in the nighttime.

② Connecting line

According to the prediction results, the distance for Shuolong Connecting Line to reach the standard in the long-term operation is as follows:

The distance for the traffic noise contribution value of AK0+000~AK2+500 to reach Class 4a standard in the *Environmental Quality Standard for Noise* is 58m from both sides of the highway centerline in the nighttime, and the traffic noise contribution value of this section is up to standard in the daytime. The distance for the traffic noise contribution value to reach Class 2 standard is 46m from both sides of the highway centerline in the daytime, and 167m from both sides of the highway centerline in the nighttime.

The distance for the traffic noise contribution value of AK2+500~AK5+410 to reach Class 4a standard in the *Environmental Quality Standard for Noise* is 59m from both sides of the highway centerline in the nighttime, and the traffic noise contribution value of this section is up to standard in the daytime. The distance for the traffic noise contribution value to reach Class 2 standard is 44m from both sides of the highway centerline in the daytime, and 153m from both sides of the highway centerline in the nighttime.

(4) Noise contour of traffic noise prediction results

Please refer to Figure 8.3-1~Figure 8.3-9 for the horizontal and vertical noise contour of traffic noise contribution values predicted at a certain distance from the centerline of the typical sections of the main line and connecting line of the proposed highway in the long term of operation.

(5) Environmental Noise Value Prediction at Sensitive Points

There are 12 acoustic environment sensitive points along the Line, including 2 at schools and 10 at villages. In this assessment, an acoustic environment prediction is made for the 12 acoustic environment sensitive points within the project assessment scope. The prediction results are shown in Table 8.3-16.

Table 8.3-16 List of Prediction Results of Acoustic Environmental Sensitive Points within the Assessment Scope of the Project Recommended Route

S/N	Description of Sensitive Points	Chainage	Distance from highway center line (m)	Height above pavement at sensitive point (m)	Noise impact correction attributed to houses and trees, dB(A)	Correction for sound shadow zone, dB(A)	Background value		Characteristic Year	Traffic noise contribution value, dB(A)		Predicted environmental noise, dB(A)		Evaluation Standard	Excess of predicted environmental noise, dB(A)		Increment compared with current value, dB(A)		Number of households with excessive environmental noise in the medium term	Number of people in households with excessive environmental noise in the medium term
							Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		
1	Bulitun	K4+800	LHS 148	-20	0	-9.8	50.5	46.4	2025	40.6	37.6	50.9	46.9	2	Up to standard	Up to standard	0.4	0.5	/	/
									2031	43.8	40.6	51.3	47.4		Up to standard	Up to standard	0.8	1.0		
									2039	46.6	43.6	52.0	48.2		Up to standard	Up to standard	1.5	1.8		
2	Xuanjie teaching school	K5+100	LHS 89	-20	0	-12.6	46.1	44.2	2025	40.0	37.0	47.1	45.0	2	Up to standard	Up to standard	1.0	0.8	/	/
									2031	43.2	40.0	47.9	45.6		Up to	Up to	1.8	1.4		

S/N	Description of Sensitive Points	Chainage	Distance from highway center line (m)	Height above pavement at sensitive point (m)	Noise impact correction attributed to houses and trees, dB(A)	Correction for sound shadow zone, dB(A)	Background value		Characteristic Year	Traffic noise contribution value, dB(A)		Predicted environmental noise, dB(A)		Evaluation Standard	Excess of predicted environmental noise, dB(A)		Increment compared with current value, dB(A)		Number of households with excessive environmental noise in the medium term	Number of people in households with excessive environmental noise in the medium term
							Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		
															standard	standard				
									2039	46.0	43.0	49.1	46.7		Up to standard	Up to standard	3.0	2.5		
3	Buguo Row 1 Floor 1	K5+400	LHS 17.5	-15	0	-19.6	50.5	46.4	2025	39.2	36.1	50.8	46.8	4a	Up to standard	Up to standard	0.3	0.4	/	/
									2031	42.3	39.1	51.1	47.1		Up to standard	Up to standard	0.6	0.7		
									2039	45.1	42.1	51.6	47.8		Up to standard	Up to standard	1.1	1.4		
	Buguo			-9	0	-19.5			2025	42.3	39.3	51.1	47.2		Up to	Up to	0.6	0.8		

S/N	Description of Sensitive Points	Chainage	Distance from highway center line (m)	Height above pavement at sensitive point (m)	Noise impact correction attributed to houses and trees, dB(A)	Correction for sound shadow zone, dB(A)	Background value		Characteristic Year	Traffic noise contribution value, dB(A)		Predicted environmental noise, dB(A)		Evaluation Standard	Excess of predicted environmental noise, dB(A)		Increment compared with current value, dB(A)		Number of households with excessive environmental noise in the medium term	Number of people in households with excessive environmental noise in the medium term
							Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		
	Row 1 Floor 3														standard	standard				
									2031	45.4	42.1	51.7	47.8		Up to standard	Up to standard	1.2	1.4		
									2039	48.3	45.3	52.5	48.9		Up to standard	Up to standard	2.0	2.5		
	Buguo Row 2		LHS 41.5	-15	-3	-13.6	50.5	46.4	2025	39.7	36.7	50.8	46.8	2	Up to standard	Up to standard	0.3	0.4	/	/
									2031	42.8	39.7	51.2	47.2		Up to standard	Up to standard	0.7	0.8		
									2039	45.7	42.7	51.7	47.9		Up to	Up to	1.2	1.5		

S/N	Description of Sensitive Points	Chainage	Distance from highway center line (m)	Height above pavement at sensitive point (m)	Noise impact correction attributed to houses and trees, dB(A)	Correction for sound shadow zone, dB(A)	Background value		Characteristic Year	Traffic noise contribution value, dB(A)		Predicted environmental noise, dB(A)		Evaluation Standard	Excess of predicted environmental noise, dB(A)		Increment compared with current value, dB(A)		Number of households with excessive environmental noise in the medium term	Number of people in households with excessive environmental noise in the medium term
							Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		
															standard	standard				
4	Datun	K5+300	LHS 147	-13	0	-7.7	50.5	46.4	2025	42.8	39.8	51.2	47.3	2	Up to standard	Up to standard	0.7	0.9	/	/
									2031	45.9	42.8	51.8	48.0		Up to standard	Up to standard	1.3	1.6		
									2039	48.8	45.7	52.7	49.1		Up to standard	Up to standard	2.2	2.7		
5	Dunli	K5+800	RHS 180	-10	0	-6.1	50.5	46.4	2025	44.2	41.2	51.4	47.5	2	Up to standard	Up to standard	0.9	1.1	/	/
									2031	47.3	44.2	52.2	48.4		Up to	Up to	1.7	2.0		

S/N	Description of Sensitive Points	Chainage	Distance from highway center line (m)	Height above pavement at sensitive point (m)	Noise impact correction attributed to houses and trees, dB(A)	Correction for sound shadow zone, dB(A)	Background value		Characteristic Year	Traffic noise contribution value, dB(A)		Predicted environmental noise, dB(A)		Evaluation Standard	Excess of predicted environmental noise, dB(A)		Increment compared with current value, dB(A)		Number of households with excessive environmental noise in the medium term	Number of people in households with excessive environmental noise in the medium term
							Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		
															standard	standard				
									2039	50.1	47.1	53.3	49.8		Up to standard	Up to standard	2.8	3.4		
6	Yixian Village Primary School	K11+850	LHS 60	-12	0	-9.6	48.5	40.0	2025	46.4	43.4	50.6	45.0	2	Up to standard	Up to standard	2.1	5.0	/	/
									2031	49.5	46.4	52.0	47.3		Up to standard	Up to standard	3.5	7.3		
									2039	52.4	49.3	53.9	49.8		Up to standard	Up to standard	5.4	9.8		
7	Guitun	K11+950	LHS	-13.5	0	-8.2	49.2	44.3	2025	45.6	42.5	50.8	46.5	2	Up to	Up to	1.6	2.2	/	/

S/N	Description of Sensitive Points	Chainage	Distance from highway center line (m)	Height above pavement at sensitive point (m)	Noise impact correction attributed to houses and trees, dB(A)	Correction for sound shadow zone, dB(A)	Background value		Characteristic Year	Traffic noise contribution value, dB(A)		Predicted environmental noise, dB(A)		Evaluation Standard	Excess of predicted environmental noise, dB(A)		Increment compared with current value, dB(A)		Number of households with excessive environmental noise in the medium term	Number of people in households with excessive environmental noise in the medium term
							Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		
			92												standard	standard				
									2031	48.7	45.5	52.0	48.0		Up to standard	Up to standard	2.8	3.7		
									2039	51.5	48.5	53.5	49.9		Up to standard	Up to standard	4.3	5.6		
8	Bangtun Row 1 Floor 1	K12+280	RHS 26	-7	0	-10.9	47.0	42.5	2025	50.5	47.5	52.1	48.7	4a	Up to standard	Up to standard	5.1	6.2	6	30
									2031	53.7	50.5	54.5	51.1		Up to standard	Up to standard	7.5	8.6		
									2039	56.5	53.5	57.0	53.8		Up to	Up to	10.0	11.3		

S/N	Description of Sensitive Points	Chainage	Distance from highway center line (m)	Height above pavement at sensitive point (m)	Noise impact correction attributed to houses and trees, dB(A)	Correction for sound shadow zone, dB(A)	Background value		Characteristic Year	Traffic noise contribution value, dB(A)		Predicted environmental noise, dB(A)		Evaluation Standard	Excess of predicted environmental noise, dB(A)		Increment compared with current value, dB(A)		Number of households with excessive environmental noise in the medium term	Number of people in households with excessive environmental noise in the medium term
							Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		
															standard	standard				
	Bangtun Row 1 Floor 3			-1	0	0			2025	61.8	58.8	61.9	58.9		Up to standard	+3.8	14.9	16.4		
									2031	64.9	61.8	65.0	61.9		Up to standard	+6.9	18.0	19.4		
									2039	67.7	64.7	67.7	64.7		Up to standard	+9.7	20.7	22.2		
	Bangtun Row 2		RHS 58	-7	-3	-7.7			2025	45.6	42.5	49.4	45.5	2	Up to standard	Up to standard	2.4	3.0	/	/
									2031	48.7	45.5	50.9	47.3		Up to	Up to	3.9	4.8		

S/N	Description of Sensitive Points	Chainage	Distance from highway center line (m)	Height above pavement at sensitive point (m)	Noise impact correction attributed to houses and trees, dB(A)	Correction for sound shadow zone, dB(A)	Background value		Characteristic Year	Traffic noise contribution value, dB(A)		Predicted environmental noise, dB(A)		Evaluation Standard	Excess of predicted environmental noise, dB(A)		Increment compared with current value, dB(A)		Number of households with excessive environmental noise in the medium term	Number of people in households with excessive environmental noise in the medium term
							Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		
															standard	standard				
									2039	51.5	48.5	52.8	49.5		Up to standard	Up to standard	5.8	7.0		
9	Sanjiadiantun	AK1+700	RHS 95	-3	0	0	49.2	44.3	2025	49.1	46.0	52.2	48.2	2	Up to standard	Up to standard	3.0	3.9	3	15
									2031	53.0	49.9	54.5	51.0		Up to standard	+1.0	5.3	6.7		
									2039	56.0	52.9	56.8	53.5		Up to standard	+3.5	7.6	9.2		
10	Waitun	AK2+900	RHS	-2	0	0	49.2	44.3	2025	48.7	44.1	51.3	47.4	2	Up to	Up to	2.1	3.1	10	40

S/N	Description of Sensitive Points	Chainage	Distance from highway center line (m)	Height above pavement at sensitive point (m)	Noise impact correction attributed to houses and trees, dB(A)	Correction for sound shadow zone, dB(A)	Background value		Characteristic Year	Traffic noise contribution value, dB(A)		Predicted environmental noise, dB(A)		Evaluation Standard	Excess of predicted environmental noise, dB(A)		Increment compared with current value, dB(A)		Number of households with excessive environmental noise in the medium term	Number of people in households with excessive environmental noise in the medium term
							Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		
			129m												standard	standard				
									2031	50.9	47.9	53.1	49.6		Up to standard	Up to standard	3.9	5.3		
									2039	54.0	50.9	55.2	51.8		Up to standard	+1.8	6.0	7.5		
11	Rentun Row 1 Floor 1	AK5+060	42m on the right	0	0	0	49.2	44.7	2025	62.0	59.0	62.2	59.2	4a	Up to standard	+4.2	13.0	14.5	3	15
									2031	65.9	62.9	66.0	62.9		Up to standard	+7.9	16.8	18.2		
									2039	68.9	65.8	69.0	65.9		Up to	+10.9	19.8	21.2		

S/N	Description of Sensitive Points	Chainage	Distance from highway centerline (m)	Height above pavement at sensitive point (m)	Noise impact correction attributed to houses and trees, dB(A)	Correction for sound shadow zone, dB(A)	Background value		Characteristic Year	Traffic noise contribution value, dB(A)		Predicted environmental noise, dB(A)		Evaluation Standard	Excess of predicted environmental noise, dB(A)		Increment compared with current value, dB(A)		Number of households with excessive environmental noise in the medium term	Number of people in households with excessive environmental noise in the medium term
							Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		
															standard					
	Rentun Row 1 Floor 3			6	0	0			2025	61.5	58.5	61.7	58.6		Up to standard	+3.6	12.5	13.9	/	/
									2031	65.3	62.3	65.4	62.4		Up to standard	+7.4	16.2	17.7		
									2039	68.4	65.3	68.4	65.3		Up to standard	+10.3	19.2	20.6		
	Rentun Row 2		RHS 66	0	-3	0	49.2	44.7	2025	49.4	46.4	52.3	48.6	2	Up to standard	Up to standard	3.1	3.9	27	137
									2031	53.2	50.2	54.7	51.3		Up to	+1.3	5.5	6.6		

S/N	Description of Sensitive Points	Chainage	Distance from highway center line (m)	Height above pavement at sensitive point (m)	Noise impact correction attributed to houses and trees, dB(A)	Correction for sound shadow zone, dB(A)	Background value		Characteristic Year	Traffic noise contribution value, dB(A)		Predicted environmental noise, dB(A)		Evaluation Standard	Excess of predicted environmental noise, dB(A)		Increment compared with current value, dB(A)		Number of households with excessive environmental noise in the medium term	Number of people in households with excessive environmental noise in the medium term
							Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		
															standard					
									2039	56.3	53.2	57.1	53.8		Up to standard	+3.8	7.9	9.1		
12	Longmei	AK2+950~AK3+150	RHS 179	0	0	0	49.2	44.3	2025	45.4	42.3	50.7	46.4	2	Up to standard	Up to standard	1.5	2.1	/	/
									2031	49.2	46.2	52.2	48.4		Up to standard	Up to standard	3.0	4.1		
									2039	52.2	49.2	54.0	50.4		Up to standard	Up to standard	4.8	6.1		

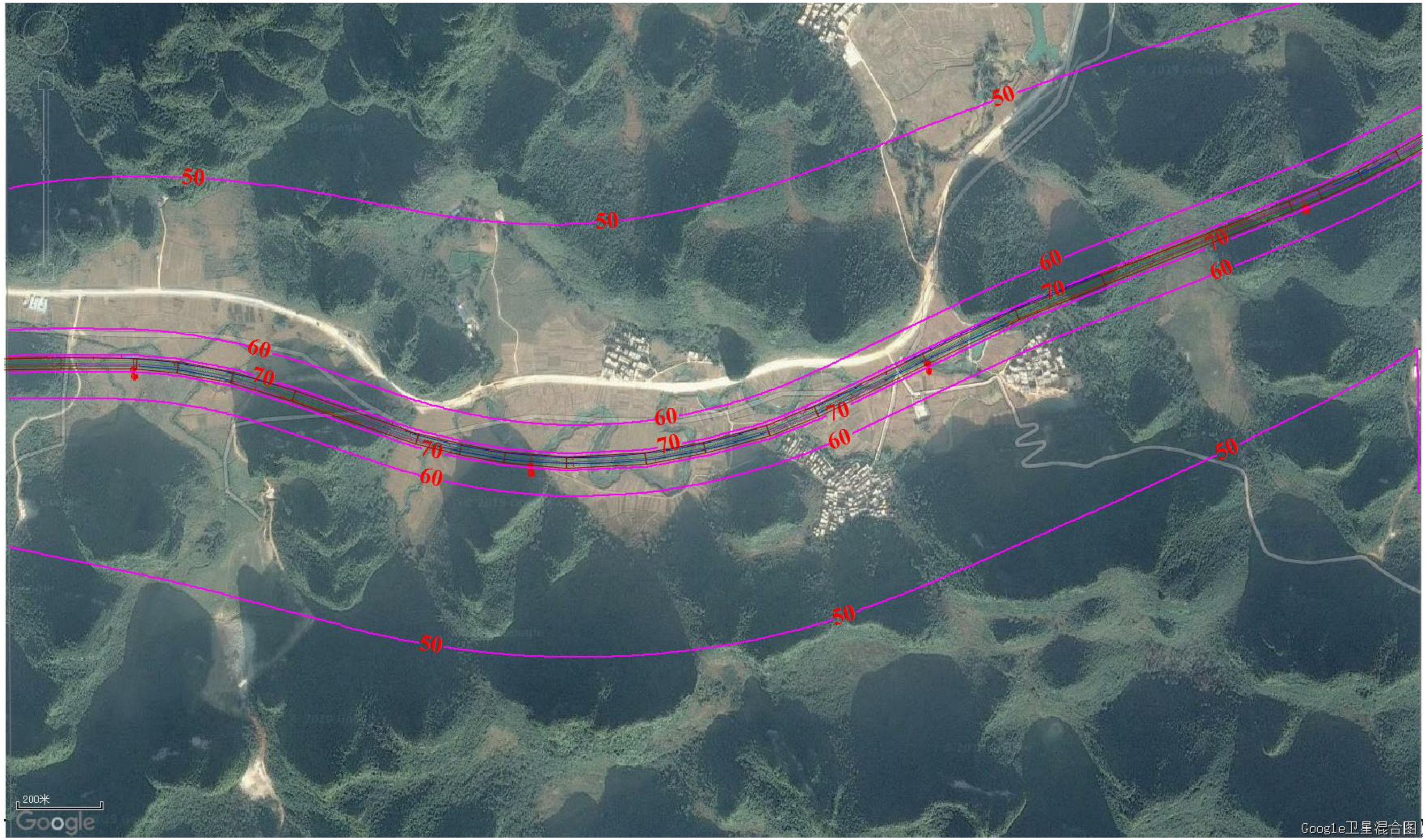


Figure 8.3-6 Daytime Noise Contour of Main Line in the Long Term of Operation

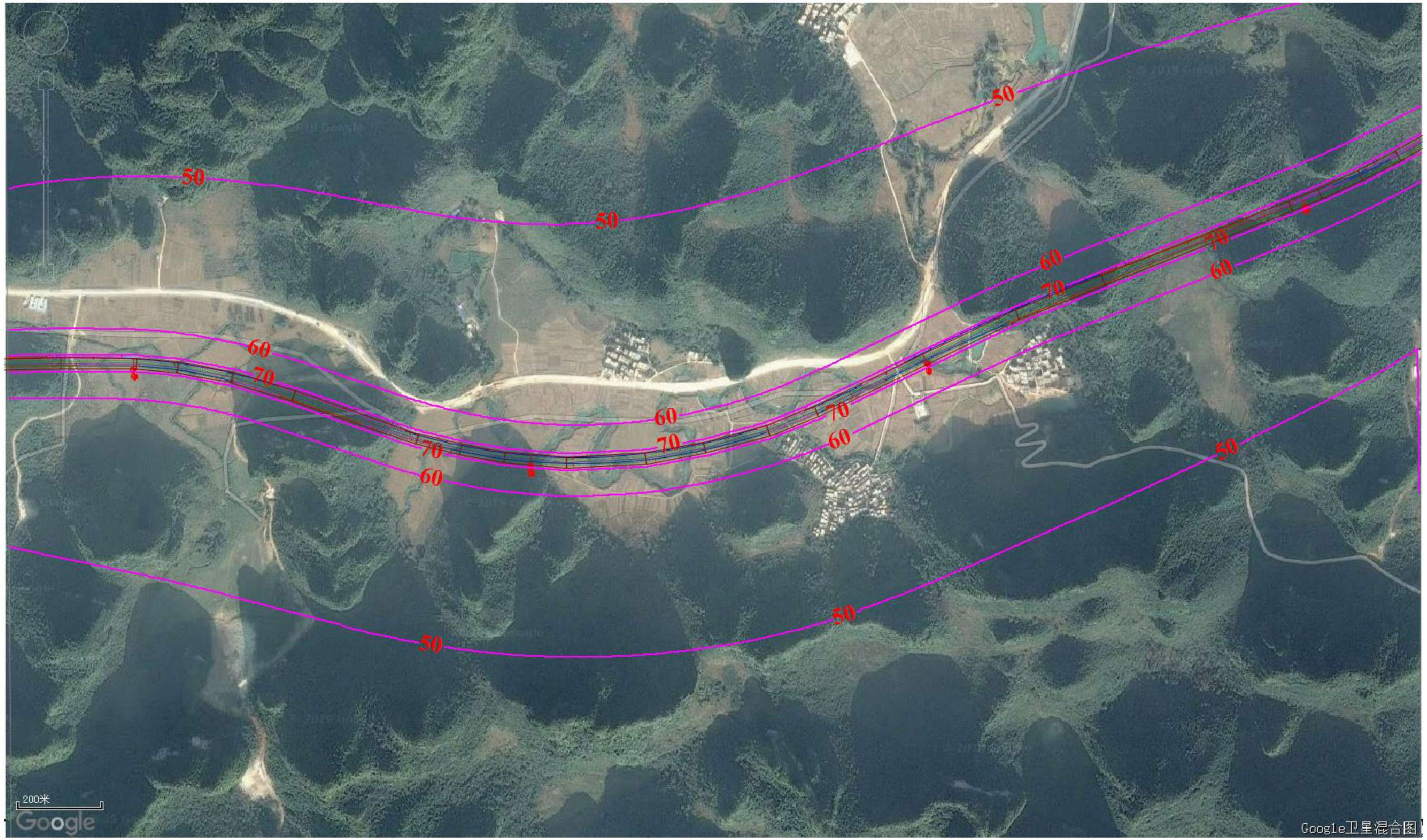


Figure 8.3-7 Nighttime Noise Contour of Main Line in the Long Term of Operation

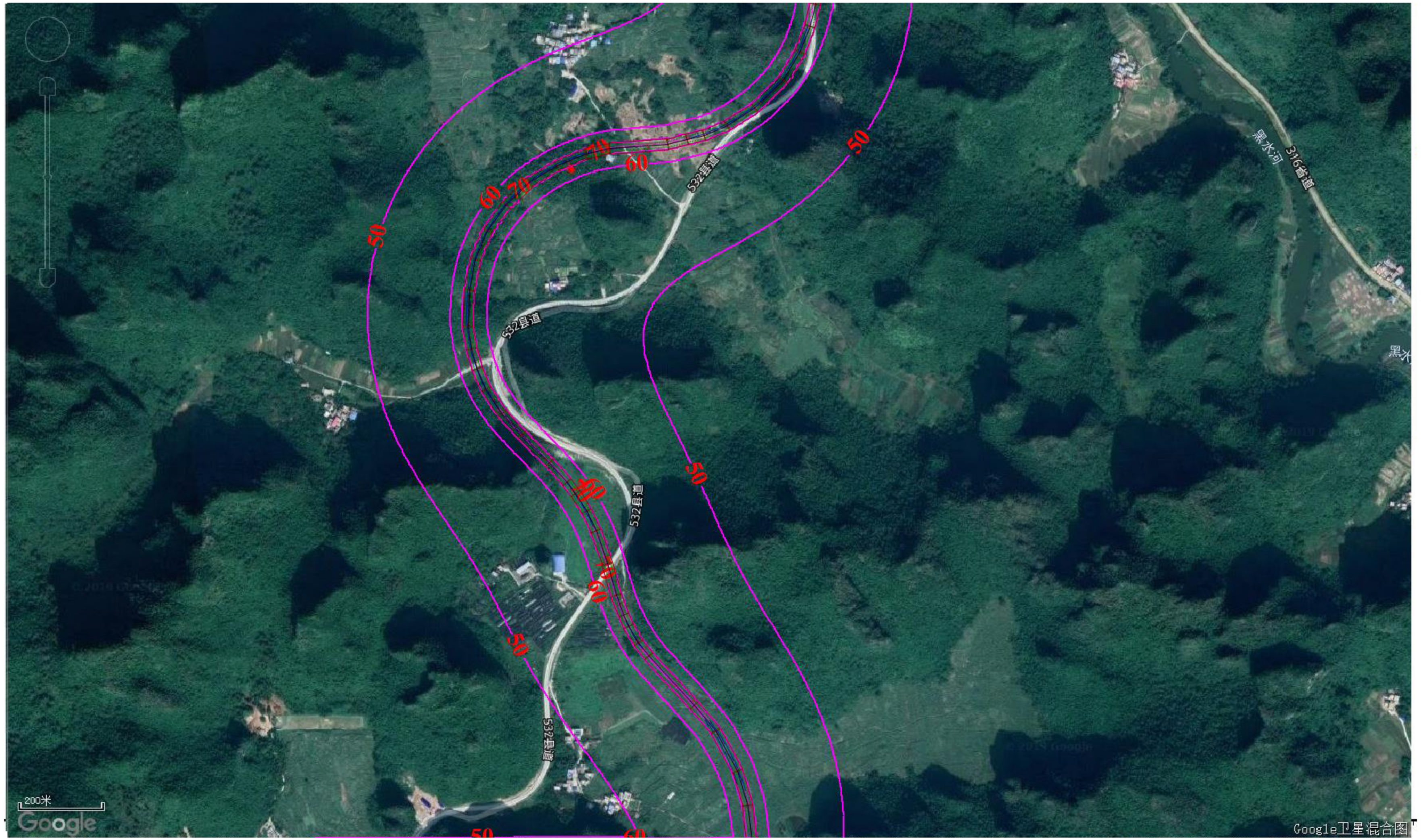


Figure 8.3-8 Daytime Noise Contour of Branch Line (AK0+000~AK2+500) in the Long Term of Operation

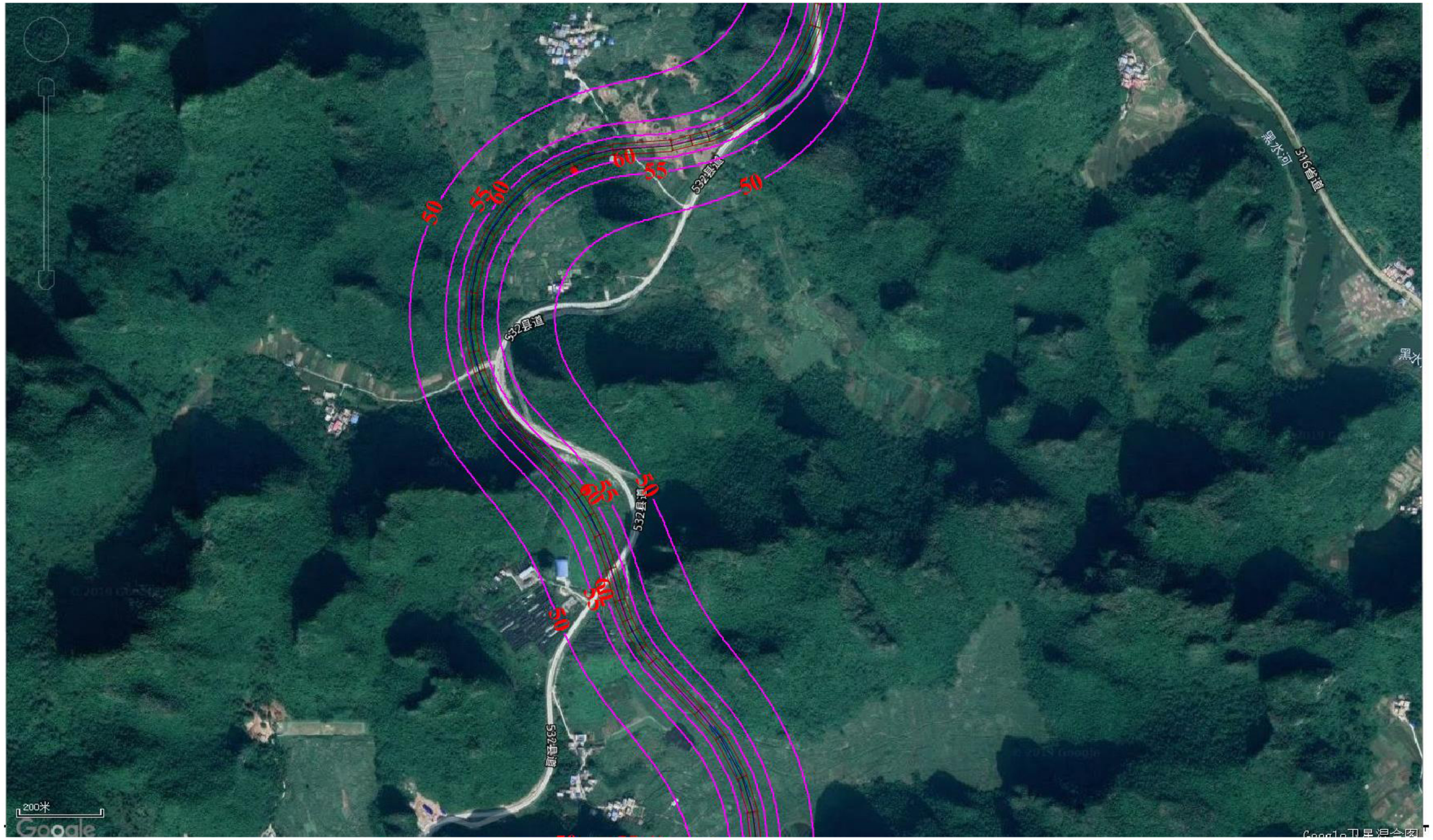


Figure 8.3-9 Nighttime Noise Contour of Branch Line (AK0+000~AK2+500) in the Long Term of Operation

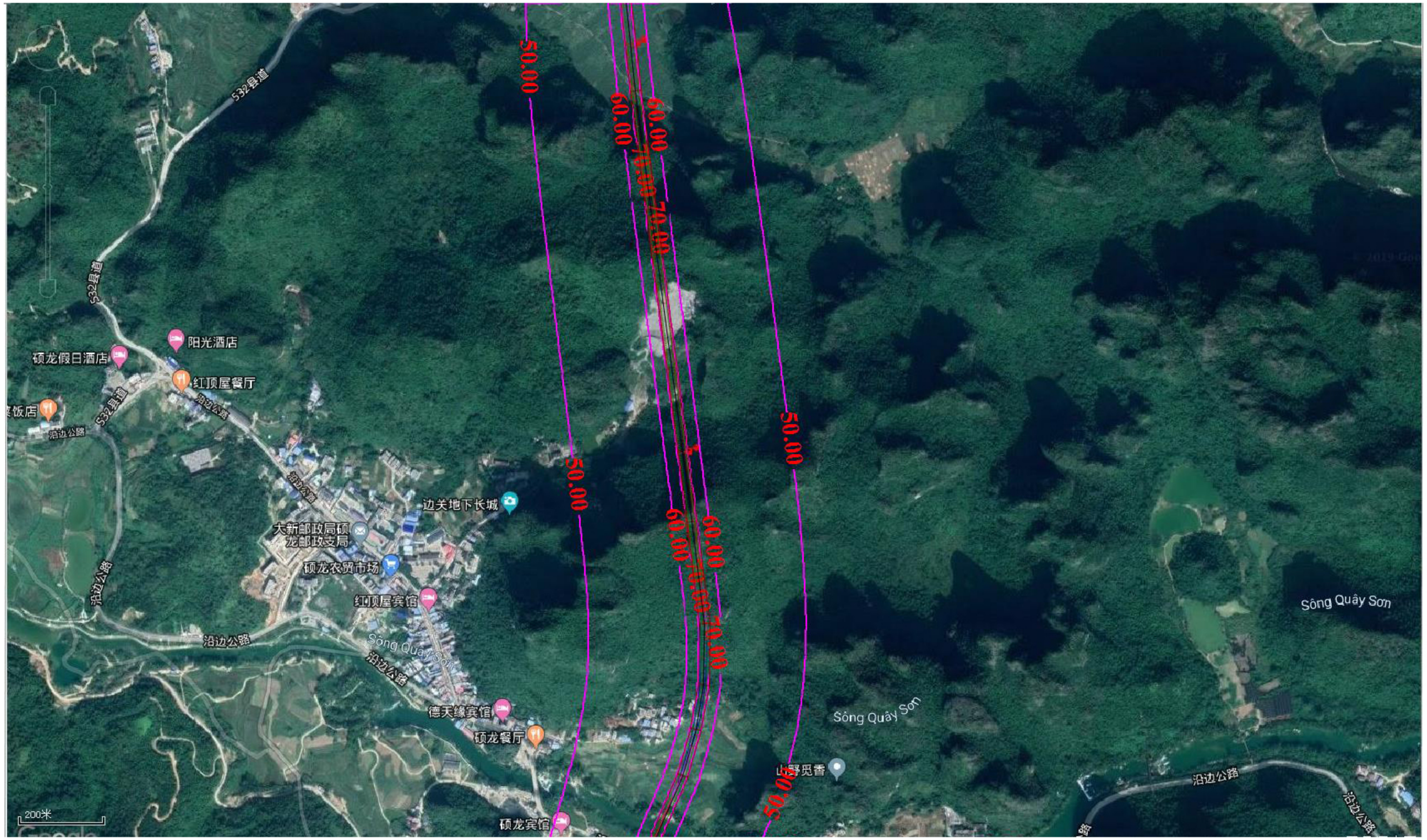


Figure 8.3-10 Daytime Noise Contour of Branch Line (AK2+500~AK5+410) in the Long Term of Operation

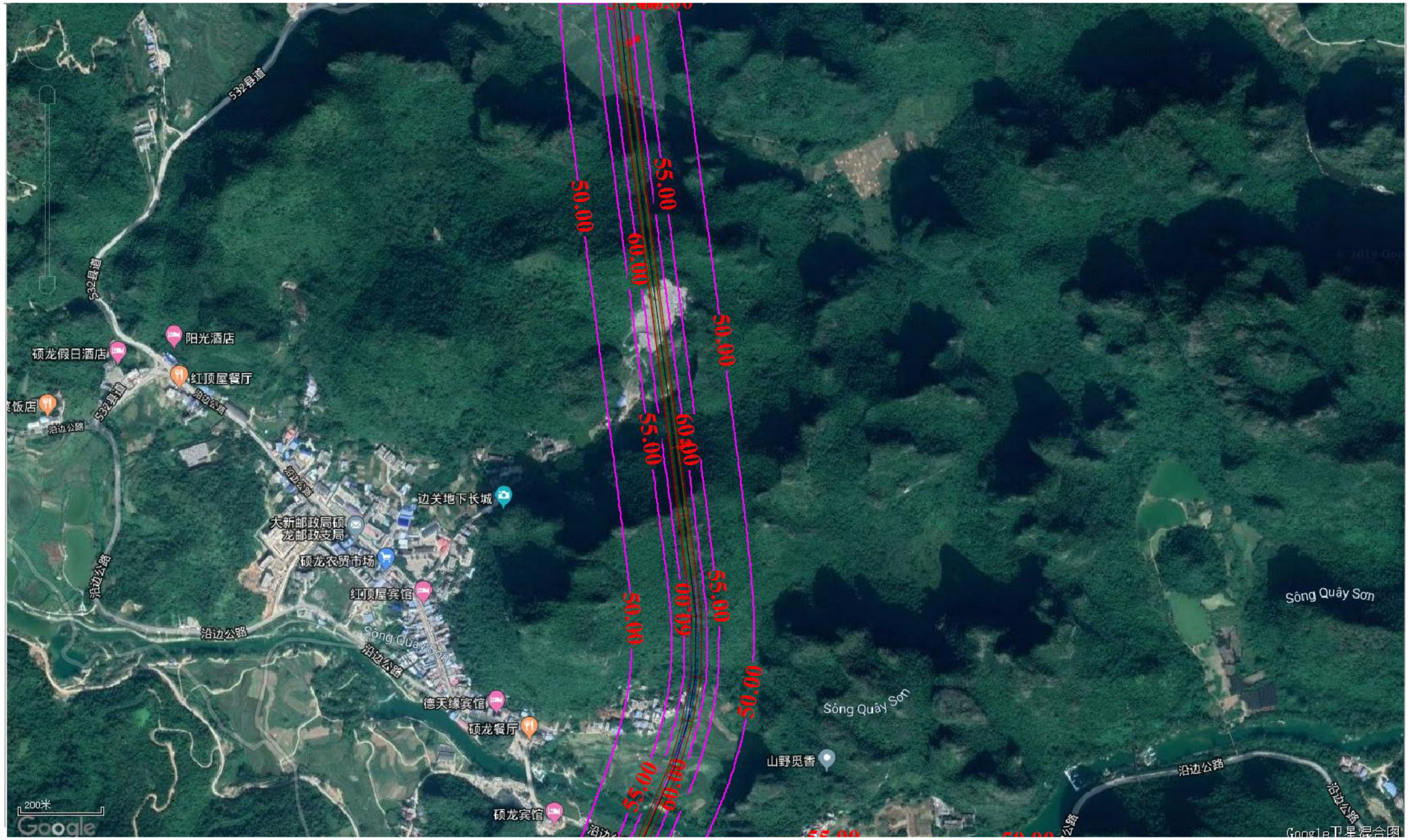


Figure 8.3-11 Nighttime Noise Contour of Branch Line (AK2+500~AK5+410) in the Long Term of Operation

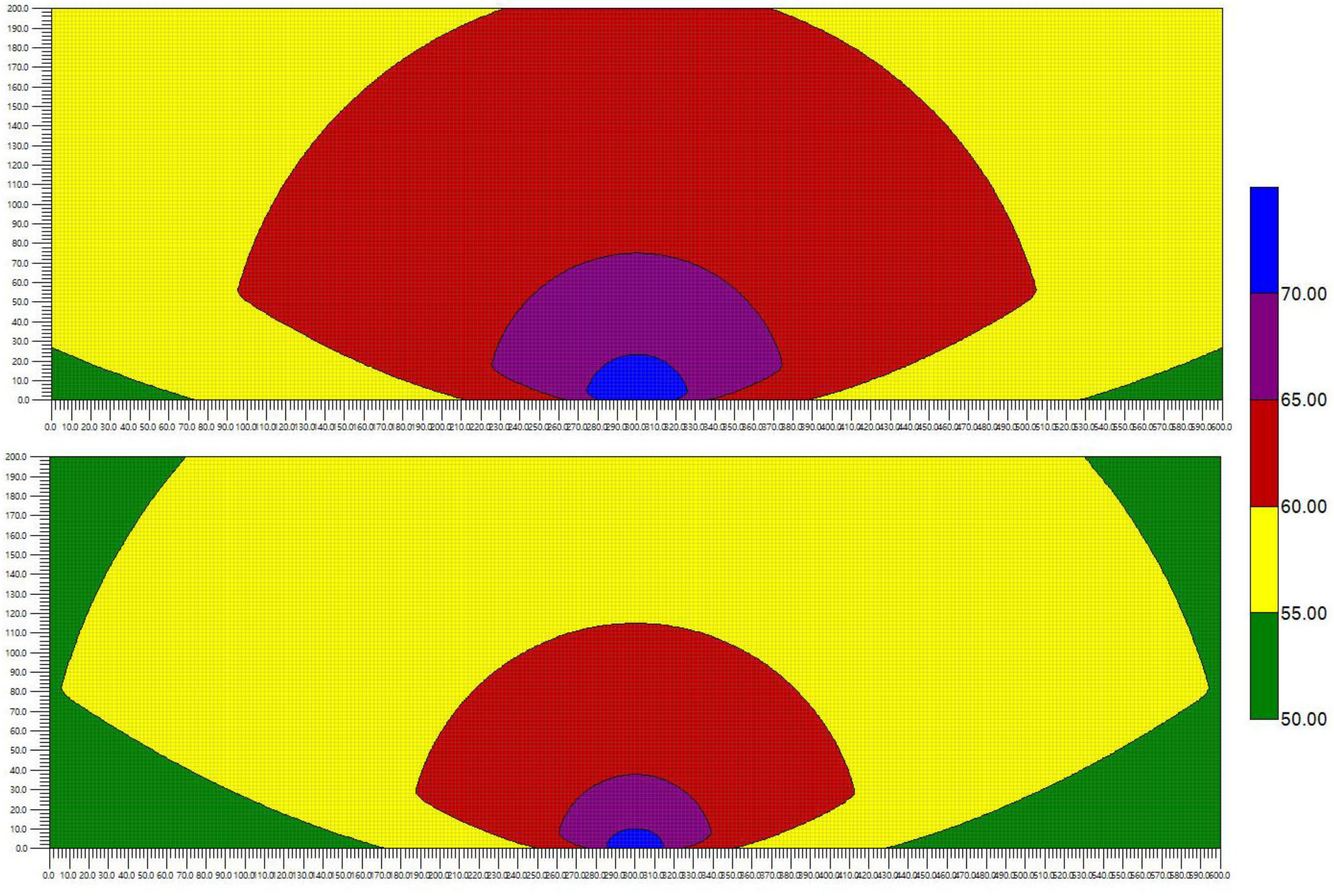


Figure 8.3-12 Vertical Daytime (Upper) and Nighttime (Lower) Noise Contour of Main Line in the Long Term of Operation

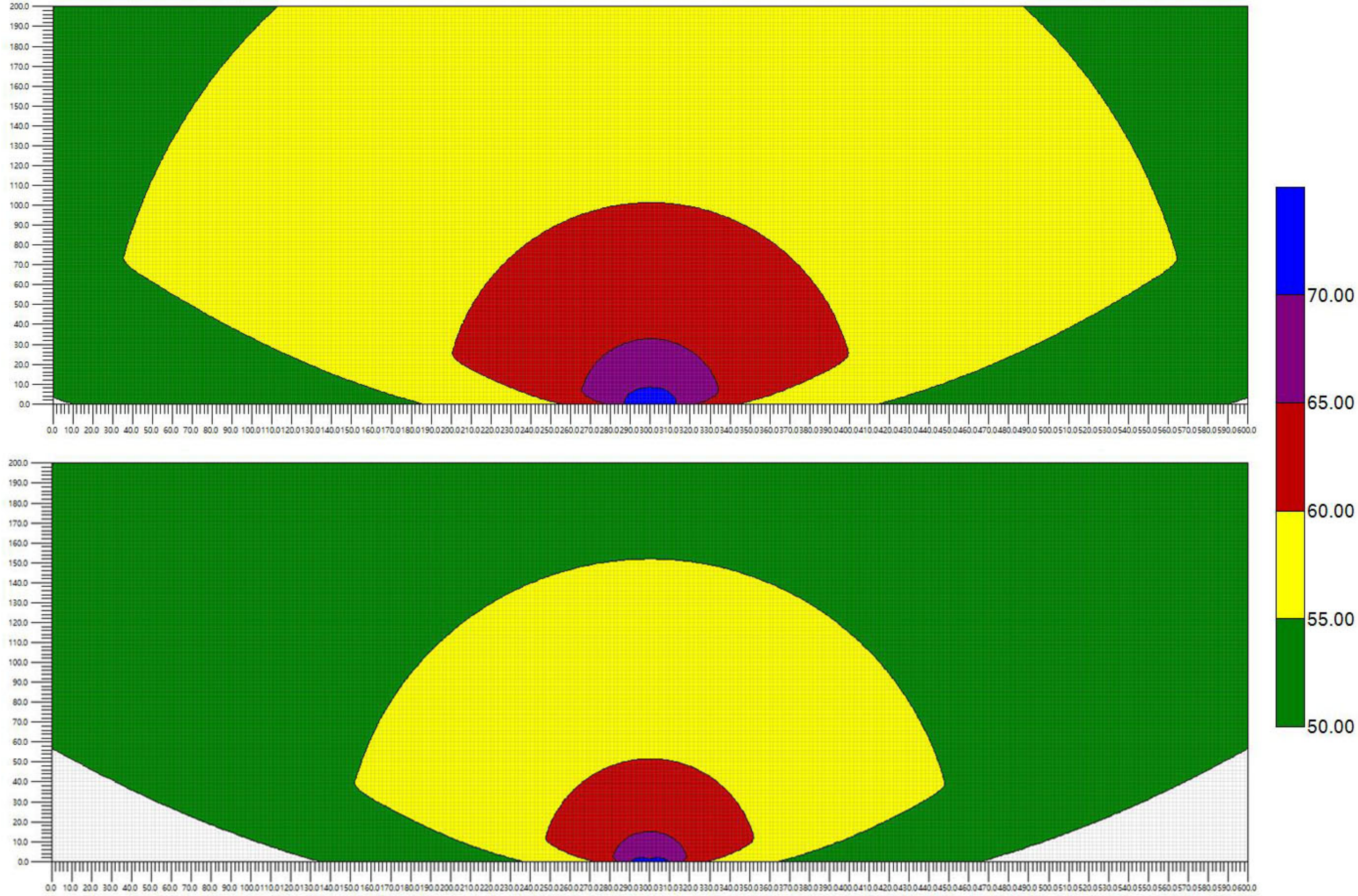


Figure 8.3-13 Vertical Daytime (Upper) and Nighttime (Lower) Noise Contour of Branch Line (AK0+000~AK2+500) in the Long Term of Operation

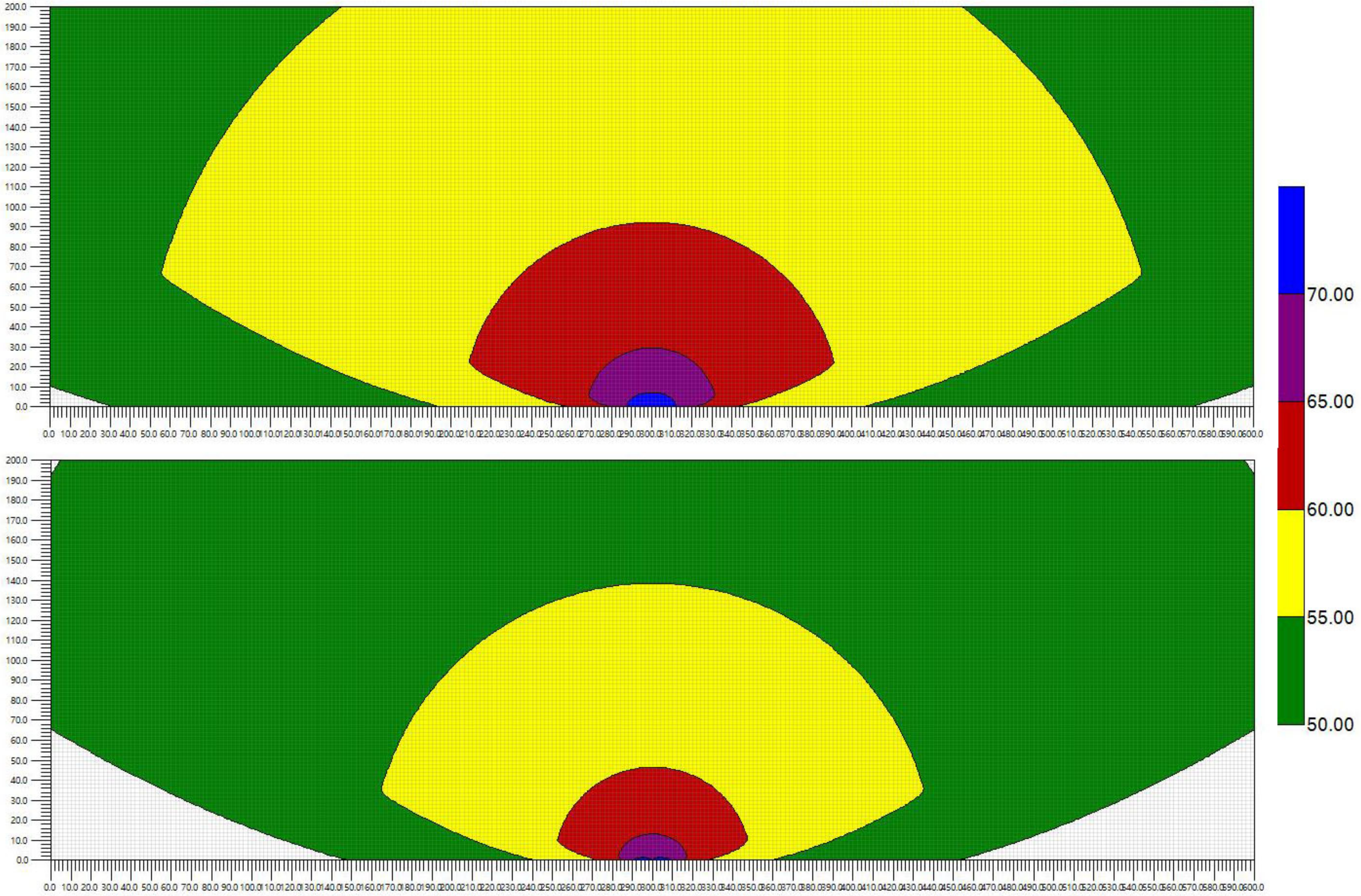


Figure 8.3-14 Vertical Daytime (Upper) and Nighttime (Lower) Noise Contour of Branch Line (AK2+500~AK5+410) in the Long Term of Operation

The statistical results indicate that the noise at all of the 12 sensitive points in the daytime till the middle term of operation of the Project reach the corresponding standards specified in the *Environmental Quality Standard for Noise* (GB3096-2008). The noise at 3 sensitive points in the nighttime exceeds the standard specified in the *Environmental Quality Standard for Noise* (GB3096-2008). The excess is 6.9 dB(A) at Bangtun, 1.0 dB(A) at Sanjiatun and 7.9dB(A) at Rentun. About 197 residents are affected by the excessive noise. Refer to Table 8.3-17 for details.

Table 8.3-17 Statistics of Excessive Noise at Sensitive Points along the Route in the Mid-term Operation of the Project

S/N	Acoustic function evaluation area	Number of Sensitive Points	Number of Sensitive Points Reaching the Standard	Number of Sensitive Points Exceeding the Standard		Excess, dB(A)		Number of people affected by excessive noise	Remarks
				Daytime	Nighttime	Daytime	Nighttime		
1	As per type II of category 4a standard	Village 10	7	0	3	/	1.0~7.9	197 persons	The most sensitive point exceeding the standard is on the first floor near the highway at Rentun. The noise at this point exceeds the standard by 7.9dB(A).
		School 2	2	0	0	/	/	/	

Total	9	0	2	1.0~7.9	197 persons	

8.3.2.3 Prediction and Analysis of Traffic Noise Impact of Component B

(1) Prediction results of highway traffic noise contribution value

According to the predicted traffic volume of the Project, The attenuation of traffic noise contribution value with distance is predicted for the Detain-Tourist Center Section and the Visitor Center-North End of Shuolong Medium Bridge Section, respectively. See Tables 8.3-18~8.3-25 for the prediction results of Component B.

Table 8.3-18 Traffic Noise Contribution Value of Detain-Tourist Center (Common Road Section) of Component B

Distance from highway centerline (m)	2023		Year 2029		Year 2038	
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime
0	62.34	59.29	63.60	60.55	64.76	61.66
10	56.16	53.11	57.42	54.37	58.58	55.48
20	51.24	48.19	52.49	49.45	53.66	50.55
30	48.09	45.05	49.35	46.30	50.52	47.41
40	46.27	43.22	47.53	44.48	48.69	45.58
50	44.98	41.93	46.23	43.19	47.40	44.29
60	43.97	40.93	45.23	42.18	46.40	43.29
70	43.15	40.10	44.40	41.36	45.57	42.46
80	42.45	39.40	43.70	40.65	44.87	41.76
90	41.83	38.78	43.09	40.04	44.25	41.15
100	41.28	38.24	42.54	39.49	43.71	40.60
110	40.79	37.74	42.05	39.00	43.21	40.10
120	40.34	37.29	41.59	38.55	42.76	39.65
130	39.92	36.88	41.18	38.13	42.35	39.24
140	39.54	36.49	40.79	37.75	41.96	38.85
150	39.18	36.13	40.43	37.39	41.60	38.49
160	38.84	35.79	40.09	37.05	41.26	38.15
170	38.52	35.47	39.77	36.73	40.94	37.83

Distance from highway centerline (m)	2023		Year 2029		Year 2038	
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime
180	38.22	35.17	39.47	36.42	40.64	37.53
190	37.93	34.88	39.18	36.14	40.35	37.24
200	37.65	34.60	38.91	35.86	40.07	36.97

Table 8.3-19 Traffic Noise Contribution Value of Detain-Tourist Center (Water Source Area Section) of Component B

Distance from highway centerline (m)	2023		Year 2029		Year 2038	
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime
0	59.33	56.29	60.58	57.54	61.73	58.65
10	52.93	49.89	54.18	51.14	55.33	52.25
20	48.01	44.97	49.26	46.22	50.41	47.33
30	44.90	41.86	46.15	43.11	47.30	44.22
40	43.10	40.05	44.35	41.31	45.50	42.42
50	41.83	38.78	43.08	40.04	44.23	41.15
60	40.85	37.80	42.10	39.05	43.25	40.17
70	40.04	36.99	41.29	38.25	42.44	39.36
80	39.36	36.31	40.61	37.56	41.76	38.68
90	38.77	35.72	40.01	36.97	41.17	38.08
100	38.24	35.19	39.49	36.45	40.64	37.56
110	37.77	34.72	39.02	35.97	40.17	37.09
120	37.34	34.29	38.59	35.54	39.74	36.66
130	36.95	33.90	38.20	35.15	39.35	36.26
140	36.58	33.54	37.83	34.79	38.99	35.90
150	36.25	33.20	37.50	34.45	38.65	35.56
160	35.93	32.88	37.18	34.14	38.33	35.25
170	35.63	32.59	36.88	33.84	38.04	34.95
180	35.36	32.31	36.61	33.56	37.76	34.67
190	35.09	32.04	36.34	33.30	37.49	34.41

200	34.84	31.79	36.09	33.04	37.24	34.16

Table 8.3-20 Traffic Noise Contribution Value of Detain-Tourist Center (Urban Road Section) of Component B

Distance from highway centerline (m)	2023		Year 2029		Year 2038	
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime
0	62.35	59.31	63.57	60.56	64.63	61.65
10	55.99	52.96	57.22	54.21	58.28	55.29
20	50.99	47.95	52.22	49.21	53.28	50.29
30	47.90	44.86	49.13	46.11	50.20	47.20
40	46.11	43.07	47.34	44.33	48.43	45.42
50	44.85	41.81	46.08	43.06	47.17	44.15
60	43.86	40.82	45.09	42.07	46.19	43.16
70	43.04	40.00	44.28	41.26	45.37	42.35
80	42.35	39.31	43.58	40.56	44.68	41.65
90	41.74	38.70	42.97	39.95	44.08	41.04
100	41.19	38.15	42.43	39.41	43.54	40.50
110	40.70	37.65	41.94	38.91	43.04	40.00
120	40.25	37.21	41.49	38.46	42.60	39.56
130	39.84	36.79	41.08	38.05	42.19	39.14
140	39.45	36.40	40.69	37.66	41.80	38.75
150	39.09	36.04	40.33	37.30	41.44	38.39
160	38.75	35.70	39.99	36.96	41.11	38.06
170	38.43	35.38	39.67	36.64	40.79	37.74
180	38.13	35.08	39.37	36.34	40.49	37.43
190	37.83	34.79	39.08	36.04	40.20	37.14
200	37.56	34.51	38.80	35.76	39.92	36.86

Table 8.3-21 Traffic Noise Contribution Value of Detain-Tourist Center (Road Section with Complex Topography) of Component B

Distance from highway centerline (m)	Year 2023		2029		2038	
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime
0	59.12	56.07	60.37	57.33	61.54	58.44
10	52.88	49.84	54.13	51.09	55.31	52.20
20	48.03	44.98	49.28	46.23	50.45	47.35

Distance from highway centerline (m)	Year 2023		2029		2038	
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime
30	45.08	42.04	46.33	43.29	47.51	44.40
40	43.44	40.40	44.69	41.65	45.87	42.76
50	42.32	39.27	43.57	40.53	44.74	41.64
60	41.46	38.42	42.71	39.67	43.89	40.78
70	40.77	37.72	42.02	38.98	43.19	40.09
80	40.18	37.14	41.44	38.39	42.61	39.50
90	39.68	36.63	40.93	37.89	42.10	39.00
100	39.22	36.18	40.48	37.43	41.65	38.54
110	38.82	35.77	40.07	37.03	41.24	38.14
120	38.45	35.40	39.70	36.66	40.87	37.76
130	38.09	35.04	39.35	36.30	40.51	37.41
140	37.77	34.72	39.02	35.98	40.19	37.09
150	37.47	34.42	38.72	35.68	39.89	36.79
160	37.19	34.14	38.44	35.40	39.61	36.51
170	36.92	33.87	38.17	35.12	39.34	36.23
180	36.65	33.60	37.90	34.86	39.07	35.97
190	36.40	33.35	37.65	34.61	38.82	35.72
200	36.16	33.11	37.41	34.37	38.58	35.48

Table 8.3-22 Traffic Noise Contribution Value of Tourist Center-North End of Shuolong Medium Bridge (Left Breadth of Separated Subgrade) of Component B

Distance from highway centerline (m)	Year 2023		2029		2038	
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime
0	69.53	66.46	70.78	67.64	72.05	69.06
10	59.78	56.72	61.03	57.89	62.30	59.31
20	54.84	51.78	56.10	52.96	57.37	54.38
30	51.81	48.75	53.06	49.93	54.34	51.35
40	50.02	46.96	51.27	48.14	52.55	49.56
50	48.75	45.70	50.01	46.88	51.29	48.29
60	47.77	44.71	49.02	45.90	50.31	47.31

70	46.96	43.91	48.22	45.09	49.50	46.51
80	46.28	43.23	47.53	44.41	48.82	45.82
90	45.68	42.63	46.93	43.81	48.22	45.23
100	45.15	42.10	46.41	43.29	47.70	44.70
110	44.67	41.63	45.93	42.82	47.22	44.22
120	44.24	41.19	45.50	42.38	46.79	43.79
130	43.84	40.80	45.10	41.99	46.39	43.39
140	43.47	40.43	44.73	41.62	46.03	43.03
150	43.13	40.09	44.39	41.28	45.69	42.68
160	42.80	39.77	44.06	40.96	45.37	42.36
170	42.50	39.46	43.76	40.66	45.06	42.06
180	42.21	39.18	43.47	40.37	44.78	41.77
190	41.94	38.90	43.20	40.10	44.51	41.50
200	41.67	38.64	42.94	39.84	44.24	41.24

Table 8.3-23 Traffic Noise Contribution Value of Tourist Center-North End of Shuolong Medium Bridge (Right Breadth of Separated Subgrade) of Component B

Distance from highway centerline (m)	**2023**		**Year 2029**		**Year 2038**	
	Daytime	**Nighttime**	**Daytime**	**Nighttime**	**Daytime**	**Nighttime**
0	64.95	61.90	66.20	63.06	67.47	64.49
10	55.24	52.18	56.49	53.35	57.76	54.78
20	50.31	47.26	51.56	48.42	52.83	49.85
30	47.27	44.22	48.52	45.38	49.79	46.81
40	45.48	42.43	46.73	43.59	48.00	45.02
50	44.21	41.16	45.46	42.32	46.73	43.76
60	43.23	40.17	44.48	41.34	45.75	42.77
70	42.42	39.37	43.67	40.53	44.94	41.96
80	41.73	38.68	42.98	39.84	44.25	41.27
90	41.13	38.08	42.38	39.25	43.66	40.68
100	40.60	37.55	41.85	38.72	43.13	40.15
110	40.13	37.07	41.38	38.24	42.65	39.67
120	39.70	36.64	40.95	37.81	42.22	39.24

Distance from highway centerline (m)	2023		Year 2029		Year 2038	
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime
130	39.30	36.25	40.55	37.42	41.83	38.84
140	38.93	35.88	40.18	37.05	41.46	38.47
150	38.59	35.54	39.84	36.71	41.12	38.13
160	38.27	35.22	39.52	36.39	40.80	37.81
170	37.97	34.92	39.22	36.09	40.50	37.52
180	37.69	34.64	38.94	35.81	40.22	37.23
190	37.41	34.36	38.67	35.54	39.95	36.96
200	37.16	34.11	38.41	35.28	39.69	36.71

Table 8.3-24 Traffic Noise Contribution Value of Tourist Center-North End of Shuolong Medium Bridge (Urban Road Section) of Component B

Distance from highway centerline (m)	2023		Year 2029		Year 2038	
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime
0	67.54	64.57	68.83	65.83	70.22	67.18
10	63.34	60.38	64.63	61.64	66.03	62.98
20	58.45	55.48	59.74	56.74	61.13	58.09
30	54.86	51.89	56.15	53.16	57.54	54.50
40	52.94	49.98	54.24	51.24	55.63	52.58
50	51.62	48.65	52.91	49.91	54.30	51.26
60	50.59	47.63	51.89	48.89	53.28	50.23
70	49.75	46.79	51.05	48.05	52.44	49.39
80	49.04	46.07	50.33	47.33	51.72	48.68
90	48.41	45.45	49.71	46.71	51.10	48.05
100	47.86	44.89	49.15	46.15	50.54	47.50
110	47.35	44.39	48.65	45.65	50.04	46.99
120	46.90	43.93	48.19	45.19	49.58	46.54
130	46.47	43.83	47.76	44.77	49.16	46.11
140	46.08	43.11	47.37	44.37	48.76	45.72
150	45.71	42.75	47.00	44.01	48.40	45.35
160	45.36	42.40	46.66	43.66	48.05	45.01
170	45.04	42.07	46.33	43.33	47.72	44.68

Distance from highway centerline (m)	2023		Year 2029		Year 2038	
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime
180	44.73	41.76	46.02	43.02	47.41	44.37
190	44.43	41.47	45.72	42.73	47.12	44.07
200	44.15	41.19	45.44	42.45	46.84	43.79

Table 8.3-25 Traffic Noise Contribution Value of Tourist Center-North End of Shuolong Medium Bridge (Common Road Section) of Component B

Distance from highway centerline (m)	2023		Year 2029		Year 2038	
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime
0	67.53	64.57	68.83	65.83	70.22	67.17
10	63.34	60.37	64.63	61.64	66.02	62.98
20	58.44	55.48	59.74	56.74	61.13	58.08
30	54.85	51.89	56.15	53.15	57.54	54.49
40	52.94	49.97	54.23	51.24	55.62	52.58
50	51.61	48.65	52.90	49.91	54.30	51.25
60	50.59	47.62	51.88	48.88	53.27	50.23
70	49.75	46.78	51.04	48.04	52.43	49.39
80	49.03	46.07	50.32	47.33	51.71	48.67
90	48.41	45.44	49.70	46.70	51.09	48.04
100	47.85	44.88	49.14	46.14	50.53	47.49
110	47.35	44.38	48.64	45.64	50.03	46.98
120	46.89	43.92	48.18	45.18	49.57	46.52
130	46.46	43.50	47.75	44.76	49.14	46.10
140	46.07	43.10	47.36	44.36	48.75	45.71
150	45.70	42.73	46.99	43.99	48.38	45.34
160	45.35	42.39	46.65	43.65	48.03	44.99
170	45.03	42.06	46.32	43.32	47.71	44.66
180	44.72	41.75	46.01	43.01	47.40	44.35
190	44.42	41.45	45.71	42.71	47.10	44.06
200	44.14	41.17	45.43	42.43	46.82	43.77

(2) Determination of traffic noise protection distance

According to the predicted traffic noise contribution value in 8.3-18 ~ 8.3-25, it is estimated that the minimum standard distance of traffic noise in Detain-Tourist Center Section and the Visitor Center-North End of Shuolong Medium Bridge Section meets Class 4a and Class 2 standards specified in *Environmental Quality Standards for Noise*, as shown in Table 8.3-26.

Table 8.3-26 Distance for Traffic Noise of the Project to Reach the Standard

Item		Forecast Period	Period	Category of standard	Standard value dB(A)	Distance from highway centerline (m)	Category of standard	Standard value dB(A)	Distance from highway centerline (m)
Detian-Tourist Center Section	General road section	Year 2023	Daytime	4a	70	0	2	60	5
			Nighttime		55	7		50	17
		2029	Daytime		70	0		60	6
			Nighttime		55	9		50	19
		2038	Daytime		70	0		60	8
			Nighttime		55	12		50	22
	Water Source Area Section	Year 2023	Daytime	4a	70	0	2	60	3
			Nighttime		55	4		50	10
		2029	Daytime		70	0		60	3
			Nighttime		55	5		50	13
		2038	Daytime		70	0		60	4
			Nighttime		55	6		50	16
	Urban section	Year 2023	Daytime	4a	70	0	2	60	5
			Nighttime		55	7		50	17
		2029	Daytime		70	0		60	6
			Nighttime		55	9		50	19
		2038	Daytime		70	0		60	7
			Nighttime		55	11		50	21
	Road Section with Complex Topography	Year 2023	Daytime	4a	70	0	2	60	3
			Nighttime		55	4		50	10
		2029	Daytime		70	0		60	3
			Nighttime		55	5		50	13
		2038	Daytime		70	0		60	4

Item		Forecast Period	Period	Category of standard	Standard value dB(A)	Distance from highway centerline (m)	Category of standard	Standard value dB(A)	Distance from highway centerline (m)
			Nighttime		55	6		50	15
Section from the Tourist Center - the North End of Shuolong Medium Bridge	Left Breadth of Separated Subgrade	Year 2023	Daytime	4a	70	0	2	60	10
			Nighttime		55	15		50	26
		2029	Daytime		70	1		60	13
			Nighttime		55	17		50	30
		2038	Daytime		70	1		60	16
			Nighttime		55	19		50	38
	Right Breadth of Separated Subgrade	Year 2023	Daytime	4a	70	0	2	60	3
			Nighttime		55	6		50	16
		2029	Daytime		70	0		60	5
			Nighttime		55	7		50	17
		2038	Daytime		70	0		60	6
			Nighttime		55	10		50	20
	General road section	Year 2023	Daytime	4a	70	0	2	60	17
			Nighttime		55	21		50	40
		2029	Daytime		70	0		60	20
			Nighttime		55	24		50	50
		2038	Daytime		70	4		60	23
			Nighttime		55	29		50	63
	Urban section	Year 2023	Daytime	4a	70	0	2	60	17
			Nighttime		55	21		50	40
		2029	Daytime		70	0		60	20
			Nighttime		55	24		50	50
		2038	Daytime		70	4		60	23
			Nighttime		55	29		50	63

(3) Analysis of traffic noise prediction results

According to the prediction results, the distance for Detian-Shuolong Highway to reach the standard in the long-term operation period is as follows:

The distance for the traffic noise contribution value of Detain-Tourist Center Section (Common Road Section) to reach Class 4a standard specified in the *Environmental Quality*

Standard for Noise is 12m from both sides of the highway centerline in the nighttime, and the traffic noise contribution value of this section is up to standard in the daytime. The distance for the traffic noise contribution value to reach Class 2 standard is 8m from both sides of the highway centerline in the daytime, and 22m from both sides of the highway centerline in the nighttime.

The distance for the traffic noise contribution value of Detain-Tourist Center Section (Water Source Area Section) to reach Class 4a standard specified in the *Environmental Quality Standard for Noise* is 6m from both sides of the highway centerline in the nighttime, and the traffic noise contribution value of this section is up to standard in the daytime. The distance for the traffic noise contribution value to reach Class 2 standard is 4m from both sides of the highway centerline in the daytime, and 16m from both sides of the highway centerline in the nighttime.

The distance for the traffic noise contribution value of Detain-Tourist Center Section (Urban Road Section) to reach Class 4a standard specified in the *Environmental Quality Standard for Noise* is 11m from both sides of the highway centerline in the nighttime, and the traffic noise contribution value of this section is up to standard in the daytime. The distance for the traffic noise contribution value to reach Class 2 standard is 7m from both sides of the highway centerline in the daytime, and 21m from both sides of the highway centerline in the nighttime.

The distance for the traffic noise contribution value of Detain-Tourist Center Section (Road Section with Complex Topography) to reach Class 4a standard specified in the *Environmental Quality Standard for Noise* is 6m from both sides of the highway centerline in the nighttime, and the traffic noise contribution value of this section is up to standard in the daytime. The distance for the traffic noise contribution value to reach Class 2 standard is 4m from both sides of the highway centerline in the daytime, and 15m from both sides of the highway centerline in the nighttime.

The distance for the traffic noise contribution value of Tourist Center-North End of Shuolong Medium Bridge (Left Breadth of Separated Subgrade) to reach Class 4a standard specified in the *Environmental Quality Standard for Noise* is 19m from both sides of the highway centerline in the nighttime, and the traffic noise contribution value of this section is up to standard in the daytime. The distance for the traffic noise contribution value to reach Class 2 standard is 16m from both sides of the highway centerline in the daytime, and 38m from both sides of the highway centerline in the nighttime.

The distance for the traffic noise contribution value of Tourist Center-North End of Shuolong Medium Bridge (Right Breadth of Separated Subgrade) to reach Class 4a standard specified in the *Environmental Quality Standard for Noise* is 10m from both sides of the highway centerline in the nighttime, and the traffic noise contribution value of this section is up to standard in the daytime. The distance for the traffic noise contribution value to reach Class 2 standard is 6m from both sides of the highway centerline in the daytime, and 20m from both sides of the highway centerline in the nighttime.

The distance for the traffic noise contribution value of Tourist Center-North End of Shuolong Medium Bridge (Common Road Section) to reach Class 4a standard specified in the *Environmental Quality Standard for Noise* is 29m from both sides of the highway centerline in the nighttime, and the traffic noise contribution value of this section is up to standard in the daytime. The distance for the traffic noise contribution value to reach Class 2 standard is 23m from both sides of the highway centerline in the daytime, and 63m from both sides of the highway centerline in the nighttime.

The distance for the traffic noise contribution value of Tourist Center-North End of Shuolong Medium Bridge (Urban Road Section) to reach Class 4a standard specified in the *Environmental Quality Standard for Noise* is 29m from both sides of the highway centerline in the nighttime, and the traffic noise contribution value of this section is up to standard in the daytime. The distance for the traffic noise contribution value to reach Class 2 standard is 23m from both sides of the highway centerline in the daytime, and 63m from both sides of the highway centerline in the nighttime.

(4) Prediction of environmental noise value at sensitive points

There are 12 acoustic environment sensitive points along the route of Component B, including 2 schools and 10 villages. In this assessment, an acoustic environment prediction is made for the 12 acoustic environment sensitive points within the project assessment scope. The prediction results are shown in Table 8.3-27.

Table 8.3-27 List of Prediction Results of Acoustic Environment Sensitive Points within the Assessment Scope of Component B

S/N	Description of Sensitive Points	Chainage	Distance from highway centerline (m)	Background value dB(A)		Characteristic Year	Traffic noise contribution value, dB(A)		Predicted environmental noise, dB(A)		Category	Excess of predicted environmental noise, dB(A)		Increment compared with current value, dB(A)		Medium-term over-standard households/household	Medium-term over-standard population/person
				Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		
1	Detian	K0+000	69	49.35	43.25	2023	43.23	40.18	50.30	44.99	2	Up to standard	Up to standard	0.9	1.7		
						2029	44.48	41.43	50.57	45.44		Up to standard	Up to standard	1.2	2.2		
						2038	45.65	42.54	50.89	45.92		Up to standard	Up to standard	1.5	2.7		
2	Liudeng	K1+900~K2+060	8	49.35	43.25	2023	57.16	54.12	57.83	54.46	4a	Up to standard	Up to standard	8.5	11.2	4	16
						2029	58.42	55.37	58.93	55.63		Up to standard	0.6	9.6	12.4		
						2038	59.59	56.48	59.98	56.68		Up to standard	1.7	10.6	13.4		

S/N	Description of Sensitive Points	Chainage	Distance from highway centerline (m)	Background value dB(A)		Characteristic Year	Traffic noise contribution value, dB(A)		Predicted environmental noise, dB(A)		Category	Excess of predicted environmental noise, dB(A)		Increment compared with current value, dB(A)		Medium-term over-standard households/household	Medium-term over-standard population/person
				Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		
		K1+900~K2+060	41	49.35	43.25	2023	46.12	43.07	51.04	46.17	2	Up to standard	Up to standard	1.7	2.9		
						2029	47.38	44.33	51.49	46.83		Up to standard	Up to standard	2.1	3.6		
						2038	48.55	45.44	51.98	47.49		Up to standard	Up to standard	2.6	4.2		
3	Aijiang Forest Farm	K3+000~K3+500	15	49.35	43.25	2023	52.92	49.87	54.50	50.73	4a	Up to standard	Up to standard	5.2	7.5		
						2029	54.17	51.12	55.41	51.78		Up to standard	Up to standard	6.1	8.5		
						2038	55.34	52.23	56.32	52.75		Up to standard	Up to standard	7.0	9.5		
			41	49.35	43.25	2023	46.12	43.07	51.04	46.17	2	Up to standa	Up to standar	1.7	2.9		

S/N	Description of Sensitive Points	Chainage	Distance from highway centerline (m)	Background value dB(A)		Characteristic Year	Traffic noise contribution value, dB(A)		Predicted environmental noise, dB(A)		Category	Excess of predicted environmental noise, dB(A)		Increment compared with current value, dB(A)		Medium-term over-standard households/household	Medium-term over-standard population/person
				Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		
												rd	d				
						2029	47.38	44.33	51.49	46.83		Up to standard	Up to standard	2.1	3.6		
						2038	48.55	45.44	51.98	47.49		Up to standard	Up to standard	2.6	4.2		
4	Aitun	K5+500~K5+700	7	49.65	46.5	2023	57.77	54.72	58.39	55.33	4a	Up to standard	0.3	8.7	8.8	5	20
						2029	59.02	55.98	59.50	56.44		Up to standard	1.4	9.8	9.9		
						2038	60.19	57.08	60.56	57.44		Up to standard	2.4	10.9	10.9		
			41	49.65	46.5	2023	41.12	38.07	50.22	47.08	2	Up to standard	Up to standard	0.6	0.6		

S/N	Description of Sensitive Points	Chainage	Distance from highway centerline (m)	Background value dB(A)		Characteristic Year	Traffic noise contribution value, dB(A)		Predicted environmental noise, dB(A)		Category	Excess of predicted environmental noise, dB(A)		Increment compared with current value, dB(A)		Medium-term over-standard households/household	Medium-term over-standard population/person
				Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		
						2029	42.38	39.33	50.40	47.26		Up to standard	Up to standard	0.7	0.8		
						2038	43.55	40.44	50.60	47.46		Up to standard	Up to standard	1.0	1.0		
5	Bagan	K5+900~K6+000	25	49.65	46.5	2023	48.40	45.35	52.08	48.97	4a	Up to standard	Up to standard	2.4	2.5		
						2029	49.65	46.61	52.66	49.57		Up to standard	Up to standard	3.0	3.1		
						2038	50.82	47.71	53.28	50.16		Up to standard	Up to standard	3.6	3.7		
			41	49.65	46.5	2023	46.12	43.07	51.24	48.13	2	Up to standard	Up to standard	1.6	1.6		
						2029	47.38	44.33	51.67	48.56		Up to standar	Up to standar	2.0	2.1		

S/N	Description of Sensitive Points	Chainage	Distance from highway centerline (m)	Background value dB(A)		Characteristic Year	Traffic noise contribution value, dB(A)		Predicted environmental noise, dB(A)		Category	Excess of predicted environmental noise, dB(A)		Increment compared with current value, dB(A)		Medium-term over-standard households/household	Medium-term over-standard population/person
				Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		
												rd	d				
						2038	48.55	45.44	52.15	49.01		Up to standard	Up to standard	2.5	2.5		
6	Aijiang Village Primary School	K6+100	135	49.65	46.5	2023	39.73	36.68	50.07	46.93	2	Up to standard	Up to standard	0.4	0.4		
						2029	40.98	37.94	50.20	47.07		Up to standard	Up to standard	0.6	0.6		
						2038	42.15	39.04	50.36	47.22		Up to standard	Up to standard	0.7	0.7		
7	Longjian	K6+700~K6+800	7	49.65	46.5	2023	57.77	54.72	58.39	55.33	4a	Up to standard	0.3	8.7	8.8	7	25
						2029	59.02	55.98	59.50	56.44		Up to standard	1.4	9.8	9.9		

S/N	Description of Sensitive Points	Chainage	Distance from highway centerline (m)	Background value dB(A)		Characteristic Year	Traffic noise contribution value, dB(A)		Predicted environmental noise, dB(A)		Category	Excess of predicted environmental noise, dB(A)		Increment compared with current value, dB(A)		Medium-term over-standard households/household	Medium-term over-standard population/person
				Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		
						2038	60.19	57.08	60.56	57.44		Up to standard	2.4	10.9	10.9		
			41	49.65	46.5	2023	41.12	38.07	50.22	47.08	2	Up to standard	Up to standard	0.6	0.6		
						2029	42.38	39.33	50.40	47.26		Up to standard	Up to standard	0.7	0.8		
						2038	43.55	40.44	50.60	47.46		Up to standard	Up to standard	1.0	1.0		
8	Wanlong	K6+900~K7+100	8	49.65	46.5	2023	57.16	54.12	57.87	54.81	4a	Up to standard	Up to standard	8.2	8.3	8	29
						2029	58.42	55.37	58.96	55.90		Up to standard	0.9	9.3	9.4		
						2038	59.59	56.48	60.01	56.90		Up to standa	1.9	10.4	10.4		

S/N	Description of Sensitive Points	Chainage	Distance from highway centerline (m)	Background value dB(A)		Characteristic Year	Traffic noise contribution value, dB(A)		Predicted environmental noise, dB(A)		Category	Excess of predicted environmental noise, dB(A)		Increment compared with current value, dB(A)		Medium-term over-standard households/household	Medium-term over-standard population/person
				Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		
												rd					
			41	49.65	46.5	2023	41.12	38.07	50.22	47.08	2	Up to standard	Up to standard	0.6	0.6		
						2029	42.38	39.33	50.40	47.26		Up to standard	Up to standard	0.7	0.8		
						2038	43.55	40.44	50.60	47.46		Up to standard	Up to standard	1.0	1.0		
9	Longhong	K9+700	36	55.5	45.7	2023	49.65	46.59	56.50	49.18	4a	Up to standard	Up to standard	1.0	3.5		
						2029	50.90	47.77	56.79	49.87		Up to standard	Up to standard	1.3	4.2		
						2038	52.18	49.19	57.16	50.80		Up to standard	Up to standard	1.7	5.1		

S/N	Description of Sensitive Points	Chainage	Distance from highway centerline (m)	Background value dB(A)		Characteristic Year	Traffic noise contribution value, dB(A)		Predicted environmental noise, dB(A)		Category	Excess of predicted environmental noise, dB(A)		Increment compared with current value, dB(A)		Medium-term over-standard households/household	Medium-term over-standard population/person
				Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		
			43	55.5	45.7	2023	49.60	46.54	56.49	49.15	2	Up to standard	Up to standard	1.0	3.5		
						2029	50.85	47.72	56.78	49.84		Up to standard	Up to standard	1.3	4.1		
						2038	52.13	49.14	57.14	50.76		Up to standard	0.8	1.6	5.1		
10	Gutun	K10+400 ~K11+200	12	55.5	45.7	2023	62.22	59.25	63.06	59.44	4a	Up to standard	4.4	7.6	13.7	16	59
						2029	63.83	60.52	64.15	60.66		Up to standard	5.7	8.6	15.0		
						2038	64.90	61.86	65.37	61.96		Up to standard	7.0	9.9	16.3		
		K10+40	43	55.5	45.7	2023	46.50	43.53	56.01	47.76	2	Up to standa	Up to standar	0.5	2.1		

S/N	Description of Sensitive Points	Chainage	Distance from highway centerline (m)	Background value dB(A)		Characteristic Year	Traffic noise contribution value, dB(A)		Predicted environmental noise, dB(A)		Category	Excess of predicted environmental noise, dB(A)		Increment compared with current value, dB(A)		Medium-term over-standard households/household	Medium-term over-standard population/person
				Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		
		0 ~K11+200										rd	d				
						2029	47.79	44.79	56.18	48.28		Up to standard	Up to standard	0.7	2.6		
						2038	49.18	46.14	56.41	48.94		Up to standard	Up to standard	0.9	3.2		
11	Shuolong Community	K12+300 ~K13+100	10	53.55	44.75	2023	63.34	60.38	63.77	60.50	4a	Up to standard	5.5	10.2	15.7	13	46
						2029	64.63	61.64	64.96	61.73		Up to standard	6.7	11.4	17.0		
						2038	66.03	62.98	66.27	63.04		Up to standard	8.0	12.7	18.3		
			43	53.55	44.75	2023	46.50	43.54	54.33	47.20	2	Up to standard	Up to standard	0.8	2.4		

S/N	Description of Sensitive Points	Chainage	Distance from highway centerline (m)	Background value dB(A)		Characteristic Year	Traffic noise contribution value, dB(A)		Predicted environmental noise, dB(A)		Category	Excess of predicted environmental noise, dB(A)		Increment compared with current value, dB(A)		Medium-term over-standard households/household	Medium-term over-standard population/person
				Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime		
						2029	47.80	44.80	54.57	47.79		Up to standard	Up to standard	1.0	3.0		
						2038	49.19	46.14	54.91	48.51		Up to standard	Up to standard	1.4	3.8		
12	Rentun	K13+200 ~K13+400	65	53.55	44.75	2023	50.15	47.19	55.18	49.15	2	Up to standard	Up to standard	1.6	4.4		
						2029	51.45	48.45	55.64	49.99		Up to standard	Up to standard	2.1	5.2		
						2038	52.84	49.79	56.22	50.97		Up to standard	1.0	2.7	6.2		

The statistical results indicate that the noise at all of the 12 sensitive points in Component B in the daytime till the middle term of operation of the Project reaches the corresponding standards specified in the *Environmental Quality Standard for Noise* (GB3096-2008). The noise at 6 sensitive points in the nighttime exceeds the standard specified in the *Environmental Quality Standard for Noise* (GB3096-2008). The excess is 0.6~6.7dB(A). About 53 households/195 residents are affected by the noise exceeding the standard. Refer to Table 8.3-28 for details.

Table 8.3-28 Statistics of Noise Exceeding the Standard at Sensitive Points along the Route in the Mid-term Operation of Component B

<table>
<tr><th rowspan="2">S/N</th><th rowspan="2" colspan="2">Acoustic function evaluation area</th><th rowspan="2">Number of Sensitive Points</th><th rowspan="2">Reaching Standard Qty./Nr.</th><th colspan="2">Number of Sensitive Points Exceeding the Standard</th><th colspan="2">Range of Exceeding the Standard dB(A)</th><th rowspan="2">Households/Personnel Qty. of Exceeding the Standard</th><th rowspan="2">Remarks</th></tr>
<tr><th>Daytime</th><th>Nighttime</th><th>Daytime</th><th>Nighttime</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Sensitive points under the simultaneous implementation of Class 4a and Class 2 standards</td><td>Area of Class 4a</td><td>Village 6</td><td>1</td><td>0</td><td>6</td><td>/</td><td>0.6~6.7</td><td>53/195</td><td></td></tr>
<tr><td>Class 2 zone</td><td>Village 6</td><td>6</td><td>0</td><td>0</td><td>/</td><td>/</td><td>/</td><td></td></tr>
<tr><td colspan="7">Total</td><td colspan="2">0.6~6.7</td><td>53/195</td><td>-</td></tr>
</table>

8.3.2.4 Prediction and Analysis of Noise Impact of Component C

(1) Noise from vehicles passing by

Measures, such as driving at low speed, no honking, sound barriers and greening shall be taken. The noise generated by motor vehicles is small and has little impact on the surrounding environment.

(2) Domestic noise

The level of noise from passengers activities is generally 60~70dB(A). The domestic noise is characterized by low intensity, discontinuity and irregularity. In general, the domestic noise has little impact on the surroundings.

(3) Equipment noise

① Noise source intensity

Vibration damping measures shall be taken for the base of diesel generator, for example, noise barrier can be placed in the equipment room. The anti-vibration and vibration reduction measures shall be improved during installation of fans, and silencers shall be installed at openings. All kinds of pumps shall be installed in their own machine rooms, and sound-absorbing materials shall be used indoors. During installation, the equipment shall be balanced and vibration reduction measures shall be taken, and noise reduction shall be realized by obstruction from surrounding buildings. By taking the above measures, the noise source intensity of the equipment is between 60 and 70 dB (A).

② Prediction mode

In this assessment, the impact of mechanical equipment noise on the surrounding environment is predicted, and the prediction mode adopts the model recommended in *Technical Guidelines for Environmental Impact Assessment – Acoustic Environment* (HJ2.4-2009).

a. Sound level calculation

The calculation formula for equivalent sound level contribution value (Leqg) generated at the prediction points by the sound sources of the construction project:

$$L_{eqg} = 10\lg\left(\frac{1}{T}\sum_i t_i\, 10^{0.1L_{Ai}}\right)$$

b. Calculation of attenuation of outdoor sound propagation

Attenuation of outdoor acoustic propagation includes geometric divergence (Adiv), atmospheric absorption (Aatm), ground effect (Agr), barrier shielding (Abar), and the attenuation caused by other effects (Amisc).

The sound level A at r from the sound source point is calculated by the following formula:

$$L_p(r) = L_P(r_0) - \left(A_{div} + A_{atm} + A_{bar} + A_{gr} + A_{misc}\right)$$

In the prediction, the influences and calculation methods such as correction caused by reflection, attenuation caused by barrier, double diffraction, outdoor sound source equivalent to indoor sound source are considered.

③ Prediction of noise impact at the plant boundary

The noise prediction is made according to the model recommended in the *Technical Guidelines for Environmental Impact Assessment – Acoustic Environment* (HJ2.4-2009), and the prediction results are shown in the table below.

Table 8.3-29 Noise Prediction at the Plant Boundary on Each Side (Unit: dB(A))

Plant Boundary	Distance between noise source and surroundings (m)	Contribution value of noise to plant boundary	Daytime standard value dB(A)	Noise exceeding the standard in daytime	Nighttime standard value dB(A)	Noise exceeding the standard in nighttime
East	30	40.5	60	Up to standard	50	Up to standard
South	50	36.0	60	Up to standard	50	Up to standard
West	55	35.2	60	Up to standard	50	Up to standard
North	70	33.1	60	Up to standard	50	Up to standard

After taking effective noise reduction measures for all noise equipment, the noises at the plant boundaries in the east, south, west and north in daytime and nighttime during the operation period meet the Class 2 standard of *Emission Standard for Industrial Enterprises Noise at Boundary* (GB12348-2008). Therefore, on the premise of taking effective measures for each noise equipment, the equipment noise of the Project has little impact on the external environment.

④ Prediction of the impact on sensitive points

The equipment of the Project is mainly arranged in the south. After taking measures such as noise reduction and distance attenuation, the contribution value of equipment noise to the residential area of Shuolong Town in the east is 39.1dB(A). After superimposing the corresponding background noise, the acoustic environmental quality of sensitive points can meet the Class 2 standard specified in the *Environmental Quality Standard for Noise* (GB3096-2008), and the equipment noise of the Project has little impact on sensitive points.

8.4 Prediction and Assessment of Impacts on Atmospheric Environment

8.4.1 Analysis of Impacts on Atmospheric Environment during the Construction Period

The impact of highway construction on ambient air mainly comes from the construction dust, including the dust generated from earth-rock excavation and filling, concrete mixing, material transportation and loading/unloading, etc., the tail gas of construction machinery, and exhaust gas derived from asphalt. Major pollutants are TSP, NO2, Co, Benzoapyrene (BaP) and THC.

8.4.1.1 Analysis of Dust Raising Impacts

From the results of monitoring at the construction sites of similar highways without dust reduction measures, it is found that the daily average raised dust concentration at a distance of 20m downwind from the site is 1303μg/m3, which is 4.34 times higher than the Class II standard specified in the *Ambient Air Quality Standards* (GB3095-2012); 311μg/m3 at a distance of 150m downwind from the site, which is 1.03 times higher than the standard; 270μg/m3 at a distance of 200m downwind from the site, which does not exceed the standard. When transport vehicles pass through, the raised dust at the construction site increases significantly. In this case, the daily average raised dust concentration at a distance of 50m downwind from the site can still reach 2532μg/m3, which is 8.44 times higher than the Class II standard specified in the *Ambient Air Quality Standards* (GB3095-2012); and, that at a distance of 150m downwind from the site is 521μg/m3, which is 1.74 times higher than the standard.

According to the above analysis, in the absence of dust prevention measures, the dust generated at the construction site of the proposed highway project and the access roads to the site will have a great adverse impact on the atmospheric environment within 150m from the roadside, especially in the area within 50m from the roadside.

8.4.1.2 Impact Analysis of Waste Gas from Fuel Machinery

The majority of highway construction machinery is fuel machinery such as excavators, spreaders and vibrators, and the major pollutants emitted by them are NO2, CO and THC. From the results of monitoring at the construction sites of similar highways without dust reduction measures, it is found that the hourly average concentration of NO_2 and CO in the ambient air at a distance of 50m from the site are 200μg/m3 and 130μg/m3 respectively, and that the 24-hour average concentration is 130μg/m3 and 62μg/m3 respectively, which reach the Class II standard specified in the *Ambient Air Quality Standards* (GB3095-2012). The fuel construction machinery has little impact on the ambient air within the assessment scope.

8.4.1.3 Pollution Analysis of Asphalt Fume and Benzo[a]pyrene

The asphalt fume produced in the construction of asphalt concrete pavement is one of the important factors affecting the atmospheric environment during the execution of the Project. Asphalt fume refers to organic particulate matters of liquid hydrocarbon nature and a small amount of gaseous hydrocarbon matters at normal temperature discharged from the manufacture of petroleum asphalt and asphalt products. It is a mixed fume containing a variety of chemical substances, with hydrocarbon mixture as the main component, especially polycyclic aromatic hydrocarbons. The polycyclic aromatic hydrocarbons represented by benzoapyrenea (Bap) are highly- cancerogenic substances.

According to the Project Feasibility Study Scheme, since most of the asphalt for use in the Project is to be purchased from the market, the main source of asphalt fume occurring during construction is the laying process. The asphalt fume emission during the spread of asphalt concrete is fugitive emission, and the major pollutants are THC, TSP, and benzoapyrene (BaP). From the monitoring data of similar expressway projects obtained in the process of asphalt concrete spreading, it is known that when the wind speed is 2 - 3m/s, the distance of influence from the fume pollutants emitted when pouring the asphalt concrete on the pavement is about 100m downwind from the construction site. There are 6 ambient air sensitive points having a minimum distance of less than 100m from the boundary line of road, which are susceptible to asphalt fume. Therefore, it is suggested that the construction contractor pay attention to controlling the temperature of asphalt concrete on the premise of meeting the construction requirements, reduce the spreading temperature as much as possible, and take water cooling measures after the spreading, which can significantly reduce the amount of asphalt fume. It is advisable to spread the asphalt concrete on the pavement in sunny and windy days when it is good for atmospheric diffusion, so as to reduce the adverse effects of asphalt fume on the surrounding environment sensitive points.

8.4.1.4 Impact of Tunnel Construction

The atmospheric environment impact of tunnel construction mainly occurs in the following three aspects:

(1) Blasting is required in tunnel construction, which can produce a high concentration of CO, nitrates, smoke, dust and other gases in the tunnel. This is likely to exert a certain effect on the health of construction personnel. According to relevant data, the concentration of CO produced by blasting in the tunnel can decrease to 100ppm about 20 minutes after proper ventilation. Under this concentration, people are able to work for 6 hours during which they feel something for it but can still stand. So, during the tunnel construction, proper ventilation should be ensured for the sake of the health of construction personnel.

(2) During the tunnel construction, such as drilling, blasting, slag loading and other operations, a large amount of dust can be produced at the entrance and exit of the tunnel as well as inside the tunnel, which can also cause great harm to the health of construction personnel.

(3) The influence range of dust from tunnel construction is mainly 100m around the tunnel portal. According to the field survey, the sensitive points distributed within 100m of the tunnel portal of the project mainly include Bulitun near the exit of Buli Tunnel (K4+695) and Rentun near the exit of Shuolong Tunnel (AK5+015). The dust generated by the tunnel construction will have certain adverse effects on residents, so dust-prevention measures should be strengthened. Other sensitive points are 100m away from the entrance and exit of the tunnel works, and the dust generated by the tunnel construction will not adversely affect the residents 100m away.

8.4.2 Analysis of Impact on Atmospheric Environment during the Operation Period

8.4.2.1 Impact Analysis of Highway Atmospheric Pollution

The ambient air pollution during the operation period of the Project mainly comes from CO and NOX in the automobile exhaust. In this assessment, NO2 and CO are selected as representative pollution factors, and the influence of NO2 and CO on the ambient air pollution along the route of the project is evaluated by the analogy analysis method.

The analogy object is Liuzhou-Nanning section of Guilin-Liuzhou-Nanning Expressway with the largest traffic volume among existing expressways in Guangxi. The analogy data comes from the monitoring data of atmospheric environmental quality at sensitive points on the side of the current Guilin-Liuzhou Expressway in the *Environmental Impact Report of Reconstruction and Expansion Project of Guilin-Nanning Section of Quanzhou-Nanning Expressway* compiled by CCCC Second Harbor Consultants Co., Ltd.

See Table 8.4-1 for comparison of main technical parameters between the analogy highway and the highway in the Project See Table 8.4-2 for the monitoring data of ambient air quality current status of the existing road of analogy project.

Table 8.4-1 Comparison of Main Technical Parameters between Analogy Highway and the Highway in the Project

S/N	Item	Project Road	Existing Road of Guilin-Liuzhou Expressway (Liuzhou-Nanning Section)
1	Location	Chongzuo	Guilin, Liuzhou, Nanning
2	Class of construction	Expressway	Expressway

3	Landform	Hilly area	Hilly area
4	Subgrade width	26	26
5	Design speed	Mainline 100km/h, branch line 80km /h	120km/h
6	Atmospheric diffusion conditions	Most of the road sections in the area where the route passes have wide terrain and good diffusion conditions	Most of the road sections in the area where the route passes have wide terrain and good diffusion conditions
7	Traffic Flow (Vehicle/Day) (converted into small vehicles)	Mainline: 6177 in the near term, 14068 in the medium term and 26421 in the long term Branch line: 4438 in the near term, 6389 in the medium term and 12214 in the long term	Current situation: about 35780~38180

Table 8.4-2 Monitoring Data of Ambient Air Quality Current Status of the Existing Road of Analogy Project

Unit: mg/m^3

Monitoring time				**Sep. 10**	**Sep. 11**	**Sep. 12**	**Sep. 13**	**Sep. 14**	**Sep. 15**	**Sep. 16**
Measuring Point	**Monitored Items**									
Diaosi (K1465+530 left 19m)	NO_2	24-hour average concentration		0.019	0.021	0.018	0.017	0.017	0.018	0.019
		Hourly Value	02:00~03:00	0.016	0.016	0.012	0.012	0.012	0.015	0.011
			08:00~09:00	0.020	0.019	0.016	0.013	0.016	0.019	0.018
			14:00~15:00	0.025	0.028	0.024	0.025	0.025	0.022	0.027
			18:00~19:00	0.022	0.024	0.023	0.024	0.020	0.022	0.024
	CO	24-hour average concentration		0.6	0.8	0.6	0.7	0.6	0.7	0.6
		Hourly Value	02:00~03:00	0.4	0.6	0.5	0.5	0.3	0.5	0.4
			08:00~09:00	0.8	0.9	0.8	0.8	0.6	0.7	0.7
			14:00~15:00	0.8	0.9	0.8	0.9	0.8	0.9	1.0
			18:00~19:00	0.7	0.9	0.7	0.8	0.9	0.9	0.7

According to the monitoring data of current status in the above table, the main air pollutants at the sensitive points of Diaosi which is 19m to the left of the current existing road in the Liujing-Nanning Toll

Station section with the largest traffic volume on the expressway can meet the requirements of Class II of *Ambient Air Quality Standard* (GB3095-2012), including the average concentration of NO_2 for 24 hours of 0.017~0.021mg/m^3, the average concentration of NO_2 for 1 hour of 0.011~0.028mg/m3 which accounts for 18% and 12% of Class II of *Ambient Air Quality Standard* (GB3095-2012) respectively; the average concentration of CO for 24 hours of 0.6~0.8mg/m^3 and the average concentration of CO for 1 hour of 0.3~1mg/m^3 accounting for 20.0% and 10% of Class II of *Ambient Air Quality Standard* (GB3095-2012). The ratios of the maximum ground-level concentration of CO to the Class II of *Ambient Air Quality Standard* are relatively low.

The construction index, topography and atmospheric diffusion conditions of the project are similar to those of the analogy highway, and the traffic volumes of the project operation in the near term, the medium term and the long term are lower than the current traffic volume of the analogy highway. From this analogy, it can be seen that NO_2 and CO in the air pollutants within the assessment range can meet the Class II of *Ambient Air Quality Standard* (GB3095-2012), and the maximum ground-level concentration of NO_2 and CO to the Class II of the Standard is relatively low. Therefore, the operation of the proposed project will not cause a great adverse impact on the ambient air along the route.

8.4.2.2 Impact Analysis of Atmospheric Pollutants in the Tunnel

According to the pollutant concentration field outside the entrance of Zhongnanshan Super-long Tunnel (with a length of 18.020km) in Qinling Mountains, the diffusion analysis and numerical analysis are carried out. The concentration distribution of exhaust pollutants at the tunnel portal attenuates with the increase of the plane distance from the highest concentration at the center of the entrance, and the attenuation is remarkable without terrain obstruction. Atmospheric stability has a great influence on the concentration distribution of pollutants outside the tunnel portal. When the atmosphere is stable, the diffusion ability of pollutants is inhibited; and when the atmosphere is unstable, the turbulent motion is strengthened, the pollutants discharged from the entrance diffuse rapidly and the concentration of pollutants around the portal is relatively low. The maximum concentration of CO at 60m and 90m outside the tunnel portal shall not exceed 10.00mg/m^3 and 8.5mg/m3. From the above conclusions, it can be seen that the pollutant discharge at the portal of this extra-long highway tunnel has little influence on the ambient air at sensitive points 60 meters away.

There are 6 tunnels Component A, among which Nongwan Tunnel (K1+344), Buli Tunnel (K3+865), Dunli Tunnel (K5+788) and Longkalang Tunnel (K7+182) are short tunnels with small interval, and Longdong Tunnel (K9+710) and Shuolong Tunnel (AK4+290) are separated long tunnels. There is one tunnel in Component B, namely Longhong Tunnel.

According to the field survey, the sensitive points distributed within 100m of the tunnel portal of the project mainly include Bulitun near the exit of Buli Tunnel (K4+695), Rentun near the exit of Shuolong Tunnel (AK5+015) and Longhongtun near the exit of Longhong Tunnel. In view of the fact that the tunnel length of the Project is far less than that of Zhongnanshan Super-long Tunnel (18.02km) in Qinling Mountains, the air flows in the tunnel is exchanged rapidly, and the accumulated amount of pollutants is small. After diffusion, dilution, and absorbed by the well-grown vegetation around to a certain extent, the concentration has been greatly reduced, which basically will not adversely affect the residents of Bulitun, Rentun and Longhongtun at the entrance and exit of the tunnel.

8.4.2.3 Analysis on Impact of Atmospheric Pollutants at Shuolong Port (Phase II of Shuolong Gate)

(1) Vehicle exhaust

Due to the open area where the project is located, good ventilation, and low motor vehicle exhaust emission, the small amount of exhaust gas emitted has little impact on the surroundings after being diluted by air. A variety of grass and trees shall be planted for greening near the ground parking spaces, and green belts shall be provided accordingly. Meanwhile, air renewal and ventilation of underground garages shall be improved to reduce the impact of automobile exhaust on the surrounding environment. In addition, it is required to flame out for temporary parking, so as to reduce the working hours of the engine and exhaust emission. Therefore, the automobile exhaust in ground and underground parking lots has little impact on sensitive points and air environment.

(3) Stench

①Toilet

The communal toilets in the Project are built based on Class I water-flush toilet specified in *Hygienic Standard for Communal Toilet* in City Municipality (GB/T17217-1998), and the emission concentration of H_2S and NH_3 are 0.01 mg/m3 and 0.3 mg/m^3, respectively. The exhaust gas (H2S and NH3) in the restroom mainly comes from feces accumulated in the closet pan, urine accumulated in the urinal and urine scale attached hereto. The output and concentration of H_2S and NH3 are related to sanitary conditions, ventilation conditions, temperature and humidity in toilets. The output of exhaust gas in toilets can be reduced through daily cleaning, and the exhaust gas is discharged to the outside for unorganized emission through the exhaust fans, and has little impact on environment.

②Garbage collection point

The domestic garbage shall be classified and stored in garbage bins, and delivered to the environmental sanitation department for concentrated treatment every day; After the above measures are taken, the garbage stench produced during the project construction has little impact on the surrounding environment.

8.5 Prediction and Assessment of Solid Waste Impact on Environment

8.5.1 Impact Analysis of Solid Water during the Construction

Solid waste generated during the highway construction mainly includes two parts. One part of solid waste comes from waste earthwork and stonework generated in the subgrade construction, it is characterized by linear distribution along the highway and large amount, and is the main sources of solid waste in the project construction. The other part of solid waste comes from the construction waste and domestic waste, including the discarded building materials, packaging materials and food residues, etc.. These solid wastes often exist in the storage yards, construction camps, mixing plant and other temporarily-occupied lands, as well as the nearby of bridges and other large-sized structures.

According to estimation, an amount of 473,000 m^3 permanent spoil is discarded by Component A, 64,300 m^3 of permanent spoil is discarded by Component B and 1630 m^3 of permanent spoil is discarded by Component C. Due to the quantity of waste earthwork & stonework is relatively large, if the spoil ground is not arranged reasonably or the contractor piles up the slag at will, it is easy to cause the unplanned distribution of waste earthwork & stonework and spoils along both sides of the work area, crowding out a considerable amount of agricultural and forestry land, making it difficult to control water and soil loss, causing great adverse effects on the ecosystem around the spoil grounds and bringing great difficulties to the recovery and utilization of temporary land at the spoil ground. It will also bring great adverse effects on the landscape environment along the route.

It is estimated that 72t domestic waste in the construction camps will be generated in Component A, 16.43t in Component B and 11.3t in Component C during the construction period. The domestic waste in the construction camps generally contains many organic matters, which is easy to cause a large number of bacteria and mosquitoes to multiply. If it cannot be collected and disposed of centrally, it will easily lead to an increase in the incidence of infectious diseases in the camp and easy to spread. Villages are distributed around some construction camps, and the stench generated by randomly dumped domestic waste will have certain adverse effects on the health of residents in surrounding villages and the surrounding landscape environment. Therefore, regular collection and disposal are necessary.

8.5.2 Impact Analysis of Solid Water during the Operation

During the operation period, the solid waste mainly comes from the domestic garbage of the staff of toll stations, maintenance areas and other service facilities; it is distributed in a dotted way along the highway. Another source of waste is the cargoes fallen down from transport vehicles, the goods loaded on vehicles of traffic accident, and the articles discarded by bus passengers, etc.; such wastes are linearly distributed along the highway.

It is estimated that the annual output of solid domestic garbage of service and management facilities along the project is 10.95 t/a. If it is not properly collected and treated, it will have a considerable adverse impact on the sanitation and landscape environment around the service facilities.

During the operation stage of the Project, the maintenance workers will maintain the whole route of the highway, clear, collect and centrally dispose of the garbage dropped by the running vehicles or passengers along the route. Therefore, this category of solid waste generally does not have a big adverse impact on the environment along the route.

Comoponent B is not designed with the traffic service facilities such as service areas and parking areas. During the operation period, the solid waste mainly comes from the domestic garbage of the staff of service facilities such as toll stations and maintenance stations of Component A, which is distributed in a dotted way along the highway. Another source of waste is the loads scattered by transport vehicles, the goods loaded by vehicles in traffic accidents, and the articles discarded by bus passengers, etc., which are linearly distributed along the highway.

It is estimated that the annual output of solid domestic garbage of service and management facilities along Component A is 10.95 t/a, and that of Component C is 109 t/a. If it is not properly collected and treated, it will have a considerable adverse impact on the sanitation and landscape environment around the service facilities.

During the operation stage of the Project, the maintenance workers will maintain the whole route of the highway, clear, collect and centrally dispose of the garbage dropped by the running vehicles or passengers along the route. Therefore, this category of solid waste generally does not have a big adverse impact on the environment along the route.

8.6 Environmental Risk Assessment

8.6.1 Evaluation Basis

8.6.1.1 Risk Investigation

According to the statistics of highway accident types in China, the main risks of driving vehicle accidents are all kinds of accidents that occurred in transporting petrochemical vehicles.

(1) The pollution accidents caused by vehicles to water bodies mainly include the gasoline (diesel oil) and engine oil carried by vehicles leak, or dangerous chemicals transport vehicles leak after a traffic accident and discharged into nearby water bodies; or the vehicle fell into the river with goods after a traffic accident occurred on the bridge deck. If petrochemical transporting vehicles fall into water bodies near rivers or reservoirs, the leakage and falling of dangerous chemicals will cause water pollution and endanger aquaculture and agricultural irrigation;

(2) Dangerous goods are scattered on the land, which affects the normal use of land, destroys the land ecology and affects agricultural production;

(3) Dangerous goods leak from vehicles near residential areas; in case of volatile chemical, it will also cause ambient air pollution in nearby residential areas;

(4) Since the space in tunnels is narrow, once a dangerous good transporting vehicle accident occurs and causes a fire, it is difficult for other vehicles to turn around and evacuate in time, which is easy to cause blockage and lead the fire spreading along with the vehicle flows. It easily leads to form a "fire dragon" burning, casualties and losses. Therefore, risk & accident prediction and analysis shall be carried out at the critical tunnels.

Once a leakage, an explosion, or a burning occurred in the transportation vehicles or its carried oil products, a malignant pollution accident within a certain range of surrounding areas will be caused in a short time, which will cause great harm to the local environment and losses to state property.

8.6.1.2 Preliminary Judgment of Risk Potential

The functional orientation of Component B is mainly the scenic highways and border highways. The running vehicles mainly include the passenger vehicle and tourist buses entering and leaving scenic spots. Most of the dangerous substances are the fuel in automobile fuel tanks, and the mass of which is far less than the critical quantity (2500t) in *Technical Guidelines for Environmental Risk Assessment on Projects* (HJ169-2018). The risk potential is Class I.

8.6.1.3 Assessment level

According to the *Technical Guidelines for Environmental Risk Assessment on Projects* (HJ169-2018), a simple analysis can be carried out for these projects with the risk potential of Class I. The qualitative explanations can be made from the aspects of describing hazardous substances, environmental impact paths, environmental harm consequences, risk prevention measures, etc. The assessment contents are analyzed according to the basic contents of simple analysis in Appendix A of the Guidelines.

8.6.2 Overview of Environmental Sensitive Objects

According to the definition of the environmental sensitive objects in the risk guidelines, combined with the investigation of highways along the route, the environmental sensitive objects for the main risks along the route are as shown in the table below.

Table 8.6-1 Distribution of Environmental Sensitive Object for Project Risks

Category	Environmental Sensitive Targets	Location & chainage of intersection with highways	Ways to affect the environmental sensitive objects
Surfacewater environment	Guichun River	It is located on the south side of the route, where K0+000~K5+500 is adjacent to the river	Gasoline and diesel oil leaked into Guichun River, polluting the water quality of the water source conservation area.
	Aitun Water Source Protection Zone in Shuolong Town	Highway section K0+200~K5+300 passes through the Grade II conservation area of the Aitun Drinking Water Source Conservation Area in Shuolong Town, where section K3+900~K5+300 is adjacent to the Grade-I conservation area of this water source conservation area.	
	Shuolong Community Water Source Conservation Area in Shuolong Town	The K9+400~K10+000 of the highway passes through the secondary conservation area of Shuolong Community Water Source Conservation Area in Shuolong Town, and the layout of K10+000~K11+400 shall be adjacent to the secondary conservation area the water source. Among them, the water source of Yuejin Canal is from Guichun River, and the water inlet of Yuejin Canal is located at river section of Detian Old Kapok Scenic Area near K7+800 (outside the water source conservation area)	
Atmospheric environment	Detian, Liudeng, Aijiang Forest Farm, Aitun, Bagan, Aijiang Complete Primary	K0+000、K1+900~K2+060、K3+000~K3+500、K5+500~K5+700、K5+900~K6+000、K6+100、K6+700~K6+800、K6+900~K7+100、K9+700、K10+400~K11+200、K12+300~K13+100、K13+200~K13+400、K13+700	Gasoline and diesel oil leak, and cause fire; the impact of combustion gas on the air quality of sensitive objects

Category	Environmental Sensitive Targets	Location & chainage of intersection with highways	Ways to affect the environmental sensitive objects
	School, Longjian, Wanlong, Longhong, Gutun, Shuolong Community, Rentun and Mitun		

8.6.3 Environmental Risk Identification

Highway projects do not involve the production, usage and storage of toxic, hazard, inflammable and explosive dangerous substances, and the main environmental risks arecaused by indirect behaviors such as transported goods or oil leakage led by traffic accidents of vehicles on highways. The functional orientation of the project is mainly the tourism highways and border highways. The running vehicles mainly include private cars and tourist buses entering and leaving scenic spots, as well as a small number of border trade vehicles. Most of the dangerous substances are the gasoline and diesel oil in automobile fuel tanks. When the vehicles encountered a traffic accident, it may cause vehicle-carried gasoline or diesel oil leaking into the surrounding environment and flowing into the Guichun River, which may cause water quality deterioration and affecting the water quality of Guichun River Water Source Conservation Area. When a fire occurs in the leaked oil products, the exhaust gas generated from combustion will cause ambient air pollution to the surrounding air.

8.6.4 Environmental Risk Analysis

8.6.4.1 Analysis of Ambient Air Pollution Consequences

The probability of occurrence of two air pollution risk accidents (the fuel leakage and the fire) at the same time is extremely low; and since the leaked fuels mainly come from the traffic accident vehicle-carried fuel, the quantity of fuel leakage will be small. The combustion products are mainly particulate matter and carbon dioxide, which mainly causes suffocation to the human body. Most sections along the route of the Project have wide terrain, so it is difficult for pollutants to gather to suffocation level. At the same time, due to the high air mobility and rapid diffusion of gas pollutants, the duration of the accident impact is short and the impact is small.

8.6.4.2 Analysis of Surface Water Pollution Consequences

According to the investigation, most sections of Guichun River in Component B are located near the route of the Project, and 1 water intake for the township water source is set up at the Guichun River. Also, the water source for Shuolong Community comes from Guichun River. In the case of traffic accident occurred on the project highway, vehicles may rush into Guichun River and cause fuel leakage directly into the surface water, or the leaked fuel on the pavement may enter the Guichun River along with the surface runoffs, which may pollute the water quality of Aitun Water Source in Shuolong Town and the water quality of Shuolong Community Water Source taken from Guichun River.

Once the pollutants directly enter the above-mentioned water sources, the content of petroleum pollutants in the water sources will exceed the standard, resulting in deterioration of water quality, and in severe cases, the water supply of the water sources will be interrupted directly.

To sum up, the possibility and pollution level of ambient air pollution risk accidents in the project are relatively small, and the main environmental risks of the project are reflected in that the accident of vehicles on highways causes the leaked fuel entering Guichun River and affects the water quality of the 2 water sources in Shuolong Town.

8.6.5 Environmental Risk Prevention Measures and Emergency Response Requirements

8.6.5.1 Environmental Risk Prevention Measures

In order to reduce the impact of project environmental risks on water quality of water sources, it is proposed to put forward risk prevention measures from several aspects such as risk sources, influencing ways and sensitive objects, etc. The details are as shown below:

(1) Risk source control measures

The project does not involve sewage discharge, and the occurrence of water pollution risk accidents is mainly caused by fuel leakage led by traffic accidents of vehicles on the highway. Therefore, by limiting the vehicle type entering the section and controlling the probability of traffic accidents, the occurrence of water pollution risks can be controlled from the source. According to the statistics of transportation departments, traffic accidents mainly occur in the process of drivers' bad driving behaviors such as fatigue driving, inattention in the driving process, speeding and illegal overtaking. The traffic accidents caused by locomotive faults are relatively few. Therefore, in order to effectively control the occurrence of traffic accidents, it is necessary to correct the bad driving behavior of drivers, and measures such as limiting the speed of vehicles, limiting the number of vehicles and setting up warning traffic signs can be taken.

Speed control: as the section of K0+000~K5+500 is close to the national border, the designed speed of this section is 40km/h, which alleviates the occurrence probability of accidents to a certain extent, and speed limit signs are set at both ends of the section. The water intake of Yuejin Canal is located at the sightseeing spots along the river in the K7+800 Detian Old Kapok Scenic Area. It is not convenient for tourists to pass through the anti-collision guardrail. It is suggested to set speed reduction belts and speed limit signs at both ends of the Section of K7+500~K8+100 to control the speed.

Limiting traffic flow: this section is located in Detian Grand Scenic Spot. Huashan Scenic Area. According to the special opinions of scenic spots on the highway crossing scenic spots, it is suggested that the highway shall be included in the scenic highway planning. The EIA suggests that the project construction department should further strengthen communication with the scenic area management department, incorporate the section into the internal roads of the scenic area, and control the passenger flow, so as to avoid excessive traffic flow on the section increasing the probability of risk accidents.

Set warning signs: the overtaking prohibited signs shall be set up at K3+900~K5+300 near the primary land conservation area of Aitun water source in Shuolong Town and K7+600~K8+000 near the water inlet of Yuejin Canal; and the signs such "You have entered the secondary conservation area for Aitun water source in Shuolong Town, please drive with cautions" shall be set up at both ends of the section of K0+460~K5+360; and the signs such as "You have entered the secondary conservation area for Shuolong Community water source in Shuolong Town, please drive with cautions" shall be set up at both ends of the section of K9+400~K10+000.

(2) Control Measures of Environmental Impact Paths

As the section of K0+000~K5+500 is close to the national border, a national defense border guardrail has been set in this section, which can effectively prevent vehicles in an accident from rushing into Guichun River. However, the existing highway is not provided with drainage ditches, and the surface runoff directly flows into Guichun River. In order to reduce the impact of accident wastewater on the water source area, this assessment suggests that the project shall build intercepting drainage ditch about 1.4km away from the section of K3+900~K5+300, which is close to the primary land conservation area for Aitun water source in Shuolong Town, and build a sedimentation tank on the mountainside of K5+300 to collect the surface runoff. After sedimentation treatment, it will be discharged into the downstream section of Aitun Dam in Guichun River to reduce the impact of surface runoff on the water quality of Aitun water source in Shuolong Town.

(3) Alternative Measures for Environmental Sensitive Objects

The Shuolong Community Water Source Plant is located in the market town of Shuolong Town, which is connected to Guichun River through Yuejin Canal. The water from the river will be supplied to water users in the market town after purification treatment. At the end of Yuejin Canal, there is the Shuolong Town Power Plant, whose water quantity and flow rate are affected by the opening and discharging of the power station. Therefore, it is suggested to strengthen monitoring at the water intake of the water plant. Once the water quality in the canal is found to be affected by leakage pollution, the water supply shall be stopped immediately, and the government shall be reported to start the emergency plan at the same time, and the water supply shall be resumed after the pollution treatment finished and the water samples are tested to be qualified.

Aitun Water Source in Shuolong Town is a planned water source, and no water intake project has been carried out yet. It is suggested that the water intake video surveillance system and rapid water quality analyzer should be set up during the construction of the water intake project in this water source area to monitor the water quality. Once pollution occurs, water intake and water supply shall be stopped immediately, and the government shall be reported to start the emergency plan. The water supply shall be resumed after the pollution treatment finished and the water samples are tested to be qualified.

8.6.5.2 Emergency Measures and Plans for Environmental Risks

According to the above analysis, the occurrence probability of water pollution risks in the project is relatively low. However, once such incidents occur and no effective preventive measures are taken, a dangerous goods transportation accident will occur, which will have a relatively great pollution impact on Guichun River water environment, the Aitun water source in Shuolong Town and the Shuolong Community water source.

In case of diesel pollution accident on the highway, the diesel oil floating on the water surface will drift under the action of water current and aeolian current, and the diesel oil will bring serious pollution to river water and aquatic organisms in a short time through its own diffusion. It is necessary to take emergency measures and start the emergency plan immediately.

1. System Location and Emergency Handling Procedures of Accident Emergency Plan

According to the division principle of the national emergency plan system for public emergencies determined by the *National Emergency Plan for Public Emergencies* (January 8, 2006) issued by the State Council, for the Project, the local emergency plan for public emergencies and the emergency plan for public emergencies departments are identified. Emergency treatment procedures mainly include the following 4 aspects:

(1) Information report

After the occurrence of a particularly significant or major public emergency, the incident shall be immediately reported to the higher emergency command agency and notified to the relevant regions and departments, no later than 1 hour. During the emergency response, the situation shall be renewed in a timely manner.

(2) Early disposal

After the occurrence of public emergencies, while reporting the information of serious and extraordinarily serious public emergencies, it is necessary to start the relevant emergency plan according to the responsibilities and the prescribed authority, timely and effectively handle the situation and control the situation.

(3) Emergency response

For extraordinarily serious public emergencies where the situation is not effectively controlled after early disposal, it is necessary to start relevant plans in a timely manner, and the higher-level emergency command organization shall uniformly command or guide relevant regions and departments to carry out disposal work. On-site emergency command organization shall be responsible for on-site emergency disposal. For public emergencies that require multiple relevant departments to participate in the disposal, the competent business department of such public emergencies shall take the lead and other departments shall provide assistance.

(4) Termination of emergency response

After the emergency disposal of the extraordinarily serious public emergencies, or the elimination of relevant risk factors, the site emergency command organization shall be revoked.

2. Environmental Risk Emergency Plan

According to the environmental characteristics of the proposed project, the operation management department shall formulate the *Emergency Plan for Pollution Accidents of Detian-Shuolong Highway* including the following contents:

(1) General requirements

The Project is located in Daxin County, Chongzuo City, the risk emergency response plan shall be incorporated into the emergency response plan system of Daxin County for environmental emergencies, while the organic links shall be considered; in this emergency response plan system for environmental emergencies, the emergency response plan developed for the operation management department shall be able to effectively cooperate with the relevant departments along with the local government.

(2) Setting and staffing of emergency agencies

① Setting of superior command center

The Operator of the Project shall set up corresponding emergency agencies, and its superior command and management shall be composed of Daxin County Government, traffic management department, public security department, fire department, environmental protection department and other relevant departments and the traffic management center of the Project, and the first person in charge of the management center is its member.

② Settings of each management sub-center

Each management sub-center of the Project shall set up an emergency agency according to the principle of territoriality, and form a road section emergency management sub-center with reference to the establishment of the higher-level command center, together with relevant territorial departments, and the first person in charge of each management center is its member.

③Emergency leadership team

The emergency leading group office of the management center shall be set in the management center office, and the director of the office shall be responsible for it.

④Safety management monitoring team

The management center has an accident safety management team under the responsibility of the team leader.

⑤Safety management personnel

It is composed of employees in the management center.

⑥Internal Collaboration Management Department

An emergency coordination office shall be set up by Daxin County Traffic Management Department and project operation management center, as a cooperative organization of emergency actions, responsible for coordinating the transport management and emergency disposal of dangerous goods on highways; each operation management sub-center and local traffic management department shall set up corresponding two-tier cooperation organization. See Figure 8.2-25 for the emergency organization system setup.

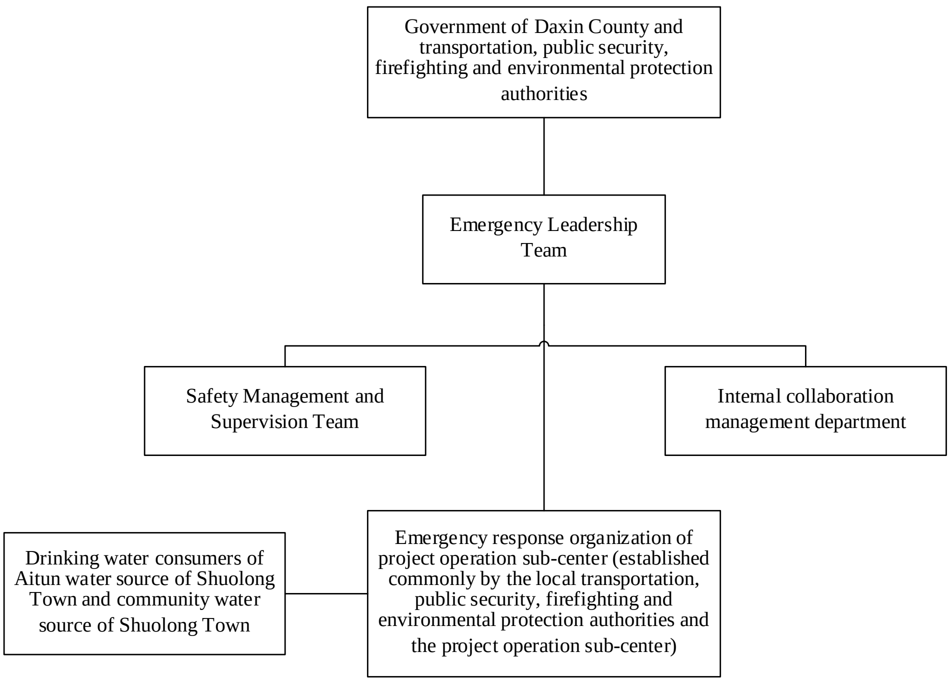


Figure 8.6-1 Accident Emergency Organization and Command Organization Chart

(3) Responsibilities and division of labor of the management center

① The responsibilities of the superior command center are determined by the regional emergency system. This report mainly outlines the responsibilities and division of labor of employees in the project management center.

The chief (the first person in charge) of the management center shall be fully responsible for safety management and the work of the general commander of emergency rescue for risk accidents.

② The deputy of the management center shall be responsible for supervising the daily safety inspection, implementation and rectification, and cooperating with the chief in the emergency rescue of safety accidents. The deputy shall also organize regular safety inspections of highway protection facilities or equipment, and report the inspection results to the superior command center.

③ The director of the office shall be responsible for the daily salary of safety management, and the liaison and coordination of emergency rescue work for safety risk accidents; supervise and urge leaders to organize employees of the project operation management department to carry out safety knowledge education and skills training.

④ The leader of safety management team shall organize the implementation of highway emergency facilities inspection and daily management.

⑤ The safety officer shall carry out daily maintenance and management of emergency facilities and protective facilities within the highway.

⑥ After the accident occurs, it shall be reported to the emergency monitoring personnel on the duty of the center in time according to the accident grade content, and the place, quantity and goods type shall be clearly defined; the personnel on duty shall report to the leader of the emergency leading group, who shall start the emergency plan of the Project after verification, and announce the information of sudden events to the departments confirmed in the emergency plan, so as to clarify the relevant emergency entities and personnel to be started.

⑦ In case of major accidents, report to the superior command and management center, so as to organize the cooperative departments in time or take emergency rescue measures through external cooperation.

(4) Accident reporting system

The operation management department of the Project shall set alarm contact information and alarm equipment in the highway, especially in sensitive sections, so as to facilitate the effective transmission of information after dangerous accidents; it is suggested that the internal and external information transmission of project emergency agencies shall be set according to the following process.

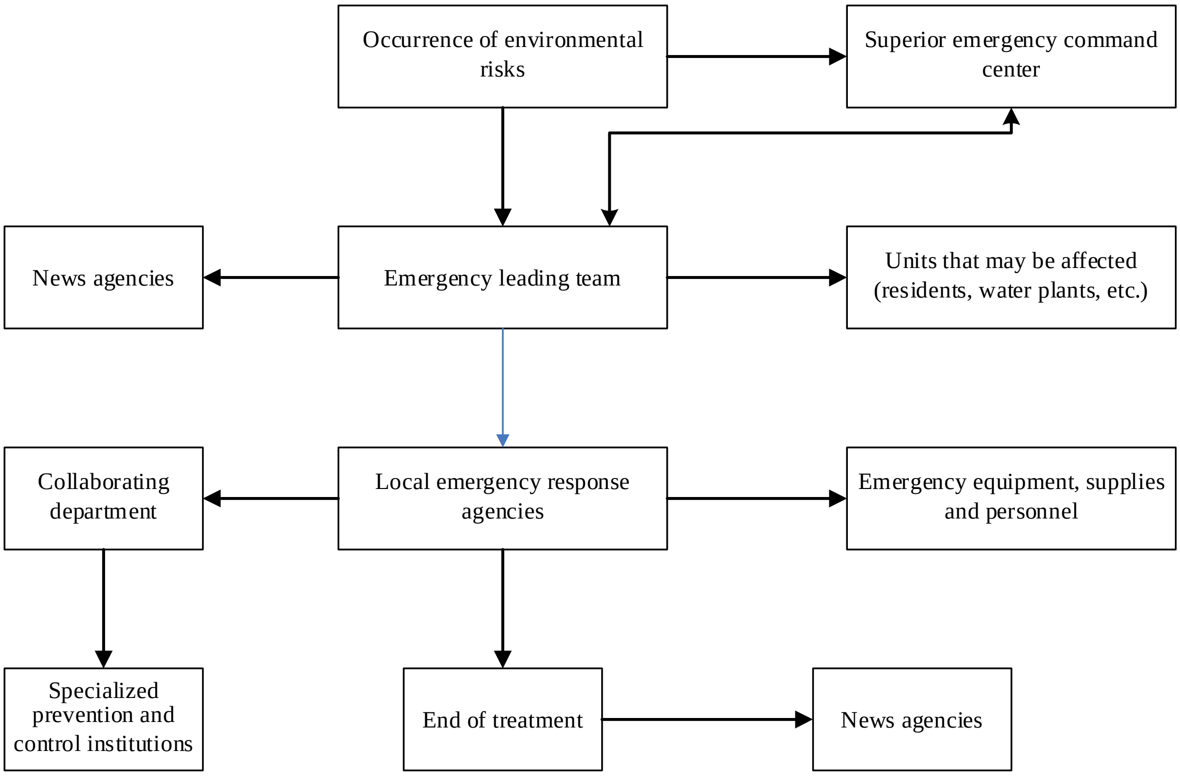


Figure 8.6-2 Accident Emergency Flow Chart

(5) Accident report content and processing flow

①Reporting Requirements

Report contents of safety management staff of the center and accident site personnel:

a. The reporter shall explain the location of the accident and the type of goods, with clear and specific address;

b. In case of fire or explosion caused by fire, the casualties and the fire of fire materials shall be specific;

c. The name, telephone number and contact method of the person who made the call shall be recorded. If the accident occurs in a densely populated area, an evacuation alarm shall be issued.

②Preventive Facilities

a. Management measures shall be formulated to prohibit and guide the passage of vehicles transporting dangerous chemicals.

b. Adequate preventive measures shall be provided for the section passing through the water environmental sensitive area, including the surface runoff system, sedimentation tank, speed bumps, speed limit and overtaking prohibited signs, etc.

③Main start-up and emergency procedures

a. Adequate emergency personnel shall be provided for each on-site emergency agency;

b. Emergency management institutions and personnel shall start and respond to emergency procedures according to the emergency response time (controlled within 0.5h);

c. Emergency and preventive measures shall be communicated to the potentially affected areas as soon as possible, so as to facilitate the affected entities and personnel to take measures;

④Accident compensation

The environmental protection department shall cooperate with relevant government functional departments to jointly organize the investigation, and determine the compensation expenses according to the losses caused by the actual accident. After the final judgment of the court, the responsible entity shall compensate the victims.

⑤Drill and inspection system

Emergency drills shall be carried out regularly according to the emergency plan, familiar with the emergency process, and regularly check the integrity of emergency equipment and materials; safety education and management in highway management departments shall be strengthened to improve employees' safety awareness; employees in the center shall be organized to respond to emergencies correctly.

3. Environmental protection requirements for the next step

At the next stage, the Owner of the Project shall strictly follow the relevant provisions of the *Measures for the Record Management of Emergency Response Plans for Environmental Emergencies in Enterprises and Institutions (Trial)* to carry out emergency plan preparation, evaluation and documentation.

8.6.6 Analysis Conclusions

After the occurrence of environmental risk accidents in Component B, the water quality of the water source crossing the highway may be affected to a certain extent. However, as the highway of the project has the functions of the scenic highway and the border highway at the same time, the proportion of vehicles with dangerous chemicals is extremely small, and the main running vehicles are private cars and tourist buses, and the environmental risks are mainly caused by traffic accidents of running vehicles. On the premise of combining the existing frontier fence and the designed speed, this assessment puts forward some preventive measures, such as speed limit, overtaking prohibited signs and water source notice board, which can effectively remind drivers to pay attention to safe driving. The proposed surface runoff and sedimentation tank can reduce the probability of leaking fuel entering Guichun River after the accident. With the implementation of the above measures, the environmental risk probability of the project is effectively reduced. At the same time, the emergency plan put forward by EIA can effectively control the impact of risks on the drinking water safety of residents in the water source, so that the impact of environmental risks can be controlled.

8.7 Investigation for Cultural Relics

No cultural relics under government protection has been found during the investigation at this stage. The Employer and the Contractor shall protect the cultural relics found during construction process in strict accordance with the following procedures:

(1) Shut down immediately;

(2) Report to the local government and cultural relics management department, and take corresponding protective measures to cultural relics;

(3) Construction can only be carried out after the cultural relics are dealt with by the cultural relics management department and it is proved that the construction will not affect the cultural relics;

(4) During the construction, the national regulations and policies on cultural relics protection shall be observed to ensure that cultural relics are not damaged.

9 Mitigation Measures for Environmental Protection

9.1 Environmental Protection Measures for Chongzuo - Jingxi Expressway to Shuolong Port Section in the Design Stage

9.1.1 Environmental Protection Measures in the Design Stage

9.1.1.1 Ecological protection measures

9.1.1.1.1 Reduction of Impact on Protected Plants and Old Trees

Protected plants in the project assessment area mainly include Zenia insignis and buerretiodendron hsienmu, and the old trees are mainly ficus lacor and longan trees. The protection measures for them are as below:

Table 9.1-1 Major Protection Measures for Protected Plants along the Project Route

Species Name	Nature	Number of Stems Affected Directly	Positional Relation with the Highway Centerline (m)		Feasibility Analysis of Route Avoidance	Feasibility Analysis of Transplanting	Protection Suggestions
Protected plants							
Excentrodendron tonkinese	National Level II	0	K4+700	80m RHS of Buli Tunnel	—	—	In-situ conservation
		0	K8+900	70m LHS of Longkalang Super Major Bridge	—	—	In-situ conservation
		0	K9+250	160m LHS of Longkalang Super Major Bridge	—	—	In-situ conservation
		0	K9+400	210m on the right side of Longkalang Super Major Bridge	—	—	In-situ conservation
		0	K9+880	180 m to the left side of Longdong No.1 Tunnel	—	—	In-situ conservation
		0	K9+900	320 m to the right side of Longdong No.1 Tunnel	—	—	In-situ conservation
		0	K10+375	Upper right of Longdong No.2	—	—	In-situ conservation

Species Name	**Nature**	**Number of Stems Affected Directly**	**Positional Relation with the Highway Centerline (m)**		**Feasibility Analysis of Route Avoidance**	**Feasibility Analysis of Transplanting**	**Protection Suggestions**
				Tunnel			
Zenia insignis Chun	National Level II	0	K8+700	270m on the right side of Longkalang Super Major Bridge	—	—	In-situ conservation
		0	K9+400	50m LHS of the route	—	—	In-situ conservation
		0	K10+330	40 m to the left of Longdong No.2 Tunnel	—	—	In-situ conservation
Cibotium barometz	National Level II	0	AK3+930	10 m to the right of Shuolong Tunnel		—	In-situ conservation
		0	AK4+390	55 m to the right side of Shuolong Tunnel		—	In-situ conservation
Acampe rigida	Regional (Guangxi)	0	K9+900	120 m to the right side of Longdong No.1 Tunnel	—	—	In-situ conservation
Cymbidium bicolor Lindl	Regional (Guangxi)	0	K10+053	90 m to the left side of Longdong No.1 Tunnel	—	—	In-situ conservation
Cheirostylis chinensis	Regional (Guangxi)	0	K9+100	190m LHS of Longkalang Super Major Bridge	—	—	In-situ conservation
Spiranthes sinensis	Regional (Guangxi)	0	AK3+930	10 m to the right of Shuolong Tunnel	—	—	In-situ conservation
Ancient tree							
Radermachera sinica	Class III old tree	0	K4+570	35m LHS of Buli Tunnel	—	—	In-situ conservation
Dimocarpus longan	Ancient tree	0	K10+050	58m LHS of Longdong Tunnel	—	—	In-situ conservation
Ficus lacor	Class III old tree	0	AK0+580	In the occupied area	—	—	Optimize the design as far as possible to avoid them; if it is

Species Name	Nature	Number of Stems Affected Directly	Positional Relation with the Highway Centerline (m)		Feasibility Analysis of Route Avoidance	Feasibility Analysis of Transplanting	Protection Suggestions
							impossible to avoid them, report it to the forestry department for the approval of transplant
Dimocarpus longan	Class III old tree	0	AK4+980	6m RHS of the connecting line	—	—	In-situ conservation
Litchi chinensis	Class III old tree	1	AK5+010	6m RHS of the connecting line	—	—	In-situ conservation
Litchi chinensis	Class III old tree	2	AK5+010	35m on the right side of the Connecting Line	—	—	In-situ conservation
Ficus lacor	Class III old tree	1	AK5+000	65m on the right side of the Connecting Line	—	—	In-situ conservation

9.1.1.1.2 Reduction of Occupation of Key Public Welfare Forest

According to the investigation, it is planned to occupy 15.7hm2 of key public welfare forests (autonomous regional level) during construction period of the Project, including approximately 4.88hm2 in Tiandeng County and 10.82m2 in Daxin County. For sections need to occupy the public welfare forests, the Route Designer shall try to avoid the public welfare forests. If it is impossible to avoid them, the Route Designer shall try to design a bridge/tunnel for the route. If it is required to adopt subgrade for the route, the Route Designer needs to go through the relevant wood land formalities as per the law, accept the supervision of the forestry authority, adopt the non-local compensation mode of "compensating every piece of land occupied", and pay a full amount of forest and vegetation recovery fees for the construction, cultivation, protection and management of public welfare forests. If possible, the public welfare forests shall be restored to the evergreen broad-leaf forest, which has a relatively strong water conservation capacity.

9.1.1.1.5 Prevention of Alien Species Invasion

1. Prevention of Alien Plant Invasion

According to the investigation, there are a total of 24 alien species in the investigation area. The alien plants need invasion source and growth space, while the project construction may create favorable conditions for the spread of these alien plants. As a result, protective measures shall be taken to prevent further spread. In order to prevent the alien plant invasion, two aspects shall be controlled properly.

I. Prevent the alien species from entering the construction site. Firstly, educate the personnel passing through or entering the construction site, improve the awareness of construction personnel against alien species invasion, and take correct measures to avoid and prevent alien species invasion. Secondly, provide strict recommendations regarding articles and vehicles entering the construction site to curb the source of invasion effectively.

II. Reduce the living and reproduction space for invasive alien plants and try not to implement large-scale excavation and destruction of native vegetation during construction. For inevitable excavation and destruction, after use, the native plants shall be used as afforestation tree species to restore the vegetation coverage as soon as possible.

III. The invasive species with great threat, e.g. Bidens pilosa and Conyza canadensis, shall be strictly controlled from the sources of material transportation and construction movement, and destroyed immediately once found. For areas with high possibility of invasion, such as areas with good hydrothermal conditions and numerous invasion sources, the area of exposed soil shall be minimized. For the inevitable areas, the used land shall be restored immediately, and the vegetation shall be restored immediately to reduce the probability of invasion.

(2) Prevention of Alien Animal Invasion

Currently, 2 kinds of alien animals have been found, and no obvious factors leading to alien animal invasion have been found yet. However, there is possibility that during the construction period or operation period of the Project, the alien animal invasion occurs due to the increase of personnel entering the protection zone and human activities, e.g. the Trachemys scripta and Oreochromis niloticus are spread to a wider area. It is also possible that, during construction, a kind of harmful invertebrate is introduced from the transported materials for construction, e.g. wooden case or sheet material.

Generally speaking, no matter it is alien plant invasion or alien animal invasion, it is possible to avoid the biological invasion caused by human factors properly supervising the construction and strengthening the vegetation restoration measures after construction.

9.1.1.1.6 Aquatic Ecological Protection Measures

The surface water bodies involved in the assessment area of the proposed highway mainly include Guichun River, Xialei River and Baidou River. The local fishery authority has confirmed that there are no "Three Grounds" (spawning ground, feeding ground and wintering ground) for important or protected fish in the waters of the assessment area. All fishes in the assessment area are common fishes, e.g. carp and crucian carp, and there are no national key protected fishes or Guangxi regional key protected fishes. In order to protect the aquatic living resources in surface water bodies of the assessment area, the following aquatic ecological protection measures are proposed in this assessment:

1. The temporary and permanent measures shall be appropriately designed for soil and water conservation, and intercepting ditches and drainage ditches and settling basins shall be designed around the construction site to prevent the running water of heavy rain from seeping into and wetting the exposed surface and causing large-scale water and soil loss. Design temporary settling basins in the catchment areas to prevent large amount of sediment from entering the surface water bodies with water.

2. In the next stage of design, the slag disposal for the bridge foundation shall be optimized. Sediments shall be collected from the mud pit of the construction platform, solidified and then sent to the spoil ground of the Project for landfill treatment or used for urban construction. The sediments must not be discarded at will.

3. In the next stage of preliminary design, the bridge location and substructure arrangement shall be further optimized to minimize the number of piers in the water.

9.1.1.1.7 Special Design for Sections with Special Requirements for Environmental Functions

There are 11 acoustic and atmospheric environmental protection targets within the scope of assessment along the proposed highway, including 8 sensitive points along the mainline (2 schools and 6 villages) and 3 sensitive points along Shuolong Connecting Line (villages).

For sections passing through protected targets such as village or school, special designs, e.g. greening and noise reduction, dust suppression and plant absorption of automobile exhaust, shall be carried out in combination with the greening works. For sections passing through sensitive sections and regions, e.g. Xialei Nature Reserve and Huashan Scenic Area, high-fill deep-cut section and auxiliary facilities along the highway, the special landscape design shall be carried out appropriately.

9.1.1.1.8 Environmental Protection Measures for the Section Passing through Xialei Nature Reserve

The mainline (chainage: K7+885 ~ K10+715) of the Project will pass through the experimental area of nature reserve in the form of tunnel (Longkalang Tunnel) + subgrade + bridge (Longkalang Super Major Bridge) + tunnel (Longdong Tunnel). The Connecting Line (chainage: AK3+600 ~ AK4+600) will pass through the experimental area of nature reserve in the form of tunnel (Shuolong Tunnel).

For the section passing through Xialei Nature Reserve, in addition to environmental protection measures for the design period, construction period and operation period, the following protection measures shall be taken to minimize the adverse impact on the ecologically sensitive areas.

1. The section passing through Xialei Nature Reserve shall be subject to special greening design, which mainly adopts tall arbor species as the greening tree species on both sides of the highway, and adopts the combinations of woody plants and herbs, evergreen trees and deciduous trees, conifers and broad-leaved trees for greening. In addition, the greening on both sides of sections near tunnel portals shall be enhanced by adopting the combination of arbor and shrub and tree species with large crown

breadth, so as to reduce the disturbance to animals caused by strong light from vehicles driving at night.

2. The design of Changkalang Tunnel and Shuolong Tunnel shall be optimized, and special landscape design shall be carried out for tunnel portals. The design form, color and shape shall be coordinated with the surrounding natural landscape for sheltering and greening. In addition, barriers shall be arranged to prevent wild animals, such as macaque, from entering the tunnel and the roads nearby.

3. For the section passing through the nature reserve, the visible area shall adopt the ecological slope protection as much as possible. In the area requiring mortar rubble protection, green plants shall be planted to weaken the artificial traces.

4. It is forbidden to arrange temporary sites, e.g. construction camp, construction, production and living area, spoil ground, temporary spoil yard and construction materials stacking point, in the nature reserve for drinking water source, or excavate sand or borrow soil within the protection zone. It is necessary to mark out the construction range strictly, control the number of temporary sites and construction temporary access, and prohibit anyone from expanding the range at will or entering the protection zones. It is forbidden to pile up domestic wastes or discharge wastewater at will in the nature reserve. The construction, production and domestic wastewater outside the protection zone must not be discharged into the protection zone.

5. Warning signs, speed limit signs and no-horn signs shall be provided 1km before the entrance of Xialei Nature Reserve. The warning sign 1km before the closest section to the protection zone shall be marked with "It's close to Xialei Nature Reserve, please drive carefully, and do not turn on high beam lights", and the warning sign for leaving the section between the two protection zones shall be marked with "You have left Xialei Nature Reserve, thank you for your support".

9.1.1.1.9 Environmental Protection Measures for Sections Passing through Huashan Scenic Area

According to the *Master Plan for Huashan Scenic Area (1994 Edition)*, the recommended scheme for the mainline (Route K) (K11+500 ~ K12+263) and the recommended scheme for the Connecting Line (Route A) (AK0+000 ~ AK5+423) will pass through the Class II protection zone of Huashan Scenic Area in the form of bridge (Bangtun Major Bridge and Shuolong Guichun River Major Bridge), tunnel (Shuolong Tunnel) and subgrade, with a length of approximately 6.179km.

For the section passing through the Huashan Scenic Area, in addition to environmental protection measures for the design period, construction period and operation period, the following protection measures shall be taken to minimize the adverse impact on the ecologically sensitive areas.

1. The sections (K11+500 ~ K12+263, AK0+000 ~ AK3+540) shall adopt the special greening design, and local species shall be adopted, organized and matched to imitate the local ecological community, thus integrating the highway landscape with the natural landscape. The ecological slope protection shall be adopted to the greatest extent in visible areas, and green plants shall be planted to

weaken the artificial traces in places that the mortar rubble protection is required.

2. Warning signs, speed limit signs and no-horn signs shall be provided 1km before the entrance of Huashan Scenic Area. The warning sign 1km before the closest section to the protection zone shall be marked with "It's close to Huashan Scenic Area, please drive carefully, and do not turn on high beam lights", and the warning sign for leaving the section between the two protection zones shall be marked with "You have left Huashan Scenic Area, thank you for your support".

9.1.1.2 Surface Water Environment Protection Measures

9.1.1.2.1 Design of River-crossing Bridges

The mainline of the Project contains 1 super major bridge (1268m) and 6 major bridges (2401.5m). The Connecting Line contains 1 major bridge (98.5m). The layout of bridges is as shown in Table 9.1-2.

Table 9.1-2 List of Recommended Bridge Schemes

S/N	Chainage		Bridge Name	Bridge Length (m)	Hole Number × Hole Diameter (m)	Structure Type	Remarks
Main line							
1	Left carriageway	ZK2+468	Nongwan No. 1 Viaduct	408	10×40	Fabricated prestressed concrete small box beam	
	Right carriageway	YK2+428		328	8×40		
2	Left carriageway	ZK3+555	Nongwan No. 2 Viaduct	450	11×40	Fabricated prestressed concrete small box beam	
	Right carriageway	YK3+566		450	11×40		
3	Left carriageway	ZK5+165	Buxuan Elevated Major Bridge	607	20×30	Fabricated prestressed concrete small box beam	
	Right carriageway	YK5+187		577	19×30		
4	Left carriageway	ZK6+960	Dunli Viaduct	848.5	28×20	Fabricated prestressed concrete small box beam	
	Right carriageway	YK6+950		878.5	28×30		
5	Left carriageway	ZK8+795	Longkalang Super Viaduct	1248	3×40	Fabricated prestressed concrete small box beam	Passing through Xialei Natural Reserve
	Right carriageway	YK8+815		1288	3×40		
6	Left carriageway	ZK12+075	Bangtun Heishui River Major Bridge	128	3×40	Fabricated prestressed concrete small box beam	Passing through Huashan Scenic Area
	Right carriageway	YK12+117		128	3×40		

<table>
<tr><th>S/N</th><th colspan="2">Chainage</th><th>Bridge Name</th><th>Bridge Length (m)</th><th>Hole Number × Hole Diameter (m)</th><th>Structure Type</th><th>Remarks</th></tr>
<tr><td></td><td></td><td>Total</td><td>6 bridges</td><td>3669.5</td><td></td><td></td><td></td></tr>
<tr><td colspan="7">Connecting line</td><td></td></tr>
<tr><td rowspan="2">1</td><td>Left carriageway</td><td>LZK5+353</td><td rowspan="2">Shuolong Guichun River Major Bridge</td><td>98.5</td><td>3×30</td><td rowspan="2">Fabricated prestressed concrete small box beam</td><td rowspan="2">Passing through Huashan Scenic Area</td></tr>
<tr><td>Right carriageway</td><td>LYK5+337</td><td>98.5</td><td>3×30</td></tr>
<tr><td></td><td></td><td>Total</td><td>1 bridge</td><td>98.5</td><td></td><td></td><td></td></tr>
</table>

During the arrangement of bridges and culverts for the Project, locations and diameters of bridges and culverts shall be taken into account to facilitate the discharge of floods and the elimination of waterlogging. On the premise of meeting the requirements of route direction and route design specifications, the bridge shall be located in the section with straight river, stable bank line and favorable geological conditions.

In order to reduce the damage to water body and water pollution, it is necessary to reasonably select the form of the bridge crossing the river (reservoir). According to the *Project Feasibility Study Report*, the Longkalang Super Major Bridge (YK8+815) of the Project is located in a wide and shallow valley. In combination with the longitudinal design, it is recommended to adopt the 31×40, 32×40m prestressed concrete box girder as the superstructure and the column-type pier and bored pile foundation as the substructure. The abutment shall be the column-type abutment, and the bridge shall be 1268m in length. The bridge structure of Shuolong Guichun River Bridge (AK5+227 ~ AK5+383) shall adopt the 3×30m prestressed concrete T-girder. As for bridges in the next preliminary design, Longkalang Super Major Bridge (YK8+815) will cross the Xialei Natural Reserve, and Bangtun Major Bridge (YK12+117) and Shuolong Guichun River Bridge (LYK5+337) will cross the Huashan Scenic Area. Reasonable crossing forms shall be selected to reduce the number of piers in the water and the amount of underwater construction. When the engineering conditions can be met, piers shall not be set in the water body, and the number of piers in the water shall be minimized.

9.1.1.2.2 Protection of Farmland Irrigation Facilities

The culvert shall be properly designed to connect the farmland irrigation system along the route smoothly. Different measures such as culvert arrangement, inverted siphon and aqueduct, or ditch modification and canal modification can be taken to restore the original functions of the farmland irrigation ditches and ensure the sustainable development of agricultural production along the route.

9.1.1.2.3 Design of Sewage Water Treatment Measures for Service Facilities

The whole project contains 1 toll station (built together with the maintenance work area). The toll station shall be equipped with corresponding sewage treatment facilities. The sewage shall be treated until meeting the requirements of the *Reuse of Urban Recycling Water - Water Quality Standard for Urban Miscellaneous Water Consumption* (GB_T18920-2002) and the *Reuse of Recycling Water for Highway Service Area - Water Quality* (JT/T645.1-2016) for standard reused water of flushing, road cleaning and urban greening, and used for greening, flushing and pavement cleaning.

Based on to the sewage composition and possible sewage output of each facility, the following scheme is presented for the design of sewage treatment facility in each service facility:

1. Toll Station & Maintenance Work Area (1 Nr.)

The toll station (1 Nr., jointly built with the maintenance work area) of the Project shall be provided with 1 set of MBR sewage treatment system with the treatment capacity of 6m3/d. The estimated cost of the sewage treatment facility and the corresponding pipe-laying works is about RMB 1 million.

See Figure 9.1-1 for the process flow of the sewage treatment.

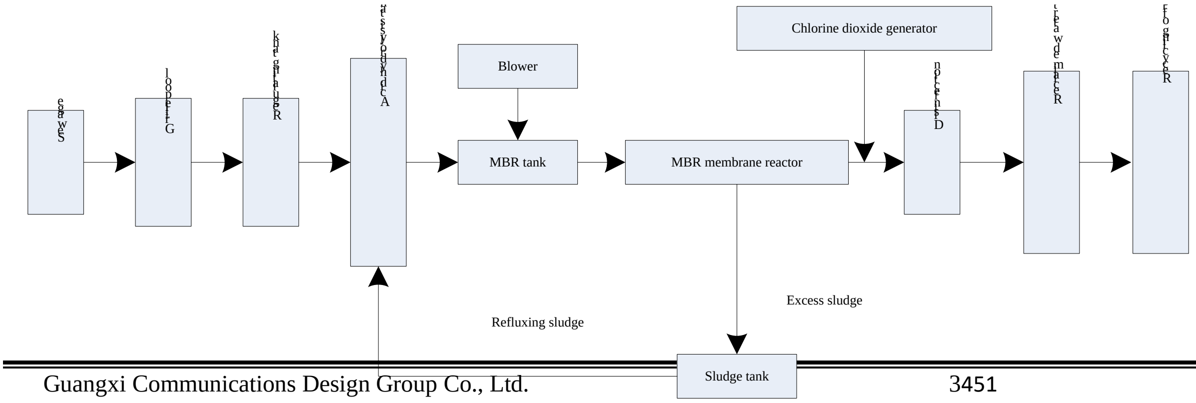


Table 9.1-1 Process Flow of Sewage Treatment

2. Other Design

For sewage treatment facilities and sewage pipelines provided for service management facilities such as the toll station of the Project, the anti-seepage design shall be properly implemented to avoid sewage infiltration. According to the possible leakage of each facility, the recommended seepage prevention measures are as follows:

① The natural clay can be adopted as the impervious layer on the premise of meeting the basic conditions as below: a. The permeability coefficient of the compacted clay impervious layer shall be less than 1.0×10-7cm/s. b. The thickness of the clay impervious layer shall be at least 2m.

② In case that the above conditions are not met, the artificially synthesized material or other materials with equivalent anti-seepage performance shall be adopted as the impervious barrier.

③ In addition, the sewage treatment facilities shall be equipped with the seepage detection system for impervious layer to detect the seepage of impervious barrier timely and take necessary pollution control measures.

Table 9.1-3 Sewage Treatment Facilities for Service Facilities and Discharge Destination

Facilities along the line	Sewage Treatment Facility and Scale	Implemented Standard	Discharge destination	Investment (RMB 10,000)
Toll Station and Maintenance Work Area	6m^3/d	Class I standard stipulated in Integrated Wastewater Discharge Standard (GB8978-1996)	Ditches nearby, and farmland irrigation system in the final.	100

9.1.1.2.4 Water Environment Protection Measures for Sections in Ecologically Sensitive Areas

The mainline (chainage: K7+885 ~ K10+715) of the Project will pass through the experimental area of Xialei Nature Reserve in the form of tunnel (Longkalang Tunnel) + subgrade + bridge (Longkalang Super Major Bridge) + tunnel (Longdong Tunnel). The recommended scheme of Connecting Line (Route A) (chainage: AK3+600 ~ AK4+600) will pass through Xialei Nature Reserve in the form of tunnel (Shuolong Tunnel). The mainline (chainage: K11+500 ~ K12+263) (Bangtun Major Bridge) and the Connecting Line (chainage: AK0+000 ~ AK5+423) will pass through the Class II protection zone of Huashan Scenic Area in the form of bridge (Shuolong Guichun River Major Bridge), tunnel (Shuolong Tunnel) and subgrade. For sections passing through ecologically sensitive areas, the following water environment protection measures shall be taken:

(1) The construction of this road section should avoid the rainy season as far as possible. In the rainy season, the subgrade construction will generate the silt-containing sewage, which contains the key pollutant of SS. Prior to construction, protective measures such as retaining wall and temporary drainage ditch shall be built to lead the surface runoff formed by rainfall to the outside of the protected zone. In addition, the temporary sedimentation tank shall be built at the end of the drainage ditch. After sedimentation, the supernatant shall be reused as much as possible, and the remainder shall be discharged into the surrounding ditches. The filled subgrade shall be compacted in time. In case of rainy days, the exposed construction surface shall be covered with plastic film or tarpaulin.

(2) It is necessary to strictly follow the water conservation scheme, protect the bare surfaces in the construction area, and timely clean up and transport the earthworks and stonework during construction. Earthworks and stonework must not be piled up in the ecologically sensitive region at will, so as to prevent them from being washed into the water body by the rain and causing water pollution.

(3) During construction, preventive and management measures shall be taken to prevent oil leakage and venting from construction machinery. For the Project, the amount of oily sewage generated from the construction of the section passing through the protected zone is small, so a collection bucket is needed to collect the oily sewage produced by the maintenance of construction machinery. The oily sewage shall be recycled and reused, and must not be discharged.

(4) The maintenance of construction machinery shall be enhanced to reduce the oil

leaking, spilling and dripping. In addition, the wastewater must not be discharged in the protected area or in the nature reserve.

(5) In the Project, Longdong Tunnel and Shuolong Tunnel will pass through Xialei Nature Reserve and Huashan Scenic Area. For tunnel construction sections, in addition to above measures, the following measures shall be taken:

Prior to construction, the hydrogeological investigation shall be implemented, and emergency response measures shall be prepared accordingly to handle the sudden water inrush and construction wastewater during tunnel construction. During construction, observation points shall be arranged near the tunnel. In case of water pollution, drop of underground water level or significant reduction of water quantity, the construction shall be stopped to find out reasons and take relevant remedial measures before the restart of construction.

During construction, oil trap and settling basin shall be arranged at tunnel portals to treat the production wastewater. The treated supernatant shall be recycled, and the waste slag in the sedimentation tank shall be stored in a centralized manner. The trapped oil substances shall be collected in closed tanks and regularly delivered to the institutions designated by local environmental protection departments for treatment.

9.1.1.2.5 Underground Water Environment Protection Measures

For sewage treatment facilities and sewage pipelines provided for service management facilities such as toll station and maintenance work area of the Project, the anti-seepage measures shall be taken appropriately. See Table 9.1-4 for the recommended anti-seepage settings.

Table 9.1-4 Major Protection Measures for Protected Plants along the Project Route

Name of facility	**Anti-seepage Measures**
Domestic sewage treatment facilities, oil separation tank and the relevant	1. The natural clay can be adopted as the impervious layer on the premise of meeting the basic conditions as below: ① The permeability coefficient of the compacted clay impervious layer shall be less than 1.0×10-7cm/s. ② The thickness of the clay impervious layer shall be at least 2m. 2. In case that the above conditions are not met, the artificially synthesized material or other materials with equivalent anti-seepage performance shall be adopted as the impervious

Name of facility	Anti-seepage Measures
pipelines	barrier. 3. In addition, the sewage treatment facilities shall be equipped with the seepage detection system for impervious layer to detect the seepage of impervious barrier timely and take necessary pollution control measures.

9.1.1.3 Acoustic Environmental Protection Measures

In the preliminary design stage, the actual route may not be consistent with the engineering feasibility study report. In the specific design, the noise protection measures shall be taken under the following principles:

1. Due to partial route change, the sensitive points originally close to the highway become far away from the route (exceeding the maximum EAD in the mid-term characteristic year of operation). As a result, the originally proposed noise protection measures shall be canceled.

2. Due to partial route change, the sensitive points originally far away from the highway become close to route, or the sensitive points that are originally not in the scope of assessment become close to the route. In the assessment, it is recommended to adjust the actual positions and limits and actual environmental characteristics of each sensitive point in the next stage of project implementation, and timely adjust the noise protection measures (e.g. providing acoustic barriers or installing sound proof windows) for buildings in the relevant sensitive points in accordance with the route and in combination with the assessment and prediction results, so as to ensure that each sensitive point within the scope of assessment reaches the noise standard in the mid-term characteristic year of operation period.

9.1.2 Environmental Protection Measures during Construction Period

During construction period of the Project, the Employer has the responsibility to protect the environment and mitigate the adverse impact on the environment. During the preparation of the Bidding Documents, the environmental impact mitigation measures shall be included in the Bidding Documents and specified in the project contract. In addition, the Contractor shall specify the implementation plan of environmental protection measures in the Bid Documents.

9.1.2.1 Ecological Impact Mitigation Measures

9.1.2.1.1 Animals and Plants Impact Mitigation Measures

(1) During the construction period, the land occupied for construction shall be strictly controlled, and constructions shall be implemented in strict accordance with the construction boundary. For sections passing through Xialei Nature Reserve (K7+885 ~ K10+715, AK3+600 ~ AK4+600), Huashan Scenic Area (K11+500 ~ K12+263, AK0+000 ~ AK5+423), the construction range must not be expanded at will. The construction management, publicity and education shall be enhanced, and construction personnel shall be prohibited from cutting down trees or killing protected animals. In addition, the construction scheme shall be optimized to minimize the disturbance of construction noise to birds and wild protected mammals.

(2) After the construction is completed, the available area on the land occupied for main body construction of the Project and the temporarily occupied land shall be timely planted with local plant species as per the design to prevent the alien plant invasion. The road sections with better vegetation preservation, in particular, shall be planted with common local arbors, and alien species are prohibited.

(3) In order to prevent forest fires, fire warning signs shall be arranged on mountains around the construction area, and areas prone to fire shall be marked out and subject to patrol inspection, especially in the vicinity of timber forests growing well along the highway, so as to prevent and eliminate forest fires.

(4) The construction temporary access, temporary stock yard, construction camp and stockyard shall be arranged in the permanently occupied area as much as possible. If the temporary land occupation is required, it is necessary to minimize the occupation of vegetation, especially the wood land. After the construction temporary access is used, if it needs to be reserved, then vegetation restoration measures shall be taken on the roadside slope. Otherwise, the topsoil shall be loosened and all vegetation shall be restored. All other temporarily occupied land shall be subject to greening treatment, vegetation restoration or re-cultivation or proper utilization.

9.1.2.1.2 Protection Measures for Vegetation at Tunnel Portals

The mainline of the Project contains 6 tunnels (3645.5km), including 1 long tunnel (1182.5km), 1 medium tunnel (642.5km) and 4 short tunnels (1820.5km). The Connecting Line (Route A) contains 1 tunnel (1430km) that is a long tunnel. There are 7 tunnels in total, with a total length of 5075.5m. These tunnel portals are located in areas with relatively sparse vegetation or with secondary forest, which mainly consists of secondary shrubs, secondary bushes and secondary forests.

For constructions of 6 tunnels, the influence on vegetation in this area has been predicted and three protection measures have been presented as below:

1. Anti-seepage measures shall be taken appropriately inside tunnels, and engineering methods shall be adopted to achieve waterproof tunnel walls, in order to eliminate the influence of tunnel constructions on underground water level, thus eliminating the influence on the growth of surface vegetation.

2. The excavation slope for the tunnel portal shall be reduced to reduce the land surface area damaged by portal excavation. Once the portal excavation is completed, the concrete or rubble-made portal walls shall be immediately built. Drainage ditches shall be laid behind the portal wall to discharge the water into the longitudinal drainage pipes and lead it down along the back of portal wall and send it to the subgrade side ditch. In addition, the excavated slopes for tunnel portals shall adopt the shotcreting slope protection or 3D network grass planting method to shorten the time of water and soil loss and protect the vegetation in corresponding areas.

3. In the construction of the two ports of the tunnel, a tunnel approach structure is added to reduce the slope of the mountain at the entrance, which can not only prevent the slope collapse above the entrance from affecting road traffic, but also reduce the loss of vegetation and productivity at the entrance. The species selected for vegetation construction are determined according to the specific habitat of the tunnel entrance. For Longdong 2# Tunnel (1182.5m) and Shuolong Tunnel (1430m) with a length of more than 1000m, ventilation facilities, lighting facilities and communication facilities must be installed in the tunnel timely during the tunnel construction and operation period to ensure the safety of construction and

traffic.

9.1.2.1.3 Wildlife Protection Measures

The following measures to protect wildlife are proposed based on the relevant requirements of the Wild Animal Conservation Law of the People's Republic of China, Regulations of the People's Republic of China on Wild Plants Protection, Terrestrial Wild Animal Protection Management Regulations of Guangxi Zhuang Autonomous Region and Wild Plant Protection Measures of Guangxi Zhuang Autonomous Region as well as ecosystem and engineering characteristics along the project:

(1) Measures to protect wild plants

① According to the Assessment, these measures are taken for the protected plants and ancient trees encountered in the construction. For the protected plants of longan ancient trees (chainage AK4+980) and litchi ancient trees (chainage AK5) within the red line of the project, it is preferably to change the line position and then transplanting is considered. The rest of the protected plants that are not within the highway occupation area shall be protected in situ. The temporary land occupation shall not be in the area with protected plants, and the rare trees shall be transplanted to a similar environment. The propagation methods of the species are investigated and the propagation methods are established before transplant to ensure the success of the transplantation. Non-local compensation modes are taken for public welfare forests and basic cultivated land to compensate in different places with the compensation location and compensation form into consideration to ensure equal quality compensation.

② The Employer shall complete the following related protection work:

A. The requirements for the protection of national and local wild protected plants should be written into the contract, and the construction management personnel and construction personnel should be trained in the identification of protected plants and relevant legal education. If any protected plants are found during the construction process, these targeted protection measures shall be implemented on the premise of consulting relevant experts.

B. The Employer has allocated special funds to ensure the implementation of protection measures.

C. The construction contractor shall arrange special persons to be responsible for the training of necessary plant identification and protection knowledge.

D. During the highway construction and later management period, a rare plant protection record system shall be established to faithfully record the relevant situation, mainly including the type and quantity of transplanted plants, ecological restoration situation and monitoring data in the later stage of construction. The rare plant protection record book shall be sorted and kept in accordance with the relevant national archive management laws and regulations.

E. Ficus lacor ancient trees (chainage AK0+580) distributed within the red line area of the land must be transplanted and protected in strict accordance with the relocation protection plan. In the scope of key investigation areas, protected plants and ancient trees that are not within the red line area shall be protected in situ and avoided reasonably.

(2) Measures to protect wild animals

1) Promote wildlife protection regulations and combat the killing of wild animals; improve the protection awareness of construction workers and prohibit hunting of wild animals. Construction personnel must abide by the Wild Animal Conservation Law of the People's Republic of China. It is strictly prohibited to hunt wild animals in and around the construction area. Construction personnel and local residents are strictly prohibited from killing amphibians and reptiles during construction.

2) Amphibious reptiles: Hoplobatrachus rugulosus, fejervarya multistriata, gekko gecko, spilornis cheela and other amphibians protected animals may be found in irrigated lands in sections K4+200 ~ K9+200 and K11+500 ~ AK5+300 and irrigated land or valley in sections K12+0 ~ K12+100 and AK5+300 ~ end point section. For the project, the Buli Viaduct, Buxuan Major Bridge, Dunli Major Bridge, Longkalang super major bridge and culvert are set in the K4+200~K9+200 section and culverts are set up in the K11+500 ~ AK5+300 section to alleviate the impact on amphibians protected animals. The two ends of the culverts are designed with gentle slopes to facilitate migration activities of amphibian.

3) Birds: Protected birds such as lophura nycthemera, centropus bengalensis, centropus sinensis, and ring-necked Pheasant are mainly concentrated in the following sections: K4+200~K9+200 and K11+500~AK5+300. Low trees + paliurus and other shrubs are planted on both sides of subgrade to form a tree layer and dense hedges under the forest, so as to increase the flying height of centropus sinensis and other birds across the highway to avoid damage caused by vehicle impact. Try to avoid blasting and mechanical noise to disturb the protected birds nearby and regulate construction behavior. Construction personnel are prohibited from hunting them.

4) Mammals: raptors such as aviceda leuphotes and elanus caeruleus, and mammals such as scandentia and prionailurus bengalensis are mainly distributed in the K1+100~K4+200, K9+200~K11+500 forests in the road sections with well-developed vegetation and little human interference, as well as the road sections crossing the Xialei Nature Reserve, which are close to the core area of the protection area and on one side of the buffer zone. During the

blasting operations, the amount of detonation is decreased and the operations are prevented in the morning, at night and in the noon to eliminate the impact on the animals.

Other wildlife protection measures mainly include:

① Construction personnel are prohibited from hunting wild animals in any way during the construction period, and wild animals in the construction area should be released nearby. If injured wild animals are found, they should be reported to the local wildlife protection department in time and handled by professionals;

② Pay attention to the prevention and treatment of snake bite and epidemic prevention of construction personnel;

③ Try to protect the landform and vegetation above the tunnel and below the bridge crossing the valley, and restore the damaged landform and vegetation in time to restore the wildlife passage.

(3) Ecological protection measures of bird migration

① If the construction period is in the bird migration season, the construction with strong noise should be reduced and tunnel blasting should be avoided during this period. In addition, strong light irradiation should be prevented at night. It is suggested that night construction should be avoided as far as possible in April ~ May and September ~ October to minimize the disturbance to migratory birds;

② The construction procedures of construction enterprises shall be standardized, the publicity and education of construction personnel shall be strengthened. Forestry and other relevant departments should be actively cooperated to intensify inspection to prevent bird hunting.

9.1.2.1.4 Ecological Protection Measures of Agriculture and Forestry

(1) When it passes or occupies farmland, the stripped topsoil shall be preserved for re-cultivation and ecological restoration of temporary land area or for improvement of newly cultivated land. At the same time, water shall be sprinkled for dust fall in the construction area to prevent the construction dust from adversely affecting the yield and quality of crops nearby;

(2) It is strictly forbidden to cut down trees outside the scope of land use in the passed forest sections. The construction access roads shall not be in the well-developed natural vegetation. At the same time, strengthen the publicity and education of forest fire prevention, erect fire warning signs around the construction area, and formulate emergency measures to deal with forest fires.

9.1.2.1.5 Soil Protection

Road sections passing through farmland and temporary occupied areas of occupied cultivated land shall be stripped of topsoil to facilitate subsequent re-cultivation or ecological restoration and protect the environment. After the topsoil of the main works or temporary works is stripped, it will be stacked in the topsoil stacking yard, and the trapezoidal temporary retaining wall with a height of 1.0m will be built by the straw bagged soil pile, to temporarily protect the topsoil stacking area, so as to maintain its fertility. Soil protection is mainly carried out in temporarily occupied areas (occupied cultivated land) such as concentrated farmland road sections and spoil ground. The main protection measures to be taken are stripping and properly preserving topsoil and including its cost in the construction budget. Preserved topsoil is used for re-cultivation, greening of nearby spoil ground and highway greening.

9.1.2.1.6 Protection Measures for Road Sections in Xialei Nature Reserve

(1) When the main line chainage K7+885~K10+715 and connecting line chainage AK3+600~AK4+600 pass through Xialei Nature Reserve, it is suggested to take measures such as "shortening excavation footage, weakening blasting charge and increasing excavation steps" in the construction of Longkalang Tunnel and Shuolong Tunnel to decrease single blasting charge, reduce blasting influence and further lower blasting shock velocity. Blasting shall be prevented in the morning, at night and in the noon to eliminate the scare of wild animals.

(2) The construction shall be carried out as far as possible to avoid the rainy season, and the construction schedule shall be arranged reasonably to control water and soil loss, and control the treatment and discharge of muck and production wastewater. Temporary drainage ditch shall be excavated by blasting in tunnel, and a settling basin shall be set at the drainage ditch in combination with terrain. After surface runoff is collected by temporary intercepting drainage ditch, it can be discharged to the nearby natural ditch after treatment by settling basin (geotextile fence shall be set at the outlet of settling basin).

(3) The prevention and control measures of water and soil loss shall be taken according to the water and soil conservation plan approved for the project, so as to minimize the water and soil loss of the sections in Xialei Nature Reserve.

(4) It is prohibited to set up borrow areas, quarries and spoil ground within Xialei Nature Reserve. Temporary occupied land such as material yard, construction camp and mixing yard should be arranged within permanent occupied land. If it is necessary to set temporary occupied land such as material yard, construction camp and mixing yard outside the land scope, the site should be selected reasonably, and measures should be taken to restore the

original appearance after use;

(5) Make the best use of existing roads as construction temporary access, which is not set in natural forests as far as possible but in a reasonable direction. Except those required for reservation by the Authority of Xialei Nature Reserve, the new construction temporary access should be restored with tree planting after use. It is forbidden to continue to use them, so as to avoid damage to the surrounding ecological environment and wildlife due to its impending effect;

(6) For road sections crossing Xialei Nature Reserve, it is suggested to select suitable and mature local restoration modes of trees, shrubs and grasses according to different geological, geomorphological and soil conditions. It is recommended to plant trees (including masson pine, schima superba, lithocarpus corneus and evergreen chinquapin), shrubs (including rhodomyrtus tomentosa, common melastoma herb, and trema orientalis), climbing plants (including pueraria lobata, parthenocissus tricuspidata and ivy) on rock slopes, and local common pioneer herbaceous species (including imperata, dicranopteris dichotoma, miscanthus spicatus, thysanolaena maxima, tuberous sword fern and cynodon dactylon).

(7) When crossing the sections of Xialei Nature Reserve (K7+885~K10+715, AK3+600~AK4+600), 2.5m high baffles or dustproof nets shall be set on both sides of the construction area, and the water shall be sprayed for dust reduction.

(8) Complete hydrogeological exploration to prevent the tunnel construction from affecting regional groundwater level and water quality.

(9) Before the construction of the project, the environmental awareness education and legal publicity shall be strengthened for the construction personnel, so that the construction personnel can understand the scope, protected objects, relevant management regulations of the reserve, environmental protection laws and regulations and environmental pollution control. The contractor shall strengthen the construction management according to the relevant requirements of the management of protected areas. It is prohibited for the construction personnel to poach wild animals, cut down trees and dig plants at will. The use of fire in the field shall be strictly controlled to prevent fire. Billboards and warning signs are made and placed in eye-catching positions in the construction area to protect the environment and wildlife.

9.1.2.1.7 Environmental Protection Measures for Sections in Huashan Scenic Area

The main line K11+500~K12+263 and the connecting line AK0+000~AK5+423 pass through the Class II Protection Zone of Huashan Scenic Area in the form of bridges (Bangtun Major Bridge, Shuolong Guichun River Major Bridge), tunnels (Shuolong Tunnel) and subgrade for about 6.179km. The following measures are taken for the crossing sections:

(1) During the construction of the project, the land is leveled, which destroys the vegetation system on the surface. The impact of the landscape during the construction period on the overall landscape of agricultural land is inevitable. Therefore, it is suggested to speed up the construction process. After the construction, the surface vegetation shall be restored in time to speed up the construction of landscape environment.

(2) The Employer shall pay attention to greening construction along K11+500~K12+263, AK0+000~AK5+423, in consideration of economy, beauty, elegancy, easy management, strong feasibility and coordination with the surrounding landscape. The site selected for greening works shall have strong suitability, and be planted with locally planted trees, shrub grass and other varieties with vigorous vitality and developed roots. Road greening will play the role of isolation, dust prevention and strong light shielding, so as to protect the environment and beautify the road appearance. The project construction changes the existing landscape ecosystem and increases the greening works and lighting works along the road, which is beneficial to the regional landscape.

(3) Comprehensive allocation of earthwork shall be carried out to reduce the high-fill deep-cut sections in scenic spots. It is strictly prohibited to discard waste earthwork at random on the bank of Xialei River and Guichun River and mountain slope.

(4) During the construction period, the transportation routes for highway construction should be shared with some tourist roads in scenic spots, which may have certain influence on the tour routes and tour safety. It is suggested that relevant departments carry out traffic control on engineering transport vehicles to reduce the impact of project construction on tourist routes in scenic spots. At the same time, the construction time is shortened while ensuring the construction safety and quality, so as to reduce the adverse impact of construction on tourists.

(6) Before the construction of road sections in scenic spots, it is necessary to coordinate with the Administration of Scenic Spots in time and implement the operation under the supervision and guidance of the Administration. Establish project construction progress reporting system, and strengthen contact and cooperate with local environmental protection department and roads authorities for scenic spots in the early stage of construction and the whole construction process.

(7) The construction scheme of "tunneling without excavation" is adopted in Shuolong Tunnel to avoid large-scale excavation of the tunnel portal to reduce the damage to the original vegetation of the mountain, that is, the tunnel pre-support method with long pipe

roofing is adopted to enter the tunnel with the excavation scope as narrow as possible, thus effectively protecting the ecological environment around the tunnel portal.

(8) The prevention and control measures of water and soil loss are strictly taken according to the water and soil conservation plan approved for the project so as to minimize the impact on the water and soil loss of the road section in Huashan Scenic Area. K11+500~K12+263 and AK0+000~AK5+423 sections shall be equipped with 2.5m-high baffles or dustproof nets on both sides of the construction area with water sprayed for dust reduction.

9.1.2.1.8 Aquatic Ecological Protection Measures

(1) The bridges with underwater pier involved in the project mainly include Bangtun Major Bridge (K11+697~K12+243) and Shuolong Guichun River Major Bridge (AK5+277~AK5+383). The rivers involved in the project include Xialei River and Guichun River. The working procedure for bridge construction shall be reasonably arranged to shorten the operation time of steel cofferdam for underwater foundation of bridges involving underwater piers. The construction shall be arranged in the dry season to avoid the peak period of fish spawning (March ~ July). Before construction, fish should be driven away, which shall be under the supervision and guidance of local fishery administrative departments.

(2) Before the bridge construction, the construction scheme shall be formulated to reduce the generation of turbid mud and sand water, so as to reduce the adverse effects of suspended solids on the spawning ground. The muck and foundation pit water produced by pile foundation construction in steel cofferdam shall not be directly discharged into the water body outside the cofferdam. Maintenance of construction machinery shall be strengthened to reduce the oil leaking, spilling and dripping.

(3) The bridge pile foundation construction mud is treated according to the construction technology, and the waste mud generated in the construction process is solidified and transported to the designated slag yard for dumping by a closed circulation method.

(4) The project construction management department shall strengthen the publicity and education work for contractors and construction personnel. It is strictly prohibited for construction personnel to catch aquatic animals by using water operations.

(5) Construction production and domestic wastewater will be discharged after being classified, collected and treated up to standard. It is prohibited to discharge them into sensitive water bodies such as water source conservation area.

9.1.2.2 Water environmental protection measures

9.1.2.2.1 Measures for Prevention and Control of Water Environment Pollution in Construction of Bridges Across River

1. The bridges with underwater pier involved in the project mainly include Bangtun Major Bridge (K11+697~K12+243) and Shuolong Guichun River Major Bridge (AK5+277~AK5+383). The rivers involved in the project include Xialei River and Guichun River. The operation sequence of pile foundation for river-crossing bridge shall be arranged in the dry season to avoid the peak period of fish spawning (March ~ July). The steel cofferdam shall be constructed in the dry season of rivers with advanced technology to shorten the operation time.

2. During the construction of steel cofferdam of bridge pile foundation in water, anti-pollution barrier shall be set in the working waters. The function of the anti-pollution barrier is to filter floating objects and suspended substances in water, control their diffusion and sedimentation range, and protect the waters outside the anti-pollution barrier (the increase of SS concentration does not exceed 10mg/L).

The anti-pollution barrier is composed of cloth (PVC double-sided coated reinforced plastic cloth) and skirt. The floating body is sealed by polystyrene foam and oil-resistant plastic mold and the spacing between floats forms a flexible section to ensure the foldability and wave riding performance of the anti-pollution curtain. The lower end of the skirt is wrapped with a chain. The anti-pollution barrier floats in the water. The upper middle part of the float and the cloth form the part above the water surface, and the skirt body is kept vertically stable by the counterweight chain to form the underwater part. The anti-pollution barriers are released, spread and recovered by boat.

3. During the pile foundation drilling and pouring construction of the river-crossing bridge, the slurry for retaining wall is circulated and not discharged. The waste slurry produced is transported to the waste slurry drying pool in the construction camp on the shore and the settled muck is transported to the waste spoil ground for landfilling.

4. The concrete required for bridge structures of the main bridge across the river shall be transported to the construction area for pouring in a closed manner by construction machinery, and shall not be mixed on site.

5. The maintenance of construction machinery shall be enhanced to reduce the oil leaking, spilling and dripping.

6. Temporary interception and drainage ditches shall be set around the bridge construction area and the construction area for the road section near the river, and temporary

sedimentation tanks shall be set at the water outlet, so that the drainage can be connected to the surrounding drainage system after sedimentation.

9.1.2.2.2 Measures for Prevention and Control of Water Environment Pollution in Construction, Production and Living Areas

1. This EIA requires that the construction, production and living areas of the project should be set beyond the water source conservation area for drinking water of Shuolong community along the route.

2. The production wastewater and rainwater drainage system in the production and living area shall be set separately. The drainage system for production wastewater is equipped with oil separation and grit chamber at the water outlet. The wastewater after oil separation and grit chamber treatment can be reused as much as possible. The isolated oil substances are collected in closed tanks and then submitted to the institutions designated by local environmental protection departments for treatment on a regular basis. The rainwater drainage system is only provided with a grit chamber at the outlet, and the surface runoff after grit treatment is connected to the surrounding drainage system.

3. The domestic sewage discharged from the living area shall be connected to the three-stage septic tank by closed PVC pipes, and the septic tank shall be covered. The domestic sewage shall be used for fertilization of forest land around the living area after being treated by the three-stage septic tank. The septic tank shall be cleaned regularly for fertility of wood land.

4. The retaining wall slurry preparation pool and waste slurry drying pool set up in the production and living area shall be 0.5m above the ground. Good rainwater interception and sewage discharge systems are established to form a complete system with the temporary drainage system built in the production and living area. The pools shall be covered in the rainstorm season and waste slurry shall be cleaned up and transported away in time after drying.

9.1.2.2.4 Prevention and Control Measures of Acoutic Environmental Pollution for Tunnel Construction

1. Before the construction of tunnel works, advance water exploration shall be carried out in the tunnel site area. Especially for long tunnels, detailed investigation shall be carried out on the distribution, type, water content, supply mode and runoff direction of groundwater in the tunnel area to analyze and demonstrate the possible position and degree of groundwater gushing out caused by the tunnel excavation. After the thorough water leakage and gushing prevention schemes are formulated, environmentally-friendly water-blocking materials are

selected for plugging.

2. During tunnel construction, follow the principle “Mainly on block, limit the emissions, and combine the emission and block”, adopt the design and construction concepts of "water blocking and leakage prevention to protect the environment" and "water exploration - pre-grouting - excavation - supplementary grouting - lining" so as to block water and prevent leakage.

3. The environmental management during tunnel construction shall be promoted. Preference is given to the environment-friendly explosives and grouting materials, and the charge quantity of nitro explosives should be reduced as much as possible in blasting construction. Preference is given to the wastewater treatment process, the treated wastewater shall be reused, and it is prohibited to discharge sewage into sensitive water bodies.

4. If water plugging measures are taken, the villagers' domestic water and irrigation water in the tunnel site area are still reduced, it is proposed to use the surrounding unaffected surface streams or groundwater exploitation for a supplement.

5. Implement water environment protection of the project in strict accordance with the prevention and control measures for surface water pollution in the Assessment. During tunnel construction, oil separation tanks and grit chambers should be installed at the entrance and exit of each tunnel to treat the production wastewater.

6. The contractor shall carry out the emergency disposal of sudden water inrush and construction wastewater during tunnel construction.

7. During tunnel construction, oil separation tanks and grit chambers should be provided at each tunnel portal, especially in medium and long tunnels. The liquid supernatant after precipitation should be recycled, and the abandoned muck in the sedimentation tank should be stacked centrally. Isolated oil substances shall be collected in closed tanks and regularly handed over to a qualified entity for treatment.

9.1.2.2.5 Protection Measures of Distributed Drinking Water Facilities in Villages along the Route

Excavation and filling of subgrade in the project construction may damage related distributed drinking water facilities and water pipelines, among which a centralized water source is built for Buguo and Dunli, which is located about 220m to the left of the red line at K5+400, and the rest villages without a centralized water source, most of the residents' drinking water is mountain spring water or from their wells. The Assessment recommends that the contractor should consult in detail the laying location of drinking water facilities and pipelines related to the villages during the construction of road sections near villages. The principle of not damaging related water pipelines and equipment should be followed as far as possible in subgrade construction. If water pipelines or equipment cannot be bypassed, it is necessary to negotiate with relevant village committees to rebuild the damaged related water transmission equipment or pipelines. Only when the villagers' drinking water is not affected can further construction be started.

The Assessment recommends that 400,000 yuan should be reserved as water environmental protection expenses for the relocation of distributed drinking water facilities in villages along the route.

9.1.2.3 Environment Protection Measures for Groundwater

1. Alleviate Measures for the Impact of Construction Camp on Groundwater

Anti-seepage measures shall be taken for septic tanks, sedimentation tanks, oil separation tanks and other facilities in the project construction camp (clay bedding with a layer of 10~15cm cement for hardening, and a layer of epoxy resin for anti-seepage). Avoid seepage of construction wastewater and pollution of groundwater quality in local areas.

2. Alleviate Measures for the Impact of Subgrade Construction on Groundwater Environment

(1) It is recommended that the drainage ditch with excavation depth lower than the groundwater level shall be in the form of filtration and infiltration wells, so that the groundwater infiltrated from the cut slope can infiltrate into the ground again through the drainage ditch, thus ensuring that the groundwater will not be lost. At the same time, the filter material can also reduce the concentration of pollutants in pavement runoff rainwater.

(2) If the fracture is an important recharge channel of groundwater, the road fill should avoid the above sections, so as not to reduce the volume of groundwater. In the fill section, attention shall also be paid to providing the culvert crossing on the drainage channel of surface water and groundwater, so as not to change the runoff path of surface water and groundwater.

3. Alleviate Measures for the Impact of Bridge Construction on Groundwater Environment

A sedimentation tank is provided in bridge construction to precipitate the drilling slurry generated in bridge foundation construction. After sedimentation in the sedimentation tank, the slurry shall be cleaned regularly and transported to the nearest spoil grounds.

9.1.2.4 Prevention and Control Measures for Ambient Air Pollution

The ambient air pollution prevention and control measures adopted in the project are as follows:

1. Scientific construction plans shall be prepared and construction shall be in sections.

2. The construction site should be sprinkled in time to keep the pavement moist. The Employer requires the construction contractor to be equipped with its own sprinkler at least. Generally, it can sprinkle water twice a day (once in the morning and once in the afternoon). In dry and hot summer or in windy weather, the water sprinkling frequency shall be appropriately increased. During construction in sensitive sections of residential areas, the frequency of sprinkling water should be increased in gale and drought weather.

3. Cement shall be transported and transferred in a closed bulk cement truck, and measures such as enclosure, dust cloth and rain shed shall be provided for the sand and gravel storage yard. The access road of the mixing yard shall be hardened and cleaned in time, and water shall be sprayed regularly in the mixing yard for timely cleaning. Dust-proof measures should be taken for building materials such as lime, sand and gravel which are easy to generate dust during construction, such as sealed storage, providing fences or piling up walls or covering with dust cloth.

4. Spoil soil, materials, and other construction wastes generated during construction should be cleared away in time. If it cannot be cleared away in time, dust-proof measures should be taken, such as covering with dust cloth and dust screen, spraying dust suppressant regularly or spraying water to reduce dust regularly, so as to prevent dust from blowing by wind erosion and transferring by water erosion.

5. Transport vehicles shall hold a vehicle permit issued by the traffic management department of the public security organ, and muck transport vehicles shall also hold a transportation permit issued by the urban management department. Transport entities and individuals shall provide on-site management personnel in the muck yard, specifically responsible for the inspection and acceptance of cleaning, loading and unloading of transport

vehicles. Transport vehicles shall be sealed to ensure the normal use of equipment, and the load shall not exceed the height of the carriage baffle, and shall not leak, scatter or fly along the way. Transport entities and individuals should strengthen the maintenance of the vehicle sealing devices, ensure the normal use of equipment, and vehicles shall not be overloaded, and the load shall not exceed the height of the carriage baffle.

6. In the construction area close to sensitive points, baffles shall be 2.5m in height, and the frequency of sprinkling water for the construction area and construction temporary access should be increased. Especially for the construction site within 50m away from sensitive points, attention should be paid to cleaning the construction area and construction access road in dry season, keeping them clean and increasing the frequency of sprinkling water. The spot check and monitoring of the atmospheric environment shall be carried out during construction for sensitive points close to the road.

7. During the construction in the sections of K7+885~K10+715 and AK3+600~AK4+600 crossing Xialei Nature Reserve, K11+500~K12+263 and AK0+000~AK5+423 crossing Huashan Scenic Area, 2.5m high baffles or dust screens should be provided on both sides of the construction area, and the frequency of sprinkling water to reduce dust for the sections should be increased.

8. Guiding opinions on site selection of mixing plant

There is one large-scale production and living area in the Project. The mixing plant of the Project is generally located in the large-scale production and living area. Villages (Dunli) are within 300m of the construction production and living area, and another site needs to be selected. The establishment of the mixing plant shall meet the following requirements:

(1) It is recommended to adopt advanced asphalt concrete mixing equipment, that is, the mixer is equipped with a sealed dust removal device, the melting and mixing of asphalt should be carried out in a sealed container, and the production equipment should not have obvious unorganized emission of asphalt smoke. However, benzo [a] pyrene is a strong carcinogen, which has a great influence on the workers who operate the asphalt concrete mixing equipment. Therefore, measures such as labor protection, providing protection devices and shifting of operators should be taken for the workers.

(2) The mixing station should be in an open place, and it should be in the downwind direction of village residential areas, schools or areas with special requirements, and the distance should not be less than 300m, so as to reduce the dust and noise pollution of the environmental sensitive points.

(3) The large-scale mixing plant (prefabrication yard) shall be equipped with dust removal device, and the pollutant discharge shall meet the relevant requirements of the *Integrated Emission Standard of Air Pollutants* (GB16297-1996), and the spot check and monitoring of the atmospheric environment during the construction period in the area where the concrete mixing plant is shall be emphasized.

9. Protective measures for tunnel construction: (1) The construction adopts wet loading and transporting muck, water curtain dust reduction and wet shotcrete support to remove dust in the tunnel and dissolve some harmful gases in the air. (2) The residual dust in the tunnel is pumped to be discharged at the tunnel exit by jet fans and hoses. (3) Blasting at night is strictly prohibited. (4) Before the tunnel construction, it is necessary to provide public notice of the construction time, construction schedule and possible impacts of the project in villages within 500m of the entrance and exit to prevent villagers from panicking.

10. Asphalt concrete should be laid centrally on sunny and windy days with good atmospheric diffusion conditions. On the premise of meeting the construction requirements, the contractor should reduce the asphalt paving temperature as much as possible, and then take water cooling measures on the paved pavement to reduce the generation of asphalt smoke.

9.1.2.5 Prevention and Control Measures for Noise Pollution

1. 15 days before the project commencement, the Employer shall report the project name, construction site and period, possible environmental noise value, and the environmental noise pollution prevention and control measures taken to the local environmental protection administrative department, and the construction can only be carried out after being approved by the department.

2. Reasonably arrange construction procedures during construction, and avoid

construction operations and transportation of construction materials at night (22: 00 to 6: 00 the next morning, Beijing time) in the construction area within 300m away from sensitive points. If continuous operation is required due to the production process, approval of the local environmental protection administrative department shall be obtained before construction, and the night construction certificate shall be applied according to the regulations. At the same time, a bulletin board should be provided on the construction site for announcements and the complaint telephone. The contractor should get the support and understanding of the affected people as much as possible, and provide channels for complaints and supervision of construction noise.

3. The EIA suggests that the construction production and living areas should be as far away from the surrounding residential areas as possible. For the construction area and construction production and living area near sensitive points, noise reduction can be carried out by establishing 2.5m high iron-sheet baffles at the field boundary. The construction of high noise mechanical equipment shall be arranged in the daytime. Construction temporary access shall be selected reasonably to avoid crossing sensitive buildings such as concentrated residential areas and schools. For construction access roads that cannot avoid crossing concentrated residential areas and close to sensitive points, measures such as speed limit, increasing the road flatness and night horn blowing prohibition should be taken to reduce the impact of traffic noise caused by vehicle transportation.

4. The contractor should pay attention to the maintenance of mechanical equipment, so that the machinery can maintain a low sound level. Arrange workers to operate machinery in shift to reduce the time of working exposure to high noise. For workers who work near the sound source for a long time, protective measures such as providing sound proof earplugs and helmets can be taken to protect the workers themselves.

5. When blasting operation is required for slope excavation and tunnel works, the blasting output should be controlled to reduce the sudden noise source intensity of blasting, and an announcement should be made before blasting, and blasting at night is strictly prohibited.

6. The main earthwork quantity of the subgrade in the construction sections close to K5+100 Xuanjie teaching school and K11+850 Yixian Village Primary School should be completed during school holidays as much as possible to reduce the impact of construction on them.

7. When blasting operation is required for Shuolong tunnel works, the blasting output should be controlled to reduce the sudden noise source intensity of blasting, and an announcement should be made before blasting, especially for villages within 500m from the tunnel blasting point. Relevant villagers shall be informed before blasting, and blasting at night is strictly prohibited.

8. For the sections crossing Xialei Nature Reserve and Huashan Scenic Area, it is suggested that measures such as "shortening excavation footage, reducing blasting charge and increasing excavation benches" should be taken for Longdong Tunnel and Shuolong Tunnel construction to reduce single blasting charge, reduce blasting impact and further reduce blasting vibration velocity. Blasting shall be prevented in the morning, at night and in the noon to eliminate the scare of wild animals.

9.1.2.6 Prevention and Control Measures for Blasting Vibration during Construction Period

According to the analysis on vibration impact, the vibration velocity at Longruntun is lower than the allowable safe vibration velocity of general civil buildings, and the vibration velocity is within the allowable safe vibration velocity range of roughcast houses. The blasting operation of the Longdong Tunnel has little impact on the safety of nearby sensitive points (houses) in Longruntun. The vibration velocity of sensitive points in Rentun is slightly higher than the allowable safe vibration velocity of general civil buildings, and higher than the allowable safe vibration velocity range of roughcast houses. The blasting operation of Shuolong Tunnel has a certain impact on nearby sensitive points in Rentun. However, the blasting vibration velocity is affected by factors such as one-time charge and geological conditions. When the engineering geological conditions are determined, the charge for blasting directly affects the vibration intensity and the safety distance. Therefore, the Assessment suggests using the current mature millisecond blasting, reducing the blasting charge in one blasting, selecting reasonable blasting parameters, millisecond delay intervals and other measures to reduce the vibration influence caused by the blasting.

9.1.2.7 Disposal Measures for Solid Waste

1. Abandoned earthwork of subgrade shall be transported to the spoil ground and temporary spoil yard determined in the project design in time. It is strictly prohibited to pile up along the construction area at will, and corresponding protective measures shall be taken according to the Soil and Water Conservation Scheme of the project.

2. The contractor shall provide management personnel to carry out on-site management on the transportation and disposal of the muck, so as to avoid rough loading and transportation and improper dumping.

3. Strengthen the production management, and regularly inspect and maintain asphalt pipelines and storage tanks. Asphalt mixing residue shall be collected in a special container to be recycled. The asphalt waste that cannot be reused shall be sent to a qualified company for recycling, and shall not be landfilled or burned directly.

4. The muck generated from bridge construction shall be transported to the spoil ground for disposal.

5. Small garbage bins are provided in the construction camp for centralized collection and then the local environmental sanitation department is entrusted to transport and dispose of the garbage. It is not allowed to throw the garbage everywhere or mix them with construction waste, which will affect the environmental sanitation.

9.1.3 Environmental Protection Measures during Operation Period

9.1.3.1 Ecological Environment Protection Measures

1. Ecological protection measures

(1) According to the requirements of highway greening design, complete the planting of trees and grass in the greenable ground within the scope of highway slope and land acquisition, so as to achieve the purposes of restoring vegetation, reducing water and soil loss, and reducing roadside water pollution caused by pavement runoff in the rainy season.

(2) Implement the greening restoration and maintenance in key areas such as the borrow pits and spoil grounds, and strengthen observation to avoid bare vegetation. Patrol the above areas in the rainy season to avoid geological disasters such as slope instability, collapse and landslide after being scoured by heavy rainfall.

(3) It is not suitable to plant root crops such as vegetables and potatoes within 50m on

both sides of the highway, but economic forests such as citrus, persimmon and pear trees can be planted.

(4) The dynamic distribution of alien invasive species shall be monitored during the operation period. Alien invasive species entering the area occupied by the highway shall be removed.

(5) The entrance and exit of the tunnel should be covered up and greened, and a stopping animal induction fence should be set up to prevent wild animals from entering the tunnel.

(6) For greening on both sides of the project road, especially the roadside trees, it is recommended to combine arbors with shrubs. Condensed planting of tall arbors such as moso bamboos and camphor trees shall be applied. For shrubs, it is recommended to mainly use compound leaf species such as Papilionaceae. The tree species with large crown width can block the outward emission of vehicle lights in the process of vehicle driving to a greater extent, which can effectively slow down the interference of strong light from vehicles driving at night to migratory birds.

(7) The dynamic distribution of alien species shall be monitored during the operation period. Alien invasive species entering the area occupied by the highway shall be removed, and should be removed as far as possible before the maturity of the seeds. After removal, they should be dried to ensure the death of the plant.

2. Ecological Protection Measures for Sections of Xialei Nature Reserve

In order to alleviate the impact of traffic noise on the acoustic environment along the route and reduce the possible crushing and fatal injury of wild animals crossing the highway during the operation period, traffic warning signs, slowdown and no-horn blowing signs are provided at the entrance and exit of the reserve and the greening of the road sections of the Reserve shall be strengthened.

(1) Provide traffic warning signs at the entrance and exit of the nature reserve. The warning sign at 1km before entering Xialei Nature Reserve says "It's close to Xialei Nature Reserve, please drive carefully, and do not turn on high beam lights", and the warning sign for leaving the nature reserve says "you have left Xialei Nature Reserve, thank you for your support". The design and construction of traffic warning signs shall comply with the relevant requirements of *Road Traffic Signs and Markings* (GB5768). Signboards can be provided at

K7+885, K10+715, AK3+600, AK4+600, etc.

(2) Slowdown and no-horn blowing signs shall be provided at the entrance and exit of the Reserve at the same time.

(3) Dense planting of nature strip in the subgrade section of the nature reserve can reduce the impact of noise, tail gas and light of vehicles on wildlife in the nature reserve. Anti-glare meshes are provided on viaduct sections, so as to reduce the influence of lights on the Reserve, and at the same time, avoid transportation materials falling into the Reserve during transportation.

(4) Standardized management of highway vehicles shall be implemented during the operation period, and all kinds of leaking and overloaded vehicles of bulk goods shall be strictly prohibited from entering the road, so as to prevent the lost goods from polluting the soil and receiving water on both sides of the road, thus causing habitat destruction. After the completion of the project construction, the vegetation and gullies under the viaduct bridges shall be restored in time. For the possible habitats of protected animals inevitably occupied by the subgrade and bridge pile foundation, compensation measures should be taken in different places to transform the unsuitable habitats such as economic forests nearby into suitable habitats such as broad-leaved forests.

3. Ecological Protection Measures of Huashan Scenic Area

(1) Warning signs and speed limit and no-horn blowing signs shall be provided 1km before entering Huashan Scenic Area. The sign 1km before the nearest road to the Reserve says "It's close to Huashan Scenic Area, please drive carefully, do not turn on high beam lights", etc. After driving out of the road between the two reserves, the sign says "You have left Huashan Scenic Area, thank you for your support". The signboards are provided at chainages K11+500 and AK5+416.

(2) Implement site clearing and greening along the highway, especially the greening of Shuolong Tunnel portal and long-distance subgrade slope.

(3) Strengthen the supervision and management of landscape resources and environment along the route, and provide warning signs for scenic spots (Duxiu Peak and Yuejin Channel) along the route. Behaviors and activities that affect landscape resources are strictly prohibited such as throwing litter and waste. A certain system of rewards and penalties should be

formulated to promote the protection and sustainable development of landscape resources in the tourist attraction.

(4) Strengthen the inspection of rare and endangered animals and plants to ensure the integrity of the protected species.

(5) Strengthen the greening of road sections. It is recommended that the road sections should adopt shrubs, such as Ardisia crenata and Myrtle, which is beneficial to roadside landscape viewing.

4. Aquatic Ecological Environment Protection Measures

(1) Provide reinforced anti-collision guardrails and warning signs to prevent motor vehicles, especially vehicles transporting dangerous cargo, from falling into the river directly when accidents happen on the bridge, causing major pollution incidents. At the same time, emergency plans should be prepared and implemented in strict accordance with emergency procedures to reduce the risk impact of dangerous accidents.

(2) In case of water pollution caused by traffic accidents on the bridge deck, the local fishery administrative department shall also be notified in a timely manner.

5. Ecological Monitoring Plan

In order to grasp and understand the impact of project construction and operation on the actual environment of ecologically sensitive areas in time, take improvement and remedial measures, and ensure that the impact of project operation on the ecological environment is minimized, the Assessment proposes to carry out ecological monitoring during the operation period. Specifically, the project Employer (or the operation entity) entrusts entities or departments with monitoring ability, focusing on the impact of noise on important ecologically sensitive areas and the distribution of animals, the population quantity of protected animals, the restoration of vegetation and the presence or absence of alien invasive species. For general road sections along the route, mainly inspect the protection of protected plants.

9.1.3.2 Water environmental protection measures

9.1.3.2.1 Maintenance of Bridge Drainage Facilities

(1) The operation management department of the project shall prohibit vehicles with oil leakage, trucks without protective canvas and overloaded vehicles from going on the road, so as to prevent oil leakage and goods from spilling on the bridge section across the river, thus

causing pollution to the water environment.

(2) Warning signs, such as speed limit, no overtaking, and no littering, should be provided for bridges across rivers, especially Longkalang Super Major Bridge crossing Xialei Nature Reserve, Shuolong Guichun River Bridge crossing Huashan Scenic Area, and Bangtun Bridge, to remind passing drivers and passengers and strengthen their awareness of environmental protection.

9.1.3.2.2 Maintenance of Other Highway Drainage Facilities

(1) Regularly check the sewage treatment and discharge of service facilities such as toll stations and maintenance work areas to ensure that the sewage treatment system is in good working condition. Drainage pipes (ditches) must be provided to discharge sewage into nearby streams or agricultural irrigation ditches. Sewage must not overflow, and it is prohibited to discharge sewage into Xialei Nature Reserve and Huashan Scenic Area. Strengthen the inspection of service facilities sewage treatment system and anti-seepage layer of sewage pipeline, so as to ensure that leakage of anti-seepage layer can be found in time and necessary pollution control measures can be taken.

(2) A complete drainage system is provided in the tunnels, and grit chambers and oil separation tanks are provided at the entrance and exit. Check and clean the grit chambers and oil separation tanks regularly.

9.1.3.3 Prevention and Control Measures for Ambient Air Pollution

1. Implement the vehicle emission inspection system, conduct spot checks on vehicle emission status at toll stations on a regular basis, and restrict vehicles with excessive exhaust emissions from entering the road;

2. Strengthen environmental management, the highway management department regularly entrusts the entity with environmental monitoring qualifications to monitor the ambient air at environmentally sensitive points along the highway, and establish archives of changes in air environmental characteristics and pollutants along the Project for future environmental management.

3. Plant more trees and grass on both sides of the highway, especially near sensitive points. In this way, it can not only purify and absorb pollutants in vehicle exhaust, but also beautify the environment and improve the landscape along the highway.

4. The impact of traffic dust isolated by planting trees on both sides of the sections of

K7+885~K10+715 and AK3+600~AK4+600 crossing Xialei Nature Reserve, K11+500~K12+263 and AK0+000~AK5+423 crossing Huashan Scenic Area on Xialei Nature Reserve and Huashan Scenic Area.

5. It is recommended to use clean energy such as gas, liquefied petroleum gas and electric energy in toll stations and maintenance work areas, and promote the installation and use of high-efficiency oil fume purification facilities and carry out regular maintenance.

9.1.3.4 Prevention and Control Measures for Acoustic Environmental Pollution

9.1.3.4.1 Noise Reduction Measures for Sensitive Points

1. Noise Source Control Analysis

The project adopts low noise asphalt concrete pavement, which actively reduces the impact of project traffic noise on the surrounding acoustic environment from the source. According to the feasibility study, asphalt concrete pavement has been used in the pavement structure of the project, and the noise reduction effect of asphalt concrete pavement has been considered in the noise prediction of sensitive points, but the acoustic environment of some sensitive points still exceeds the standard.

2. Noise Reduction Analysis of Sound Transmission Route

The measures to reduce noise in the sound transmission route mainly include setting up nature strips, sound barriers and sound proof walls, etc. Analysis is as follows:

(1) Nature Noise Reduction Forest Strips

The research results show that the 5~20m wide nature strips planted on both sides of the highway can achieve the noise reduction effect of 1.0~5.2dB(A). However, the dense planting of nature noise reduction forest strips occupies a large area with a long planting period, and the noise reduction effect cannot appear in a short time. It is influenced by many subjective and objective factors, such as community structure, plant size, forest diseases and insect pests, human disturbance, forest fire and planting effect, and the growth of the forest strips will be of varying quality, so the noise reduction effect is difficult to estimate and guarantee. In addition, most sensitive points along the route exceeding the standard are close to the highway, and a small part of the occupied area is cultivated land, so it is difficult to complete land acquisition, so the forest strip is not recommended in the Assessment.

(2) Sound Barriers and Sound Proof Walls

The project is a closed expressway. As a noise reduction measure to attenuate the traffic noise in the transmission route, and the noise reduction effect of the sound barrier is obvious for the sensitive objectives on the side close to the road, and it is built within the subgrade occupation area without additional occupation. At present, it has been widely used in various expressways. Therefore, it is recommended to give priority to setting up sound barriers in the Assessment. According to the *Design Specifications of Highway Environmental Protection* (JTG B04-2010), the extension length of the sound barrier should not be less than 2 times the distance between the protected object and the sound barrier. When the length of the sound barrier is greater than 1km, an emergency evacuation exit should be provided.

3. Noise Protection Analysis of Sensitive Buildings

Relocation can fundamentally solve the noise problem, but at the same time, relocation is easy to cause social conflicts and may cause secondary interference to the residents, so relocation is not considered. The Assessment takes the mid-term operation as the control objective. According to the Notice on Issuing the Technical Policy for Prevention and Control of Ground Traffic Noise Pollution (HF [2010] No.7), if the construction or operation of ground traffic facilities has caused the outdoor environmental noise in noise-sensitive structures to exceed the standard, and if it is not feasible to adopt outdoor technical means (sound source control and noise reduction in sound transmission route), passive protection measures (such as replacing sound proof doors and windows) should be considered for noise-sensitive structures. Passive protection measures for noise-sensitive structures should make the indoor acoustic environment quality of sensitive buildings that exceed the standard meet the requirements of the allowable noise level of various types of buildings specified in the *Code for Sound Insulation Design of Civil Buildings* (GB50118-2010). However, sensitive buildings exceeding the standard in the long-term operation should be tracked and monitored, and corresponding noise reduction measures should be taken according to the specific monitoring results in the long-term operation of the highway.

According to the on-site survey, the buildings along the project are mainly of "aluminum alloy glass window+brick-concrete structure". In view of the implementation of the noise control measures for the existing expressway and aiming at improving the noise reduction of the building itself, the Assessment proposes to give priority to setting up sound barriers for sensitive points with excessive noise along the route. If it is not suitable for setting up sound barriers or buildings with sensitive points still exceed the standard after sound barriers are provided, it is proposed to further replace sound proof windows for the buildings to ensure reasonable indoor acoustic environment quality.

There are 12 sensitive points along the proposed highway, including 8 sensitive points on the mainline side and 4 sensitive points on the connecting line side. At present, the proposed highway is in the feasibility study stage, although the route scheme has been basically determined, in the actual design, the route may be adjusted, changing the distance between sensitive points and the route, so the protective measures for sensitive points shall abide by the following principles:

1. Take the mid-term operation as the control objective. For sensitive points exceeding the standard in the mid-term, noise reduction measures such as sound barriers, aluminum alloy windows, ventilation and sound proof windows and noise reduction forest shall be taken timely according to the actual situation of sensitive points. See Table 9.1-5 for the effect, applicable objects, advantages and disadvantages of specific measures.

Table 9.1-5 Technical and Economical Comparison of Noise Control Measures

Noise Reduction Measures	Noise reduction effect	Cost Estimate	Applicable object	Advantages and Disadvantages
Aluminum alloy window	5~8dB(A)	RMB 500 Yuan/m2	A noise-reduction measure in common use for the current stage, for sensitive points with exceeding ＜3 dB(A)	General beautiful and noise-reduction effects, with low requirements for housing structures
Aluminum alloy window +sealing strip	10~15dB(A)	Aluminum alloy window RMB 500/m2Sealing strip RMB 20/m	Sensitive points exceeding 3 ~ 5 dB (A) above the standard	General beautiful and noise-reduction effects, with low requirements for housing structures
Ventilation sound proof window	15~25 dB(A), at least above 25 dB(A) when fully closing	RMB 2,000 Yuan/m2	Sensitive points exceeding more than 5 dB (A) above the standard	Fine beautiful and noise-reduction effects, with high requirements for housing structures and expensive costs
Noise reduction forest	When the dense planting height is above 4.5 m in evergreen arbors and shrubs, the noise can be reduced by 1~1.5 dB every 10 m width, at most it can be reduced by 10	RMB 200 ~ 500/m	Sensitive points with slight noise exceeding the standard and greening conditions	It can reduce noise, purify the air, beautify the road, and improve the ecological environment. The occupied land area is large, a certain noise reduction effect requires a long time, and the applicability is

Noise Reduction Measures	Noise reduction effect	Cost Estimate	Applicable object	Advantages and Disadvantages
	dB			severely restricted
Noise barrier	Obvious effects on the sensitive points of the low-layer (<5 layers) sound environment within 50 m from both sides of the route's center line, generally reducing the noise by 5-20 dB.	RMB 3,000 Yuan/m2	Concentrated sensitive points with seriously excessive noise and are close to the highway	Small occupation area and the general noise reduction effect. The long-distance sound barrier is easy to cause the depressed and monotonous driving, with high costs
Environmental relocation	Ensure the acoustic environment quality reaches the standard	The cost varies according to the number of relocated people, relocation distance and resettlement requirements	/	It can solve the noise impact caused by project construction once and for all, but the cost is high and it is easy to be opposed

2. Specific Noise Protection Measures

According to the field reconnaissance, most buildings along the project have been installed with aluminum alloy glass windows. The noise reduction effect of the sensitive points with installed glass windows of Banxin Village is tested. The results show that the noise reduction effect of ordinary aluminum alloy windows at the sensitive points can reach 3.2~5.4dB(A). According to the technical requirements of the Design Specifications of Highway Environmental Protection (JTG/B04-2010), in the Assessment, noise reduction measures are taken for sensitive points that are predicted to exceed the standard in the mid-term operation.

There are 12 acoustic sensitive points along the Project. By the middle period of project operation, there are 3 sensitive points with the noise level exceeding the standard at night, and the other 9 sensitive points can meet the standard day and night, among which the maximum excess noise level at Bangtun is 6.9 dB(A), 1 dB(A) at Sanjiatun and 7.9 dB(A) at Rentun, with 33 households (197 persons) involved, for which ventilation and sound proof windows are applied. See Table 9.1-6 for specific noise control measures.

Table 9.1-6 Exceeding Standards of Sensitive Points in Acoustic Environment and Control Measures

S/N	Sensitive Point	Evaluation Standard	Exceeding standard dB(A)	Population (person) affected in mid-term operation	Noise Reduction Measures	Estimated investment (RMB10,000)
1	Bangtun	4a	6.9	30	Install ventilated sound insulation windows with the installation capacity of 20 m2	4.0
2	Sanjiadiantun	2	1.0	15	Aluminum alloy glass windows have been installed at this sensitive point to meet the requirements of noise reduction, so it is not needed to take additional noise prevention measures	
3	Rentun	4a/2	7.9	152	Install ventilated sound insulation windows with the installation capacity of 90 m2	9.0
Total						13.0

3. In the next stage, a qualified entity should design and construct noise reduction facilities, strengthen the design, construction, and acceptance management, and do well in the maintenance of sound barriers.

4. Enough noise control expenses shall be reserved to strengthen the noise tracking monitoring of sensitive points along the route in the operation period, and to add and perfect measures in time according to the monitoring results.

5. For sensitive points with noise exceeding the standard in long-term operation, follow-up monitoring shall be taken and control measures shall be implemented in a timely manner.

6. In the preliminary design stage, the actual route may not be consistent with the engineering feasibility study report. In the specific construction, the noise protection measures shall be taken under the following principles:

(1) If the distance between the sensitive point and the highway increases (exceeding the standard EAD in each characteristic year) due to the change of the route, the noise protection measures originally proposed shall be canceled.

(2) If the distance between sensitive points and the highway is reduced, or sensitive

points that were not originally within the assessment scope are covered in the assessment scope due to the change of the route, the noise protection measures of sensitive points shall be taken in reference to the similar sensitive points according to the specific conditions, so as to ensure that the noise of each sensitive point within the route assessment scope reaches the standard in each characteristic year during the operation period. The Assessment proposes to set aside 500,000 yuan for remedial measures such as installing sound barriers and sound proof windows for sensitive points with excessive noise after the completion of the project.

7. In the preliminary design stage, the subgrade excavation face shall be designed reasonably, and the cutting shall be reserved to shield the mountain, so as to effectively reduce the impact of traffic noise on sensitive objectives along the route.

9.1.3.4.4 Acoustic Environmental Protection Measures for the Section Crossing Xialei Nature Reserve

(1) Warning signs, speed limit signs and no-horn blowing signs shall be provided 1km before the entrance of Xialei Nature Reserve. The warning sign 1km before the closest section to the reserve say "It's close to Xialei Nature Reserve, please drive carefully, and do not turn on high beam lights", and the warning sign for leaving the section between the two reserves say "You have left Xialei Nature Reserve, thank you for your support". Signboards can be provided at K7+885, K10+715, AK3+600, AK4+600, etc.

9.1.3.4.5 Acoustic Environmental Protection Measures for Sections Crossing Huashan Scenic Area

Warning signs, speed limit signs and no-horn blowing signs shall be provided 1km before the entrance of Huashan Scenic Area. The warning sign 1km before the closest section to the reserve say "It's close to Huashan Scenic Area, please drive carefully, and do not turn on high beam lights", and the warning sign for leaving the section between the two reserves say "You have left Huashan Scenic Area, thank you for your support". The signboards are provided at chainages K11+500 and AK5+416.

9.1.3.5 Disposal Measures for Solid Waste

1. Garbage cans will be provided in toll stations of the project to collect solid waste, and the garbage will be regularly transported and removed by the environmental sanitation department;

2. Build a temporary storage room that meets the requirements, and entrust an entity with corresponding hazardous waste disposal qualification to properly dispose of hazardous wastes such as waste lubricating oil, waste mineral oil, waste diesel oil, waste gasoline and waste oil sludge and oil residue generated after oil separation.

9.1.3.6 Preventive Measures for Accident Risks

Traffic accidents of vehicles transporting dangerous goods in the main river (reservoir) crossing bridge and vicinity of villages will have great adverse effects on the water body, ecology, residents along the line and driving safety. It is necessary to take risk prevention measures strictly, formulate emergency plans and report it to competent authorities for record.

9.1.3.6.1 Preventive Measures for Accident Risks

Following measures are proposed in the Assessment to avoid dangerous goods transportation accidents after project operation:

1. The Employer shall prepare an emergency plan and set up an emergency office for handling accidents, so as to communicate, contact and coordinate with competent authorities and other relevant departments in case of risks and accidents, and carry out the treatment at accident scenes.

2. Highway management agencies shall prepare emergency plans and corresponding management measures to prevent dangerous goods transportation accidents according to the risk prediction results of transportation accidents, the *Regulation of Automobile Transportation of Dangerous Goods* (JT617-2004) issued by the Ministry of Transport and relevant regulations on safety management, including emergency plans for pollution situations, engineering protection measures, and contact methods with relevant departments.

3. Relevant departments must enhance the management of dangerous goods transport vehicles, and strictly implement the *Specifications for Highway Transportation of Dangerous Goods* and *Regulations on Safety Management of Dangerous Chemicals*; strictly control dangerous goods transport vehicles without “three certificates" to drive on the road; Vehicles transporting dangerous goods shall be registered in public security organs for record before driving on the road and shall transport goods following the designated routes and time;

4. Under severe weather conditions such as heavy rain and fog, dangerous goods transport vehicles should be prohibited from passing through the Project, especially the major bridge sections crossing Baidou River, Xialei River and Guichun River;

5. Enhance daily drills of emergency agencies and provide corresponding technical equipment and personnel, so as to perform duties after an accident. Emergency response time shall be controlled within 1h.

6. Set up a material warehouse in the toll station of the Project, provide a certain number of accident emergency devices (each place equipped with several hand-held and hand-pushed fire extinguishers, 0.5t oil absorption felt, 5 sets of gas masks, etc.) as emergency materials to control the occurrence of major pollution accidents.

9.1.3.6.2 Risk Control Measures for River-crossing Bridges

1. Enhance the management of vehicles and check the “three certificates”: transport license, driver's license and security officer certificate that specified in the regulations issued by public security authorities before dangerous goods transport vehicles driving on the road. All vehicles transporting dangerous chemicals must hang a triangular flag with the words "Dangerous Goods" in black on a yellow background at a conspicuous position in front of the vehicle. Overloading of dangerous goods transportation vehicles is strictly prohibited. Drivers must receive professional training and keep the vehicles transporting dangerous goods in safe driving speed. Strictly prohibit external open flames, and allocate specially trained appliance crew for escorting. The vehicle shall be equipped with complete accident emergency equipment, such as emergency telephones and gas masks.

2. The vehicles transporting dangerous goods must be reported to road administration authorities for inspection before driving on the road. The vehicles must be provided with conspicuous signs of dangerous goods to facilitate management and monitoring. When vehicles transporting dangerous goods need to pass through water sections such as Baidou River, Xialei River and Guichun River along the line, the monitoring center shall conduct immediate monitoring, so as to take emergency actions in case of leakage accident of dangerous goods.

3. According to the data of the traffic police department, when the height of the crash bearer is greater than 1/3 of the diameter of the automobile tire, it can basically prevent the automobile from turning into the water, and effectively prevent the influence of liquid hazardous chemicals or petroleum accident pollution on the quality of surface water such as rivers and reservoirs along the line. The Assessment requires the Owner to enhance the anti-collision design of water-crossing bridges, especially the sections crossing Xialei Nature Reserve and Huashan Scenic Area, such as Longkalang Super Major Bridge (K8+181~K9+209), Bangtun Major Bridge (K11+697~K12+243) and Shuolong Guichun River Major Bridge (AK5+227~AK5+383). Make sure that the strength of the bridge can meet the strength requirements for avoiding the accident vehicles falling into the river.

4. The vehicles transporting dangerous goods need to be reported before passing through the proposed expressway and may pass through the above sections under the escort of road administration vehicles. The vehicles loaded with dust flying bulk cargoes such as coal, lime, cement and earthwork must be covered by tarpaulins before driving on the road, so as to prevent the scattered materials from causing water pollution after being washed by rain. In case of severe weather such as strong wind and heavy fog, corresponding sections shall be

closed to reduce the incidence of traffic accidents.

5. According to the requirements of bridge maintenance in *Technical Specifications for Highway Maintenance*, enhance the safety inspection and monitoring of bridge works to ensure the safety of important water sections, especially bridges crossing water bodies.

9.1.3.6.3 Environmental Risk Prevention Measures for Road Sections crossing Xialei Nature Reserve and Huashan Scenic Area

Enhance the monitoring and management of road sections (chainages K7+885~K12+263, AK0+000~AK5+423) crossing Huashan Scenic Area and Xialei Nature Reserve. It is suggested to set a speed limit sign on this section to reduce the possibility of accident risk and set up one warning board at K7+885, K10+715, AK3+600, AK4+600, K10+500, AK5+416 sections respectively, with emergency contact persons and telephone numbers of the relevant risk accident handling authorities marked on the warning board (the management agency during the highway operation period and the environmental risk emergency rescue personnel of this section).

9.1.4 Investment Estimation of Environmental Protection

The environmental protection facilities and investment of the Project are divided into two parts, one part is the one-off environmental protection investment (including environmental pollution prevention and control investment, ecological environmental protection investment and environmental management investment) generated simultaneously during the construction period of the main works, and the other part is environmental protection investment (including environmental protection facilities operation and maintenance investment and environmental management investment) generated continuously during the project operation period.

9.1.4.1 Investment in Environmental Protection during Construction Period

The total investment of the Project is RMB 2705.091232 million, including a total investment of RMB 8,316,000.00 for environmental protection during the construction period (excluding investment in existing environmental protection measures for water and soil conservation works and main works). The investment funds for environmental protection during the construction period are included in the total project investment, accounting for 0.31% of the total project investment. See Table 9.1-7 for details of various environmental protection facilities and investments.

Table 9.1-7 Investment Estimation Table of Environmental Protection Measures during Construction Period

S/N	Item	Specific Contents of Environmental Protection Investment	Investment (RMB 10,000)	Implementation Period	Implementing Unit	Responsible Subject
I	**Prevention and Control of Environmental Pollution**		**386**	/	/	/
1	**Prevention and Control of Acoustic Environmental Pollution**		**88**	/	/	/
1.1	Simple enclosure and temporary mobile sound barrier during the construction period	During the construction period, set up a 2.5m high iron sheet barrier, enhance the maintenance of construction machinery and equipment and keep the noise at a relatively low level.	25	Construction Period	Construction Contractor	Employer
1.2	Prevention and control of noise pollution at sound-sensitive points during the operation period	Ventilated soundproof window with an area of 20 m^2 is installed in Bangtun and that with an area of 90 m2 is installed in Rentun, totaling 110m^2.	13			
1.3	Reserve funds for noise pollution prevention and control at sensitive points	It is used to install sound barriers and soundproof windows at sensitive points exceeding the standard noise level in actual construction	50			
2	**Prevention and Control of Ambient Air Pollution**		**70**	/	/	/
2.1	Water sprinkling for dust control during the construction period	Water sprinkling for dust control during the construction period	30	Construction Period	Construction Contractor	Employer
2.2	Prevention and control measures of transportation dust pollution	Costs for covered transportation or closed transportation	15	Construction Period	Construction Contractor	Employer
2.3	Prevention and control measures for dust pollution in construction, production and living quarters	Covering of stacked materials in construction camp and dust removal devices for concrete mixing equipment	25	Construction Period	Construction Contractor	Employer
2.4	Dust control measures during tunnel construction	Tunnel ventilation (included in the project cost, not included in the direct investment in environmental protection)	—	Construction Period	Construction Contractor	Employer
3	**Water pollution prevention and control**		**198**	/	/	/
3.1	Treatment of construction production wastewater and domestic sewage	Sedimentation tank construction and manual cleaning costs (tentative estimation), septic tanks	50	Construction Period	Construction Contractor	Employer

S/N	Item	Specific Contents of Environmental Protection Investment	Investment (RMB 10,000)	Implementation Period	Implementing Unit	Responsible Subject
3.2	Prevention and control of wastewater during bridge construction	Setting up of temporary drainage ditch and temporary sedimentation tank for water-related bridges (Longkalang Major Bridge, Bangtun Heishui River Major Bridge and Shuolong Guichun Major Bridge) crossing Xialei Nature Reserve and Huashan Scenic Area. (Tentative estimation)	30	Construction Period	Construction Contractor	Employer
3.3	Wastewater treatment during tunnel construction	Setting up of oil separation tank and grit chamber at the entrance and exit of the tunnel, and cyclic utilization of supernatant after precipitation; Arrangement of six tunnels, with each tunnel estimated to be RMB 30,000.	18	Construction Period	Construction Contractor	Employer
3.4	Sewage treatment facilities in toll stations, maintenance work areas, etc.	One toll station (jointly built with the maintenance work area): one MBR sewage treatment reclaimed water reuse system; a total of RMB 1 million	100	Operation Period	Construction Contractor	Employer
4	**Prevention and Control of Solid Waste Pollution**		**30**	/	/	/
4.1	Costs for disposal of household garbage	Dustbin purchase cost and household garbage removal and disposal cost (tentative estimation)	10	Construction Period	Construction Contractor	Employer
4.2	Treatment of pier excavation mud and wall protection mud	Mud drying tank, closed mud tank, etc.	20	Construction Period	Employer	Employer
II	**Ecological environmental protection**		**6**	/	/	/
2.1	Additional investment for water and soil conservation	Design within main works or water conservation works; included in the investment for main works and water conservation works	/	Construction Period	Construction Contractor	Employer
2.2	Landscape works		/	Construction Period Operation Period	Construction Contractor	Employer
2.3	Drainage and protection works		/	Construction Period	Construction Contractor	Employer
2.4	Temporary land reclamation cost or vegetation restoration cost		/	Construction Period Operation	Construction Contractor	Employer

S/N	Item	Specific Contents of Environmental Protection Investment	Investment (RMB 10,000)	Implementation Period	Implementing Unit	Responsible Subject
				Period		
2.5	Compensation cost of major public welfare forest		/	Construction Period	Construction Contractor	Employer
2.6	Costs for transplanting of protective plants, protection signs for ancient trees and fence protection	Estimated	4	Construction Period Operation Period	Construction Contractor	Employer
2.7	Plant protection and quarantine, removal of alien plants	Reserved	2	Construction Period Operation Period	Construction Contractor	Employer
III	**Preventive Measures for Accident Risks**		**140**			
3.1	Water quality protection measures in nature reserves and scenic spots	Cost for SS-class reinforced RC anti-collision guardrails for the bridge, warning signs of road sections, etc.	60	Construction Period Operation Period	Construction Contractor	Employer
3.2	Risk control measures for river-crossing bridges	Cost for collision barriers for the bridge across water bodies	30			
3.3	Water environment risk prevention measures and emergency rescue	Emergency plan preparation, emergency rescue equipment and appliances for dangerous goods transportation accidents	50	Construction Period	Construction Contractor	Employer
IV	**Environmental Management Cost**		**220**	/	/	/
1	Costs for environmental monitoring during the construction period	Monitoring of water, gas, sound and ecology during the construction period; 400,000 yuan/year	120	Construction Period	Monitoring organization	Employer
2	Costs for environmental impact assessment and completion acceptance of environmental protection	Costs for environmental impact assessment and completion acceptance of environmental protection	100	Preparation period	EIA Organization	Employer
				Operation Period	Acceptance Entity	

S/N	Item	Specific Contents of Environmental Protection Investment	Investment (RMB 10,000)	Implementation Period	Implementing Unit	Responsible Subject
V	**Protection, reconstruction and compensation special funds for distributed drinking water sources**	**Protection, reconstruction and compensation costs for occupying distributed drinking water sources**	**40**	/	/	/
VI	**Basic contingency**	Calculated as 5% of the sum of items one to five	**39.6**	/	/	/
Total			**831.6**	/	/	/

9.1.4.2 Investment in Environmental Protection during Operation Period

The environmental protection investment during the operation period of the Project is included in the project operation cost. See Table 9.1-8 for details of various environmental protection facilities and investment.

Table 9.1-8 Estimation Table of Environmental Protection Investment in Operation Period

S/N	Item	Specific Contents of Environmental Protection Investment	Investment	Implementation Period	Implementing Unit	Responsible Subject
I	**Operation and Maintenance Cost of Environmental Protection Facilities**					
1	Road garbage	Garbage clearing cost for road garbage, convenience bus shelter garbage	RMB 50,000 Yuan/year	Operation Period	Operating Entity	Operating Entity
2	Wastewater treatment facilities	Operation and maintenance cost for sewage treatment facilities in toll stations	RMB 100,000 Yuan/year	Operation Period	Operating Entity	Operating Entity
II	**Environmental Management Cost**					
1	Environmental risk emergency	Costs for daily maintenance of emergency rescue materials, environmental risk emergency rescue training and daily emergency rescue drills	RMB 200,000 Yuan/year	Operation Period	Operating Entity	Operating Entity
2.	Environmental monitoring	Water, gas and acoustic	500,000 yuan/characterist	Operation Period	Environmental Monitoring	Operating Entity

S/N	Item	Specific Contents of Environmental Protection Investment	Investment	Implementation Period	Implementing Unit	Responsible Subject
	cost in characteristic years	environmental monitoring cost in characteristic years (short-term, mid-term and long-term)	ic year		Agency	
Total			RMB 850,000 Yuan/year			

9.2 Environmental Protection Measures for Detian-Shuolong Highway and Demonstration of Their Technical and Economic Feasibility

9.2.1 Environmental Protection Measures in Design Stage

9.2.1.1 Ecological protection measures

9.2.1.1.1 Reduction of Impact on Protected Plants and Old Trees

The protected plants in the project evaluation area are mainly excentrodendron tonkinese, cymbidium bicolor Lindl and cibotium barometz, and the old trees are mainly ficus microcarpa and litchi, among which the ficus microcarpa located in K11+150 and the epiphytic cymbidium bicolor Lindl are located in the project area. It is suggested to bypass the old trees and protected plants in the project area. If bypass is impractical, report it to competent authorities for transplanting.

Table 9.2-1 Major Protection Measures for Protected Plants in Project Area

Description	**Nature**	**Total number/Number in the project area (Nr.)**	**Positional Relation with the Highway Centerline (m)**		**Feasibility Analysis of Route Avoidance**	**Protection Suggestions**
Ficus microcarpa Linn. f.	Class III old tree	1/0	K11+150	Close to the left as far as possible	When the conditions of land acquisition and demolition permit, the impact can be minimized by moving the expanded road to the right side of the existing road.	Give priority to optimizing the design, bypass the protected plants as much as possible, report it to forestry authorities if bypass is impractical, and transplant the protected plants scientifically under the guidance of the forestry authorities if it is approved.
Cymbidium bicolor Lindl	National Level II	5/5	K11+150	2m on the left		

9.2.1.1.2 Reduction of Occupation of Key Public Welfare Forest

The Project occupies about 1.08hm2 of public welfare forest, and occupies key public welfare forest sections in the form of subgrade. It is suggested that the Designer should optimize the design in the next stage, contract the side slope and minimize the occupation of the public welfare forest. Go through formalities for forest land requisition following relevant regulations and pay the forest vegetation restoration fee as per the occupied area.

9.2.1.1.3 Design Measures for Optimizing the Land Occupation and Ecological Impact of

Temporary Works

At present, the site selection of the mixing plant made by the Employer is basically reasonable. After completion, the impact on natural vegetation can be effectively reduced after the land reclamation scheme and corresponding vegetation restoration measures are implemented. At present, the site of spoil ground selected by the Employer is located within the community water source conservation area of Shuolong Town, which is unreasonable. The site shall be re-selected, and it is recommended to locate it in the wasteland on the south side of the existing border highways on the east side of Longhongtun, avoiding areas, such as water sources and nature reserves that cannot be disturbed specified by laws and regulations. In addition, it is suggested that the Employer shall handle the procedures of land use and forest use for temporary sites as soon as possible, obtain the forest administrative license from competent departments, strictly implement technical documents such as water and soil conservation during the construction process and propose ecological compensation measures, and implement greening recovery measures such as land reclamation after the completion of highways to reduce the damage to natural vegetation.

9.2.1.1.4 Cultivated Land Protection Scheme

To implement the *Land Administration Law of the People's Republic of China*, the *Notice of Several Opinions on Implementing the Strictest Farmland Protection System in Highway Construction* by the Ministry of Transport and other relevant laws and regulations, abide by followings in the design stage:

(1) Minimize the occupation of cultivated land and bypass economic crop areas;

(2) Try to avoid occupation of cultivated land for temporary land occupation facilities such as spoil ground and construction camp;

(3) Bypass specialized large-scale irrigation and water conservancy facilities and restore the occupation of water conservancy facilities.

9.2.1.1.5 Prevention of Alien Species Invasion

The invasive alien species listed by the state is prohibited in the greening of the Project and local species are preferred. The construction period of highway greening shall be shortened to prevent the invasion of alien species caused by long-term exposure of the ground surface. The greening structure shall be designed as arbors, shrubs and grass, and the number of greening species shall be as rich as possible. Mixed planting of multiple species shall be adopted to avoid planting a large area of single species for greening and to improve the ability to resist the invasion of alien species. Native species shall be used for vegetation restoration of temporary land occupation.

9.2.1.1.6 Suggestions on Ecological Protection Design of Highway Slope

The bank sides of the riverside section, the tunnel portals, the side slopes, etc. shall be in harmony with the natural landscape around the scenic spots. It is suggested to:

(1) Take the comprehensive protection form with ecological protection accompanied by engineering protection; The local herbaceous plants are planted under bridges and culverts along the stream bridge sections to form animal corridors and reduce the obstruction of the Project on wild animals.

(2) Selection of greening structure and species: The greening structure shall be designed as arbors, shrubs and grass, and local species shall be adopted as far as possible. Fast-growing and deciduous tree species such as eucalyptus, poplar and melia azedarach shall not be used, and invasive alien species are prohibited.

(3) Preferential greening tree species are: melastoma malabathricum, Rhodomyrtus tomentosa, cratoxylum cochinchinense, parthenocissus tricuspidata, dicranopteris dichotoma, miscanthus sinensis, imperata cylindrica, neyraudia reynaudiana, saccharum arundinaceum, etc. Greening tree species shall be self-sustained with normal succession after being planted.

9.2.1.2 Protection Measures for Surface Water Environment

9.2.1.2.1 Protection of Farmland Irrigation Facilities

The culvert shall be properly designed to connect the farmland irrigation system along the route smoothly. Different measures such as provision of culverts, inverted siphons and aqueducts, or ditch and canal diversion can be taken to restore the original functions of the farmland irrigation ditches and ensure the sustainable development of agricultural production along the route.

9.2.1.2.3 Environmental Protection Measures for Drinking Water Source Conservation Area

The section of about 5.1km long with chainage K0+200~K5+300 crosses the land area of the Grade-II conservation zone of Aitun Water Source in Shuolong Town and the section of about 600m long with chainage K9+400~K10+000 crosses the Grade-II conservation zone of Community Water Source in Shuolong Town. The following requirements are put forward for the environmental protection measures of the above sections to protect the drinking water environment:

Table 9.2-2 Schedule of Water Environment Protection Measures for the Project Crossing Water Environment Sensitive Area

Name of Water Source	Measure name		Specific Measures
Aitun water source in Shuolong Town	Relation with highway		Highway section K0+200~K5+300 passes through the Grade II conservation area of the Aitun Drinking Water Source Conservation Area in Shuolong Town, where section K3+900~K5+300 is adjacent to the Grade-I conservation area of this water source conservation area.
	Engineering measures	Design	Section K3+900~K5+300 is about 1.4km and close to the Grade-I land area of the water source conservation area. This section is fully utilized in the engineering design and not within the scope of engineering construction, so as to reduce the impact on the water source during the construction period.
		Speed limit	Because this section is close to the national border, the speed of this section is designed to be 40km/h, which can reduce the probability of car accidents to a certain extent.
		Crash barrier	The Guichun River section K0+000 to K5+500 is close to the national border and the national defense border is provided with protective fences. A certain number of forest belts are planted in the riverside segment of this section, and the vegetation in the riverside section plays a blocking role.
	EIA suggestions	Road runoff system	Section K3+900 ~ K5+300 (about 1.4km) is a fully utilized section and not within the scope of project construction. But since this section is close to the planned water intake of the Aitun water source, to reduce the impact of operational road runoff and risk accidents on the water source, it is recommended to set up a 1.4km road runoff collection system on the river side of this section and set up an oil separation sedimentation tank outside the K5+300 water source conservation area. The water will be diverted to the downstream of Aitun Dam for discharge after being treated.
		Speed limit warning board	Warning boards of water source entrance and exit, speed limit signs and “No Overtaking” traffic signs shall be set up at the entrance and exit sections of the conservation area (K0+200, K5+300) in both directions. The design and construction of the signs shall meet the corresponding requirements in the *Road Traffic Signs and Markings* (GB5768).

Aitun water source in Shuolong Town	Relation with highway		Highway section K9+400~K10+000 passes through the Grade-II conservation area of the Shuolong Community Drinking Water Source Conservation Area in Shuolong Town. The water source of the Yuejin Canal is taken from Guichun River, and the water inlet of the Yuejin Canal is located in the river section of the Detian Old Kapok Scenic Area near K7+800 (outside the water source conservation zone).
	Engineering measures		Consideration has been given to setting up intercepting drains
	EIA suggestions	Sedimentation Tank	Roadside drainage ditch has been considered in the engineering design. It is suggested to set up a grit chamber on the river side of K7+800, and the surface runoff of the pavement near the water inlet of the Yuejin Canal is discharged into the Guichun River at the downstream of the water inlet.
		Speed limit warning board	Warning boards of water source entrance and exit are set at the entrance and exit sections of the conservation area in both directions (K9+400, K10+000); Speed limit traffic signs are set at both ends of the section K7+500~K8+100 near the water inlet of the Yuejin Canal to remind careful driving. The design and construction of the signs shall meet the corresponding requirements in the *Road Traffic Signs and Markings* (GB5768).
		Warning board	
		Crash barrier	Corrugated steel crash barriers are set on the river side near the K7+500~K8+100 section of the Yuejin Canal water inlet (a small number of tourist passages are properly opened at the Detian Old Kapok Scenic Area at K7+800)

Table 9.2-3 Schedule of Investment for Drinking Water Source Conservation Facilities of the Project

S/N	Item	Main Measures	Quantity	Investment / RMB 10,000	Remarks
1	Aitun water source in Shuolong Town	Road runoff system	1.4km	14.0	Double drainage system is adopted in local sections, and road runoff collection pipelines are set up, which is calculated as RMB 100,000/km
		Sedimentation Tank	1 Nos.	0.5	2m3/ tank is calculated as RMB 5,000
		Signboard	12 Nos.	6.0	RMB 5000/Nr.
2	Community Water Source in Shuolong Town	Road runoff system	1.2km	/	The main project has been considered and not included in the EIA

		Sedimentation Tank	1 Nos	0.5	2m3/ tank is calculated as RMB 5,000
		Reinforced barrier	0.6km	30.0	Corrugated steel crash barrier is calculated as RMB 500 /m
		Signboard	8 Nos	4.0	RMB 5000/Nr.

9.2.1.3 Acoustic Environmental Protection Measures

In the construction design stage, the actual route may not be consistent with the engineering feasibility study report. In the specific design, the noise protection measures shall be taken under the following principles:

1. Since the original sensitive points close to the highway become far away from the route (more than the maximum EAD in the mid-term characteristic year of the operation) due to partial rerouting, the noise protection measures originally planned to be taken are cancelled.

2. The original sensitive points far away from the highway become close to the route, or sensitive points that were not in the assessment range are next to the route due to partial rerouting. In the assessment, it is recommended to adjust the actual positions and limits and actual environmental characteristics of each sensitive point in the next stage of project implementation, and timely adjust the noise protection measures for buildings in the relevant sensitive points in accordance with the route and in combination with the assessment and prediction results, so as to ensure that each sensitive point within the scope of assessment reaches the noise standard in the mid-term characteristic year of operation period.

9.2.2 Environmental Protection Measures during Construction

The Employer has the responsibility to protect the environment and mitigate the adverse impact on the environment during the construction of the Project. During the preparation of the Bidding Documents, the mitigation measures for the environmental impact should be included in the Bidding Documents and specified in the Project contract. The contractor should include the implementation and implementation plans for environmental protection measures in the Bid Documents.

9.2.2.1 Ecological Impact Mitigation Measures

9.2.2.1.1 Protection Measures for Huashan National Scenic Spot

(1) It is forbidden to set up stockyards, temporary stock yards, spoil ground, and other activities that may cause damages to landscape resources and natural vegetation in the core tourist attraction of scenic spots, to reduce the landscape impact of scenic spots caused by

construction activities;

(2) The construction red line is strictly controlled, especially construction enclosures and scenic spot reminders at road sections near the Huashan Scenic Area, to avoid affecting nearby scenic spots.

(3) Construction supervision and management of existing forests are strengthened. Take the initiative to report the construction section, process and time period with the management department of Huashan Scenic Area, and accept the supervision and inspection of the management office to avoid construction disputes.

9.2.2.1.2 Measures for Ecological Protection of Terrestrial Plants

(1) Key protection plants and protection measures for ancient trees

There are 6 areas distributing protected plants and ancient trees outside the engineering area within the assessment area along the project. Since 3 of them are close to the project area, it is recommended to block and label the surrounding areas for in-situ conservation and to avoid the impact of construction activities. Because the remaining 3 further sites are not greatly affected by construction activities, it is recommended to set up warning signs for in-situ conservation. Specific measures are shown in Table 9.2-4.

Table 9.2-4 Major Protection Measures for Protected Plants along the Project Route

Description	Nature	Total number/Number in the project area (Nr.)	Positional Relation with the Highway Centerline (m)		Protection measures and suggestions	Engineering measures
Excentrodendron tonkinese	National Level II	2/0	K13+050	15 m on the right	It is recommended to block and label the surroundings for protection because it is close to the route	Enclosure + label
Excentrodendron tonkinese	National Level II	2/0	K13+600	50m on the left	It is recommended to set up warning signs to remind constructors because it is far away from the route,	Warning signs
Cymbidium bicolor Lindl	National Level II	2/0	K13+050	15 m on the right	It is recommended to enclose and label for protection because it is close to the route	Enclosure + label
Cibotium barometz	National Level II	2/0	K9+400	290m on the right	It is recommended to set up warning signs to remind constructors because it is far away from the route	Warning signs
Cibotium barometz	National Level II	2/0	K5+360	45m on the	It is recommended to set up warning signs to remind	Warning signs

Description	Nature	Total number/Number in the project area (Nr.)	Positional Relation with the Highway Centerline (m)		Protection measures and suggestions	Engineering measures
				left	constructors because it is far away from the route,	
Litchi chinensis	Class III old tree	1/0	K12+560	20m on the right	It is recommended to block and label the surroundings for protection because it is close to the route	Enclosure + label

(2) Construction activities should be controlled within the scope of land acquisition, especially the construction access roads and temporary land occupation at the road section of K2+000~K3+600 and K7+300~K9+800 should be minimized to reduce the occupation and destruction of public welfare forests.

(3) Construction vehicles should not be parked without authorization or scattered as much as possible. The domestic garbage of construction workers should be unified treated and transported out of the construction area in a centralized manner to prevent random littering and crushing of the wood land vegetation and crops.

(4) Setting up warning signs The warning sign indicates the scope of the construction area of the project. It is forbidden to occupy lands by construction crossing the border or cut down trees. Vegetation loss caused by the land occupation should be minimized.

(5) A Project management organization is established to allocate eco-environment management, strengthen the monitoring or investigation of the protected plants and ancient trees to avoid the digging of them along the route during the construction activities, and record and report to the competent authority regularly.

(6) Propaganda and education of constructors shall be improved. It is forbidden to hunt wild animals.

(7) Field survey is required before construction in the bird breeding season to observe whether there any birds near the construction area, such as places where the heron is concentrated. If any, the construction of the route section near the heron breeding site should be temporarily suspended, and should be continued after the breeding ends and baby birds leave the nest.

(8) The entrance and exit of the tunnel should be covered up and greened, and a "stopping animal induction fence" should be set up to prevent wild animals from entering the tunnel.

9.2.2.2 Water environmental protection measures

9.2.2.2.1 Management measures

(1) Construction management and project supervision are improved to prevent sudden environmental accidents.

(2) The construction machinery is strictly inspected to prevent oil from leaking and polluting the water body. Construction materials such as oil and asphalt should not be stacked near the surface water body, and should be equipped with temporary shelter canvas; Measures are taken to prevent mud and loose construction materials from blocking the water channel or existing Irrigation ditches, etc.

(3) The water and soil protection plan should be strictly followed to do a good job of protecting the exposed surface of the construction area. The waste earthwork in construction should be cleared and transported in time, and should not be piled up without permission to avoid the rain from scouring into the water body and causing water pollution.

9.2.2.2.2 Measures for Prevention and Control of Water Environment Pollution in Construction, Production and Living Areas

(1) This EIA requires that the construction, production and living areas of the project should be set outside the water source conservation area for drinking water along the route. Domestic wastewater produced during construction shall not be discharged into the water body within the water source conservation area for drinking water.

(2) The wastewater from construction, production and living areas after oil separation and desilting is reused as much as possible. After the isolated oil substances are collected in closed tanks, they are regularly handed over to the agency designated by the local environmental protection department for treatment.

(3) The construction domestic sewage is used for fertilization in the wood land around the construction and living areas after being treated by tertiary septic tanks which are regularly cleared and used for the wood land fattening.

9.2.2.2.3 Measures for Prevention and Control of Water Environment Pollution in Tunnel Construction

(1) Before the construction of Longhong Tunnel Works, a detailed survey should be carried out to analyze and demonstrate the possible location and groundwater gushing caused by the tunnel excavation, and formulate a thorough water leakage and gushing prevention plan, then, environmentally-friendly water-blocking materials are selected for plugging.

(2) During tunnel construction, oil separation and grit chambers should be installed at the entrance and exit of each tunnel to treat the production wastewater. The supernatant after sedimentation shall be recycled, and the waste slag from the sedimentation tank shall be stored in a centralized way; oil substances trapped shall be collected in closed tanks and delivered to the institutions designated by the local environmental protection department for treatment on a regular basis.

9.2.2.2.4 Protection Measures for Drinking Water Source Section

(1) During the construction of K0+200~K5+300 and K7+500~K8+100, the construction contractor should arrange the material stockyard away from the water body, and take covering measures. For example, the exposed surface should be covered during the suspension of construction to prevent materials, earth and stone entering the water intake of the Aitun water source and the Yuejin Channel caused by rainwater erosion;

(2) The construction contractor should place a number of similar warning signs such as "Construction of road section of water source conservation area" on the K0+200~K5+300 and K7+500~K8+100 road sections, to remind the construction personnel to regulate their construction behavior and prohibit improper conduct from polluting water bodies;

(3) During the construction, the construction contractor shall carry out publicity and education activities for the protection of the water source conservation area, and explicitly prohibit the littering of domestic garbage and other solid waste into the water source conservation area, the dumping of domestic sewage and other acts that damage the water quality of the water source conservation area, and shall establish corresponding rewards and penalties system.

9.2.2.3 Prevention and Control Measures for Ambient Air Pollution

(1) The construction site should be sprinkled in time to keep the pavement moist. The Employer requires the Contractor to provide at least its own sprinkler, and appropriately

increase the number of watering in dry and windy weather.

(2) Closed transport trucks for bulk cement are used to transport cement, while enclosure, dustproof cloth, and rainproof sheds are set up on the gravel stockyard. Dust-proof measures shall be taken for the powder stockyard, such as closed storage, setting up fences or enclosures, or using dust-proof cloth for covering.

(3) Scattered materials should be cleaned in time to avoid further dust problem.

(4) It is recommended to directly purchase commercial asphalt which is not mixed at the construction site.

(5) The site selection for large mixing plant (precast yard) shall meet the requirements of specifications and shall be equipped with dust removal device.

(6) In the construction area close to sensitive points and cultivated lands, construction fences shall be installed, and the frequency of sprinkling water for the construction area and construction access road should be increased. Especially for the construction site within 50 m away from sensitive points, attention should be paid to cleaning the construction area and construction access road in the dry season, keeping them clean and increasing the frequency of sprinkling water.

(7) Temporary work areas should be hardened in time, and a tire cleaning tank for transportation vehicles should be set up to avoid muds on the road.

(8) Asphalt concrete should be laid centrally on sunny and windy days with good atmospheric diffusion conditions. On the premise of meeting the construction requirements, the asphalt paving temperature shall be reduced as much as possible, and then water cooling measures shall be taken on the laid pavement to reduce the generation of asphalt smoke.

9.2.2.4 Prevention and Control Measures for Noise Pollution

(1) 15 days before the project commencement, the Employer shall report the project name, construction site and period, possible environmental noise value, and the environmental noise pollution prevention and control measures taken to the local environmental protection administrative department, and the construction can only be carried out after being approved by the department.

(2) The time is reasonably arranged, and construction operations and transportation of construction materials are avoided for the construction area close to the sensitive point at night (Beijing time 22:00 to 6:00 A.M.). For the construction section near the school, try to complete the main earthwork quantity of the subgrade during school holidays to reduce the impact of construction.

(3) For construction areas and construction, production and living areas close to sensitive points, noise can be reduced by setting a 2.5 m high iron baffle at the site boundary. The construction of high-noise mechanical equipment should be concentrated in the daytime.

(4) The Contractor shall pay attention to the maintenance of mechanical equipment to keep them at a lower sound level.

(5) When blasting operation is required for tunnel works, the blasting output should be controlled to reduce the sudden noise source intensity of blasting, and an announcement should be made before blasting. Blasting at night is strictly prohibited.

9.2.2.5 Disposal Measures for Solid Waste

(1) Abandoned earthwork of subgrade shall be transported to the spoil ground and temporary stock yard determined in the project design in time. It is strictly prohibited to pile up along the construction area at will, and corresponding protective measures shall be taken according to the Soil and Water Conservation Scheme of the project.

(2) The Contractor shall provide management personnel to carry out on-site management on the transportation and disposal of the muck, so as to avoid rough loading and transportation and improper dumping.

(3) Special containers are equipped for asphalt mixing residues to recycle them. The asphalt waste that cannot be reused should be sent to a qualified company for recycling, and must not be landfilled or directly incinerated or discarded at will.

(4) Small garbage bins are provided in the construction camp for centralized collection, and then the local environmental sanitation department is entrusted to transport and dispose of the garbage. It is not allowed to throw the garbage everywhere or mix them with construction waste, which will affect the environmental sanitation.

9.2.3 Environmental Protection Measures during Operation Period

9.2.3.1 Ecological Environment Protection Measures

(1) The dynamic distribution of alien invasive species shall be monitored during the operation period. Alien invasive species entering the area occupied by the highway shall be removed. And they shall be removed before the seeds mature as far as possible, then, they are dried after removing to ensure that the plants die.

(2) When water pollution is caused by traffic accidents at the Project subgrade near Guichun section, the local fishery administrative department shall also be notified in a timely manner.

9.2.3.2 Water environmental protection measures

(1) Strengthen the daily inspection and maintenance of facilities such as road runoff collection system and accident emergency response system, so as to avoid the blockage of drainage ditch (pipe), accident emergency tank and sedimentation tank, which will lead to the reduction or even loss of the capability to dispose of hazardous goods.

(2) Desilting, inspection and cleaning of oil separation tanks are regularly performed in tunnel road sections.

(3) According to the monitoring plan for the operation period, the water quality in sensitive sections is regularly monitored.

9.2.3.3 Prevention and Control Measures for Ambient Air Pollution

To strengthen environmental management, the highway management department regularly entrusts the entity with environmental monitoring qualifications to monitor the ambient air at environmentally sensitive points along the highway, and establish archives of changes in air environmental characteristics and pollutants along the Project for future environmental management.

9.2.3.4 Prevention and Control Measures for Acoustic Environment Pollution

9.2.3.4.1 Noise Reduction Measures for Sensitive Points

According to the actual investigation, the current domestic noise control measures for highways mainly include the installation of sound barriers and sound proof windows (including general aluminum alloy windows and ventilation sound proof windows), greening, low-noise pavement, and environmental protection relocation. The cost effects, advantages and disadvantages of main measures are shown in Table 9.2-5.

Table 9.2-5 Technical and Economical Comparison of Noise Control Measures

Noise Reduction Measures	Noise reduction effect	Cost Estimate	Applicable object	Advantages and Disadvantages
Aluminum alloy window	5~8dB(A)	RMB 500 Yuan/m2	A noise-reduction measure in common use for the current stage, for sensitive points with exceeding ＜3 dB(A)	General beautiful and noise-reduction effects, with low requirements for housing structures
Aluminum alloy window+sealing strip	10~15dB(A)	Aluminum alloy window RMB 500/m2 Sealing strip RMB 20/m	Sensitive points exceeding 3 ~ 5 dB (A) above the standard	General beautiful and noise-reduction effects, with low requirements for housing structures
Ventilation sound proof window	15~25 dB(A), at least above 25 dB(A) when fully closing	RMB 2,000 Yuan/m2	Sensitive points exceeding more than 5 dB (A) above the standard	Fine beautiful and noise-reduction effects, with high requirements for housing structures and expensive costs
Noise reduction forest	When the dense planting height is above 4.5 m in evergreen trees and shrubs, the noise can be reduced by 1~1.5 dB every 10 m width, at most it can be reduced by 10 dB	RMB 200 ~ 500/m	Sensitive points with slight noise exceeding the standard and greening conditions	It can reduce noise, purify the air, beautify the road, and improve the ecological environment. The occupied land area is large, a certain noise reduction effect requires a long time, and the applicability is severely restricted
Noise barrier	Obvious effects on the sensitive points of the low-layer (<5 layers) sound environment within 50 m from both sides of the route's center line,	RMB 3,000 Yuan/m2	Concentrated sensitive points with seriously excessive noise and are close to the highway	Small floor area and the general noise reduction effect. The long-distance sound barrier is easy to cause the depressed and monotonous driving, with high costs

Noise Reduction Measures	Noise reduction effect	Cost Estimate	Applicable object	Advantages and Disadvantages
	generally reducing the noise by 5-20 dB.			
Environmental relocation	Ensure the acoustic environment quality reaches the standard	The cost varies according to the number of relocated people, relocation distance and resettlement requirements	/	It can solve the noise impact caused by project construction once and for all, but the cost is high and it is easy to be opposed

The Project is a Class-II highway, with scattered villagers along the route. Since the level crossing is required for parts crossing villages with roads in villages, the sound barrier is not conducive to the villagers' trip. Greening and noise reduction require a lot of lands, resulting in new land use and limited noise reduction effects; Relocation for noise reduction has so large investment that social problems may be easily caused. Therefore, the most commonly-used noise reduction measures for Class-II highways are considered in the Project. By installing ventilation and sound proof windows for residents with exceeding standards during the mid-operation period, the impact of traffic noise caused by project operation is reduced on sensitive point noise.

There are a total of 12 acoustic environmental sensitive points along the project route. By the mid-operation period, all of them meet the standards during the day, but 6 sensitive points exceed the standards at night, while the remaining 6 sensitive points are able to meet the standard day and night. The sensitive points exceed 0.6~6.7 dB(A) at night in the mid-operation stage. It is planned to achieve the noise reduction effect by replacing the ventilation and sound proof windows. For anti-noise measures of each sensitive point in the intermediate operation period, see Table 9.2-6.

Table 9.2-6 Standard Excessive Conditions of Sensitive Points in Acoustic Environment and Preventive Measures

S/N	Sensitive Point	Chainage	Relationship with the highway center line	Evaluation Standard	Exceeding standard dB(A)	Number of people affected by excessive noise households / persons	Proposed protective measures	Noise reduction [dB(A)]	Noise after measures	Estimated investment (RMB10,000)
1	Liudeng	K1+900~K2+060	8 m on the left	4a	Nighttime +0.6	4/16	Ventilation and sound proof window of 40 m2	≥15	Up to standard	8
2	Aitun	K5+500~K5+700	7 m at both sides	4a	Nighttime + 1.4	5/20	Ventilation and sound proof window of 50 m2	≥15	Up to standard	10
3	Longjian	K6+700~K6+800	7m at both sides	4a	Nighttime +1.4	7/25	Ventilation and sound proof window of 70 m2	≥15	Up to standard	14
4	Wanlong	K6+900~K7+100	8 m at both sides	4a	Nighttime + 0.9	8/29	Ventilation and sound proof window of 80 m2	≥15	Up to standard	16

S/N	Sensitive Point	Chainage	Relationship with the highway center line	Evaluation Standard	Exceeding standard dB(A)	Number of people affected by excessive noise households / persons	Proposed protective measures	Noise reduction [dB(A)]	Noise after measures	Estimated investment (RMB10, 000)
5	Gutun	K10+400~K11+200	12 m at both sides	4a	Nighttime + 5.7	16/59	Ventilation and sound proof window of 160 m2	≥15	Up to standard	32
6	Shuolong Community	K12+300~K13+100	10 m at both sides	4a	Nighttime + 6.7	13/46	Ventilation and sound proof window of 130 m2	≥15	Up to standard	26

According to estimates, it is planned to replace ventilation and sound proof windows for a total of 530 m2 for sensitive points exceeding the standard in the Project, and it is estimated that the environmental protection investment will be RMB 1.06 million. After taking this measure, the acoustic environment in sensitive points can meet the requirements of the corresponding functional area.

9.2.3.4.2 Other requirements

Given that the project is in the feasibility study stage, the specific alignment of the highway may also be adjusted to a certain extent. This may shorten the distance of the original sensitive points farther away from the highway to the route, or the sensitive points that were not originally in the assessment range may become close to the route, and the height difference between the sensitive point and the Project may change compared with that in the feasibility study stage. So, some sensitive points affected by noise more than the predicted value of this assessment. To this end, it is proposed to set aside some funds for remedial measures in the assessment, such as installing sound barriers and sound proof windows for sensitive points where noise exceeds the standard after the Project is completed.

(1) In the next stage, a qualified entity should design and construct noise reduction facilities, strengthen the design, construction, and acceptance management, and do well in the maintenance of sound barriers.

(2) Enough noise control expenses shall be reserved to strengthen the noise tracking monitoring of sensitive points along the route in the operation period, and to add and perfect measures in time according to the detection results.

(3) For sensitive points with long-term noise exceeding the standard, follow-up monitoring shall be employed to timely implement prevention measures.

9.2.3.5 Disposal Measures for Solid Waste

(1) Garbage cans are provided at scenic areas and parking islands along the route, and sanitation personnel are arranged to clean and collect domestic garbage which shall be cleaned and transported by the sanitation department on a regular basis;

(2) Publicity is enhanced along the route, and signs of "No littering and protect the tourist attraction environment" are set up.

9.2.3.6 Preventive Measures for Accident Risks

(1) The Employer shall prepare an emergency plan and set up an emergency office for handling accidents, so as to communicate, contact and coordinate with competent authorities and other relevant departments in case of risks and accidents, and carry out the treatment at accident scenes.

(2) In conjunction with the tourist attraction management department and the traffic police inspection post, the traffic flow entering the scenic spots near the water source protection area is controlled, especially in the high tourist season, to avoid traffic congestion on sensitive road sections and increment of the probability of accidents.

(3) The water treatment and discharge of environmental protection facilities are regularly checked in the section of the water source conservation area to ensure that the sewage treatment system is in good working conditions.

9.2.4 Investment Estimation of Environmental Protection

The environmental protection facilities and investment of the Project are divided into two parts, one part is the one-off environmental protection investment (including environmental pollution prevention and control investment, ecological environmental protection investment and environmental management investment) generated simultaneously during the construction period of the main works, and the other part is environmental protection investment (including environmental protection facilities operation and maintenance investment and environmental management investment) generated continuously during the project operation period.

9.2.4.1 Investment in Environmental Protection During Construction Period

The total investment of the Project is RMB 270.227837 million, including a total investment of RMB 2.74 million for environmental protection during the construction period (excluding investment in existing environmental protection measures for water and soil conservation works and main works). The investment funds for environmental protection during the construction period are included in the total project investment, accounting for 0.98% of the total project investment. See Table 9.2-7 for details of various environmental protection facilities and investments.

Table 9.2-7 Investment Estimation of Environmental Protection Measures during Construction Period of the Project

S/N	Item	Specific Contents of Environmental Protection Investment	Investment (RMB 10,000)	Implementation Period	Implementing Unit	Responsible Subject
I	**Prevention and Control of Environmental Pollution**		**160**	/	/	/
1	**Prevention and Control of Acoustic Environmental Pollution**		**114**	/	/	/
1.1	Simple enclosure and temporary mobile sound barrier during the construction period	Provide 2 m high iron baffle during the construction period and strengthen maintenance for construction machinery and equipment	8	Construction Period	Construction Contractor	Employer
1.2	Prevention and control of noise pollution at sensitive points during the operation period	Soundproof windows with an area of 530 m2 are replaced.	106	Operation Period	Construction Contractor	Employer
2	**Prevention and Control of Ambient Air Pollution**		**31**	/	/	/
2.1	Water sprinkling for dust control during the construction period	Water sprinkling for dust control during the construction period	10	Construction Period	Construction Contractor	Employer
2.2	Prevention and control measures of transportation dust pollution	Cost for covered transportation or closed transportation	6	Construction Period	Construction Contractor	Employer
2.3	Prevention and control measures for dust pollution in construction, production and living quarters	Covering measures for stocked materials in the construction camp; dust removal devices for concrete mixing equipment	15	Construction Period	Construction Contractor	Employer
3	**Water pollution prevention and control**		**10**	/	/	/
3.1	Treatment of construction production wastewater and domestic sewage	Sedimentation tank construction and manual cleaning costs (tentative estimation), septic tanks	2	Construction Period	Construction Contractor	Employer
3.2	Prevention and control of	Temporary drainage ditches and sedimentation tanks	4	Construction	Construction	Employer

S/N	Item	Specific Contents of Environmental Protection Investment	Investment (RMB 10,000)	Implementation Period	Implementing Unit	Responsible Subject
	construction wastewater for the road section near the river	shall be provided in the section near the river. (Tentative estimation)		Period	Contractor	
3.3	Wastewater treatment during tunnel construction	Setting up of oil separation tank and grit chamber at the entrance and exit of the Longhong tunnel, and cyclic utilization of supernatant after precipitation; Arrangement of 1 tunnel in the Project, with each tunnel estimated to be RMB 40,000.	4	Construction Period	Construction Contractor	Employer
4	**Prevention and Control of Solid Waste Pollution**		**5**	**/**	**/**	**/**
4.1	Construction solid waste for the road section near the river	Disposal of subgrade spoil at sections along the river, solid waste from existing road excavation and concrete waste blocks	3			
4.2	Costs for disposal of household garbage	Dustbin purchase cost and household garbage removal and disposal cost (tentative estimation)	2	Construction Period	Construction Contractor	Employer
II	**Ecological environmental protection**		**10**	**/**	**/**	**/**
2.1	Additional investment for water and soil conservation	Design within main works or water conservation works; included in the investment for main works and water conservation works	/	Construction Period	Construction Contractor	Employer
2.2	Landscape works		/	Construction Period Operation Period	Construction Contractor	Employer
2.3	Drainage and protection works		/	Construction Period	Construction Contractor	Employer
2.4	Temporary land reclamation cost		/	Construction	Construction	Employer

S/N	**Item**	**Specific Contents of Environmental Protection Investment**	**Investment (RMB 10,000)**	**Implementation Period**	**Implementing Unit**	**Responsible Subject**
	or vegetation restoration cost			Period	Contractor	
2.5	Compensation cost of major public welfare forest		/	Construction Period	Construction Contractor	Employer
2.6	Costs for transplanting of protective plants, protection signs for ancient trees and fence protection	Optimize the design or transplantation of 5 cymbidiums bicolors sp. obtusum and 1 banyan tree within the project scope. Post and install fences for the 3 protected plants adjacent to the project area. The estimated cost for transplanting protection is RMB 40,000/place, the estimated cost of posting and fence protection is RMB 15,000/place, and the estimated cost of setting up warning signs is RMB 5,000/place.	10	Construction Period Operation Period	Construction Contractor	Employer
III	**Preventive Measures for Accident Risks**		**60**			
3.1	Water environment risk prevention measures and emergency rescue	Emergency plan preparation, emergency drills and training	5	Construction Period	Construction Contractor	Employer
3.2	Protection measures for water quality in sections of water source conservation area for drinking water	Costs for road (bridge) surface runoff collection and drainage system, sedimentation tank and warning signs for road sections	55	Construction Period	Construction Contractor	Employer
IV	**Environmental Management Cost**		**34**	/	/	/
1	Costs for environmental monitoring during the construction period	Monitoring of water, gas, sound and ecology during the construction period; RMB 76,000/year	11.4	Construction Period	Monitoring organization	Employer

S/N	Item	Specific Contents of Environmental Protection Investment	Investment (RMB 10,000)	Implementation Period	Implementing Unit	Responsible Subject
2	Costs for supervision and completion acceptance of environmental protection	Estimated RMB 124,000 for Environmental supervision, and RMB 102,000 for completion acceptance fees of environmental protection	22.6	Construction Period	Supervisor	Employer
				Completion stage	Acceptance Entity	
Total			**264**	/	/	/

9.2.4.2 Investment in Environmental Protection during Operation Period

The environmental protection investment during the operation period of the Project is included in the project operation cost. See Table 9.2-8 for details of various environmental protection facilities and investment.

Table 9.2-8 Investment Estimation of Environmental Protection Investment in Operation Period of the Project

S/N	Item	Specific Contents of Environmental Protection Investment	Investment	Implementation Period	Implementing Unit	Responsible Subject
I	**Operation and Maintenance Cost of Environmental Protection Facilities**					
1	Road garbage	Clearing costs for road garbage, garbage removal costs for the scenic area and the parking island	RMB 20,000 Yuan/year	Operation Period	Operating Entity	Operating Entity
II	**Environmental Management Cost**					
1	Environmental risk emergency	Costs for environmental risk emergency rescue training and daily emergency rescue drills	RMB 100,000 Yuan/year	Operation Period	Operating Entity	Operating Entity
2.	Environmental monitoring cost in characteristic years	Water, gas and acoustic environmental monitoring cost in characteristic years (short-term, mid-term and long-term)	RMB 100,000/Characteristic Year	Operation Period	Environmental Monitoring Agency	Operating Entity

S/N	Item	Specific Contents of Environmental Protection Investment	Investment	Implementation Period	Implementing Unit	Responsible Subject
Total			RMB 220,000 Yuan/year			

9.2.5 Technical and Economic Study of Environmental Protection Measures

9.2.5.1 9.2.5.1 Overview of Environmental Protection Measures for Highway

1. Mature environmental protection control measures have been accumulated in the design, construction and operation periods of highway construction projects, and the measures are technically feasible; Environmental protection will follow the principle of phased implementation, so as to achieve economic investment, reasonable technology, operability and environmental benefits.

2. The main influences during the construction period are water, gas and sound pollution, vegetation destruction and water and soil erosion. The key points of prevention and control are to enhance management and supervision, including the organization and management of construction procedures and the publicity and education of environmental protection for construction personnel. All environmental engineering and environmental protection management and supervision requirements shall be taken as constraints of engineering contractors.

3. The main environmental problems during the operation period are the traffic noise impact caused by the highway operation and risk accidents on the road section passing through the drinking water source conservation area.

This Chapter mainly studies the technical and economic feasibility of the noise reduction measures and drainage system of the drinking water source conservation area.

9.2.5.2 Feasibility Analysis of Sewage Treatment Process

Temporary production and domestic sewage treatment measures for engineering construction mainly include setting up temporary sedimentation tanks, septic tanks, oil separation tanks and supporting temporary intercepting drains and drainage ditches. These facilities are simple in structure, mainly fall into geotechnical engineering, without technical obstacles. But the waste oil in the oil separation tanks shall be regularly cleared and removed and transferred to relevant authorities for treatment. It is forbidden to dump it at will.

9.2.5.3 Feasibility Analysis of Environmental Protection Measures for Drinking Water Source Conservation Area

(1) Feasibility Analysis of Collection and Drainage System of Pavement Runoff

It is recommended in the assessment to install a collection and drainage system for pavement runoff near the first-level protection zone at the Aitun water source area in Shuolong Town, where the pavement drainage system is to set up a masonry drainage ditch on the roadside so that the pavement runoff can be discharged into the sedimentation tank through the drainage ditch. The pavement drainage ditch has a simple structure and mainly involves geotechnical engineering, without technical obstacles.

(2) Feasibility of oil separation sedimentation tank and accident pool

In the Assessment, oil separation sedimentation tanks are set up outside the water source area in Shuolong Town and Detian Old Kapok Scenic Area to collect pavement runoff from road sections of the first-level protection zone near the water source area, and the treated runoff rainwater is discharged into the water intake of the Aitun water source area and the downstream of the water inlet of Yuejin Channel, avoiding the impact of pavement runoff on the inlet water quality near the water inlet. The oil separation sedimentation tank is a concrete structure with mature technology, which can effectively deal with the sediment and oil pollution in the pavement runoff. The oil separation sedimentation tank is set at the lower end of the slope of the corresponding road section. The pavement runoff and the fuel with risk leakage can flow into the tank (which can also be used as an accident oil tank) by the gravity flow. It is not difficult in technology and feasible in the operation.

Therefore, it is feasible to set up the pavement runoff collection system and the oil separation sedimentation tank for the environmental protection in the Aitun water source area and Yuejin channel water intake section in Shuolong Town according to the Assessment.

9.2.5.4 Feasibility Analysis of Noise Control Measures

According to the actual investigation, the current domestic noise control measures for highways mainly include the installation of sound barriers and sound proof windows (including general aluminum alloy windows and ventilation sound proof windows), greening, low-noise pavement, and environmental protection relocation. The cost effects, advantages and disadvantages of main measures are shown in Table 9.2-5. The technical and economic scheme of noise reduction measures adopted in the Assessment is specifically demonstrated as follows:

1. Feasibility Analysis of Sound Barrier Construction

Advantages: good noise reduction effect, setting in the subgrade range, the most widely-used noise reduction measure in expressway project construction. Disadvantages: high costs, a blocking effect on both sides of the pavement, and no obvious effect on the remote or scattered residential areas.

2. Analysis of noise reduction of ventilation and sound proof window

Advantages: Achieving the noise reduction effect, and meeting meet the ventilation requirements of residents;

Disadvantages: high structural requirements for the house, suitable for new houses and better structure.

3. Analysis of Greening Noise Reduction

Advantages: In addition to the noise reduction effect, it can also beautify the environment and purify the air;

Disadvantages: large land occupation, and the limited noise reduction effect if the green belt cannot reach a certain width.

4. Noise Reduction Analysis of Relocation

Advantages: the best effects, generally considered when other facilities are difficult to realize.

Disadvantages: difficult implementation in the relocation, and much higher costs compared with other measures.

5. Technical and Economic Analysis of Noise Control Measures for the Proposed Project

The Project is a Class-II highway, with scattered villagers along the route. Since the level crossing is required for parts crossing villages with roads in villages, the sound barrier is not conducive to the villagers’ trip. Greening and noise reduction require a lot of lands, resulting in new land use and limited noise reduction effects; Relocation for noise reduction has so large investment that social problems may be easily caused. Therefore, the most commonly-used noise reduction measures for Class-II highways are considered in the Project. By installing ventilation and sound proof windows for residents with exceeding standards during the mid-operation period, the impact of traffic noise caused by project operation is reduced on sensitive point noise.

By comprehensively comparing the noise reduction effects and investment of noise reduction measures, the assessment proposes that the noise protection is mainly the use of sound barriers or replacement of the ventilation sound proof window for sensitive points exceeding standards, which is reasonable and feasible from a technical and economic perspective.

9.3 Environmental Protection Measures and Demonstration of Technical and Economic Feasibility of Shuolong Port (Phase II of Shuolong Gate)

9.3.1 Environmental Protection Measures during Construction Period

9.3.1.1 Ecological Impact Mitigation Measures

9.2.2.1.1 Protection Measures for Huashan National Scenic Spot

(1) It is forbidden to set up stockyards, temporary stock yards, spoil ground, and other activities that may cause damages to landscape resources and natural vegetation in the core tourist attraction of scenic spots, to reduce the landscape impact of scenic spots caused by construction activities;

(2) The construction red line is strictly controlled, and the construction enclosures shall be provided to avoid affecting the scenic spot.

(3) Construction supervision and management of existing forests are strengthened. Contact the management department of Huashan Scenic Area and report the construction section, technology and time period, and accept the supervision and inspection of the management department.

9.2.2.1.2 Measures for Ecological Protection of Terrestrial Plants

(1) Construction vehicles shall not be parked at will or in a scattered way as much as possible. The domestic garbage of construction workers shall be treated in an unified way and transported out of the construction area in a centralized manner to prevent random littering

and crushing of the wood land vegetation and crops.

(2) Provision of warning signs. The warning sign indicates the scope of the construction area of the project. It is forbidden to occupy lands by construction crossing the border or cut down trees. Vegetation loss caused by the land occupation should be minimized.

(3) Strengthen publicity and education for construction workers. Catching and killing wild animals are prohibited.

(4) Field survey is required before construction in the bird breeding season to figure out whether there any birds near the construction area, such as places where the heron is concentrated to breed. If any, the construction of the section near the heron breeding site shall be temporarily suspended, and shall be proceeded after the breeding ends and baby birds leave the nest.

9.3.1.2 Protection Measures for Water Environment

9.2.2.2.1 Management measures

(1) Construction management and project supervision are improved to prevent sudden environmental accidents.

(2) The construction machinery is strictly inspected to prevent oil from leaking and polluting the water body. Construction materials such as oil and asphalt should not be stacked near the surface water body, and should be equipped with temporary shelter canvas; Measures are taken to prevent mud and loose construction materials from blocking the water channel or existing Irrigation ditches, etc.

(3) Protect the exposed surface in the construction area. The waste earthwork shall be cleared and transported in time, and shall not be piled up without permission to avoid the rain from scouring into the water body and causing water pollution.

9.2.2.2.2 Measures for Prevention and Control of Water Environment Pollution in Construction, Production and Living Areas

(1) The wastewater from construction, production and living areas after deoiling and desilting shall be reused as much as possible. After the isolated oil substances shall be collected in closed tanks and regularly treated by the agency designated by local environmental protection department.

(2) The construction domestic sewage will be discharged into Shuolong Sewage

Treatment Works after being treated by the three-stage septic tank.

9.3.1.3 Prevention and Control Measures for Ambient Air Pollution

(1) The construction site should be sprinkled in time to keep the pavement moist. The Employer requires the Contractor to provide at least its own sprinkler, and appropriately increase the number of watering in dry and windy weather.

(2) Enclosure, dustproof cloth, and rainproof sheds are provided on the gravel stockyard. Dust-proof measures shall be taken for the powder stockyard, such as closed storage, setting up fences or enclosures, or using dust-proof cloth for covering.

(3) Scattered materials should be cleaned in time to avoid further dust problem.

(4) It is recommended to directly purchase commercial asphalt which is not mixed at the construction site.

(5) Temporary work areas shall be hardened in time, and a tire cleaning tank for transportation vehicles shall be provided to avoid mud on the road.

9.3.1.4 Prevention and Control Measures for Noise Pollution

(1) 15 days before the project commencement, the Employer shall report the project name, construction site and period, possible environmental noise value, and the environmental noise pollution prevention and control measures taken to the local environmental protection administrative department, and the construction can only be carried out after being approved by the department.

(2) Reasonably arrange the transportation time. In the construction area near the sensitive points, avoid construction operations and transportation of construction materials at night (Beijing (Peking) time 22: 00-6: 00 the next day);

(3) For construction areas and construction, production and living areas close to sensitive points, noise can be reduced by setting a 2.5 m high iron baffle at the site boundary. The construction of high-noise mechanical equipment should be concentrated in the daytime.

(4) The Contractor shall pay attention to the maintenance of mechanical equipment to keep them at a lower sound level.

9.3.1.5 Disposal Measures for Solid Waste

(1) Temporary spoil ground shall be provided. It is prohibited to pile up along the construction area at will, and corresponding protective measures shall be taken according to the soil and water conservation scheme of the Project.

(2) The Contractor shall provide management personnel to carry out on-site management on the transportation and disposal of the muck, so as to avoid rough loading and transportation and improper dumping.

(3) Small garbage bins are provided in the construction camp for centralized collection, and then the local environmental sanitation department is entrusted to transport and dispose of the garbage. It is not allowed to throw the garbage everywhere or mix them with construction waste, which will affect the environmental sanitation.

9.3.2 Environmental Protection Measures during Operation Period

9.3.2.1 Protection Measures for Water Environment

The domestic sewage (8.8m3/d) of the Project is discharged into Shuolong Sewage Treatment Plant for centralized treatment through municipal sewage pipe network after being treated by septic tanks to reach the Class III standard of the *Integrated Wastewater Discharge Standard* (GB8978-1996), and then discharged into Guichun River after being treated to reach the Class I B standard of the *Discharge Standard of Pollutants for Municipal Wastewater Treatment Plant* (GB18918-2002)

Shuolong Sewage Treatment Plant was put into use in October 2015. The Sewage Treatment Plant uses a multi-stage composite moving bed bio-membrane reactor treatment process, and it treats 1,000 tons of sewage every day. Multi-stage composite moving bed bio-membrane reactor is a new high-efficiency reactor between activated sludge process and fixed bio-membrane process. The filler with large specific surface area in the reactor moves freely in the water due to stirring. When sewage continuously passes through the reactor with moving filler, bio-membrane grows on the filler, and microorganisms on the bio-membrane multiply. Heterotrophic and autotrophic microorganisms utilize C, N and P in the water for metabolism, thus playing a role in purifying sewage. The water discharge of the Project is 8.8 t/d, accounting for 0.9% of the sewage treatment capacity of Shuolong Town. The current water supply in Shuolong Town is 600t/d, and the water discharge is calculated as 80% of its water supply, so the water discharge of the residents in Shuolong Town is 480t/d. Therefore, Shuolong Sewage Treatment Works can still receive the domestic sewage produced by the Project. The project is located within the pollutant receiving scope of Shuolong Town Sewage Treatment Works. After field survey, the municipal sewage pipe network has been built, so it is feasible to introduce domestic wastewater into Shuolong Town Sewage Treatment Works for treatment.

9.3.2.2 Prevention and Control Measures for Ambient Air Pollution

A variety of grass and trees shall be planted for greening near the ground parking spaces, and green belts shall be provided accordingly. Meanwhile, ventilation of underground garages shall be improved to reduce the impact of automobile exhaust on the surrounding environment. In addition, it is required to flame out for temporary parking, so as to reduce the working hours of the engine and exhaust emission. Therefore, the automobile exhaust in the ground parking lot has little impact on the sensitive points and air environment.

The amount of waste gas produced by toilets can be reduced through daily cleaning, and the waste gas pollutants are led to the outside for unorganized emission through the exhaust fans.

The domestic garbage shall be classified and stored in garbage bins and delivered to the environmental sanitation department for concentrated treatment every day.

9.3.2.3 Prevention and Control Measures for Acoustic Environment Pollution

Measures, such as driving at low speed, no honking and greening shall be taken.

The anti-vibration and vibration reduction measures shall be improved during installation of fans, and silencers shall be installed at openings. All kinds of pumps shall be installed in their own machine rooms, and sound-absorbing materials shall be used indoors. During installation, the equipment shall be balanced and vibration reduction measures shall be taken, and noise reduction shall be realized by obstruction from surrounding buildings.

9.3.2.4 Disposal Measures for Solid Waste

(1) Garbage cans are provided at sightseeing and rest areas for passengers, and sanitation

personnel are arranged to clean and collect domestic garbage which shall be cleaned and transported by the sanitation department on a regular basis;

(2) Publicity is enhanced along the route, and signs of "No littering and protect the tourist attraction environment" are set up.

9.3.3 Investment Estimation of Environmental Protection

The investment for environmental protection of the Project is about RMB 660,000, accounting for 0.6% of total investment. See the following table for investment estimation of environmental protection of the Project.

Table 9.3-1 Investment for Environmental Protection of the Project

S/N	Item	Treatment measure	Investment amount (Unit: RMB 10,000)
1	Wastewater treatment	Construction period: sedimentation tanks and drainage ditches	5
		Operating period: three-stage septic tank and supporting sewage pipe network	8
2	Off-gas treatment	Construction period: control of dust pollution at the site	5
		Operating period: ventilation equipment of the underground garage	5
3	Solid waste treatment	Construction period: disposal of construction waste, spoil and domestic garbage	8
		Operating period: garbage collection buckets	2
4	Noise treatment	Construction period: barriers, etc	5
		Operating period: anti-vibration and vibration reduction measures, sound absorption materials, etc.	3
5	Landscaping	Greening in the plant area	10
6	Environmental management	Monitoring, supervision, acceptance and other expenses	15
7	Total		66

10 Analysis of Environmental Impact Economical Profit and Loss

10.1 Analysis of Environmental Impact Economical Profit and Loss of Chongzuo - Jingxi Expressway to Shuolong Port Section

10.1.1 Economic Analysis of Environmental Loss in Engineering Construction

The environmental losses caused by highway construction are mainly the change in the original land use value due to the occupation of land, the loss of existing ecological benefits in local areas caused by the destruction of surface vegetation, and the adverse effects of the atmosphere, the sound, the water environment and other environmental resources within the assessment area during the engineering construction and after the operation. The specific analysis is as follows:

(1) Economic loss analysis of land occupation and soil erosion and estimation of engineering loss

Among them, the economic loss of land occupation can be estimated by the project compensation cost, and the total cost of the project land acquisition and demolition compensation estimated by "engineering feasibility" is RMB 174,536,800.00. The estimated engineering cost of the new soil erosion is RMB 10,212,700.

(2) Economic estimation of other environmental losses

The environmental changes caused by the project construction also include the adverse impact on the air, sound, water environment and social environment along the route. So, the costs for the measures taken to reduce the adverse impact of the project construction on the roadside environment, can be estimated as the economic loss of the engineering environment. For details, see the section of investment of environmental protection works.

10.1.2 Economic Analysis of Engineering Construction Benefits

As a key infrastructure, the highway project has a huge boost on regional economic development after its construction. Its economic benefits are difficult to quantify because its benefits mainly include benefits of reduced operating costs, passenger time saving, decreasing traffic accidents, and so on. According to the estimation of "engineering feasibility", after the project operation, the economic benefit due to the above benefits is estimated to be RMB 489,818,100.00 during the assessment period.

10.1.3 Analysis and Comparison of Environmental Profit and Loss in Engineering Construction

See Table 10.1-1 for the quantitative calculation of the environmental impact of the proposed project on economic profit and loss.

Table 10.1-1 Quantitative Analysis of Economic Profit and Loss of Engineering Environmental Impact

Environment Elements	IMPACT, MEASURES AND INVESTMENT	BENEFIT (+) COST (-) (RMB: TEN THOUSAND)	REMARKS
Environmental and economic losses			
Social environment	Costs for the Project demolition and resettlement	-17453.68	Added to the investment of the Project
Ecological environment	Investment for engineering water and soil conservation	-1021.27	Included in investment of main works
	Plant protection measures	-6	
	Compensation of ecological public welfare forest	-770.71	Included in investment of main works
Acoustic environment	The iron baffle is set, and the maintenance of machinery and equipment are strengthened to maintain a low noise level during the construction period. Noise control measures, etc. during the operation period.	-88	Ventilated soundproof window with an area of 20 m2 is installed in Bangtun and that with an area of 90 m2 is installed in Rentun, totaling 110m2.
Surfacewater environment	Treatment of production and domestic wastewater in the construction of the campsite, and prevention and treatment of wastewater for the tunnel construction; Installation of sewage treatment facilities in the toll station and so on during the operation period.	-198	
Atmospheric environment	Costs for watering and dust removal, transportation by covering, or closed transportation during the construction	-70	
Disposal of Solid Wastes	Garbage collection and disposal, and treatment of pier excavation slurry and encasing slurry at construction camp	-30	

Environment Elements	IMPACT, MEASURES AND INVESTMENT	BENEFIT (+) COST (-) (RMB: TEN THOUSAND)	REMARKS
	during the construction period		
Accident risk measures	Expenses of SS grade reinforced steel concrete anti-collision guardrails, road warning signs and other expenses for bridges crossing nature reserves and scenic spots; costs for other anti-collision fences for bridges crossing water bodies; preparation of emergency response plans for dangerous goods transportation accidents, emergency rescue equipment and so on	-140	
Environmental management and technology investment	Expenses for technical training, monitoring, supervision and so on	-220	
Unpredictable environmental protection costs	Direct environmental investment is estimated at 10%	-75.2	
Total		-827.2	
Environment and economic benefits			
Social and economic benefits	Direct Economic Benefits	+48981.81	Data according to feasibility study report
	Indirect Economic Benefits	—	No estimation
Total	Benefits: RMB +489,818,100.00, costs: RMB-8,272,000.00		Benefits/Costs=59.21: 1

10.2 Analysis of Environmental Impact Economical Profit and Loss of Detian-Shuolong Highway

10.2.1 Economic Analysis of Environmental Loss in Engineering Construction

The environmental losses caused by highway construction are mainly the change in the original land use value due to the occupation of land, the loss of existing ecological benefits in local areas caused by the destruction of surface vegetation, and the adverse effects of the atmosphere, the sound, the water environment and other environmental resources within the assessment area during the engineering construction and after the operation. The specific analysis is as follows:

(1) Economic loss analysis of land occupation and soil erosion and estimation of engineering loss

Among them, the economic loss of land occupation can be estimated by the project compensation cost, and the total cost of the project land acquisition and demolition compensation estimated by "engineering feasibility" is RMB 39,216,333.00. The estimated engineering cost of the new soil erosion is RMB 1,263,200.

(2) Economic estimation of other environmental losses

The environmental changes caused by the project construction also include the adverse impact on the air, sound, water environment and social environment along the route. So, the costs for the measures taken to reduce the adverse impact of the project construction on the roadside environment, can be estimated as the economic loss of the engineering environment. For details, see the section of investment of environmental protection works.

10.2.2 Economic Analysis of Engineering Construction Benefits

As a key infrastructure, the highway project has a huge boost on regional economic development after its construction. Its economic benefits are difficult to quantify because its benefits mainly include benefits of reduced operating costs, passenger time saving, decreasing traffic accidents, and so on. According to the estimation of "engineering feasibility", after the project operation, the economic benefit due to the above benefits is estimated to be RMB 72,135,900 in the preliminary operation period.

10.2.3 Analysis and Comparison of Environmental Profit and Loss in Engineering Construction

See Table 10.2-1 for the quantitative calculation of the environmental impact of the proposed project on economic profit and loss.

Table 10.2-1 Quantitative Analysis of Economic Profit and Loss of Engineering Environmental Impact

Environment Elements	IMPACT, MEASURES AND INVESTMENT	BENEFIT (+) COST (-) (RMB: TEN THOUSAND)	REMARKS
Environmental and economic losses			
Social environment	Costs for the Project demolition and resettlement	-3921.6333	Added to the investment of the Project

Environment Elements	IMPACT, MEASURES AND INVESTMENT	BENEFIT (+) COST (-) (RMB: TEN THOUSAND)	REMARKS
Ecological environment	Investment for engineering water and soil conservation	-126.32	Included in investment of main works
	Plant protection measures	-10	
	Compensation of ecological public welfare forest	-10.8	Included in investment of main works
Acoustic environment	The iron baffle is set, and the machinery and equipment are maintained and serviced. Noise control measures are imposed during the operation period.	-106	Set up an acoustic barrier during the construction period; 530m2 of soundproof windows will be replaced during the operation period.
Surfacewater environment	Relevant measures such as sedimentation tank, septic tank in the construction area, temporary drainage outlet, sedimentation tank in the sections along the river, oil separation and sedimentation tank in Longhong Tunnel	-10	
Atmospheric environment	Costs for watering and dust removal, transportation by covering, or closed transportation during the construction	-31	
Disposal of Solid Wastes	Domestic garbage collection and disposal, and treatment of pier excavation slurry and encasing slurry during the construction period	-5	
Accident risk measures	Road runoff sedimentation tank, warning sign, emergency plan preparation, emergency drill, and training in water source protection section	-60	
Environmental management	Monitoring, supervision, acceptance and other expenses	-34	
Total		-264	
Environment and economic benefits			
Social and economic benefits	Direct Economic Benefits	+7213.59	Data according to feasibility study report
	Indirect Economic Benefits	—	No estimation
Total	Benefits: +RMB 72,135,900.00; costs: - RMB 2,640,000.00		Benefits/Costs=27.3: 1

10.3 Analysis of Economic Profit and Loss under the Environmental Impact of Shuolong Port (Phase II of Shuolong Gate)

10.3.1 Economic Analysis of Environmental Loss in Engineering Construction

The environmental losses caused by the project construction are mainly the change in the original land use value due to the occupation of land, the loss of existing ecological benefits in local areas caused by the destruction of surface vegetation, and the adverse effects of the atmosphere, the sound, the water environment, and other environmental resources within the assessment area during the engineering construction and after the operation. The specific analysis is as follows:

(1) Economic loss analysis of land occupation and soil erosion and estimation of engineering loss

Among them, the economic loss of land occupation can be estimated by the project compensation cost, and the total cost of the project land acquisition and demolition compensation estimated by "engineering feasibility" is RMB 16,993,800.00. The estimated engineering cost of the new soil erosion is RMB 860,000.

(2) Economic estimation of other environmental losses

The environmental changes caused by the project construction also include the adverse impact on the surrounding air, sound, and water environment, and social environment. So, the costs for the measures taken to reduce the adverse impact of the project construction on the roadside environment can be estimated as the economic loss of the engineering environment. For details, see the section on investment of environmental protection works.

10.3.2 Economic Analysis of the Benefits from Engineering Construction

As a key infrastructure, the project has a huge boost on regional economic development after its construction. Its economic benefits are difficult to be quantified because its benefits mainly include benefits of reduced operating costs, passenger time saving, decreasing traffic accidents, and so on. According to the estimation of the "engineering feasibility report", after the project operation, the economic benefit due to the above benefits is estimated to be RMB 72,135,900 in the preliminary operation period.

10.3.3 Analysis and Comparison of Environmental Profit and Loss in Engineering Construction

See Table 10.3-1 for the quantitative calculation of the environmental impact of the proposed project on economic profit and loss.

Table 10.3-1 Quantitative Analysis of Economic Profit and Loss of Engineering Environmental Impact

Environment Elements	**IMPACT, MEASURES AND INVESTMENT**	**BENEFIT (+) COST (-) (RMB: TEN THOUSAND)**	**REMARKS**
Environmental and economic losses			
Social environment	Costs for the Project demolition and resettlement	-1670	Added to the investment of the Project
Ecological environment	Investment for engineering water and soil conservation	-86	Included in investment of main works
	Plant protection measures	-10	
Acoustic environment	The iron baffle is set, and the machinery and equipment are maintained and serviced. Noise control measures are imposed during the operation period.	-8	Set up enclosure during construction period. Set equipment damping during operation period
Surfacewater environment	Sedimentation tank and septic tank in the construction area, tertiary septic tank, supporting sewage pipe network and other related measures in the operation period	-13	
Atmospheric environment	Sprinkling water for dust removal and covering transportation during construction, and ventilation adopted during operation.	-10	
Disposal of Solid Wastes	Domestic garbage collection during construction period and operation period	-10	
Environmental management	Monitoring, supervision, acceptance and other expenses	-15	
Total		-66	
Environment and economic benefits			
Social and economic benefits	Direct Economic Benefits	+9670.85	Data according to feasibility study report
	Indirect Economic Benefits	—	No estimation
Total	Benefits: +RMB 96,708,500; costs: - RMB 660,000		Benefits/Costs=146:1

11 Purpose, Method and Process of Social Assessment

According to AIIB's Environmental and Social Framework, proposed projects are divided into categories A, B and C according to the environmental and social impact. The Guangxi Chongzuo Border Connectivity Improvement Project will occupy 2517.94 mu of land resources, requiring the demolition of 3858.16 square meters of residential houses and the derelict compound of Shuikou Customs in Shuolong, Nanning, with 945 households with 4067 people affected, which directly leads to involuntary resettlement, and brings social risks such as loss of livelihood sources, income decline and loss of residential houses to the affected people. Noise, dust, and traffic inconvenience caused by the construction will have some negative social impacts on the production and life of residents, enterprises, and organizations along the route. In addition, this Project might cause significant adverse environmental impacts. Therefore, Guangxi Chongzuo Border Connectivity Improvement Project is recognized as a category A project in Environmental and Social Policy (ESP) of AIIB. AIIB requires the Client to perform environmental and social impact assessment (ESIA), and prepare the resettlement plan for the Project and provide it to AIIB as an independent document in accordance with the Environmental and Social Standard 2: Involuntary Immigration (ESS 2). According to the requirements, the Owner shall complete the resettlement plan at the stage of social assessment on the Project.

11.1 Purpose of Social Assessment

The social assessment on the Project mainly aims at, through a lot of surveys and research as well as broad public engagement, identifying the principal interested parties in the Project, understanding the needs and suggestions of all interested groups, and integrating such needs and suggestions into the project design. it also aims at, according to the local economic and social development, evaluating the social benefits and adverse effects of the Project, identifying possible social risks, and focusing on the impact of the Project on groups such as rural households, poor families, women and ethnic minorities affected by land acquisition and demolition, and the impact on residents' travel during the project construction. For the social assessment, a series of measures and actions will be proposed to maximize the positive impact of the proposed project and minimize its negative impact so that the interests of vulnerable groups can be protected during the implementation of the Project. These measures and actions will be summed up to serve as recommendations for this study report.

11.2 Method of Social Assessment

By means of literature research, symposiums, on-site visits and questionnaires, the project area and project impact scope are defined, key interested parties are identified, the data on the economic and social development status of the project area and the baseline of affected households are collected, the social benefits and negative impacts of the Project are evaluated, and measures to mitigate the negative impacts are proposed.

11.3 Process of Social Assessment

Entrusted by the Employer, Guangxi Communications Design Group Co., Ltd. has successively established a task force for social stability risk assessment and a task force for social assessment to carry out social assessment on the Project in two stages, namely the social stability risk assessment stage, and the social assessment and resettlement stage.

Social stability risk assessment refers to a project evaluation activity required by the Chinese government before the examination and approval of major engineering construction projects closely related to the interests of the masses, that is, to carry out a systematic social investigation on the factors that may cause social instability in the construction of major engineering construction projects by analyzing and evaluating the risk levels, and formulate risk response strategies and plans. Although the social stability risk assessment is not quite consistent with the content of social assessment required by AIIB, social investigation, information disclosure, public participation, and stakeholder analysis should also be carried out in the project area during the evaluation process, which is consistent with the public participation required by the social assessment of AIIB construction projects, and its role is basically the same.

11.3.1 Stage for Assessment of Social Stability Risks

In mid-to-late September 2019, the task force for social stability risk assessment conducted a careful analysis and study on the project feasibility study report and environmental impact assessment report. On this basis, the project area and project impact scope were determined. The task force collected a large lot of information, including economic and social development statistics of Guangxi Zhuang Autonomous Region, Chongzuo City, Daxin County, Tiandeng County, Fuxin Town and Shuolong Town involved in the project area, and data and research literature on poverty and gender in the project area, identified key interested parties, and prepared a social stability risk analysis and investigation plan. In October and November 2019, members of the task force went to Daxin County and Tiandeng County to hold symposiums attended by personnel from government departments concerned such as governments of Fuxin Town and Shuolong Town and representatives of some affected villages to listen to the opinions and suggestions of the participants on the Project. They went to villages greatly affected by the Project to collect relevant documents and materials, understand the opinions and demands of villagers and interested parties, and launch extensive public participation and investigation.

11.3.2 Social Assessment and Resettlement Planning Stage

In the preparation stage of the resettlement action plan, personnel of the task force for formulation of the social assessment and resettlement plan, together with the staff of the leading team for resettlement of Guangxi Chongzuo Border Connectivity Improvement Project, went to Daxin County and Tiandeng County from March 18 to 27, 2020, visited the planning and natural resources departments, human resources and social security departments and housing and urban-rural development departments, and made discussions with leaders and relevant staff in charge of land requisition compensation and resettlement of landless peasants, mainly focusing on the socio-economic and cultural development of the project area, methods and standards for compensation of permanent land requisition, housing demolition and temporary land occupation of the Project, and methods for resettlement of landless peasants, etc.

The members of the task force went to Shuolong Town, Daxin County and Fuxin Town, Tiandeng County, Chongzuo City to learn about the information on profiles of population, land and economic and social development of all towns, profiles of economic and social development, employment of local labor force, income sources and levels of residents, and social status and social participation of women in villages (communities) along the project route, concentrated areas for ethnic minorities other than Zhuang in the project area, profiles of vulnerable groups such as the poor, the population enjoying the minimum social security and the disabled, compensation standards, compensation payment methods and resettlement methods for landless peasants for permanent and temporary land acquisition in local areas in similar construction projects in the past, and responsibilities and working methods of township governments in land acquisition and resettlement of landless peasants for construction projects, etc. The task force also solicited the opinions and suggestions of the township governments on the land requisition compensation and resettlement of the Project.

The members of the task force went to Liliang Village and Xuanjie Village in Fuxin Town, Tiandeng County, as well as Detian Village, Aijiang Village, Shuolong Community, Yining Village, Yixian Village and Aijiang Forest Farm in Shuolong Town, Daxin County affected by land acquisition and demolition of the Project, made discussions with cadres of villagers’ committees of villages (communities) and villagers to learn about the land, population, agricultural production, labor employment, and villagers' livelihood sources and income levels of all villages, and carried out extensive investigation and consultation on the understanding about and the attitude to the Project, the willingness to accept compensation, and opinions and suggestions of villagers. They also randomly selected 246 households in 7 villages to conduct a questionnaire survey.

On July 22 to 23, 2020, the Social Evaluation Working Group. went to Daxin County to visit the Commerce and Port Administration Bureau, Tourism Bureau, and Statistics Bureau; and went to Shuolong Town and visited some merchants, households and relocated households for Chongzuo - Jingxi Expressway, the first expressway in Daxin County, to understand the social benefits and negative social impacts of the project.

From October 20 to 21, 2020, the preparation personnel of the Resettlement Plan went to Daxin County and Shuolong Town to conduct due diligence investigation on the compensation and resettlement of land acquisition and land replacement affected by the Component C and to understand the social benefits and the negatives effect of the Project.

12 Overview of Health and Social Economy in Project Area

The construction areas of the Project involve Fuxin Town of Tiandeng County and Shuolong Town of Daxin County of Chongzuo, Guangxi, and the affected areas of the Project include Liliang Village and Xuanjie Village in Fuxin Town, as well as Yixian Village, Yining Village, Shuolong Community, Detian Village and Aijiang Village of Shuolong Town.

12.1 Health Status of Guangxi Zhuang Autonomous Region

In 2018, the average life expectancy of residents in Guangxi was 77.03 years, the maternal mortality rate was 10.49/100,000, and the infant mortality rate was 3.58‰. The main health indicators of residents in Guangxi were among the top in China's western region. By the end of 2018, there were 33,700 medical and health organizations, 255,900 beds in medical and health organizations, 420,000 health personnel, 5.19 beds per 1,000 persons in medical and health organizations, 2.15 licensed (assistant) physicians per 1,000 persons and 2.84 registered nurses per 1,000 persons in the region. The doctor-nurse ratio gradually became reasonable.

The annual per capita funding level of the new rural cooperative medical system has increased from RMB 30 in 2003 to RMB 540 in 2016. The number of people involved in the new rural cooperative medical system has increased from 1.18 million to 41.37 million, and the participation rate has increased from 59.80% to 99.28%, consolidating the basic medical security. The actual reimbursement rates for hospitalization and outpatient treatment for special chronic diseases of the poor reached 90% and 80% respectively, and remarkable results were achieved in the health-based poverty alleviation. There are 310,000 health technicians in the region at present, including 100,000 persons having bachelor's degree or above, accounting for 32.27%, and 19,800 persons having the deputy senior professional titles or above, accounting for 6.38%. The education level, professional and technical ability and service level have been improved significantly.

12.2 Economic and Social Development in Project Area

12.2.1 Socioeconomic Profile of Fuxin Town, Tiandeng County

Tiandeng County is located in the northernmost part of Chongzuo City, with Daxin County in the south and about 9 kilometers to the China-Vietnam border. The county has a total area of 2,159.23 square kilometers, of which 46,530.47 hectares are cultivated land, accounting for 21.5% of the total land area. Tiandeng County has jurisdiction over 13 towns, 116 villagers' committees and 8 community committees.

At the end of 2019, the annual GDP of the county was RMB 7.341 billion, and the fiscal revenue was RMB 382 million.

At the end of the year, the county had 119,100 registered households with a total registered population of 459,500, of which the male population was 243,900 and the female population is 215,600. The per capita disposable income of all residents in 2019 was RMB 16,518 (RMB 29,058 for urban residents and RMB 11,588 for rural residents).

Fuxin Town is located in the southwest of Tiandeng County, bordering Longming Town, Shangying Township, and Tuhu Township, Shuolong Township, Naling Township and Quanming Township in Daxin County. It is 31km away from the urban area of the county. There are 234 natural villages in 13 administrative villages, with a total population of 33,074. The town has a total area of 278 square kilometers, including 35450 mu of cultivated land and 298517 mu of wood land. There are lofty mountains with rising layers of peaks in the county. The county is also rich in forest, mineral, water and tourism resources. The entire town has more than 50,000 mu of anise trees. It is rich in star anise and anise oil, and is known as the "hometown of star anise". In recent years, Fuxin Town has promoted industrial restructuring and vigorously developed the commercial crop cultivation and forestry production, such as sugar cane, red cluster pepper, fresh ginger, Kuding tea, anise trees, and longan trees; through making full use of natural resources, it has established Genghu and Nianchang hydropower stations and developed some tourist attractions. The basic situation of Fuxin Town and the economic and social development in 2019 are shown in Table 12.2-1.

Table 12.2-1 Basic Profile of Fuxin Town

Item	Unit	Overview
I. Territory area	**km²**	278
II. Number of administrative villages (communities) under its jurisdiction	**Nr.**	13
III. Population and labor force		
1. Total number of households and total population	households / persons	8384/33074
1.1 Households and population of the Zhuang nationality	households / persons	8384/32838
1.2 Households and population of other nationalities	households / persons	0 household/236
1.3 Rural Population	10,000 persons	3.2082
1.4 Non-rural Population	10,000 persons	0.0992
1.5 Female population	10,000 persons	1.6282
1.6 Households and population enjoying the "Five Guarantees"	households / persons	138/140
1.7 Households and population receiving subsistence allowances	households / persons	770/2476
1.8 Poor households and population	households / persons	2711/11113
2. Total rural labor force	10,000 persons	2.1498
2.1 Total agricultural labor force	10,000 persons	2.0853
2.2 Total labor force in industry and construction industry	10,000 persons	0.5160
2.3 Total labor force in commercial and service industries	10,000 persons	0.3969
IV. Cultivated land and grain output		
1. Cultivated land area	Mu	35450
2. Per capita cultivated land of agricultural population	Mu	1.1
V. Per capita annual net income	**RMB**	8354

VI. Per capita living area	m2	25

12.2.2 Socioeconomic Profile of Shuolong Town, Daxin County

Daxin County is located in the northern part of Chongzuo City, with a total area of 2,742 square kilometers. It has jurisdiction over 14 townships (towns), 1 overseas Chinese economic management area, 146 administrative villages (communities) and 1,356 natural villages. It borders Tiandeng County in the north and Vietnam in the west. The national boundary line is 43 kilometers long. It has a national category-1 port, Shuolong Port, and 3 cross-border trade points between border residents, Yanying, Shuolong and Detian. Located at the intersection of three central cities, Nanning, Baise and Chongzuo, as one of the major convenient land routes leading from China to Vietnam and Southeast Asian countries, it has the advantages of being located along the border, and adjacent to the sea, the provincial capital and the airport.

In 2019, the annual GDP of the county was RMB 9.867 billion, and the fiscal revenue was RMB 393 million.

The total population of the county at the end of the year was 385,495, including 199,437 males and 186,058 females. The county had a resident population of 310,000, including urban population of 91,000, accounting for 29.35% of the resident population.

The annual per capita disposable income of all residents in the county was RMB 19,871 (RMB 34,918 for urban residents and RMB 14,042 for rural residents).

Shuolong Town is located in the southwest of Daxin County, bordering Naling Township and Leiping Town in the east, Kanwei Township and Baowei Township in the southeast, Xialei Town in the northwest, and Fuxin Town, Tiandeng County in the northeast, with Leibang Highway and 316 Provincial Highway passing through the territory and 325 Provincial Highway extending along the border, and it is an ecological border trade tourism town in Daxin County. Shuolong Town is located on the China-Vietnam border, facing Vietnam across the river on the west. It is connected to Vietnam by highway on land. It borders Ha Lang District and Trung Khanh District in Cao Bang Province, Vietnam. There is a national category-2 port, Shuolong Port, and 3 cross-border trade points between border residents, Detian, Shuolong and Yanying, in the town. It is 13 kilometers from Detian Waterfall Scenic Area on the west, 50 kilometers from Daxin County on the east, and 201 kilometers to Nanning, the provincial capital. The Heishui River, Guichun River and Yuejin Canal run through the whole town. Water and hydropower resources are very abundant. After the 1960s, 7 small hydropower stations have been built, including Aijiang Hydropower Station, Shatun Hydropower Station and Class I and II Shuolong Hydropower Stations.

Shuolong Town has jurisdiction over 1 community, 9 village committees, 83 villager (resident) groups, and 71 natural villages. Among them, 7 administrative villages and 42 natural villages are adjacent to Vietnam, with a 37-kilometer borderline. The town has a total population of 13,601 from 3,310 households, a total area of 169 square kilometers, including 12,758 mu of cultivated land, and an agricultural population of 11,967 from 3,182 households.

In recent years, Shuolong Town has made great efforts to develop port economy and tourism economy. It has developed from a former border town into a "town with flourishing border trade" and a "famous tourism town". The economic and social development of the whole town has shown a good overall situation of improvement, harmony and stability in people's livelihood. In 2017, Shuolong Town received more than 1.19 million tourists, with a comprehensive tourism income of over RMB 600 million and over 3,000 people engaged in tourism in the whole town.

The basic situation of Shuolong Town and the economic and social development in 2019 are shown in Table 12.2-2.

Table 12-2Basic Profile of Shuolong Town

Item	Unit	Overview
I. Territory area	**km^2**	**169**
II. Number of administrative villages (communities) under its jurisdiction	**Nr.**	**10**
III. Population and labor force		
1. Total number of households and total population	households / persons	3310/13601

1.1 Households and population of the Zhuang nationality	households / persons	3310/13601
1.2 Households and population of other nationalities	households / persons	
1.3 Rural Population	10,000 persons	1.1967
1.4 Non-rural Population	10,000 persons	0.1634
1.5 Female population	10,000 persons	0.63
1.6 Households and population enjoying the "Five Guarantees"	households / persons	58/60
1.7 Households and population receiving subsistence allowances	households / persons	258/723
1.8 Poor households and population	households / persons	1155/4306
2. Total rural labor force	10,000 persons	0.68
2.1 Total agricultural labor force	10,000 persons	0.52
2.2 Total labor force in industry and construction industry	10,000 persons	0.03
2.3 Total labor force in commercial and service industries	10,000 persons	0.13
IV. Cultivated land and grain output		
1. Cultivated land area	Mu	12758
2. Per capita cultivated land of agricultural population	Mu	0.93
V. Per capita annual net income	**RMB**	8000
VI. Per capita living area	m2	30

12.2.3 Socioeconomic Profile of Villages Affected

There are a total of 7 villages (communities) affected by land acquisition and demolition in the project construction, namely: Liliang Village and Xuanjie Village, Fuxin Town; Yining Village, Yixian Village, Shuolong Community, Detian Village and Aijiang Village, Shuolong Town. The population of 7 villages is 10,539 from 2,638 households, of which Shuolong Community has the largest population, with

676 households and 2641 persons in total; Detian Village has the smallest population, with 151 households and 596 persons in total. Other villages have a population of 969-2302.

The affected villages/communities have much farmland, among which Yining Village has the most, with a per capita of 5.4 mu, Detian Village has the least, with a per capita of 1.34 mu, and other villages/communities have a per capita between 1.62-3.16 mu. Most of the affected villages have relatively more per capita cultivated land, Yining Village has the most up to 3.73 mu, while Detian Village has relatively less, with a per capita of 0.67 mu, and other villages/communities have a per capita between 1.06-2 mu.

All affected villages have some irrigated land in their cultivated land. Among them, Shuolong Community has more irrigated land; the existing irrigated land of Shuolong Community covers an area of 1675.53 mu, accounting for 31.98% of all agricultural land in the Community. Yining Village has less irrigated land; the existing irrigated land of Yining Village covers an area of only 60 mu, accounting for 1.15% of all agricultural land in the Village.

According to the survey, the agriculture of the villages/communities in the project area is dominated by rice, corn, sugar cane, vegetables and fruits. However, the income of local villagers mainly comes from non-agricultural industries, especially Shuolong Town in Daxin County, which is located on the China-Vietnam border and has rich tourism resources. Therefore, the income of villagers here mainly comes from tourism and border trade. In 2019, the per capita net income of villagers in all affected villages was RMB 6,000 - 8,000; the per capita net income of villagers in Xuanjie Village and Liliang Village was relatively low, i.e., RMB 6,100 and RMB 7,913 respectively, and that of villagers in other villages was RMB 8,000. The per capita housing area of villagers in all affected villages was over 30 square meters.

See Table 12.2-3 for details of economic and social development of affected villages/communities in 2019.

Table 12.2-3 Overview of Villages/Communities Affected by Permanent LA

Item	Unit	Quantity

			Fuxin Town, Tiandeng County		**Shuolong Town, Daxin County**				
			Liliang Village	**Xuanjie Village**	**Yining Village**	**Yixian Village**	**Detian Village**	**Aijiang Village**	**Shuolong Community**
Households and population (household registration)	Total households and population	households / persons	550/2302	331/1405	250/969	277/1151	151/596	403/1475	676/2641
	Where: Male	Persons	1177	720	536	565	295	752	1254
	Female	Persons	1125	685	433	586	301	723	1387
	Where: Households and population of the Zhuang nationality	households / persons	550/2302	331/1405	250/969	277/1151	151/596	403/1475	676/2641
	Households and population of other nationalities	households / persons	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	Households and population enjoying the "Five Guarantees"	households / persons	11/11	8/8	11/11	6	2	5	14
	Households and population receiving subsistence allowances	households / persons	77/248	26/80	42/141	14/43	9/21	42/113	32/74
	Poor households and	households / persons	230/918	93/418	220/869	58/226	40/140	177/616	107/359

	population								
Labor and employment	Total labor force	Persons	1359	841	787	817	374	971	1842
	Where: Male	Persons	719	454	381	395	193	469	875
	Female	Persons	640	387	406	422	181	506	967
	Total employment	Persons	1359	841	787	817	374	971	1842
	Where: Agriculture, animal husbandry and fishery	Persons	1359	760	468	487	214	581	1111
	Industry	Persons	0	0	0	0	0	0	0
	Construction industry	Persons	0	0	0	0	0	0	0
	Transportation	Persons	0	0	0	0	0	0	0
	Business service industry	Persons	0	0	0	0	0	0	0
	Miscellaneous	Persons	0	81	319	330	160	390	731
Land and output	Total farmland area	Mu	3730.8	2444	5235.95	3637.85	800	2625.3	5239.1
	Where: Cultivated land	Mu	2714	1453	3616.95	2306.85	399	1560.3	3452.1
	Paddy field	1610.1	1009.35	60	627.54	262	902.322	1675.53	1610.1
	Plantation Land	Mu	0	0	19	16	5	12	12
	Woodland	Mu	619.8	750	1549	1273	383	1019	1718
	Grassland	Mu	241	0	51	42	13	34	57
	Others	Mu	156 (forestry and fruit)	241	0	0	0	0	0

	Average output of major crops per mu	RMB	900	2000	7178	7178	7128	7178	7178
	Net income per mu of cultivated land	RMB	850	1000	3000	3000	3000	3000	3000
Villager livehood	Per capita annual net income	RMB	7913	6100	8000	8000	8000	8000	8000
	Per capita living area	㎡	33	45	30	30	30	30	30
Number of natural villages under its jurisdiction		Nr.	12	7	9	9	5	5	10
Per capita farmland		Mu	1.62	1.74	5.40	3.16	1.34	1.78	1.98
Per capita cultivated land		Mu	1.18	1.03	3.73	2.00	0.67	1.06	1.31

12.2.4 Comparison of Economic and Social Development Between the Project Area and the Affected Area

According to the statistical data, on the whole, the per capita cultivated land and housing area of the affected villages are higher than the average level of Fuxin Town and Shuolong Town in the project area, but the net income per capita of the former is lower than the average level of the latter. On the whole, the overall economic development level of the affected villages is lower than the average level of the project area. The main reason for this situation is the high proportion of the low-income population in most villages in the affected area. Although the proportion of the recipients of subsistence allowance and the poverty-stricken population is lower than the average level of the project area in addition to a higher proportion of five-guarantee households than the average level in Fuxin Town and Shuolong Town, the proportion of the low-income population of five-guarantee households, the recipients of subsistence allowance, and the poverty-stricken households in the two affected villages Liliang and Yining is higher than the average level in the project area, and the proportion of the recipients of subsistence allowance and the poverty-stricken households in Aijiang Village is also higher than the average level in the project area. Only the proportion of the recipients of subsistence allowance and the poverty-stricken population in Xuanjie Village, Detian Village, and Shuolong Community is lower than the average level of the project area. However, although there is a relatively smaller poverty-stricken population in Xuanjie Village, the per capita net income of the village is low. Therefore, on the whole, only two villages in the project affected area, Detian, and Shuolong, have reached the average level of the project area, while the low-income population of other villages is significantly higher than the overall level of the project area. See Table 12.2-4 for details.

Table 12.2-4 Comparison of Economic and Social Development Between the Project Area and the Affected Area

Item	Project Area	Affected Village							
		Average level	Liliang	Xuanjie	Yining	Yixian	Detian	Aijiang	Shuolong
Proportion of Five-guarantee Household (%)	0.45	0.54	0.48	0.57	1.14	0.52	0.34	0.34	0.53
Proportion of Recipient of Subsistence Allowance (%)	7.26	6.83	10.77	5.69	14.55	3.74	3.52	7.66	2.8
Proportion of Poverty-stricken Population (%)	35	33.65	39.88	29.75	89.68	19.64	23.49	41.76	13.59
Per capita cultivated land (mu)	1.09	1.47	1.18	1.03	3.73	2	0.67	1.06	1.31
Per capita income (RMB)	8250	7727.7	7913	6100	8000	8000	8000	8000	8000
Floor Area per Capita (m2)	26.46	32.65	33	45	30	30	30	30	30

12.3 General Conditions of Population of the Project Area

From late March to early April 2020, the task force established for preparation of the social evaluation and resettlement action plan, in cooperation by the staff of the leading team for resettlement of Guangxi Chongzuo Border Connectivity Improvement Project, Tiandeng County Sub-headquarters for Long'an-Shuolong

Expressway Project Construction and Daxin County Sub-headquarters for Long'an-Shuolong Expressway Project Construction, performed questionnaire surveys through sampling on 246 households (164 households affected by land acquisition and demolition, and 82 households not directly affected by land acquisition and demolition) in Liliang Village and Xuanjie Village in Fuxin Town, Tiandeng County, as well as Detian Village, Aijiang Village, Shuolong Community, Yining Village, Yixian Village and Aijiang Forest Farm in Shuolong Town, Daxin County.




Figure 12-1 Questionnaire Surveys on Villagers in the Project Area by the Task Force for Social Assessment and Resettlement

12.3.1 Gender and Age Structure

In the 246 households investigated, there are 1162 people of which 581 are male, accounting for 50.0% and 581 are female, accounting for 50.0%. For the ethnic composition, there were 1,134 Zhuang people, accounting for 97.6%, 16 Han people, accounting for 1.4%, and 16 people from other ethnic minorities (Yao, Miao, Tujia and Vietnamese), accounting for 1.4%. From the angle of view of gender and age structure: the population aged under 16 is 280, accounting for 24.10% of the total population, of whom 154 are males, accounting for 26.51% of the total male population, and 126 are females, accounting for 21.69% of the total female population; the population aged 16-40 is 394, accounting for 33.91% of the total population, of which 173 are males, accounting for 29.26% of the total male population and 193 are females, accounting for 33.22% of the total female population; the population aged 41-60 is 326, accounting for 28.06% of the total population, of which 183 are males, accounting for 31.5% of the total male population and 174 are females, accounting for 29.95% of the total female population; the population aged over 60 is 162, accounting for 13.94% of the total population, of whom 74 are males, accounting for 12.74% of the total male population and 88 are females, accounting for 15.15% of the total female population. For the scale of the households surveyed, the average population of the households was 4.72.

See Table 12.3-1 for the age composition of the family members of the households surveyed.

Table 12.3-1 Age Composition of Family Members

Age	Male		Female		Total	
	Population (person)	Percentage (%)	Population (people)	Percentage (%)	Population (people)	Percentage (%)
< 16 yrs	154	26.51	126	21.69	280	24.10
16-40 years	187	32.19	207	35.63	394	33.91
41-60 years	166	28.57	160	27.54	326	28.06
> 60 yrs	74	12.74	88	15.15	162	13.94
Total	**581**	**100**	**581**	**100**	**1162**	**100**

12.3.2 Education of Labor Force

For the education of family members, in the surveyed households, there were 882 people aged 16 or above, accounting for 75.90% of the total population. Among them, 427 are males, accounting for 48.41%, and 455 are females, accounting for 51.59%.

Among the 882 samples, 51 are illiterate, accounting for 5.78% of the total population; 242 have received primary school, accounting for 27.44%; 424 have received junior high school education, accounting for 48.07%; 123 have received senior high or technical secondary school education, accounting for 13.95%; 30 have received junior college education, accounting for 3.4%; and 12 have received undergraduate or above education, accounting for 1.36%.

In general, among the workforce samples, the population at junior high school educational level is the largest, accounting for nearly half of those aged 16 and above; the population at the primary school educational level is the second largest, accounting for more than a quarter of those aged 16 and above; the population at the senior high or technical secondary school educational levels accounts for about one tenth; the population at the junior college or above educational level is relatively small, and the total population is less than one twentieth. See Table 12.3-1 for the education of the family members of the households surveyed.

Table 12.3-2 Education of Family Members Aged 16 or Above by Gender

Degree of education	Total	
	Population (people)	Percentage (%)
Illiterate	51	5.78
Primary school	242	27.44
Junior high school	424	48.07
Senior high/technical secondary school	123	13.95
Junior College	30	3.40
Undergraduate or above	12	1.36
Total	**882**	**100.00**

12.3.3 Labor Force Employment

This survey involved 882 working-age persons, including 645 employed persons, accounting for 73.13% and 237 unemployed persons, accounting for 26.87%.

Among 645 employed persons, there were 329 males, accounting for 51.01% of the total and 316 females, accounting for 48.99%. Among them, there are 28 public institution workers, accounting for 4.34%; 71 enterprise employees, accounting for 11.01%; 104 private business owners or self-employers, accounting for 16.12%; 310 farmers, accounting for 48.06%; 132 casual laborers, accounting for 20.47%.

Among 237 employed persons, there are 98 males, accounting for 41.35% of the total and 139 females, accounting for 58.65%. Among them, there are 12 retirees, accounting for 5.06% of the unemployed population; 76 housekeepers, accounting for 32.07%; 1 waiting for school enrollment, accounting for 0.42%; 97 unemployed persons, accounting for 40.93%; 51 students, accounting for 21.52%.

See Table 12.3-3 for the employment details of the working-age population of the households surveyed.

Table 12.3-3 Employment of Working-age Population by Gender

Item		Population (people)			Percentage (%)
		Male	Female	Subtotal	
Employed	Party and government organ	4	1	5	0.78

population	workers				
	Public institution workers	12	11	23	3.57
	Enterprise employee	43	28	71	11.01
	Private business owner	9	12	21	3.26
	Self-employer	46	37	83	12.87
	Farmer	146	164	310	48.06
	Casual laborer	69	63	132	20.47
	Total	**329**	**316**	**645**	73.13
Unemployed population	Retiree	7	5	12	5.06
	Housekeeper	20	56	76	32.07
	Waiting for school enrollment	1	0	1	0.42
	Unemployed	45	52	97	40.93
	Student	25	26	51	21.52
	Total	**98**	**139**	**237**	26.87
Total		**427**	**427**	**882**	

12.3.4 Income and Expenditure

In 2019, the average household income of the 246 households was RMB 55,322, and the per capita income was RMB 11,712; the average expenditure per household was RMB 40,536, and the per capita expenditure was RMB 8,582, accounting for 73.3% of its net income. Average male income per household was RMB 35,253 and average female income per household was RMB 20,070. On average, female income accounted for 36.3% of the total household income, as shown in Table 12.3-4.

Table 12.3-4Household Income and Expenditure

Index	Average household income/expenditure (RMB/household)	Per capita income/expenditure (RMB/person)
Net income	55322	11712
Total expenditure	40536	8582

In this survey, the income of most households falls into two segments, namely RMB 10,001 ~ 30,000 and RMB 50,001 ~ 100,000, and the number of such households accounts for 55.3% of the total number of households; the number of households with income of RMB 30,001 ~ 50,000 takes the second place, accounting for 24.8% of the total number of households, as shown in Table 12.3-5.

Table 12.3-5 Distribution of Household Income

Revenue (yuan/year)	Below 10,000	10001~30000	30001~50000	50001~100000	Above 100,000	Total
Number of households (Nr.)	30	68	61	68	19	246
Specific gravity (%)	12.20%	27.64%	24.80%	27.64%	7.72%	100.0

13 Social Impact of the Project

The Project is located in Tiandeng County and Daxin County, Chongzuo City, in the southwest of Guangxi Zhuang Autonomous Region, China. The construction of the Project is conducive to improving the transportation infrastructure in the project area, directly promoting the development of transportation, tourism, commerce, and related industries, and resulting in economic development, social prosperity of the project area. However, when the Project is under construction and after it is put into operation, it will have certain adverse effects on some relevant interest groups.

13.1 Analysis on Interested Parties

Interested parties of a project refer to all parties that have direct and indirect interest relations with the project and have direct and indirect influence on the success of the Project.

13.1.1 Identification of Main Stakeholders

Interested parties of the project can be roughly divided into five groups: governments at all levels and relevant agencies in the project area, project implementing agencies and contractors, various groups served by the project, households affected by land acquisition and demolition, and groups affected by construction. See Table 13.1-1 for details.

Table 13.1-1 Project Stakeholders

Category	Stakeholders
Governments at all levels and relevant agencies in the project area	The project leading team, Chongzuo Municipal Government, governments of Daxin County and Tiandeng County, county natural resources bureau and county housing and urban-rural development bureau, labor and social security bureau at the county level, and governments of Shuolong Town and Fuxin Town
Project implementing agency and contractor	Guangxi Chongzuo City Construction Investment Development Group Co., Ltd., contractor
Project service groups	Residents in the project area, various enterprises and

	institutions closely related to the development of transportation, road users, pedestrians, etc.
Groups affected by land acquisition and demolition and relocation of ancillary facilities	Families affected by permanent land requisition, families affected by house demolition, families affected by temporary land occupation, areas participating in gravel supply, units affected by migration of professional facilities, and areas receiving and resettling people affected by the project
Groups affected by construction	Residents, farmers, shops, institutions, pedestrians and vehicles along the road

13.1.2 Analysis on Main stakeholders

According to the different properties, the interested parties include aggrieved parties and benefited parties.

After investigation and analysis, the key interested parties of the Project are as follows:

(1) Project Leading Group

Under the leadership of Chongzuo Municipal People's Government, a project leading group was set up, headed by the mayor of Chongzuo Municipal People's Government and joined by representatives of other government agencies in Chongzuo, including Transportation Bureau, Finance Bureau, Development and Reform Commission, Ecological Environment Bureau, Natural Resources Bureau, Water Conservancy Bureau, Forestry Bureau, Audit Bureau and the governments of Daxin County and Tiandeng County. The project leading group provides comprehensive support for the implementation of the project, especially in terms of high-level policy and strategic instructions, inter-departmental communication and coordination, and consultation and solution of key issues, so as to ensure the smooth implementation and successful completion of the project. The work of the leading team determines whether the Project can proceed smoothly at each key point. Its responsibilities determine that it is the benefited party of the Project.

(2) Guangxi Chongzuo City Construction Investment Development Group Co., Ltd.,

Guangxi Chongzuo City Construction Investment Development Group Co., Ltd.

is responsible for the implementation of the Project, including the engineering construction, service, and goods procurement, the operation and maintenance of the existing roads during the project construction period, and the standardized, safe and effective use of funds, and operation and maintenance of all assets built under the Project after the completion of the Project. Guangxi Chongzuo City Construction Investment Development Group Co., Ltd. has set up a Project Construction Office, which is specifically responsible for the daily work during the preparation period and implementation of the Project. Guangxi Chongzuo City Construction Investment Development Group Co., Ltd. is the beneficiary of the project.

(3) Governments at all levels and relevant functional departments in the project area

Such governments and functional departments include Chongzuo Municipal Government, Chongzuo Municipal Transportation Bureau, governments of Daxin County and Tiandeng County, natural resources bureaus and bureaus of housing and urban-rural development at county level, human resources and social security bureaus at county level, relevant functional government departments, and governments of Fuxin Town and Shuolong Town. This is an important infrastructure construction project. Governments at all levels and relevant functional departments are responsible for the formulation and implementation of relevant policies, coordination and cooperation among departments and ensuring the smooth progress of the Project during the project construction in the area. The construction of the Project can promote the economic and social development of the area under its jurisdiction, facilitate the employment and improvement in income of the people in the area, and help the area to shake off poverty and become rich. The successful completion of the Project is conducive to the governments at all levels to promote the effective play of regional economic and social functions. Therefore, governments at all levels and relevant functional departments are also benefited parties of the Project.

(4) Project implementation institute

The implementation agencies of the Project include the Guangxi Chongzuo Border Connectivity Improvement Project Implementation Office, Tiandeng County

Sub-headquarters for Project LA and Demolition, Daxin County Sub-headquarters for Project LA and Demolition; the main responsibilities of the sub-headquarters are as follows: complete the relevant work assigned by the superior leaders, the leading team for resettlement of **Guangxi Chongzuo Border Connectivity Improvement Project**, and the Guangxi Chongzuo Border Connectivity Improvement Project Implementation Office; after the county people's government issues the pre-announcement of land acquisition, contact the project owner, determine the organizations for survey, counting and measurement, and arrange to carry out the current land use investigation. The current land use investigation shall include the land ownership, land type and land area, as well as the ownerships, types and quantities of rural villagers' houses, other ground attachments and young crops. Fill the *Land Acquisition Questionnaire* timely after the investigation; select a professional evaluation company, calculate the compensation standard, quantity and amount of the houses to be demolished according to law, and disclose and publicize the purpose, location, compensation standard, resettlement route, the insured objects of the land-expropriated farmers, the insured objects of the households to be resettled, the standard and the fund raising method of the proposed land acquisition and proposed house demolition; organize the registration and confirmation of LA compensation within the county; calculate and verify the number of land-expropriated farmers and the number of households to be resettled according to law, preliminarily select the resettlement site together with the local township (town) government and the affected entities, plan the resettlement site, formulate the resettlement plan, and coordinate the "three supplies and one leveling" of the resettlement site; sign contracts with relevant units such as Water Resources & Electric Power Group Co., Ltd., China Telecom, China Mobile, China Unicom, and China Broadcast Network, as well as enterprises and public institutions, villagers' groups, villagers and residents affected by land acquisition, and timely transfer the compensation details of land acquisition, demolition and temporary land occupation to the Guangxi Chongzuo Border Connectivity Improvement Project Implementation Office; publicize land acquisition purpose of the Project to the masses affected by the environmental and social impacts of the Project, receive, record and handle the appeal events; implement the land acquisition compensation and resettlement plan within the county, and handle impact compensation, resettlement and other related work in conjunction with the natural resources bureau, labor and social security bureau, township government and village committee; supervise the construction contractor to complete the land reclamation work after temporary land occupation as required, and organize the acceptance of the land reclamation results; coordinate and deal with other related work. The Daxin County Sub-headquarters of Land Acquisition and Demolition of the Project is also responsible for applying to the People's Government of Daxin County for the land acquisition, demolition compensation and resettlement funds of Component B, and timely allocating the compensation for land acquisition, demolition and temporary land occupation of Component B to the bank accounts of all stakeholders.

The project construction organizations have the responsibilities of leading, guiding and coordinating the Project construction to ensure the completion of the Project construction tasks on schedule as required for quality, and they are the benefited parties of the Project.

(5) Local People and Related Enterprises Served by the Project

Such groups include residents in the project area, and enterprises closely related to the development of transportation. After completion, the Project will facilitate residents travel, shorten residents' travel time; and be conducive to improving the economic efficiency and benefits of enterprises related to transportation, tourism and commerce. The local people, enterprises of all sorts, road users and pedestrians are the beneficiaries of the Project.

(6) Contractor

The construction quality of the contractor will directly affect the operation effect after the completion of the Project. The contractor will be associated with the Project through the Owner, and the project construction can bring income to it. Therefore, the contractor is the benefited party of the Project.

(7) Villages, organizations and villagers' households affected by land requisition and demolition

Such villages, organizations and villagers' households are as follows: 7 villages affected by the permanent land requisition and house demolition of the Project, including Liliang Village and Xuanjie Village in Fuxin Town, Tiandeng County, as well as Yining Village, Yixian Village, Shuolong Community, Detian Village and Aijiang Village in Shuolong Town, Daxin County; 9 organizations, including Liliang Village Water Plant, Kangmiao River Sewage Treatment Plant, Yixian Village Primary School, Aijiang Wood Farm in Daxin County and Dam Site Hydro Project Administrative Office, Daxin Detian Old Kapok Tourism Development Co., Ltd., Detian Management and Protection Station of Guangxi Xialei Natural Reserve Management Office, Guangxi CTS Detian Waterfall Tourism Development Co., Ltd. and a troop; 844 households affected by permanent land acquisition, 19 households affected by house and attachment demolition and 186 households affected by temporary land occupation. Including the areas participating in the provision of gravel, the areas receiving and resettlement of the project-affected people. These affected village collectives, organizations and households will suffer certain losses in agricultural and forestry production due to the reduction of cultivated land (especially some basic farmland and irrigated land) resulted from the construction of the Project. Due to relocation arising from house demolition, the normal living order for a period of time has been disrupted, and the removal of business houses also reduced the economic income of the original owners; due to the reduction of some construction land, the original site layout of the affected organizations have been broken and the readjustment is required. These villages, organizations and affected households are aggrieved parties during the construction of the Project.

(8) Organizations affected by relocation of special facilities

Special facilities affected by the construction of the Project include telegraph poles, power lines, transformers and overhead communication optical cables, water plants and wastewater treatment plants, which belong to the departments of electric power, telecommunication, radio and television, water conservancy, ecological and environmental protection respectively. These departments are aggrieved parties during the construction period of the Project.

(9) Groups affected by project construction

During the construction, the Project will have a certain impact on the work and life of the surrounding residents, and the daily operation and management of institutions, enterprises and shops, such as increase of noise and dust, inconvenient transportation, and drop in shop customer flow, educed agricultural output and loss of fresh products transportation. These groups are aggrieved parties during the construction period of the Project.

13.2 Social Benefits of the Project

The construction of the Project will promote foreign economic exchange and cooperation among Chongzuo, Daxin and Tiandeng counties, directly promote the development of foreign trade, tourism and transportation industry, drive the rise and prosperity of business and catering service industries along the route, promote the employment of local labor force, especially poor people and women, improve the income level of the masses, provide convenience for the resident travel, shorten travel time and improve the travel comfort.

Chongzuo - Jingxi Expressway, which started construction at the end of 2012 and opened to traffic in June 2016, has already played a role in promoting local economic development and bringing some business opportunities and wealth opportunities to local people. During the investigation of the social evaluation team, both local government departments and ordinary people took the benefit of the road construction as an example to show that the construction of this project also brings them many benefits.

In recent years, buses from Nanning, Chongzuo, and Daxin to Detian Scenic Area have arrived at Detian Scenic Area through the main route of Chongzuo - Jingxi Expressway and Shuolong Connecting Line. Those buses exit the expressway via Tiandeng Toll Station, then go to Detian Waterfall via the Shuolong connecting line from Liliang. The west side of Shuolong Town is the only way which must be passed. After the opening of Chongzuo - Jingxi Expressway, with the convenience of transportation, the number of buses from Nanning, Chongzuo, and Daxin to Detian increased greatly, which brought business opportunities to the people in Daxin County and Shuolong Town.

(1) Building a regional international transportation hub to promote economic exchanges and cooperation between Guangxi, the other provinces, and ASEAN countries, especially Vietnam

The construction of the Project is of great significance to further build and perfect the China-ASEAN international corridor, and build a regional international transportation hub.

Component A (Wuzhou (Longyanzui) - Shuolong Expressway (Chongzuo-Jingxi Expressway - Shuolong Port Section)) is one of the sections of Wuzhou (Longyanzui) - Shuolong Expressway belonging to 7 transverse lines in the *Expressway Network Planning of Guangxi (2018-2030)*, one of the important transportation infrastructures for border economy and trade, a direct high-grade highway from Chongzuo City, Daxin County, Tiandeng County and Nanning to Shuolong Port, a national border port between China and Vietnam, an important international road channel for connection of Guangxi, China with ASEAN, and the "last kilometer" bottleneck section of the road connecting Guangxi and Vietnam. The completion of the Project will establish a highway network between China and Vietnam to realize connectivity and mutual benefit between China and Vietnam. The construction of the Project has received support from relevant parties of Vietnam. Component B (Detian-Shuolong Highway) is the dedicated road planned for Detian Waterfalls Scenic Area. There are many tourist attractions along the Project. The construction of the Project can greatly improve the traffic capacity of the port tourist highway and provide safe, comfortable and convenient traffic conditions for domestic and foreign tourists. According to the data provided by Guangxi CTS Detian Waterfall Tourism Development Co., Ltd., 760,000 person-times of tourists entered Detian Scenic Area in 2012. With the opening of Chongzuo - Jingxi Expressway, the number of tourists increased to 1,358,200 person-times in 2018 and 1,487,100 person-times in 2019. With the implementation of this project, the number of tourists will be increased, which will greatly promote the construction of Sino–Vietnamese Detian–Ban Gioc Waterfalls International Tourism Cooperation Zone. The International Tourism Cooperation Zone with the core scenic spot of Detian Waterfall as the center crosses both sides of the border between China and Vietnam. China and Vietnam have designated corresponding areas as the scope of the cooperation zone, resulting in a closed area with joint development, connected channels, barrier-free passage and special tourism policies. It will be built into a pilot area for China's opening to the outside world in terms of border tourism and an international tourism cooperation demonstration area. The construction of the Project will greatly promote the development of tourism services and related industries in China and Vietnam and become a new economic growth point in the areas along the line.

(2) Promoting the local economic prosperity of Chongzuo City, Daxin County, and Detian County, and realizing the prosperity of the border and the people

The construction of the Project can open up a new inter-provincial channel between Guangdong and Guangxi, realize the effective connection between the areas along the route and Guangdong-Hong Kong-Macao Greater Bay Area, and facilitate undertaking the relocation of industries in the east. The implementation of the Project will open up major traffic arteries between Daxin County, Tiandeng County and more developed areas, help the people of the two counties to shake off poverty and achieve prosperity, and improve the living standards of the people along the route. At present, the relatively low road grade and traffic accidents easily happening in the project area restrict the development of local economy and foreign trade, as well as the local social and economic development (to a certain extent). The implementation of the Project will greatly improve the regional highway capacity, improve the highway network in Guangxi Beibu Gulf Economic Zone, enhance the reliability of the road network and traffic safety, facilitate the development of the land around the highway, and the investment attraction and economic and trade development of the cities and towns along the route, and greatly promote the speeding up of development of new urbanization, tourism and industrialization, the coordinated development of urban and rural areas and regions, and the improvement of the living standards of the people along the highway.

Liang Yingxian, a resident of Shuolong Community in Shuolong Town, was affected by the demolition of her restaurant with an annual turnover of about RMB 100,000 when the Shuolong connecting line of Chongzuo - Jingxi Expressway was built in 2012. She then built a 5-story building with the demolition compensation in a parcel of land next to the expressway and opened a Sunshine Hotel with an annual turnover of RMB 500,000 to RMB 600,000 in 2017 and 2018. Not only has her livelihood been restored, but it is also much better than before the road was built.

Daxin County Guichunhe Food Co., Ltd. is located in the west of Shuolong Town. The background of the establishment of the company is the opening of Chongzuo - Jingxi Expressway. The company has already been benefited. During the investigation of the social evaluation team in the company, the company boss introduced that he expected that with the opening of Chongzuo - Jingxi Expressway, the number of tourists would increase greatly and the sales volume of local products would increase greatly, so he set up this food company in September 2016 to produce and sell agricultural local products such as brown sugar, rice candy, and stem of dendrobium. The annual turnover in 2017 and 2018 is RMB 20,000 to RMB 30,000, and it will reach nearly RMB 80,000 in 2019.

Figure 13-1 Business License of Daxin County Guichunhe Food Co., Ltd.

According to statistics, there were only 10 restaurants in Shuolong Street before the expressway was built in 2012, and now there are 40 restaurants. According to the average employment of 20 people in each restaurant, about 800 local people can be employed.

(3) The construction of the Project will, directly and indirectly, provide more employment opportunities, being conducive to promoting the increase of employment and income level of labor, especially the poverty-stricken household and women in the villages along the line

During the construction and after operation of the Project, a large number of direct and indirect jobs will be created to increase the employment opportunities of the local labor force.

First, there will be a lot of temporary employment opportunities during the construction period. This project has a large investment and a long construction period, in which the construction period of Component A is 36 months and that of Component B is 2 years. In addition, highway construction is labor-intensive and includes many construction works, such as temporary works, subgrade works, pavement works, bridge & culvert works, tunnel works, intersection works, traffic works, facilities, greening and environmental protection works along the route, and other works, etc. of

Component A, thus generating a large number of temporary employment opportunities. According to the feasibility study, the temporary labor demand of the 2 components during the construction period is about 3,204,765 man-days, and according to the remuneration of RMB 101.25 per man-day, it can generate an income of RMB 324,482,500 for the employees. According to the investigation, temporary employment during the construction period of highway projects mostly employs local labor in Guangxi. In addition, some direct job opportunities will be created in engineering management, engineering design, engineering construction, engineering supervision, etc., but most of these jobs require higher expertise and technology. In addition, the construction of the Project will also promote the development of industries such as building materials, transportation, commerce and service, resulting in a lot of indirect employment opportunities.

After the operation of the project, 110 long-term and sustainable jobs will be created, including 75 in toll stations, 5 in parking areas, 5 in maintenance and management, and 25 in management sub-centers. According to the calculation of the per capita salary of about RMB 3,000, the per capita annual income can reach RMB 36,000. It is understood that most of these jobs only require junior high school education or above, and the local people can meet the job requirements after job training. More importantly, a lot of indirect employment opportunities will also be created, mainly including employment opportunities in the tourism and passenger transport industries, and employment opportunities generated by promoting the industrial development activities along the route. The increase of employment opportunities will be definitely conducive to improving the income level of the labor force in the project area.

According to the information provided by Shuolong Town Government, the number of tourists received in the town in 2017 exceeded 1.19 million person-times, and the comprehensive tourism income exceeded RMB 600 million. There are 117 tourist reception hotels, guesthouses and hostels in Shuolong Town. There are more than 3,000 people working in tourism in the town, and 120 poverty-stricken people are engaged in tourist services such as hotel waiters, cleaners, chefs, and security guards. At the same time, 16 hotels and restaurants were mobilized to purchase rice, vegetables, chickens and ducks, and other agricultural products from poverty-stricken households, which increased the income level of the poverty-stricken households.

According to the manager of Daxin Detian Old Kapok Hotel, which opened in 2011, there are 120 employees in the hotel, 90% of whom are locals, and the number of men and women is basically equal. Most of the garden security guards are male and most of the cleaning attendants are female. The monthly salary of young waiters is about RMB 2000. The hotel plans to expand tourism projects such as water recreation, Detian Town, and Guichun River Trail in the next step. However, the quality of local employees is difficult to meet the requirements of hotel development, and it is difficult to recruit employees from other places, mainly due to the remote location and inconvenient transportation. Although Chongzuo - Jingxi Expressway has been completed, it is far from meeting the demand of local economic and social development for smooth traffic. After the completion of the Wuzhou (Longyanzui)-Shuolong Expressway and Detian-Shuolong Highway of this project, the local traffic conditions can be greatly improved, and it is easy to travel to and from hometown, and more young and high-quality talents will be willing to apply.

(4) The construction of the Project is conducive to perfecting the structure of the regional road network, improving traffic conditions, and enhancing travel efficiency

The Project is built according to the expressway standard to improve the grade of regional road network, enhance the traffic capacity of roads and greatly improve the transportation efficiency. After the opening of Chongzuo - Jingxi Expressway, the travel time from Daxin County to Nanning is shortened from 2 hours to more than 1 hour, and that to Chongzuo is reduced from 80 ~ 90 minutes to more than 50 minutes; the travel time from Shuolong Town to Nanning is shortened from more than 4 hours to 2 and a half hours, and that to Chongzuo is shortened from more than 2 hours to more than 1 hour.

The improvement of traffic conditions and the shortening of travel time have improved the comfort of local people, which is conducive to the external transportation and sales of local fresh agricultural and sideline products. According to the survey by the social evaluation team, it was difficult to transport local native products and their prices were low due to poor road conditions in the past. After the improvement of transportation, the external sales of local native products increased greatly, and the prices of products in short supply in some markets increased significantly. According to local people, Cleome gynandra and Gracilaria lemaneiformis were RMB 8/kg and RMB 50/kg respectively in 2012 and reached RMB 16/kg and RMB 70/kg after 2017. The growth of the export of native products is beneficial to revitalize border areas and enrich the local people.

With the improvement of highway grade and transportation conditions, the traveling cost of vehicles is greatly reduced, and the operation cost of vehicles is reduced, including the reduction of costs for fuel, tires, warranty, wear and accidents.

(5) The construction of the Project will help the local people to expand the scope of activities, increase their knowledge and improve their quality.

After the completion of the Project, the travel conditions for residents along the route will be improved, the scope of their working and living activities will be expanded, external exchanges will be enhanced, and their horizons and knowledge will be broadened, so that they will have more choices in their work and life, which will help them to enhance their competence and improve their quality.

The construction of the Project is conducive to the further improvement of the status of women. The improvement of traffic conditions will increase rural women's employment opportunities and choices, thus improving women's economic status. In particular, working outside promotes rural women's acquisition of modernity to further promote the realization of gender equality. For example, Daxin County Guichunhe Food Co., Ltd. has 2 employees in the off-season and 5 employees in the peak season. Except for the boss himself, all the other employees are women from local poverty-stricken families. The average monthly income of these women can reach about RMB 1800. They work near their home, which is convenient for taking care of their families and reduces the problem of "left-behind children".

The construction of the Project is conducive to improving the education level of rural teenagers. The construction of the Project will promote the development of the rural economy and the increase of farmers' income in the project area, as well as the broadening of horizons and modernization of thinking, which will enable more households to realize the importance of their children receiving a higher level of education, and also enable them to become more economically capable of cultivating their children, thus helping to improve the cultural level of the local labor force.

13.3 Negative Impacts and Risks of the Project

Due to the construction of the Project, more land resources will be occupied, and some residents' houses will be demolished, posing risks to the affected people, including losing their sources of livelihood, income decline, losing employment opportunities, and losing residential houses. Noise and dust generated from construction will have a negative impact on the production and life of residents along the line. In addition, the noise and exhaust generated during the highway operation will also have negative impacts on the local environment and the living quality of residents.

13.3.1 Impacts and Risks Caused by Land Acquisition and House Demolition

The construction of the Project requires a total of 1597.87 mu of permanent LA, 677 mu of temporary land occupation and 3858.16 m2 of house demolition. Land acquisition and house demolition involve 7 villages/communities and 9 organizations in 2 townships in 2 counties under the jurisdiction of Chongzuo City. A total of 945 households with 4067 people are negatively affected in different ways to different extent by the Project.

(1) Impact of Permanent LA

The Project requires a total of 1597.87 mu of permanent LA, including 20.27 mu of state-owned land and 1577.6 mu of collective land. The permanent land acquisition affects 7 villages (communities) in 2 townships, namely, Liliang Village and Xuanjie Village in Fuxin Town, Tiandeng County, as well as Yining Village, Yixian Village, Shuolong Community, Detian Village and Aijiang Village in Shuolong Town, Daxin

County. There are also 9 affected units: Liliang Village Water Plant, Kangmiao River Sewage Treatment Plant, and Yixian Village Primary School, Aijiang Wood Farm in Daxin County, Dam Site Hydro Project Administrative Office, Daxin Detian Old Kapok Tourism Development Co., Ltd., Detian Management and Protection Station of Guangxi Xialei Natural Reserve Management Office, Guangxi CTS Detian Waterfall Tourism Development Co., Ltd. and an army unit. Permanent acquisition of farmland affects 3635 people in 844 households. Among them, the acquisition of collective farmland affects 3590 people in 833 households, and the acquisition of state-owned wood land affects 45 people in 11 households in Aijiang Forest Farm. It can be seen that the permanent land requisition involves a wide range of impacts, and a lot of villages, organizations and population affected.

Among the 1597.87 mu of land permanently acquired for the Project, there is farmland of 1540.13 mu, accounting for 96.39% of the total land acquired. The proportion of farmland in the land permanently acquired for the Project is relatively high. Among the 1540.13 mu of farmland permanently acquired, 1530.01 mu belongs to the 7 rural collectives, accounting for 99.34% of the total farmland acquired. The state-owned land belonging to Aijiang Wood Farm is 10.12 mu, accounting for 0.66%. The permanent acquisition of farmland mainly affects 7 villages/communities.

Among 1530.01 mu of collective-owned farmland to be permanently acquired, 340 mu is prime cultivated land, accounting for 22.22%; 685.83 mu is general cultivated land, accounting for 44.83%; 468 mu is wood land, accounting for 30.59%; 19.26 mu is grassland, accounting for 1.26%; and 16.92 mu is other farmland, accounting for 1.11%. In general, the total proportion of basic cultivated land and general cultivated land is relatively high, up to 67.05%.

Of the 1530.01 mu of collective basic cultivated land and general farmland, 155.2 mu is irrigated land, accounting for 10.14%, and 1374.81 mu is non-irrigated land, garden land and other farmland, accounting for 89.86%.

Among 1190.01 mu of collective-owned general cultivated land, 685.83 mu is general farmland (irrigated land and non-irrigated land), accounting for 57.63%; 468 mu is wood land, accounting for 39.33%; 19.26 mu is grassland, accounting for

1.62%; and 16.92 mu is other farmland (rural roads, ponds, ditches and raised paths through fields), accounting for 1.42%. The Project occupies a lot of fertile land.

The wood land of 468 mu acquired for the Project mainly includes shrubland, open forest land, arbor forest, bamboo forest and other general commercial forest. Tree species such as longan, masson pine, cedar, theaceae, and buerretiodendron hsienmu, etc. are planted. The acquisition of wood land will bring some losses to the local forestry.

According to investigation, the 7 villages/communities affected by permanent LA in the Project currently have 23713 mu of farmland, and 1530.01 mu of farmland is acquired in these villages/communities, accounting for 6.45% of the total farmland. In terms of villages/communities, the permanent LA of the Project has a greater impact on Xuanjie Village than that on other villages, with the land loss proportion in Xuanjie Village being 22.11%; and the impact on Yining Village is relatively small, with the land loss proportion in Yining Village being 0.92%. See Table 13.3-1 for details of the land loss in the 7 villages/communities.

Table 13.3-1 Impact of Permanently Acquired Farmland on the 7 Villages (Communities)

County	Township/town	Village/community	Existing farmland area (mu)	Acquired farmland area (mu)						Land loss proportion
				Total	Basic farmland	General cultivated land	Wood land	Grass land	Others	
Tiandeng	Fuxin Town	Liliang Village	3730.8	333.7	119.8	142.9	71			8.94%
		Xuanjie Village	2444	540.3	35.2	312.1	191		2	22.11%
Daxin	Shuolong Town	Yining Village	5235.95	48.1	1.6	28.4	18.1			0.92%
		Yixian Village	3637.85	192.6	101.2	49	42.4			5.29%
		Shuolong Community	5239.1	337.92	82.2	102.44	119.1	19.26	14.92	6.45%
		Detian	800	13.5		8	5.5			1.69%

		Village								
		Aijiang Village	2625.3	63.89		42.99	20.9			2.43%
Total			**23713**	**1530.01**	**340**	**685.83**	**468**	**19.26**	**16.92**	**6.45%**

Among the basic cultivated land and general farmland acquired for the Project, there is a total of 155.2 mu of irrigated land, from 5 affected villages, accounting for 2.66% of the total existing irrigated land (5824.84 mu) in these villages. In general, the acquisition of irrigated land of the Project have small impact on the local villages. In terms of villages, Xuanjie Village is most affected by the acquisition of irrigated land in the Project, and the area of irrigated land acquired from it accounts for 6.14% of its total existing irrigated land; Yixian Village and Liliang Village take the second place, and the area of irrigated land acquired from them accounts for 4.13% and 2.42% of their total existing irrigated land respectively; Shuolong Community is least affected, and the area of irrigated land acquired from it accounts for 0.48% of its total existing irrigated land; there is no irrigated land in the farmland acquired in Yining and Detian Village. See Table 13.3-2 for details.

Table 13.3-2 Impact of Permanently Acquired Irrigated Land on the 7 Villages (Communities)

County	Township/town	Village/community	Existing irrigated land	Acquired irrigated land	Proportion of acquired irrigated land
Tiandeng	Fuxin Town	Liliang Village	1610.1	39	2.42%
		Xuanjie Village	1009.35	62	6.14%
Daxin	Shuolong Town	Yining Village	60		
		Yixian Village	627.54	25.9	4.13%
		Shuolong Community	1675.53	8.1	0.48%
		Detian Village	262		
		Aijiang Village	902.32	20.2	1.21%

Total area of existing irrigated land in affected villages	**5824.84**	**155.2**	**2.66%**

Totally, 844 households with 3635 people are affected by the permanent acquisition of farmland for the Project, of which 833 households with 3590 people are from the 7 affected villages/communities, and the rest 11 households with 45 people are from Aijiang Wood Farm.

According to the preliminary statistical results, 833 households are affected by permanent acquisition of farmland, to different extent, with different land losses. Among them, 346 households have a land loss less than 20%, accounting for 41.54% of the total affected households; the total number of households that have a land loss more than 50% is 160, accounting for 19.21%. Among them, 22 households have a land loss more than 80%, accounting for 2.64% of the total affected households. The permanent acquisition of farmland for the Project has a great impact on these households. See Table 13-4 for the specific distribution of land loss proportion of the households affected.

Table 13.3-3 Table 13-4 Distribution of Land Loss Proportion of Households Affected by Permanently Acquired Farmland

S/N	Land loss proportion	Tiandeng County (household)		Daxin County (household)					Total (household)	Proportion
		Liliang Village	Xuanjie Village	Yining Village	Yixian Village	Shuolong Community	Detian Village	Aijiang Village		
1	Land loss ≥90%				2	4	2	2	**10**	**1.20%**
2	80%≤ land loss < 90%				9		2	1	**12**	**1.44%**
3	70%≤ land loss <80%	1			12	6	4		**23**	**2.76%**
4	60%≤ land loss <70%	11			9	16	3	1	**40**	**4.80%**
5	50%≤ land loss <60%	13			6	52	2	2	**75**	**9.00%**

6	40%≤ land loss <50%	11	6		8	52	8	7	**92**	**11.04%**
7	30%≤ land loss<40%	8	34		17	29	3	6	**97**	**11.64%**
8	20%≤ land loss <30%	15	30	1	16	38	7	31	**138**	**16.57%**
9	Land loss <20%	16	127	26	56	24	3	94	**346**	**41.54%**
Total		**75**	**197**	**27**	**135**	**221**	**34**	**144**	**833**	**100.00%**

(2) Impact of House Demolition

In the construction of the project, 8 agricultural supporting makeshift houses with a total area of 329.2 square meters should be demolished in Fuxin Town, Tiandeng County, and 3,528.96 square meters of houses should be demolished in Shuolong Community, Shuolong Town, Daxin County, which includes 4 residential houses, 4 commercial houses located beside the highway whose usage has changed from "residential to commercial", 2 makeshift houses with iron ceilings for small shops, 1 temporary office and 1 vacant agricultural supporting makeshift house. Totally, 18 local households with 78 people are affected by house demolition. The agricultural supporting makeshift houses in Gutun are subjected to collective ownership and are currently vacant. The temporary office located in Shuolong Street, Shuolong Community is owned by the anti-smuggling duty office.

For the 10 local residents whose current residential and commercial houses are affected, the demolition of residential and commercial houses has a relatively large impact on the life of these households because they need to move to other places for transition before the current residential and commercial houses are demolished and new houses are built, and some even need to build houses in different places, thus requiring an adaptation period for the new residential and commercial environment.

Among the 6 commercial buildings, 4 are brick and concrete buildings, of which 3 are private hotels and 1 is a restaurant, belonging to 4 families; the remaining 2 buildings are makeshift houses with iron ceilings, 1 of which was a shop that originally sold native products and the other is a small restaurant, belonging to 2 families respectively.

House demolition of the Project will cause certain losses to the commercial operation of villagers.

(3) Impact of Temporary Land Occupation

The Project requires a temporary land occupation area of 677 mu, which affects 816 people in 186 households from 2 towns and 7 villages. Please refer to Table 11-4 for details of the impact of temporary land occupation of the Project. The temporarily occupied land of the Project is mainly used for construction, production and living, stacking of muck, and construction of temporary access roads. The occupation period is 3 years for Component A, and 1.5 years for Component B. On the one hand, temporary occupation of land will prevent the affected households from farming for 1.5 - 3 years; on the other hand, due to construction excavation, occupation and collapse, the temporarily occupied land will be damaged to a certain extent.

Table 13.3-4 Impact of Temporary Land Occupation

County	Township/ town	Village/community	Temporary Land Occupation (mu)			Period of the Temporary Land Occupation (years)	Affected population	
			Agricultural Land	Unused land	Total		Household (Nr.)	Population
Tiandeng County	Fuxin Town	Liliang Village	120.1	3.7	123.8	3	7	25
		Xuanjie Village	218.6	1.6	220.2	3	78	359
Daxin County	Shuolong Town	Yining Village	8.1	0.9	9	3		
		Yixian Village	129.3	22.1	151.4	3	68	312
		Shuolong Community	95.2	13.4	108.6	3	33	120
			31		31	1.5		
		Detian Village	24.8		24.8	1.5		
		Aijiang Village	8.2		8.2	1.5		

Total	**635.3**	**41.7**	**677**		**186**	**816**

13.3.2 Adverse Impact on Local Area during Project Construction Period and Operation Period

During the construction period of the Project, due to the need of road construction, the existing traffic on the relevant roads in the region will be temporarily organized by detouring and half-width passage, which will reduce the vehicle operation speed and affect the normal traffic.

During the construction process, noise, dust and automobile exhaust will be generated during transportation of road building materials. During the operation period of the Project, automobile noise and exhaust pollution will affect local residents, organizations, enterprises and schools on both sides of the line at varying degrees.

13.4 Resettlement

Resettlement mainly involves compensation for population affected by permanent land acquisition, temporary land occupation and house demolition, the provision of production and living conditions, and income restoration so as to sustainably guarantee their livelihoods.

The project area involves two counties of Chongzuo City: Daxin County and Tiandeng County. Since the two counties have no difference in land acquisition compensation and resettlement laws and policies for land-expropriated farmers, the population affected by permanent LA will be resettled in a unified manner. The population affected by temporary land occupation in the two counties will be resettled in a unified manner based on research results, consultation and negotiation since no specific regulations or policies have been formulated.

The population affected by permanent LA in the Project is 844 households with 3,635 people; the collectively-owned farmland acquisition involves 7 villages/communities, and the affected population is 833 households with 3,590 people; the acquisition of state-owned farmland involves 11 households with 45 people in Aijiang Forest Farm of Daxin County.

13.4.1 Income Restoration and Resettlement of the Population Affected by Permanent Collectively-owned Farmland Acquisition

According to relevant provisions in the *Notice of the General Office of the People's Government of Guangxi Zhuang Autonomous Region on Implementation of Location-based Land Prices for Land Acquisition* (GZBH [2020] No.5), cities and counties can further develop more resettlement methods for land-expropriated farmers in combination with local conditions. In addition to one-time monetary compensation for resettlement, land-expropriated farmers can be resettled through provision for agricultural production, land usufruct returning, housing, employment, stock ownership, resettlement in other places and other ways.

According to the samples of the investigation participated by the public collected in the social stability risk analysis report of the Project, 93% of the respondents hope to get one-time monetary compensation and 4% hope to obtain job opportunities as compensation. Therefore, the income restoration method for the population affected by the permanent acquisition of collective-owned farmland for the Project is mainly monetary compensation. For the village collective with large land loss, land is reserved to development the commercial service industry in the land-expropriated village. Meanwhile, the land-expropriated farmers with the qualifications stipulated in the *Notice of the Trial Measures for Social Security of Land-expropriated Farmers in the Guangxi Zhuang Autonomous Region* and approved by the villagers' representatives assembly can also get social security.

According to the regulations and practices of relevant documents, for farmer households whose land has been expropriated, the compensation fee for land acquisition shall belong to relevant village collectives (village committee or villager group) or the farmer households contracting the land according to the contracted-responsibility on household basis. For houses, young crops, and general attachments on the land (including tombs and pools), the compensation fee will be paid to the owners of the ground attachments and young crops. For transportation facilities, water conservancy facilities, municipal facilities, electric power facilities, and telecommunications (broadcasting and TV) facilities on the land, the compensation fee shall be exclusively used in the restoration of these facilities by the organization designated by the owner of the removed facilities. Ancient tombs with the value of cultural relics shall be protected or compensation fees shall be paid for them in accordance with relevant regulations.

The area of land to be permanently acquired by the Project is 1597.87 mu, including 1577.6 mu of collective-owned rural land.

The 1577.6 mu of collective land includes 340 mu of prime farmland, accounting for 21.55%, 1190.01 mu of general farmland, accounting for 75.48%, 5.3 mu of rural homestead, accounting for 0.24%, and 42.29 mu of unused land, accounting for 2.68%.

The total compensation for permanent expropriation of rural collective land in the project is 58,613,200 yuan, including 49,636,200 yuanfor affected villagers and 8,977,000 yuan for village collective.

13.4.2 Resettlement of the Population Affected by Temporary Land Occupation

The temporarily occupied land of the Project is mainly used for construction, production and living, dumping of spoil, and construction of temporary access roads. The resettlement of the population affected by temporary land occupation involves mainly the distribution of the compensation fees for land occupation and ground attachments and the land reclamation after construction. The project temporarily covers an area of 677 mu, affecting 816 people in 186 households.

(1) Distribution of compensation fees for temporary land occupation

According to the provisions in the *Measures of Guangxi Zhuang Autonomous Region on Implementation of the Land Administration Law of the People's Republic of China* and the unified annual output standards determined in the *Notice of the Office of Chongzuo Municipal People's Government on Implementation of Unified Annual Output Value Standards for Upcoming Land Acquisition*, the land occupation compensation rates of the Project are 1,810 yuan/mu and 1,086 yuan/mu for farmland

and unused land respectively in Fuxin Town and 1,829 yuan/mu and 1,097.4 yuan/mu for farmland and unused land respectively in Shuolong Town. The temporary land occupation period is 1.5-3 years. The total compensation for temporary land occupation in the Project calculated on the above basis is 3,428,100 yuan, of which 1,212,600 yuan is for the affected village collectives.

According to the research, the compensation rates for young crops and ground attachments of the Project are higher than their actual values and will ensure full income restoration of the affected families.

(2) Land reclamation

For land damaged by excavation, compression, collapse, etc. during construction, the land user will reclaim such land in strict conformity with the reclamation program approved by the land and resources authority to ensure that it is restored to the original condition. The contractor will strip top soil for occupied cultivated land and wood land, and the stripped top soil will be used for land reclamation. If reclamation is nonconforming, land reclamation fees will be paid.

13.4.3 Resettlement of the Population Affected by House Demolition

According to the sampling questionnaire survey conducted during the RAP preparation stage of the Project, 93% of the respondents directly affected by the land requisition and house demolition hope to get one-time monetary compensation. Nevertheless, based on local experience with similar projects, people with houses to be demolished will often again ask for homestead replacement before signing an agreement.

According to the regulations of relevant documents and practices, the Housing and Urban-Rural Development Bureaus of Tiandeng County and Daxin County have drawn up the resettlement site and scheme for households to be relocated with the assistance of Fuxin and Shuolong Town Governments.

(1) Resettlement of population affected by demolition of agricultural makeshift houses

The resettlement scheme for the people affected by the demolition of agricultural makeshift houses is monetary compensation.

(2) Demolition and relocation of operating houses

The main operating houses within the scope of land to be used by the Project are small inns, small restaurants and local specialty stores beside the roads in Gutun, Shuolong Community, Shuolong Town, Daxin County.

According to the relevant documents, local situation and practice, the Natural Resources Bureau and the Housing and Urban-Rural Development Bureau of Daxin County proposed the resettlement schemes for the households with their operating houses to be demolished: monetary compensation will be provided for main buildings and ancillary facilities; the County Housing and Urban-Rural Development Bureau and the Employer will, based on the will of the affected people, help coordinate the renting of houses in districts suitable for commercial operation for them to continue commercial operation, or replace the operating houses with homesteads covering an area not exceeding the area permitted by the state in districts of equivalent commercial value in the principle of “one new site for one occupied site” for them to continue commercial operation after resettlement and reconstruction. The operating losses of merchants in the construction period of the Project will be compensated in money.

Due to the particularity of the value of commercial houses, the relocation design of these houses shall follow the principle of "restoring the original function, original scale, and original standards", and the Owner of the Project shall negotiate with the owners of the removed houses.

Due to the fact that the house valuation has not been carried out yet, in order to facilitate the estimation and calculation, the compensation for operating houses in the Project are temporarily calculated on the basis of the compensation rates for demolition of houses of appropriate structure (including interior finishing and decoration), the final rate of which however is subject to the results of actual evaluation by a professional evaluation company and the compensation agreement concluded between the land user and the relocated household during the implementation of the Project.

(3) Resettlement of the population affected by residential house demolition

For local households relocated due to demolition of their residential houses or operating houses, they are given monetary compensation or assigned new homesteads that cover an area not exceeding the area permitted by the state according to the principle of “one new site for one occupied site”.

① Monetary compensation

Monetary compensation refers to the payment of housing compensation, homestead compensation (for the difference between the area of the homestead expropriated and the area of the land replacement), temporary resettlement subsidy and relocation subsidy to the relocated households.

According to the Notice of Daxin County People's Government on the Issuance of the Compensation Rates for Land Acquisition (Occupancy) and House Demolition of Daxin County (XZF [2017] No. 14), and the Notice of the People’s Government Office of Tiandeng County on the Issuance of the Interim Measures for the Resettlement Guarantee Work for the Land Acquisition and Demolition of Construction Land (TZBF [2017] No. 27), rural homesteads shall be compensated at the compensation rate for farmland; the main body of the houses shall be compensated per different structural types according to the area circled by the outer wall; for house decoration, interior and exterior walls shall be compensated according to the wall area, the floor shall be compensated according to the actual paved area, aluminum alloy windows, security windows, ordinary ceilings, and shop doors shall be compensated according to the actual area, indoor suite room doors shall be compensated according to the number of door leaves, kitchen worktops (washing tables) shall be compensated according to the number of worktops, the cabinet combination shall be compensated according to its length (in meter), the stoves shall be compensated as per different materials according to the number or length (in meter), and stair handrails shall be compensated according to their materials and length (in meter).

The standards for the temporary resettlement subsidies (referring to residential houses) and relocation subsidies for households relocated due to house demolition shall be determined by the people's government of the county with reference to the Rules for the Implementation of the Regulations on Management of Demolition of Urban Housing in the Guangxi Zhuang Autonomous Region, and shall be calculated per household.

The Project necessitates demolishing 329.2 m2 of agricultural makeshift houses in Fuxin Town, Tiandeng County, and demolishing 3,858.16 m2 of various categories of houses (including residential houses, operating houses, agricultural makeshift houses, and temporary offices) in Shuolong Community. The compensation for HD and subsidies for temporary resettlement and relocation is 3,670,200 yuan.

② Replacement of Rural Residential Land

As to the reconstructed homesteads for resettlement of relocated households whose houses (residential houses and operating houses) have been demolished, the township government is responsible for the site selection in order to perform the task assigned by the county’s natural resources bureau; the county’s natural resources bureau is responsible for the land acquisition according to the standard of permanent land acquisition for main works; the relocated household is responsible for applying for approval of construction to the county’s natural resources bureau. The original homesteads, vacant land, bleak slope, and wasteland in the village must be fully utilized, the occupation of farmland must be strictly controlled, the occupation of prime farmland is not permitted, and the village and town planning must be complied with. As far as possible, the households shall be resettled in the original place. The reconstruction area shall be in accordance with the relevant provisions of the Measures of Guangxi Zhuang Autonomous Region on Implementation of the Land Administration Law of the People's Republic of China, and it shall be verified and approved by the county’s natural resources bureau in the principle of "one housing site for one household, with an area of not more than 150 m2".

The sub-headquarters (Construction Office) is responsible for arranging the contractor to carry out the supply of water, electricity, access roads and ground leveling of the reconstructed homesteads for relocated households with demolished houses, and the relocated households generally need to reconstruct their homesteads by themselves.

At present, the resettlement scheme initially determined by the Housing and Urban-Rural Development Bureau of Daxin County for 10 households with residential and operating houses to be demolished is as follows:

① Resettlement of three households at another site

The resettlement site is initially selected in Longhongtun of this community, and the plot is located between Gutun and Longhongtun, beside the existing highway from Detian to Shuolong and opposite to CNOOC Gas Station. Within the scope of *Regulatory Detailed Planning of Shuolong Town, Daxin County*, the area of resettlement land for each household is equal to the area expropriated, totaling 390.1 m2 (about 0.6 mu, which has been included in the permanent LA of the project). The houses of two households to be relocated in Gutun are about 0.91 km away from the currently selected site, and the house of one household to be relocated in the 1st team of the subdistrict is about 2.88 km away from the currently selected site. The new location is conveniently located, with complete surrounding facilities and strong commercial atmosphere. The compensation for these three households to be resettled at another site, including interior trim (200 yuan/m2), has been budgeted at the rate of 1,100 yuan/m2, and the final rate is subject to the results of actual evaluation by a professional evaluation company. In addition, the Project has budgeted the subsidies for temporary resettlement at the rate of 3,000 yuan/household (300 yuan per month in the transitional living period of 10 months) and the subsidies for relocation at the rate of 800 yuan/household (including the expenses on moving out of the old house once and moving into the new house once).

According to the research, these households have stopped farming at present, and the relocation to the new site will facilitate them to engage in border trade and tourism, and at the same time, as the resettlement site is still in the same administrative village, so the education of their children and the work of the working population will not be affected basically. The three households are very satisfied with the new site.

② Resettlement of seven households at the original site

For the construction of the Project, a total of only 371.3 m2 of homesteads of the seven households are occupied, accounting for 38.34% of their existing homesteads. Among them, four households currently occupy homesteads exceeding 150 m2 in area, and after the land acquisition of the Project, one household still occupies a homestead exceeding 150 m2 in area. According to the principles of "one new site for one occupied site" and the total area of the homestead occupied by the family not exceeding 150 m2, the Projects will need to arrange for 180.21 m2 of land for reconstruction next to the original site. According to preliminary investigation, there are enough open spaces behind or on the left and right sides of these 7 households, which are located within the scope of Regulatory Detailed Planning of Shuolong Town, Daxin County, and can meet the requirements of land for reconstruction. The seven households will be resettled at the original site: After the existing houses are demolished, they are merged with the open spaces behind the houses or on the left and right sides to the reconstructed homesteads for the construction of new houses. Among them, three households occupy homesteads of the same size and four households occupy smaller homesteads. Monetary compensation will be given for the difference in the homestead area.

After signing an agreement with the relocated households, the Employer will build temporary pre-fabricated or rented houses next to or behind the original sites of the houses according to the actual situation on site. The Employer will only demolish the original houses after the relocated households have transferred all their belongings to the temporary pre-fabricated or rented houses, and then lay the water pipes and electric cables, build the access roads and level the ground for the new homesteads as adjusted. The relocated households will build their new houses on the new homesteads by themselves, and then move into the new houses after these new houses are constructed. The compensation for these seven households to be resettled at the original site, including interior trim (200 yuan/m2), has been budgeted at the rate of 1,100 yuan/m2 of floor area, and the final rate is subject to the results of actual evaluation by a professional evaluation company. In addition, the Project has budgeted the subsidies for temporary resettlement at the rate of 3,000 yuan/household (300 yuan per month in the transitional living period of 10 months) and the subsidies for relocation at the rate of 800 yuan/household (including the expenses on moving out of the old house once and moving into the new house once). The land for homestead and reconstruction is included in the permanent land acquisition. This resettlement method is conducive to making use of building materials from the old houses when these households build new houses and also convenient for relocation. Therefore, these households are also satisfied with the resettlement scheme.

13.4.4 Demolition and Relocation of Unowned Tombs

When the deadline for tomb relocation required in the tomb relocation notice is reached, if no one claims a tomb, the tomb will be regarded as an unowned tomb. The acquisition and demolition sub-headquarters shall be responsible for numbering the unowned tombs, taking photos for the landform of the place for relocation after relocating them to the place through hiring labor workers.

13.4.5 Resettlement Strategy of Vulnerable Groups

1. Types of vulnerable groups and ways of support from the government

The vulnerable groups affected by the Project are households enjoying the five guarantees, households enjoying the minimum subsistence allowance and poverty-stricken households. The list of households enjoying the five guarantees and households enjoying the minimum living guarantee comes from the official statistics as of 2019, and the list of poverty-stricken households comes from the official register in 2015. According to the preliminary investigation, the elderly, widowed or divorced female-headed families are almost included. These groups are all low-income groups, but they are different in poverty level, family ownership of labor force, etc., so the government adopts different ways to support them. Households enjoying the five guarantees and households enjoying the minimum subsistence allowance, as recognized by the county civil affairs department, enjoy the social security, of which the security funds are from government finance; poverty-stricken households are the list screened and determined by the county government in 2015 according to the standard of "two assurances and three guarantees". The way to support them is "precise poverty alleviation", that is, through a series of poverty alleviation policies, including industrial poverty alleviation, employment and social security poverty alleviation, education poverty alleviation, medical assistance and poverty alleviation, as well as poverty alleviation teams formed by government departments and state-owned enterprise staff to help directly in the village and mobilizing social forces to help, so that poverty-stricken households with different causes of poverty can get different kinds of precise support. There are two types of benefits for poverty-stricken households: first, direct cash subsidies, cash income or fee reductions, such as the living and tuition subsidies for students in school, dividends and rewards in some poverty alleviation projects with a stable income, and medical care and insurance premiums; reduced payment and other expenses; the second is to improve the income level by obtaining employment opportunities, microloans and technical training. After several years of support, poverty-stricken households will continuously improve their income, thus steadily getting rid of poverty. Poverty alleviation work is mainly carried out by the "Leading Group Office of Poverty Alleviation and Development" (referred to as "Poverty Alleviation Office") at all levels of the government, while all relevant government departments participate in poverty alleviation work within their jurisdictions by implementing relevant poverty alleviation policies at higher levels and dispatching poverty alleviation teams according to their own responsibilities.

2. Social security enjoyed by households enjoying the minimum subsistence allowance and households enjoying the five guarantees

(1) Social security enjoyed by households enjoying the minimum subsistence allowance

On September 1, 2009, Guangxi issued the Measures on Minimum Subsistence Allowance for Rural Residents of the Guangxi Zhuang Autonomous Region, establishing a minimum social security system for rural areas. The security object is the rural residents whose annual per capita net income is lower than the minimum subsistence allowance standard of local rural residents. The government responsibility system is implemented for the minimum subsistence allowance for rural residents. It is included in the financial budget, and the civil affairs department of the county government pays the minimum subsistence allowance for rural residents monthly through banks.

Households enjoying the minimum subsistence allowance are mainly those who lack sufficient working ability due to illness, disability, old age and infirmity, and cannot maintain a normal life on their own and need subsidies from the government. The minimum subsistence allowance standard for rural residents shall be determined by the Municipal People's Government in accordance with the expenses of eating, dressing, water and electricity necessary to maintain the basic life of rural residents throughout the year. The rural minimum living standard in Chongzuo City in 2020 is 5,100 yuan per person per year. Civil affairs departments at the county level and township people's governments regularly or irregularly investigate and understand the living conditions of poor rural residents, and promptly bring all eligible poor rural residents into the scope of protection. Xu Hanzhong, for example, is from a household enjoying the minimum subsistence allowance with two family members in Shuolong Community, Daxin County. The social security enjoyed by the family includes the minimum subsistence allowance of 265 yuan per capita per month (the difference between the per capita net income of the family and the standard of minimum living guarantee) and the government-paid medical insurance for rural residents of 250 yuan per capita per year and endowment insurance premiums for the population aged 16-60 years of 100 yuan per capita per year.

(2) Social security enjoyed by households enjoying the five guarantees

The household enjoying the five guarantees refer to the elderly, the disabled and the underage in rural areas who have no ability to work, no source of livelihood, or no legal obligors to provide for or support them, or have legal obligors to provide for or support them who however have no capability to do so. On January 11, 2006, the State Council adopted the Regulations on Rural Five-Guarantees Subsistence Work in order to ensure the normal livelihood of rural recipients of the Five-Guarantees Subsistence Scheme and to promote the development of the rural social security system. The funds for supporting the rural households enjoying the five guarantees shall be arranged in the financial budget of the local people's government. The standard of support for the five guarantees in rural areas is not lower than the average standard of living of local villagers.

Households enjoying the five guarantees receive five social security items: food security (to supply grain and oil, non-staple food and domestic fuel), clothing security (to supply daily necessities such as clothing and bedding and pocket money), medical security (to provide disease treatment and care for those who cannot take care of themselves), housing security (to provide housing that meets basic living conditions), funeral security (to properly handle funeral affairs) or education security (to guarantee the expenses that orphans under or over 16 years of age and still receiving compulsory education need to receive compulsory education according to the law). For example, Liang Gaoquan from a household enjoying the five guarantees in Aijiang Village, Shuolong Town, Daxin County, enjoys a government support fund of 595 yuan/month, totaling 7140 yuan a year.

3. Government and social support for poverty-stricken households

In 2015, due to the Chinese government's decision to comprehensively solve the rural poverty problem in China within five years, the State, provinces, autonomous regions, cities and counties all set up the Leading Group Office for Poverty Alleviation and Development ("Poverty Alleviation Office"), and governments and functional departments at all levels issued a series of poverty alleviation policies. The Poverty Alleviation Office at the county level is responsible for implementing the principles, policies and measures formulated by the government at a higher level for poverty alleviation through development, and organizing and coordinating the poverty alleviation work of various government departments and all walks of life in the region. Government agencies, such as county-level civil affairs bureaus, labor and social security bureaus, agricultural and rural bureaus, veterans affairs bureaus, health bureaus, medical security bureaus, education bureaus, all implement national, district and municipal poverty alleviation policies in relevant industries within their own work scope, and promote "work for relief" in transportation, water conservancy, housing construction and other industries to provide job opportunities for poverty-stricken households with working ability; finance, development and reform departments give priority to approving poverty alleviation projects. In addition, a poverty alleviation team composed of county-level government agencies and state-owned enterprises and institutions is stationed in the village to help. According to the actual situation of poverty-stricken villages and poverty-stricken households, the poverty alleviation team adopts precise support measures, such as introducing funds and projects for poverty-stricken villages, improving local infrastructure, helping to sell agricultural and sideline products, training the labor force of poverty-stricken households in applicable technologies, and providing small loans. In these ways, it can help poverty-stricken households obtain the ability and opportunity to raise their income level persistently, getting rid of poverty stably. Huang Shiwu, for example, is from a poverty-stricken household with seven people in Yixian Village, Shuolong Community, Daxin County. According to the poverty alleviation policies, the support enjoyed by the family in 2020 includes poverty alleviation microcredit discount of 50,000 yuan; poverty alleviation microcredit entrusted business dividends of 4,000 yuan/year; industrial poverty alleviation awards of 1,965 yuan; compulsory education students' living and nutrition subsidies 1,800 yuan (1,800 yuan/person/year); 400 yuan for pension contribution assistance (4 persons in total, 100 yuan/person/year); 1,750 yuan for individual health insurance contribution assistance (7 persons in total, 250 yuan/person/year). The family of Nong Lishan, a poverty-stricken household with five people, enjoys the following support according to the poverty alleviation policy: 1,560 yuan of the 2020 industrial poverty alleviation award; 1,800 yuan (1,800 yuan/person/school year) of living and nutrition allowance for students receiving compulsory education; 200 yuan of endowment insurance contribution subsidy (2 persons in total, 100 yuan/person/year); 1,250 yuan (5 persons in total, 250 yuan/person/year) of medical insurance individual contribution subsidy; 252 yuan/year of dividend income from pigeon breeding (a poverty alleviation industry). According to statistics, the per capita income of these two poverty-stricken households in 2020 has exceeded 10,000 yuan.

4. The income level of households enjoying the minimum subsistence allowance, households enjoying the five guarantees and poverty-stricken households affected by the Project and the national poverty alleviation strategy

The questionnaire survey on 160 affected households of the Project shows that the per capita disposable income of the 160 households is 13,250.01 yuan, the annual per capita income of households enjoying the minimum subsistence allowance is 7,439.86 yuan, and the annual per capita income of poverty-stricken households is 10,017.10 yuan. The standard of low income of rural families in 2019 issued by Chongzuo Municipal Government is 6,000 yuan per capita per year. Judging from this, the annual per capita income of poverty-stricken households affected by the Project has been far higher than the low-income line determined by the government after years of precise assistance from the government and all sectors of society.

According to the government's poverty alleviation plan, all poverty-stricken households in the project area will be lifted out of poverty by the end of 2020. In fact, in May 2020, all poverty-stricken households in the project area have achieved the goal of getting rid of poverty. In order to ensure poverty-stricken households get rid of poverty stably, the government's poverty alleviation strategy is to maintain the support policy for another 2-3 years. If some households still have difficulties in living after the support policy is stopped and meet the standard of minimum living guarantee, these households will enjoy the minimum social security and receive a living subsidy monthly from the government.

5. The resettlement strategy for vulnerable groups of the Project

The vulnerable groups affected by the Project are all households affected by land acquisition, and there are no vulnerable groups in households affected by house demolition. Due to land expropriation, households of vulnerable groups lose part of their land. For households enjoying the minimum subsistence allowance and households enjoying the five guarantees, because they lack or have weak labor force, they have insufficient ability to cultivate land, and their basic livelihood is guaranteed by the society, so they often abandon the land, find someone to cultivate land or simply cultivate their own land, so their agricultural income is low. The land acquisition of the project can make them get a cash income higher than their agricultural income without farm work, and their basic living is fully guaranteed by the government. Therefore, there is no need to establish special resettlement measures for them in the Project.

For poverty-stricken households, with the precise support of local governments and all sectors of society, by May 2020, poverty-stricken households will be lifted out of poverty. Therefore, the impact of land acquisition on them in the Project is basically the same as that of other non-poverty-stricken households. Moreover, they will continue to enjoy the current support policies in the next 2-3 years, including various cash subsidies, fee reduction and other benefits, and their income level will keep steady or continue to increase. Even if some households return to poverty after the support policy is suspended, they will enjoy the minimum social security or other social assistance. Therefore, there is no need to formulate special resettlement measures for the affected poverty-stricken households in the Project.

In conclusion, no separate vulnerable community development plan is to be prepared to support these low-income families to restore their livelihoods.

In order to help the resettled people create an environment of self-reliance and self-development, and try to restore or improve the living standards of immigrants in a short time, the project implementing agency will cooperate with the labor and social security, finance, education, science and technology, women's federations and other departments in Tiandeng and Daxin county to organize free training on technical skills for land-losing people caused by this Project. Technical training will be carried out according to the adjustment of economic structure, the change of labor market and the requirements of employers in each county, adhering to the principle of practicality and effectiveness. The technical training will be an effective action to restore and improve the income of affected people.

Considering that the main labor force in many affected families lacks necessary job skills, especially women, over half of women are assured to participate in each training. Affected people, who are trained to gain labor skills, can find jobs nearby. Technical training will cover all affected persons.

14. Mechanisms for Public Participation and Complaint

The engagement of interested parties is an essential part of the Project's social assessment process. The effective participation of the stakeholders can improve project sustainability and acceptability, and enhance the public understanding and support of the Project.

The owner of this project attaches great importance to public participation and has conducted extensive consultation to ensure public participation during social stability risk assessment, social evaluation and resettlement plan preparation. During the implementation phase of the project, public participation will be further encouraged and effective consultation will be carried out with them.

14.1 Public Participation

The Task Force has successively organized public participation in two stages.

14.1.1 Public Engagement in the Social Stability Risk Assessment Stage

In October and November 2019, the Social Stability Risk Assessment Working Group went to Daxin County and Tiandeng County to hold symposiums attended by personnel from government departments concerned such as governments of Fuxin Town and Shuolong Town and representatives of some affected villages to listen to the opinions and suggestions of the participants on the Project. They went to villages greatly affected by the Project to collect relevant documents and materials, understand the opinions and demands of villagers and interested parties, and launch extensive public participation and investigation.

The Task Force held a forum in Daxin County Municipal People's Government on the morning of October 17, 2019, inviting representatives of relevant departments of Daxin County Municipal People's Government and Shuolong Town People's Government. A forum was held in Shuolong Town People's Government on the afternoon of October 17, inviting representatives from relevant departments of Shuolong Town People's Government, Shuolong Community, Yixian Village, Xiangkou Village and Yining Village.

The Task Force held a forum in Tiandeng County Municipal People's Government on the morning of November 7, 2019, inviting representatives of relevant departments of Tiandeng County Municipal People's Government and Fuxin Town

People's Government. A forum was held in the village committee of Xuanjie Village, Fuxin Town on the afternoon of November 7, inviting representatives of relevant departments of Fuxin Town Municipal People's Government and Xuanjie Village People's Government.

At the forum, the leader of the task force gave a detailed introduction to the background and basic construction of the proposed project, and the participants expressed their opinions and opinions on the project from different point of view. There are mainly the following points from opinions, suggestions and demands of the participants:

(I) Route design

1. The drainage ditches shall be reasonably designed to prevent the cultivated land from being flooded during rainy seasons.

2. Pay attention to road noise during design.

3. Toll stations are suggested to be located between K4 and K5 to avoid occupying basic farmland;

(II) Compensation for land acquisition

1. Publicity and interpretation of compensation and resettlement policies for land expropriation and demolition shall be ensured in the project area.

2. Land acquisition and relocation shall be carried out in accordance with the laws and regulations, and compensation shall be timely in place in full amount according to the government standards.

3. Since 606 mu of agricultural land has been requisitioned for the rural scenery tourism project in Xuanjie Village, Fuxin Town, the agricultural land of Xuanjie Village shall be requisitioned at the minimum for the Project, with proper resettlement of the public of land acquisition.

(III) Precautions in construction

1. The Contractor shall recruit employees in accordance with laws and regulations;

2. The project management department shall be well managed during the construction period to grantee safe and civilized construction;

3. During the construction, the local ethnic customs shall be respected, the relations with the local people shall be improved, and the reasonable demands of the masses shall be satisfied as far as possible during the construction.

4. During construction, the water conservancy infrastructure shall not be affected

or less affected as far as possible. Damage to the original drainage ditch should be avoided as far as possible, and if damaged, the drainage ditch shall be restored in time.

5. Pay attention to pollution problems like noise and sewage during construction to avoid polluting water source protection areas;

6. After the construction, the temporary land occupation shall be reclaimed and the solid wastes shall be cleared.

(IV) Relocation of discipline facilities

1. If the relocation of telecommunication facilities is involved, communication should be made with the telecommunication department in advance.

2. The route plan should be provided to the China Southern Power Grid in time to facilitate its preparation of relocation plan.

3. During the construction, consideration should be given to the relocation of related hydropower across the highway.

Investigators Hold a Forum in Daxin County Government   Investigators Hold a Forum in Shuolong Township Government of Daxin County

Investigators Hold a Forum in Tiandeng Government   Investigators Hold a Forum in Village Committee of Xuanjie Village in Fuxin Town of Fuxin Township

14.1.2 Public Participation during Social Evaluation and Resettlement Planning

From March 18 to 27, 2020, the task force on social assessment and resettlement action plan, together with the staff of the leading team for resettlement of Guangxi Chongzuo Border Connectivity Improvement Project, went to Daxin County and Tiandeng County, visited the planning and natural resources department, human resources and social security department, housing and construction department and other relevant government functional departments, and held forums with the leaders and relevant staff in charge of land acquisition compensation and resettlement of landless peasants; went to Liliang Village and Xuanjie Village in Fuxin Town, Detian Village, Aijiang Village, Shuolong Community, Yining Village and Yixian Village in Shuolong Town, as well as Aijiang Forest Farm in Daxin County affected by land acquisition and demolition of the Project, and held extensive investigation and negotiation on the understanding of the villagers and forest farm workers about the project, their attitudes, compensation wishes and opinions and suggestions.

Feedback from survey on public participation is as follows:

(1) The local government and relevant competent authority of industries of the local development and reforming authority, construction, land, planning, transportation, tourism, water conservancy, environmental protection, and forestry all agreed with the construction of the project, expressed the desire to start construction as soon as possible, and strongly supported the implementation of the project.

(2) Most of the surveyed public thought that the route of the project was basically reasonable. The construction of the project would be conducive to improving the local traffic conditions and most of the surveyed public desire that the construction of the project could promote the local economic development.

(3) They believed that the local environmental adverse effects of noise, tail gas and dust generated in the construction of the project were temporary and acceptable, but meanwhile they hoped that the construction party of the project would take

corresponding measures to reduce the impact to a minimum, especially dust and noise control measures.

(4) Most of the public held that they would agree to land acquisition/relocation if the project was required. A small number of the public held indifferent attitudes because of the little possibility of land acquisition/relocation. Some of the public did not agree to land requisition/relocation for fear of losing their main source of livelihood after the land was requisitioned, and they also expressed their willingness to land acquisition/relocation if the compensation problem could be properly solved.

(5) There were still some of the public who had a smattering knowledge of the policy of land acquisition/relocation. They only knew that the state has formulated relevant policies, but they did not know the specific contents of the policies. For the compensation requirements for land acquisition/relocation, most of the public hoped to get economic compensation. Villagers along the proposed highway, especially those who may be subject to land acquisition or relocation, held that the general requirement of compensation was to meet the needs of future life and ensure long-term life.

According to the questionnaire survey, more than 60% of the villagers knew about the project one month ago, 84.6% of the villagers supported the construction of the project, 1.9% of the villagers did not support the construction of the project because they did not know about the project, and 98.1% of the villagers agreed to occupy part of their land under the condition that the compensation standard was legal and the compensation fee could be paid in time. Nearly 70% of the villagers knew more about the local policies and standards for compensation for permanent and temporary land expropriation, and 57.7% of the villagers knew the complaint ways and means. The working group explained the construction scope and impacts of the Project, compensation rates for land acquisition and land occupation, construction method and schedule, and appeal mechanism, etc. to the villagers who attended the forum and accepted the questionnaire survey. By the end of the investigation, all villagers were fully aware of the Project and fully supported the Project. They said that as long as they could receive compensation in full and on time after their land was acquired or occupied, they would agree to the occupation of their land for the Project.

Figure 14-1 Forums between the Social Evaluation and Resettlement Work Force and Relevant Authorities and Village Committees1

14.1.3 Public Participation in the Environmental Impact Assessment Stage

14.1.3.1 First disclosure:

According to the *Measures for Public Participation in Environmental Impact*

Assessment and the *Technical Guideline for Environmental Impact Assessment of Construction Project - General Programme* (HJ2.1-2016), the disclosure of project environment information and survey on public participation are conducted by means such as on-line disclosure, bulletins on the construction site and newspaper. The first disclosure was conducted by the Employer on the website of the Department of Transport of the Guangxi Zhuang Autonomous Region in September 2019, to disclose the following information:

(I) The name of the construction project, site and route selection, construction content and other basic information, as well as the existing project and its environmental protection for renovation, expansion and relocation projects;

(II) The name and contact information of the Employer;

(III) Name of preparation organization of environmental impact statement;

(IV) Internet links to public opinion forms;

(V) Ways and means of submission of public opinion forms.

Figure 14.1-2 Screenshort of the First Disclosure of Environmental Impact Assessment

During the first disclosure period, one feedback was received from the villagers of Xuanjie Village, who believed that the construction of the project occupied land resources, the noise of road operation affected the lives of local residents and the drinking water sources of residents. After verification of the *Plan for Designation of Legislation of Drinking Water Protection in Tiandeng County*, *Plan for Delineation of*

Centralized Legislation of Drinking Water Protection in Villages and Towns in Tiandeng County and *Plan for Delineation of Centralized Legislation of Drinking Water Protection in Villages in Tiandeng County*, there is no approved legislation of drinking water protection in Xuanjie Village, and the village is in a decentralized drinking water source area. This evaluation suggests that if there is occupation or influence during construction, the Employer will be responsible for the migration of drinking water sources to ensure the safety of domestic water for the surrounding residents. In this project, two tunnels (Nongwan Tunnel and Buli Tunnel) are designed in the northeast of Xuanjie Village, crossing the mountain 580m in total and covering an area of only 0.0154 hm2. Small quantities of construction have limited influence on the flow direction and flow rate of groundwater in the region. In view of the complicated underground rivers in the project area, this evaluation suggests that before construction, hydrogeological investigation should be further carried out to find out the distribution, type, water content, recharge method and runoff direction of groundwater in the area where the tunnel is located, analyze and demonstrate the possible location and degree of groundwater gushing due to tunnel excavation, formulate detailed prevention and control plans for water leakage and gushing, and select environmentally friendly water plugging materials for plugging. According to the noise prediction, the maximum increase of noise level of sensitive points in the evaluation range before and after the project construction is 21.5dB(A). By the middle of the project operation, 9 of the 11 sensitive points can meet the standard of day and night, and the night noise prediction values of the remaining 2 sensitive points (Buguo and Bangtun) exceed the standard to varying degrees, with the exceeding range of 4.9~5.2 decibels. For sensitive points where the prediction of sound environment exceeds the standard, noise reduction shall be carried out by installing sound barriers and sound insulation strips on the road side. During the operation period of the project, noise has little impact on residents along the line. The construction of the project occupies a certain amount of local land resources. The route of the project is designed to conform to the requirements of topography and geomorphology as much as possible, reduce high fill and deep excavation, save land, avoid large demolition as much as possible, make full use of wasteland and poor land, and occupy less arable land, especially the land in the basic farmland protection area. Meanwhile, the Employer should assist the local government to strengthen communication with the masses in the Xuanjie Village of Tiandeng, do the ideological work of the masses well, and carry out land acquisition and demolition work after obtaining the consent of the masses.

14.1.3.2 Second disclosure

The second publicity was conducted on February 26, 2020 after the draft for comments was completed, including on-line disclosure, bulletins on the construction site and disclosure through local mainstream medium, Guangxi Daily. The information was published twice through the newspaper within 10 working days. No public feedback was received during the two public announcements.

14.1.3.2.1 Online Disclosure

The second disclosure was conducted on the official website of Chongzuo Municipal People's Government on February 26, 2020 and ended on March 10, 2020. No feedback was received from the public in the disclosure period. The details of the disclosure are as follows:

Aen Monzhoh Vangjcan Gvangjsih Cungzcoj Si Yinzminz Cwngfuj

广西崇左市人民政府门户网站

www.chongzuo.gov.cn

请输入搜索内容

首页 走进崇左 信息公开 网上办事 互动交流 数据发布

当前位置：首页 > 信息公开 > 基础信息公开 > 部门文件

梧州（龙眼咀）至硕龙高速公路（崇靖高速至硕龙口岸段）二次公示

2020-02-26 08:37 来源：崇左市交通局 【字体：大 中 小】 打印

目前，梧州（龙眼咀）至硕龙高速公路（崇靖高速至硕龙口岸段）一期工程环境影响报告书（征求意见稿）》已初步完成。根据《环境影响评价公众参与办法》（生态环境部令第4号，2019年1月1日起施行）的要求，现公开以下信息：

一、环境影响报告书征求意见稿的网络链接

见附件1

二、查阅纸质报告书的方式和途径

请联系环评编制单位

三、征求意见的公众范围

高速公路沿线群众及有关单位

Figure 14.1-3Screenshort of the Second Online Disclosure

14.1.3.2.2 Disclosure in Local Mainstream Media

The project was publicized in a local mainstream media, Guangxi Daily on February 28, 2020 and March 5, 2020 from February 28, 2020 to March 12. 2020. No public feedback was received during the disclosure period. The public picture in the newspaper is shown below:

广西日报

2020年2月28日 星期五

要闻 3

广西发布疫情防控三级应急响应工作指导意见

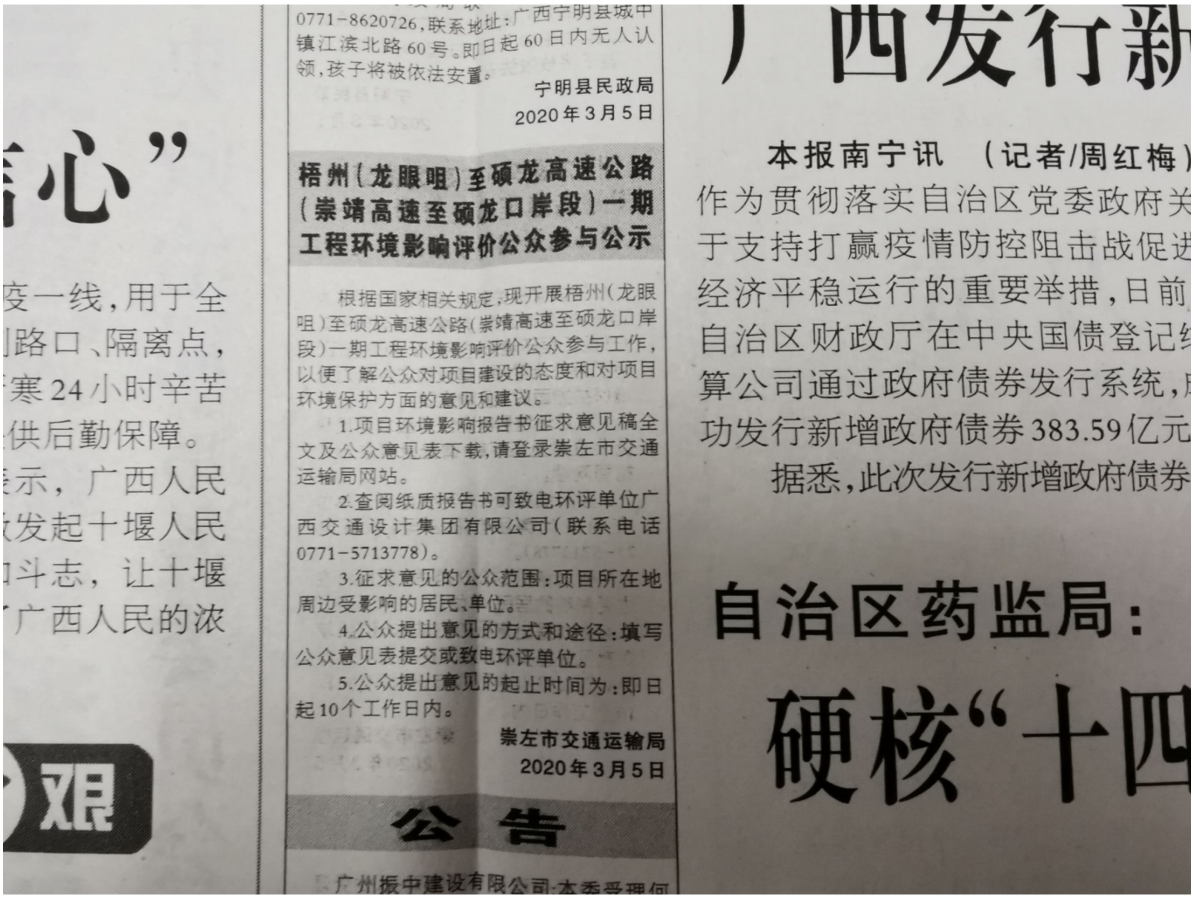
一、疫情防控总体要求

二、严格实施疫情分区分级精准防控

三、完善社区疫情防控措施

六、完善公共服务场所疫情防控措施

九、加强应急响应后管


0771-8620726，联系地址：广西宁明县城中镇江滨北路60号。即日起60日内无人认领，孩子将被依法安置。

宁明县民政局

2020年3月5日

梧州（龙眼咀）至硕龙高速公路（崇靖高速至硕龙口岸段）一期工程环境影响评价公众参与公示

根据国家相关规定，现开展梧州（龙眼咀）至硕龙高速公路（崇靖高速至硕龙口岸段）一期工程环境影响评价公众参与工作，以便了解公众对项目建设的态度和对项目环境保护方面的意见和建议。

1.项目环境影响报告书征求意见稿全文及公众意见表下载，请登录崇左市交通运输局网站。

2.查阅纸质报告书可致电环评单位广西交通设计集团有限公司（联系电话0771-5713778）。

3.征求意见的公众范围：项目所在地周边受影响的居民、单位。

4.公众提出意见的方式和途径：填写公众意见表提交或致电环评单位。

5.公众提出意见的起止时间为：即日起10个工作日内。

崇左市交通运输局

2020年3月5日

公　告


广西日报

要闻 3

曾万明在自治区发展壮大村级集体经济工作领导小组会议上强调

抓住关键点　找准突破口　确保发展壮大村级集体经济三年行动圆满收官

支持战"疫"促稳增长

广西发行新增政府债券383.59亿元

自治区药监局：

硬核"十四条"支持企业复产转产扩产

一句话新闻

我区义务教育均衡发展今年整体接受"国检"

防城港4个重大项目集中开工

Figure 14.1-4 Second Disclosure in Guangxi Daily (March 5, 2020)

14.1.3.2.3 Post Disclosure on Site

The project overview was posted on the bulletin boards of the administrative villages with sensitive places along the project from February 26, 2020 to March 10,

2020. No public feedback was received during the period.

14.2 Appeal Mechanism

As required by AIIB's *Environmental and Social Framework*, an appropriate appeal mechanism shall be established in accordance with the ESP and ESS to learn the APs' environmental and social concerns and grievances on the compensation for land requisition and resettlement. to ensure that they (subject to negative impacts) can protect their rights and interests through this mechanism.

The project establishes an open appeal channel to receive and respond to stakeholders' concerns, complaints and appeals. The contact information and mailing address of the organizations and personnel receiving appeals from the affected population will be displayed on the bulletin board near the construction site, town government, village committee and village government.

14.3 Scope of Appeals

The scope of appeals includes, but is not limited to, the following:

(1) Issues related to LA compensation and resettlement, including the measurement of affected land and houses, calculation of compensation fees, payment of compensation fees, and resettlement for production and living of resettled people, etc.;

(2) Issues related to the safety of people's lives and property related to construction, including any personal injury caused by inadequate construction protection; Property losses of related people or entities caused by construction activities, including damage degree judgment, loss quantity measurement, and compensation calculation, etc.;

(3) Prevention and control of environmental pollution related to construction, including noise pollution caused by vehicle traffic, and machinery, etc.; Air pollution caused by construction activities; Water pollution caused by treatment of various wastes;

(4) Damages to cultural resources out of the project area

14.4 Appeal Modes

The channels of appeal are as follows:

(1) Letter or e-mail;

(2) Appeal by telephone. All telephone complaints should be recorded and submitted to the grievance redress team;

(3) Oral, where all oral appeals shall be submitted to the grievance redress team in writing;

The above appeal modes have been disclosed in the affected area, and mass media utilized to strengthen publicity and reportage to make the stakeholder groups full aware of their appeal right.

14.5 Appeal Channels

In order to solve the specific problems in the process of project construction in a timely and effective manner and protect the legitimate rights and interests of resettled people and related interest groups, this project has established a public complaint channel, including village committees, forest farm resettlement team, township government, land requisition and demolition sub-headquarters of the project, county natural resources bureau, housing and urban-rural construction bureau, county human resources and social security bureau, ecological environment bureau, compliant handling bureau, project resettlement leading group, project implementation office of Guangxi Chongzuo Border Connectivity Improvement Project, court, etc.

The general appeal procedure is as follows:

(1) Where a resettled people or other stakeholder groups are not satisfied with the compensation and resettlement scheme for land acquisition and demolition, and the safety and environmental problems caused by construction, they may file oral or written appeals to the local villagers' committee and the resettlement team of the forest farm. For an oral appeal, the villagers' committee and the resettlement team of the forest farm shall keep a written record. The villagers' Committee and the resettlement team of the forest farm shall deal with the appeals within 2 weeks;

(2) Where the resettled people or the stakeholder groups are not satisfied with the dealing results of villagers' committees or the resettlement team of the forest farm, they can file the appeal to the local town government office orally, by telephone or in

writing after receiving the results. For an oral appeal or appeal by telephone, the town government office shall keep a written record. The town government office shall, within 2 weeks, obtain the original complaint records from the villagers' committee and the forest farm resettlement team, deal with the complaints, and give a written decision to the complainants;

(3) If immigrants or related interest groups are not satisfied with the treatment results of the town government, they can submit written complaint to the corresponding project land acquisition and demolition sub-headquarters after receiving the decision. The project land acquisition and demolition sub-headquarters should obtain the original complaint records from the town government within 2 weeks, deal with the complaint matters, and issue a written treatment decision to the complainant;

(4) If immigrants or related interest groups are not satisfied with the processing results of the project land acquisition and demolition sub-headquarters, they can submit written complaints to the local county natural resources bureau, Housing and Urban-Rural Development Bureau, Human Resources and Social Security Bureau, Ecological Environment Bureau or Complaint Handling Bureau after receiving the decision. The county Natural Resources Bureau, Housing and Urban-Rural Development Bureau, Human Resources and Social Security Bureau and Ecological Environment Bureau should retrieve the original complaint records from the Project Land Acquisition and Demolition Sub-headquarters within 2 weeks and make a decision on the complaint matters; The Complaint Handling Bureau shall reply within 1 week, or transfer it to the Natural Resources Bureau, Housing and Urban-Rural Development Bureau, Human Resources and Social Security Bureau, and Ecological Environment Bureau for specific treatment. The department receiving the written grievance shall issue a written decision to the filing person;

(5) If the resettled person or stakeholder groups are dissatisfied with the handling results of the relevant functional departments of the county government, they can bring a lawsuit to the civil court according to the Civil Procedure Law after receiving the decision.

The resettled people or stakeholder group can also directly appeal directly to any level of the appeal channels, or directly to the project resettlement leading group or the AIIB which will deal with the complaints (https://www.aiib.org/en/policies-strategies/operational-policies/policy-on-the-project-affected-mechanism.html).

All oral or written appeals will be reported to AIIB in internal and external resettlement monitoring reports.

For the appeal channel and the procedure structure of the Project, see Figure 14.2-1.

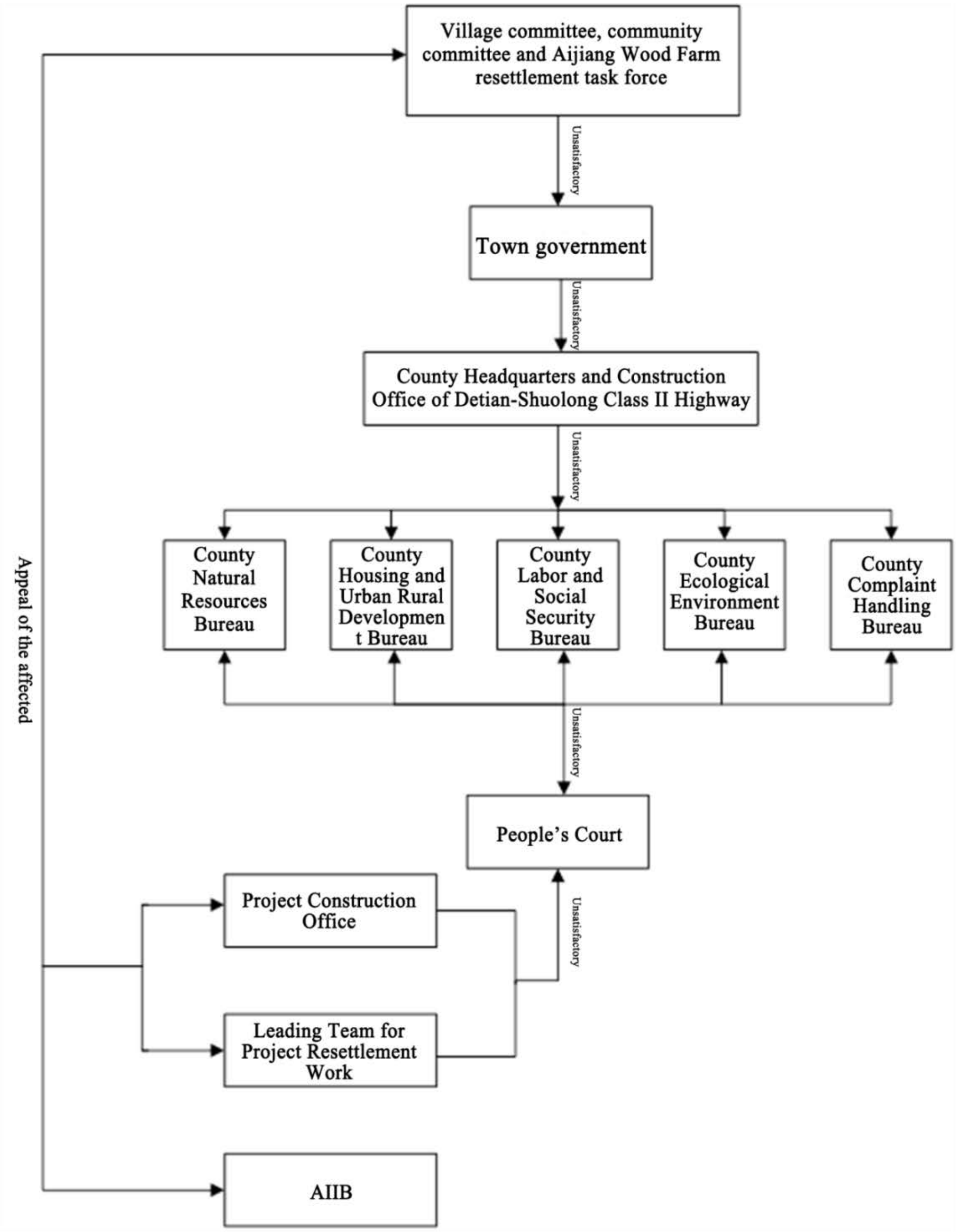


Figure 14.2-1 Appeal Channel and Procedure Structure

15 Poverty Impact Analysis

15.1 China’s Poverty Standard and Poverty Alleviation Standard

In 1986, China formulated the national standard for poverty alleviation for the first time, with an annual per capita net income of farmers of RMB 206, up to RMB 625 in 2000 and RMB 1,274 in 2010. The poverty standard was raised to RMB 2300 in 2011. The current poverty line is based on the constant price of RMB 2,300 in 2011, up to RMB 2,855 in 2015, RMB 3,535 in 2018, RMB 3,747 in 2019 and RMB 4,000 in 2020.

The poverty stricken population is shaken off poverty by households by measuring whether the household’s annual per capita net income (including income from manual labor, productive income, property income, and transfer income) stably exceeds the national poverty-alleviation standard or not, and whether their food and clothing, compulsory education, basic medical care and housing security could be guaranteed. The withdrawal of poverty-stricken villages is based on the poverty incidence as the main measure, and the comprehensive factors such as the village infrastructure, basic public services, industrial development, and collective economic income shall be taken into account. Poverty-stricken counties include key counties in the national poverty alleviation and development work and counties in concentrated contiguous poverty-stricken areas, with the poverty incidence as the main measure. In principle, if the poverty incidence in poverty-stricken counties falls below 2% (3% in the western region), the county-level poverty alleviation and development leading group will propose the withdrawal of the poverty-stricken county, which will be submitted to the municipal poverty alleviation and development leading group for preliminary examination and the provincial poverty alleviation and development leading group for verification, and the withdrawal list will be announced to the public for comments. If there is no objection to the publicity, the list shall be reported to the poverty alleviation and development leading group of the State Council after being approved by the poverty alleviation and development leading group of the provinces (autonomous regions and municipalities directly under the central government). The leading group for poverty alleviation and development under the State Council will organize relevant departments and relevant forces for special assessment and inspection of local withdrawal. For those who do not meet the conditions or do not fully perform the withdrawal procedures, the relevant authority shall be instructed to carry out verification and treatment. For poverty-stricken counties that meet the withdrawal conditions, the provincial government will formally approve the withdrawal.

15.2 Poverty in Daxin County and Tiandeng County in Chongzuo City, Guangxi

Guangxi is one of the major battlefields in China’s poverty alleviation campaign. From 2016 to 2019, a total of 4.5 million registered poverty stricken population were lifted out of poverty, 4,719 poverty-stricken villages and 25 poverty-stricken counties had been got rid of poverty. The incidence of rural poverty dropped from 10.5% at the end of 2015 to 0.6% at the end of 2019. The whole region of Guangxi has been lifted out of poverty on November 20, 2020.

Guangxi was one of the provincial administrative regions with the largest number of poverty-stricken counties in China, including 28 national poverty-stricken counties, 21 autonomous district-level poverty-stricken counties. Chongzuo was a region with the most poverty-stricken counties in Guangxi, including 2 national poverty-stricken counties and 5 autonomous district-level poverty-stricken counties. Chongzuo had 341,800 rural poor in 2016, with an incidence of 18.16%. In recent years, Chongzuo City has been making painstaking efforts in the poverty alleviation campaign and has achieved remarkable results in its poverty alleviation work. Chongzuo has vigorously promoted the “Four Main Campaigns” - compulsory education, basic medical care, housing safety and drinking water safety, and fought the battle on “five fronts” - poverty alleviation through the development of industries, village collective economic development, poverty alleviation relocation and infrastructure construction, so as to lead the whole city to shake off poverty and improve quality and efficiency. Infrastructure like water, electricity, roads, and communications in poverty-stricken areas have changed greatly. Basic public services such as education and medical care have improved significantly. The production and living conditions of poverty stricken population have been continuously improved. Chongzuo’s rural poor population decreased to 10,900 by the end of 2019, and the actual number of poverty reduction was 336,600. The incidence of poverty decreased from 18.16% in 2016 to 0.54% by the end of 2019. The number of poverty-stricken villages decreased from 303 in 2016 to 25 at the end of 2019. The poverty headcount ratio in the region at the end of the year 2019 was 1.2%, 2.1 percent lower than that at the end of the previous year. In the whole year, the per capita disposable income of rural residents in poverty-stricken areas (33 national-level poverty-stricken counties) was RMB 11,958, an increase of 11.1% (6.7% after adjusting for inflation) over the previous year.

Daxin County is a county in Yunnan-Guangxi-Guizhou rocky desertification area, and was a key county for poverty alleviation and development in the autonomous region. At the end of 2015, a new round of precise identification campaign was embarked, identifying 54 poverty-stricken villages in the county, 16,742 poverty-stricken households and 64,480 poverty-stricken population during the 13th Five-Year Plan, with a poverty incidence rate of 21.18%. After several years of poverty alleviation and development, a total of 14,512 households and 57,891 population in Daxin County had been get rid of poverty from 2016 to 2018, with the incidence of poverty reduced to 2.43%. On April 24, 2019, the people’s government of the autonomous region approved the removal of poverty in Daxin County.

Tiandeng County wass a key county in the national poverty alleviation and development work. During the 13th Five-Year Plan period, Tiandeng had 54 poverty-stricken villages, 21907 poverty-stricken households, with a total poverty-stricken population of 91073 and a poverty incidence rate of 21.24%. After several years of poverty alleviation, the poverty incidence rate dropped to 1.51% by the end of 2019. The indicators of "Guarantee of Food and Clothing, Access to Housing, Education and Medical Treatment" all met the criteria of poverty alleviation. In May 2020, Tiandeng County withdrew from the poverty county.

15.3 Poverty in the Project Area and the Affected Villages

Fuxin Township of Tiandeng County and Shuolong Township of Daxin County in the construction area of the project had relatively high incidence of poverty. According to the materials provided by the township government, the poverty-stricken population in Shuolong Township in 2019 was 4,306, totaling 1,155 households, accounting for 31.66% of the total population in the town. There are 11,113 poverty stricken population from 2.711 households in Fuxin Township, accounting for 33.60% of the total population of the town. Generally speaking, the numbers of poverty stricken population in both towns are higher than the average level of the whole county. The poverty stricken population in both towns accounts for more than one third of the total population of the town.

In recent years, Fuxin Township has actively exploited the local advantageous resources, developed characteristic breeding and planting industries, made full efforts in poverty alleviation, vigorously developed agricultural poverty alleviation industries, consolidated the industrial foundation, and walked out of a characteristic road of promotion of income increase thorough industrial development, thus laying a solid foundation for winning the battle against poverty.

Relying on the township's location advantage, the development model of "base + cooperative + company" is applied, and the village committee establishes the cooperative and find sales channels through rural e-commerce platform for unified sales. The poverty alleviation plans by developing industries have been prepared for ten villages, and has effectively promoted the poverty alleviation of poverty-stricken villages and households in the whole town.

Table 15.3-1 Basic Survey of Households and Population of Fuxin Township and Shuolong Township in Project Area in 2019

Item	Unit	Quantity	
		Shuolong Town, Daxin County	Fuxin Town, Tiandeng County
Total number of households and total population	households / persons	3310/13601	8384/33074
Households and population of the Zhuang nationality	households / persons	3310/13601	8384/32838
Households and population of other nationalities	households / persons		0 household/236
Rural Population	10,000 persons	1.1967	3.2082
Non-rural Population	10,000 persons	0.1634	0.0992
Female population	10,000 persons	0.63	1.6282
Households and population enjoying the "Five Guarantees"	households / persons	58/60	138/140
Households and population receiving subsistence allowances	households / persons	258/723	770/2476
Poor households and population	households / persons	1155/4306	2711/11113

15.4 Poverty in the Affected Villages

In the “List of Poverty-stricken Villages in Guangxi 13th Five-Year Plan”, among the 7 villages (communities) affected by permanent land acquisition and house demolition in Liliang Village and Xuanjie Village of Fuxin Township of Tiandeng County, and Yining Village, Yixian Village, Shuolong Community, Detian Village and Aijiang Village of Shuolong Township in Daxin County, Yining Village Shuolong Township and Yiliang Village and Xuanjie Village of Fuxin Township are poverty-stricken villages, of which Liliang Village and Yining Village are extreme poverty-stricken villages. The seven villages have a total population of 10,539, including 3,546 poverty stricken population, accounting for 33.65% of the total population. The most impoverished population is centralized in Yining Village of Shuolong Township, with 89.68% poverty stricken population in the whole village, followed by Aijiang Village, with 41.76% of the poverty stricken population. The poverty-stricken population in Liliang Village accounted for 39.88% in the whole village. The poverty-stricken population ratio in other villages is relatively smaller, while it is also above 10%. In Shuolong Community, which has the least poverty-stricken population, all kinds of poverty-stricken population have reached 13.59% of the whole community population, followed by 19.64% in Yixian Village, 23.49% in Detian Village and 29.75% in Xuanjie Village.

In addition, each village has some households enjoying “five guarantees” and minimum living guarantees. Among them, Yining Village has the most households enjoying the minimum living guarantees, accounting for 14.55% of the whole village population, followed by 10.77% in Liliang Village and the lowest 2.8% in Shuolong Community. See Table 15.4-1 for details.

Table 15.4-1 Basic Survey of Families and Population (Household Registration) of the Affected Villages (Communities) in Project Area in 2019

Item		Unit	Quantity						
			Fuxin Town, Tiandeng County		Shuolong Town, Daxin County				
			Liliang Village	Xuanjie Village	Yining Village	Yixian Village	Detian Village	Aijiang Village	Shuolong Community
Households and population (household registration)	Total households and population	households / persons	550/2302	331/1405	250/969	277/1151	151/596	403/1475	676/2641
	Where: male	Persons	1177	720	536	565	295	752	1254
	Female	Persons	1125	685	433	586	301	723	1387
	Where: Households and population of the Zhuang nationality	households / persons	550/2302	331/1405	250/969	277/1151	151/596	403/1475	676/2641
	Households and population of other nationalities	households / persons	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	Households and population enjoying the "Five Guarantees"	households / persons	11/11	8/8	11/11	6	2	5	14
	Households and population receiving subsistence	households / persons	77/248	26/80	42/141	14/43	9/21	42/113	32/74

	allowances								
	Poor households and population	households / persons	230/918	93/418	220/869	58/226	40/140	177/616	107/359

15.5 Situation of Vulnerable Groups in the Affected Population

According to statistics, the population affected by the permanent expropriation of agricultural land in the project is 844 households totaling 3635 people, including 78 people from 18 households and 4 people from 1 household affected by the demolition of ancillary facilities. According to statistics, the vulnerable groups identified by the government (including households enjoying the minimum subsistence allowance, households enjoying the five guarantees and poverty-stricken households registered in 2015, the same below) are 194 households with 760 people, accounting for 20.91% of the total population affected. Among them, there are 11 households enjoying the five guarantees with 48 people, accounting for 6.32% of the total population of vulnerable groups; there are 71 households enjoying the minimum subsistence allowance with 274 people, accounting for 36.05%; and there are 112 poverty-stricken households with 438 people, accounting for 57.63%. See Table 15.5-1 for the specific distribution of vulnerable groups in the population affected by permanent acquisition of farmland and demolition of houses.

Table 15.5-1 Table 15-3 Vulnerable Groups in the Population Affected

Scope of Works	County	Township/town	Village	Affected population									
				Total		Low-income population							
						Total		Household enjoying the five guarantees		Household enjoying the minimum subsistence allowance		Poverty-stricken household	
				Household (household)	Population (person)	Household (household)	Population (person)	Household (household)	Population (person)	Household (household)	Population (person)	Household (household)	Population (person)
Component A	Tiandeng County	Fuxin Town	Liliang	75	312	15	51			15	51		
			Xuanjie	197	890	37	154	7	33	30	121		
	Subtotal of Tiandeng County			272	1202	52	205	7	33	45	172		
	Daxin County	Shuolong Town	Yining	27	117	21	80	1	1	7	26	13	53
			Yixian	135	588	24	101			6	28	18	73
			Shuolong Community	78	311	22	84			3	9	19	75
	Subtotal of Daxin County			240	1016	67	265	1	1	16	63	50	201
Subtotal of Component A				512	2218	119	470	8	34	61	235	50	201
Comp	Daxi	Shuolon	Detian	34	187	2	7					2	7

onent B	n County	g Town	Village										
			Aijiang Village	144	570	59	228	2	10	9	34	48	184
			Shuolong Community	143	615	14	55	1	4	1	5	12	46
			Aijiang Forest Farm	11	45								
Subtotal of Component B				332	1417	75	290	3	14	10	39	62	237
Subtotal of Tiandeng County				272	1202	52	205	7	33	45	172		
Subtotal of Daxin County				572	2433	142	555	4	15	26	102	112	438
Total				**844**	**3635**	**194**	**760**	11	48	**71**	**274**	**112**	**438**

15.6 Poverty Causes of Poverty-Stricken Population in Project Area

The task force of social assessment investigated and analyzed the main causes of poverty among poverty-stricken families in the project area through questionnaires, forums and personal interviews. In general, the mode of livelihood of poverty-stricken households is relatively unitary, with migrant workers as the main source of income. Traditional agricultural production is also one of the sources of income, but it only accounts 6.06% in the total income. There is not a single cause of poverty in many poverty-stricken families, but a combination of many factors, such as serious illness, disability, old age, and heavy burden of education expenditure.

According to discussions and interviews, poverty-stricken households used to rely on traditional farming as their main source of livelihood. With the adjustment of agricultural production structure, the planting area of cash crops has become larger, and the planting area of grain crops has gradually decreased. At present, grain is mainly for home use and feed. For poverty-stricken households, traditional farming can only solve the problems of food and clothing instead of the source of economic income. On the one hand, the investment in the cultivation of cash crops is relatively high, and poverty-stricken households often need to borrow due to lack of capital. On the other hand, the unstable prices of cash crops in recent years will lead to unstable income of poor households. Some poverty-stricken households also raise pigs, cattle and poultry, but they are too little to be as the main source of income. In recent years, the labor force from poverty-stricken families, especially young people, has been out as migrant workers, and income from manual labor has become the main source of income for families. Some of the migrant workers choose to work temporarily or seasonally in the county or Guangxi district during slack season, while others work long-term in distant places, mainly in coastal cities of Guangdong. However, due to their generally low level of education and low comprehensive quality, they can only work in industries without special employment skills requirements like construction, transportation, cleaning, housekeeping and catering, and be paid a very low salary. Moreover, since the young people have gone out as migrant workers, only the elderly and children stay in the villages, arising the problem of "left-behind children" which cannot be ignored and greatly impacting the transmission of traditional Chinese filial piety.

The task force of social assessment has learned that all poverty-stricken families interviewed supported the construction of the project, believing that the construction of the project would provide numerous employment opportunities for the local area, help improve the living standards of the people along the line, and help poverty-stricken families to get jobs in the local area. The negative impact of the project on poverty-stricken population was mainly reflected in the occupation of land resources by road construction and the demolition of houses. Some poverty-stricken households hoped that the project Employer would provide more employment information to increase their income like providing some temporary jobs in the project. Some poverty-stricken families hoped their children could get technical training opportunities so that they could get formal jobs after the completion of the project.

15.7 Poverty Reduction Measures

For households enjoying the five guarantees, households enjoying the minimum subsistence allowance and poverty-stricken households, the government has adopted different support policies. Guangxi also provides a living subsidy to inhabitants 0-3 km from the land border at the standard of 210 yuan/person/month.

15.7.1 Household Enjoying the Five Guarantees

The household enjoying the five guarantees refer to the elderly, the disabled and the underage in rural areas who have no ability to work, no source of livelihood, or no legal obligors to provide for or support them, or have legal obligors to provide for or support them who however have no capability to do so. Households enjoying the five guarantees mainly receive food security (to supply grain and oil, non-staple food and domestic fuel), clothing security (to supply daily necessities such as clothing and bedding and pocket money), medical security (to provide disease treatment and care for those who cannot take care of themselves), housing security (to provide housing that meets basic living conditions), funeral security (to properly handle funeral affairs) or education security (to guarantee the expenses that orphans under or over 16 years of age and still receiving compulsory education need to receive compulsory education according to the law). On January 11, 2006, the State Council adopted the Regulations on Rural Five-Guarantees Subsistence Work in order to ensure the normal livelihood of rural recipients of the Five-Guarantees Subsistence Scheme and to promote the development of the rural social security system. The funds for supporting the rural households enjoying the five guarantees shall be arranged in the financial budget of the local people's government. The standard of support for the five guarantees in rural areas is not lower than the average standard of living of local villagers. The family of Liang Gaoquan, a household enjoying the five guarantees in Aijiang Village, Shuolong Town, Daxin County, for example, enjoys a support fund of 595 yuan/month, totaling 7,140 yuan a year. There is also a living subsidy of 210 yuan/month for border people living within 0-3 km of the border, totaling 9,660 yuan a year.

15.7.2 Households Enjoying the Minimum Subsistence Allowance

On September 1, 2009, Guangxi issued the Measures on Minimum Subsistence Allowance for Rural Residents of the Guangxi Zhuang Autonomous Region, establishing a minimum social security system for rural areas. The security object is the rural residents whose annual per capita net income is lower than the minimum subsistence allowance standard of local rural residents. Households enjoying the minimum subsistence allowance are mainly those who lack sufficient working ability due to illness, disability, old age and infirmity, and cannot maintain a normal life on their own and need subsidies from civil affairs departments. The minimum subsistence allowance standard for rural residents shall be determined by the Municipal People's Government in accordance with the expenses of eating, dressing, water and electricity necessary to maintain the basic life of rural residents throughout the year. The rural minimum living standard in Chongzuo City in 2020 is 5,100 yuan per person per year. The minimum subsistence allowance for rural residents is the responsibility of the Government, and is included in the fiscal budget. The civil affairs departments of county governments distribute the minimum subsistence allowance for rural residents monthly through banks. Civil affairs departments at the county level and township people's governments regularly or irregularly investigate and understand the living conditions of poor rural residents, and promptly bring all eligible poor rural residents into the scope of protection. Xu Hanzhong, for example, is from a household enjoying the minimum subsistence allowance in Shuolong Community, Daxin County. The government subsidies enjoyed by his family include the minimum subsistence allowance of 265 yuan/person/month (the difference between the per capita net income of the family and the standard of minimum living guarantee), the living subsidy for border people of 210 yuan/month, the medical insurance for rural residents of 250 yuan/person/year, the endowment insurance (aged 16-60) of 100 yuan/person/year, and awards in place of industrial subsidies of 4,300 yuan. There are two persons in his whole family, which received 11,360 yuan of all kinds of government support funds, with an average of 5,680 yuan/person.

15.7.3 Poverty-stricken Households

In 2015, the Chinese government decided to comprehensively solve the problem of rural poverty in China within five years. The poverty-stricken households affected by this project were all identified in 2015. **Poverty-stricken households are mainly due to heavy family burden or insufficient labor skills. They have a low income level and an annual per capita disposable income lower than the national poverty alleviation standard of that year, they have not achieved the "two assurances and three guarantees" (no lack of food and clothing; guaranteed compulsory education, basic medical care and housing safety), and at the same time, they have no urban houses in cities, no enjoy-type cars, and no large deposits.** Rural households whose annual per capita disposable income exceeds the national poverty alleviation standard can be recognized as poverty-stricken households if they meet one of the following conditions and are approved by democratic appraisal: first, with children who drop out of school due to poverty at the compulsory education stage; second, with family members suffering from major diseases or long-term chronic diseases, leading to large rigid expenditures that directly affect normal production and living; third, without housing or with only dangerous residence buildings and no other safe housing. With regard to poverty-stricken households that have built up a documentary card, governments at all levels will send cadres from organs and State-owned enterprises and institutions to participate in village-based assistance and, depending on their different circumstances, take a variety of precise measures to help them until they get out of poverty. Generally speaking, there are measures to alleviate poverty for the people's livelihood (including such assistance measures as the five guarantees of support, the guarantee of the minimum subsistence guarantee, assistance for the destitute, and temporary assistance), health care and medical care, education assistance and poverty (assistance for pre-school childcare, living subsidies for compulsory education, high school subsidies, vocational education scholarship subsidies, and university education support), and disability assistance and poverty (all disabled persons who are incapable of working and who meet the conditions are covered by the minimum subsistence allowance): Enjoying minimum subsistence allowance; for persons with disabilities who have part of the labour force, strengthening vocational skills training and providing start-up capital support are adopted in accordance with the actual situation), increasing industrial income to alleviate poverty (mainly through policy support, credit support, material support, skills training, land transfer, industrial guidance and other supportive measures) and relocating to alleviate poverty (mainly targeting remote mountainous areas and people living in adobe houses, earthen caves and dilapidated houses) The Government has also taken measures to promote employment (such as relocating the poor, supporting industries and promoting employment). The poverty-stricken households in the project area will basically get rid of poverty by the end of 2020, but the support policies they enjoy will continue to be effective for 2-3 years until the poverty-stricken households get rid of poverty stably. The family of Huang Shiwu, a poverty-stricken household with seven people in Yixian Village, Shuolong Community, Daxin County, for example, enjoys the following support according to the poverty alleviation policy in 2020: poverty alleviation microcredit discount of 50,000 yuan; poverty alleviation microcredit entrusted business dividends of 4,000 yuan/year; industrial poverty alleviation awards of 1,965 yuan; arable land power subsidies of 794 yuan; border people's living subsidies of 1,470 yuan/person (7 persons in total, 210 yuan/person); compulsory education students' living and nutrition subsidies 1,800 yuan for elementary school (1 person in total, 1,800 yuan/person/year); 131 yuan for pension (1 person in total, 131 yuan/person/month over 65); 400 yuan for pension contribution assistance (4 persons in total, 100 yuan/person/year); 1,750 yuan for individual health insurance contribution assistance (7 persons in total, 250 yuan/person/year). The family of Nong Lishan, a poverty-stricken household with five members, enjoys the following eight poverty alleviation policies: the 2020 industrial poverty alleviation award of 1,560 yuan; arable land power subsidy of 297 yuan; a pension of 131 yuan (1 person in total, 131 yuan/person/month); frontier subsidy of 1,050 yuan (5 persons in total, 210 yuan/person/month); compulsory education students' life and nutrition subsidy primary school of 1,800 yuan (1 person in total, 1,800 yuan/person/school year); 200 yuan for pension insurance contribution subsidy (2 persons in total, 100 yuan/person/year); 1,250 yuan for medical insurance individual contribution subsidy (5 persons in total, 250 yuan/person/year); 252 yuan/year of dividend income from pigeon breeding (a kind of poverty alleviation industry).

Governments at all levels, civil administration department and Disabled Persons' Federation also regularly or irregularly distribute temporary relief funds and materials to poverty-stricken families to ensure their basic livelihood.

The questionnaire survey on 160 affected households of the Project shows that the per capita disposable income of the 160 households is 13,250.01 yuan, the annual per capita income of households enjoying the minimum subsistence allowance is 7,439.86 yuan, and the annual per capita income of poverty-stricken households is 10,017.10 yuan. The low-income standard issued by the Chongzuo Municipal Government for rural households in 2019 is 6,000 yuan per capita per year. It indicates that the annual per capita income of poverty-stricken households has been well above the low-income line after several years of government support. In order to ensure poverty-stricken households get rid of poverty stably, the government's support policy will last for another 2-3 years. If some households still have difficulties in living after the support policy is stopped and meet the standard of minimum living guarantee, these households will enjoy the minimum subsistence allowance and receive a living subsidy monthly from the government.

16 Gender

Women are the main beneficiaries of the Project, so their opinions are indispensable for the smooth implementation of the Project and the maximization of social benefits. Women's participation rights should be guaranteed to promote equal opportunities for men and women to benefit from the Project.

16.1 General Conditions of Women Population of the Project Area

At the end of 2018, Daxin County had a total population of 385013 (according to the data of the public security bureau), of which the male population was 199153, accounting for 51.7% of the total population, and the female population was 185860, accounting for 48.3% of the total population. Shuolong County had a total population of 10,540, of which the male population was 5,448, accounting for 51.7% of the total population, and the female population was 5,092, accounting for 48.3% of the total population.

Tiandeng County had 119,100 registered households with a total population of 458,700, of which the male population was 243,500, accounting for 53.1% of the total population, and the female population was 215,200, accounting for 46.9% of the total population. Fuxin County had a total population of 25,040, of which the male population was 12,793, accounting for 51.1% of the total population, and the female population was 12,247, accounting for 48.9% of the total population.

In the 246 households investigated, there are 1162 people of which 581 are male, accounting for 50.0% and 581 are female, accounting for 50.0%.

Table 16.1-1 Gender Population Profile in Project Area

Scope of the project area	Population (person)	Male (person)	Female (person)	Gender ratio (Female = 100)
Shuolong Town	10540	5448	5092	106.99
Fuxin Township	25040	12793	12247	104.46
246 households surveyed	1162	581	581	100.00

16.2 Current Development of Women in the Project Area

According to the investigation, the final evaluation of *Development Plan for Women in*

Chongzuo City (2011-2020) is under way in the project area. The women's federations of counties have not carried out special women development plans, but they cooperate with other business authorities every year to promote the development of women. The main activities include:

(1) Trainings in various production technologies are conducted for women, mainly in agricultural planting, aquaculture and handicraft processing;

(2) The Women’s Federation helps urban and rural women who meet the conditions for small secured loans to apply for small secured loans;

(3) The Women’s Federation conducts employment trainings and migrant work trainings jointly for women with the Human Resources and Social Security Bureau, the Agriculture Bureau, the Poverty Relief Office and other departments, including legal and rights protection knowledge, basic professional training, such as housekeeping and cleaning skills.

(4) Assist women in getting non-agricultural jobs, including the provision of information on going out for non-farming jobs, car rental to designated places and reimbursement of ticket fares for working outside. However, women’s migration also brings positive and negative impacts on themselves and their families. The positive impact is reflected in the fact that women’s migrant work not only enhances their economic independence and improves their status in the family and society, but also reduces the economic pressure of male labor force in the family, increases the family income and improves the family prospects and children’s educational conditions. The negative impact is reflected in the fact that their long-term absence and lack of care for the children left behind in their hometown have a greater impact on the healthy growth of children. Besides, long-term marital separation is not conducive to communication with their spouses, affecting goodwill as between spouses and family harmony. However, on the whole, the positive impact is greater than the negative impact. Therefore, migrant work is still a way for women’s development. According to research, women mainly work in factories, supermarkets, housekeeping companies and hotels with low skill requirements and are paid with a low salary.

16.3 Socio-economic Status of Women in Project Area

The Resettlement Action Plan Task Force pays special attention to the conditions of the women in the project area during the socio-economic survey. They try to fully understand women's education, employment and income, family status, social status, participation in public affairs, etc. in the process of the questionnaire survey and panel discussion.

In terms of educational level, according to the questionnaire survey of 246 households, the proportion of females at the primary school education level or below in the total female population is 33.1%, while that of males is 25.99%, which indicates that the proportion of females at a low educational level is significantly higher than that of males; the proportion of females at the junior high school and senior high school educational level in the total female population is 62.14%, while that of males is 69.79%, which indicates that the proportion of females at a middle educational level is significantly lower than that of males; the proportion of females at a junior college educational level or above in the total female population is 4.76%, while that of males is 4.22%, which indicates that the proportion of females at a high educational level is slightly higher than that of males. In general, the educational level of females is lower than that of males. See Table 16.3-1 for details.

Table 16.3-1 Comparison of Educational Levels of Females and Males

Degree of education	Male		Female		Total	
	Population (people)	Percentage (%)	Population (people)	Percentage (%)	Population (people)	Percentage (%)
Illiterate	8	1.87	43	9.45	51	5.78
Primary school	103	24.12	138	30.33	241	27.32
Junior high school	222	51.99	203	44.62	425	48.19
Senior high/technical secondary school	76	17.80	47	10.33	123	13.95
Junior College	14	3.28	16	3.52	30	3.40
Undergraduate or above	4	0.94	8	1.76	12	1.36
Total	**427**	**100**	**455**	**100**	**882**	**100.00**

In terms of employment, according to the results of the questionnaire survey, of 645 employed people, 51% are males and 49% are females, with males slightly higher than females. Of the 237 unemployed population, 41.35% are males and 58.65% are females, with females much higher than males. The results of this survey are consistent with the information learned by the task force at the forum, that is, in the division of labor in the local villagers' households, males perform more household economic functions, while females undertake more responsibilities of household work, taking care of the elderly and education of their children.

In terms of the employment distribution structure, 4.87% of males work in party and government public institutions, while the proportion of females is 3.82%, which is higher for females than for males; 13.07% of males are employees in enterprises, while the proportion of females is 8.86%, which is higher for males than for females; 2.74% of males are private business owners, while the proportion of females is 3.8%, which is higher for females than for males; 13.98% of males are self-employed, while the proportion of females is 11.71%, which is higher for males than for females; 44.38% of males are only engaged in agricultural production, while the proportion of females is 51.9%, which is higher for females than for males; 20.97% of males are casual laborers, while the proportion of females is 19.94%, which is higher for females than for males. It can be seen from the survey results that although there are some differences between females and males in the industrial and occupational distribution of employment, there is no significant difference between females and males in terms of the employment distribution breadth. See Table 16.3-2 for details.

Table 16.3-2 Comparison of Industrial and Occupational Distribution of Employment between Females and Males

Item		Population (people)				Subtotal	Percentage (%)
		Male	Percentage (%)	Female	Percentage (%)		
Employed population	Party and government organ workers	4	1.22	1	0.32	5	0.78
	Public institution workers	12	3.65	11	3.48	23	3.57
	Enterprise employee	43	13.07	28	8.86	71	11.01
	Private business owner	9	2.74	12	3.80	21	3.26
	Self-employer	46	13.98	37	11.71	83	12.87
	Farmer	146	44.38	164	51.90	310	48.06
	Casual laborer	69	20.97	63	19.94	132	20.47
	Total	**329**	**100**	**316**	**100.00**	**645**	**73.13**

Unemployed population	Retiree	7	7.14	5	3.60	12	5.06
	Housekeeper	20	20.41	56	40.29	76	32.07
	Waiting for school enrollment	1	1.02	0	0.00	1	0.42
	Unemployed	45	45.92	52	37.41	97	40.93
	Student	25	25.51	26	18.71	51	21.52
	Total	**98**	**100**	**139**	**100**	**237**	**26.87**
Total		**427**		**455**		**882**	**100**

In terms of income, it can be seen from the questionnaire survey results that of the average annual household income of RMB 57,685.39, males earn RMB 36,822.56, accounting for 63.83%; females earn RMB 20,862.82, accounting for 36.17%, with the economic income earned by females significantly lower than that of males. According to information, in local households, the majority of females who do not take up an occupation due to housework are females aged under 40, mainly because the children in the households are young or need to be picked up when going to school, and the females need to cook and tutor their children in homework. Therefore, the number of females who work is less than that of males, which results in significantly lower household wage income and operational income of females. Meanwhile, Also among the male and female population who go out to work, the income of males is generally higher than that of females because the type of work they are engaged in requires high physical strength. However, for the same type of work, the income of females and males is equivalent with no obvious difference. See Table 16.3-3 for details.

Table 16.3-3 Comparison of Household Income between Females and Males

Item		**Average annual income of male (yuan)**	**Average annual income of females (yuan)**	**Average annual household income (yuan)**	**Proportion in average household income (%)**	
					Male	**Female**
Household income	Net agricultural income	953.64	1361.64	2315.28	1.65	2.36
	Wage income	18808.98	11560.16	30369.15	32.61	20.04
	Operational	11555.69	5760.21	17315.90	20.03	9.99

	income					
	Property income	1927.58	237.69	2165.27	3.34	0.41
	Transfer income	1540.17	1116.55	2656.73	2.67	1.94
	Government subsidies	2036.50	826.57	2863.07	3.53	1.43
	Total	**36822.56**	**20862.82**	**57685.39**	**63.83**	**36.17**

16.4 Impacts on Women

Women are the main beneficiaries of the project. The positive impact of the project on women is mainly shown in:

(1) The project can provide certain direct and indirect employment opportunities for women.

The Project can provide 3,204,765 man-days of temporary employment during the construction period, generating an income of 324,482,500 yuan for the practitioners. According to the research, at least 1/3 of these job opportunities are suitable for women. It is estimated that 1,068,255 man-days of employment will be provided for local women, resulting in an income of 108,160,800 yuan. The Project can provide 110 stable jobs during the operation period, including about 40 suitable for women that can bring 36,000 yuan of income per year for each female employee.

Besides, the construction of the project can promote the development of transportation, tourism and business services, with a large number of jobs suitable for women. Therefore, the construction of the project will create a large number of jobs for women, improving the income level of women and the quality of family life.

(2) It can promote the improvement of women's cultural level and professional skills.

The construction of the project can improve the local transportation infrastructure, expand the opening up and communication with the outside, promote the flow of personnel, and help people broaden their thinking and horizon. According to the investigation, the education level of women in the project area is obviously lower than that of men. With the increase of women’s non-agricultural employment opportunities, women will be promoted to receive higher-level cultural education and professional technical training, thus improving their quality. The improvement of women’s quality is also conducive to children’s education and the improvement of family life quality.

(3) It can improve women’s ability to participate in public affairs.

Women’s participation in decision-making of public affairs is the most direct and fundamental manifestation of women’s social status. During the construction of the project, women can obtain various knowledge, fully understand relevant policies and regulations, and express their opinions through participating in various forums, accepting various interviews, and communicating with the government, enterprises and other departments. Such experiences will greatly enhance women’s awareness of participation in public affairs and help women improve their ability to participate in public affairs.

16.5 Women’s Attitudes to the Project and Their Needs

According to the investigation, women in the affected areas of the project have played an important role in family affairs and social life. Most of the women interviewed have already known about the construction of the project in their villages and have no objection to the construction of the project. All the women have talked about their own opinions and suggestions on the compensation and resettlement of land requisition for the project. The hope, in line with men, is that the compensation for land expropriation will be paid in time according to the standards set by the government, and the old-age pension will be more secure in the future. Young women hope to get some training opportunities to improve their labor skills and will be able to work in more stable and well-paid jobs near their village in the future. Middle-aged and elderly women hope that the project will provide some employment opportunities suitable for their age and physical condition. In general, they all hope that they can take care of their family and meanwhile have a suitable job, so as to raise the level of household income and better secure children’s education, family unexpected expenses and future old-age care.

16.6 Gender Action Plan

Women are equally entitled to all compensation payments, training programs and other assistances, and all resettlement sites and compensation received are common property of family couples. Names of both husband and wife should be filled in when they handle relevant certificates, to protect the property of relocated personnel. For the sake of assurance, the project implementation agency will make necessary explanations and publicity to the women in the community to ask them to pay close attention to resettlement in the resettlement phase.

In the project, a gender action plan should be implemented to enhance women's awareness and ability to participate in public affairs, increase their employment, improve their social status, and promote equal opportunities for men and women to benefit from the project. The gender action plan mainly includes:

(1) Public participation and consultation. It is mandatory to make sure that the women in the project area participate in the consultation, supervision, and assessment in each stage of the project preparation, implementation, and subsequent operation of the project, their opinion being consulted and respected. The project Employer shall strengthen contact and cooperation with the project district government office and Women's Federations at all levels, and disseminate information by radio and television, publicity boards, publicity brochures and other ways so as to protect women's right to know about matters related to project construction. For public participation such as forums on issues related to project construction, 40% of women's participation shall be ensured; women's opinions should be taken into account in decision-making and plan preparation.

(2) Increasing employment opportunities. In the preparation phase of the project, the project Employer should fully understand the employment needs and intentions of women, and try its best to create employment opportunities for women during the implementation and operation phases of the project. Some jobs suitable for women, such as toll collectors and cleaners, should be provided to women in priority. **It is suggested that 1/3 of the jobs created by the project be provided to women.**

(3) The project Employer should pay more attention to female-headed single-parent

households by providing them with employment opportunities, so as to improve their living conditions and enhance their self-confidence. For particularly difficult female-headed households, the government and the project Employer shall adopt appropriate assistance policies to ensure that these families benefit from the project as well as other families.

17 Overview of Ethnic Minorities in the Project Area

17.1 General Conditions of Ethnic Minorities Population in the Project Area

Guangxi is a multi-ethnic autonomous region with 12 long-dwelling peoples, including Han, Zhuang, Yao, Miao, Dong, Mulao, Maonan, Hui, Jing, Yi, Shui and Gelao. In the resident population, the minority population accounts for 38% of the total population, of which Zhuang is the most populous minority in Guangxi, accounting for 33% of the total population.

Chongzuo City is a multi-ethnic border city with Zhuang as the main population, inhabited by 28 ethnic groups such as Zhuang, Han, Yao, Miao and Dong. Among them, Zhuang, Han and Yao are long-dwelling peoples. It is the prefecture-level city with the highest proportion of minority population in Guangxi and the largest concentration of Zhuang population in China. In 2009, the total population of ethnic minorities of the city was 2,169,500, accounting for 89.66% of the city's total population, of which the total population of Zhuang was 2,159,700 million, accounting for 89.26% of the city's total population, the total population of Yao was 6,526, accounting for 0.27% of the city's total population, and other ethnic minorities accounted for 0.13%. Ethnic minorities with a population of more than 500 included Zhuang, Yao, Miao and Dong nationalities. The total population of Han nationality was 250,000, accounting for 10.34% of the city's total population. The Han population was mainly distributed in cities and towns, government organs, farms and some villages along the Zuo River, and Huan'an Village, Bahe Township, Tiandeng County, etc. Yao people mainly lived in remote areas, close to the mountain and distributed in 15 villages in 8 townships (towns) in 4 counties (districts), including Fusui, Tiandeng, Ningming and Jiangzhou.

The ethnic groups in Daxin County are mainly Zhuang, accounting for 96.89% of the total population of the county. In addition, there are Han, Miao, Yao, Dong, Hui, Yi, Jing, Shui, Tujia, Mulao and other ethnic groups, which are the descendants of officers and soldiers left over from past dynasties' wars and cadres dispatched south. Most of them live in towns, factory and mine areas, a few live in villages. And there are also a small number of Vietnamese who get married across national boundaries. The languages of the masses in Daxin County are mainly Zhuang and Chinese. Most of the residents of Shuolong Subdistrict settle down from other places to do business in the county, mainly speaking vernacular, and a few speak Zhuang or other dialects, but Mandarin (Beijing Standard Tone) has been popularized. Local people mainly eat rice and corn as staple food, supplemented by wheat, sweet potatoes and taro. The meat includes pork, beef, chicken, duck, goose, and fish, etc., and the edible method is similar to that of other places. Rural people generally live in brick and tile houses, and fire bricks and mud wall houses. In front of or behind the houses, stone strips, wood strips or bamboo are used to build drying racks to dry clothes and grain. Toilets, cattle pens, pig pens, chicken and duck sheds are generally built, and people and animals are separated. Inhumation is still practiced in villages.

The indigenous population in Tiandeng County is Zhuang, accounting for 98.9% of the total population. The other ethnic groups are Yao, Han, Miao and Dong, etc., but their folk customs and culture are not different from that of Zhuang. The Yao population in Tiandeng County is concentrated in Minzu Village, Lejiu Village, Handong Village, Dingming Village and Guihe Village in Xiangdu Town., while Han people are mostly concentrated in Getun, Huai'an Village, Bahe Township, Jiaofengtun, Balan Village and Lengniantun, Nayang Village. There are no other ethnic minority communities in towns and villages affected by the Project. The adults can all speak Tiandeng Zhuang dialect. Putonghua is widely used in primary and secondary school teaching and county-level meetings. People use Chinese characters for their work, study and communication. The food is mainly corn and rice, followed by sweet potatoes, taros, vegetables and meat. Farmers usually build fenced houses while wealthy households build reinforced concrete buildings. Inhumation is still practiced in villages.

17.2 Basic Conditions and Status of Zhuang Ethnic Group in Project Area

In the project area, Zhuang is the dominant ethnic group, which is mainly reflected in the following aspects:

1. Zhuang is the main residential ethnic group in Lingnan with a long history

The ancestors of Zhuang nationality, such as Xi'ou and Luoyue, were the earliest pioneers in Lingnan (today's Lingnan covers Guangdong, Hainan and the majority of Guangxi). In prehistoric times, the complex landform constituted by mountains, hills, plateaus and basins and the climate characterized by rainy and hot seasons in the same period created favorable conditions for the emergence of wild rice and the development of early rice farming of Zhuang nationality. In the pre-Qin period, the productivity of the people of Xi'ou and Luoyue developed continuously, which wrote a glorious chapter in the history of the Zhuang people. After the unification of China in Qin Dynasty, the Zhuang nationality began to merge into the big family of the Chinese nation. The central government implemented the ethnic policy of "harmony with Baiyue nationality" (allowing the Zhuang people to get involved in the political power management, respecting the Zhuang people's customs, encouraging intermarriage with the Zhuang people, and "autonomy" with the Zhuang people according to local conditions) in the places inhabited by the Zhuang nationality, which laid a foundation for the formation, development and consolidation of a unified multi-ethnic country.

Tiandeng County and Daxin County of Chongzuo City where the Project is located are the important homelands of Luoyue ancestors of Zhuang nationality. Zhuang nationality is the main ethnic group living there for a long history.

2. Zhuang population accounts for the vast majority in the project area

Zhuang is the most populous minority in China. In Tiandeng County and Daxin County, the Zhuang population accounts for 96.89% and 98.9% respectively. In the project areas of Fuxin Town and Shuolong Town, the registered population is all Zhuang people.

3. Although the Zhuang nationality has its own language, it is not the only language used by the Zhuang population in the project area

Zhuang nationality has Zhuang language, which can be roughly classified into two major dialects: northern and southern. The two major dialects are further classified into about 20 dialects. The principal difference between these dialects is the local the accent with different intonation. Apart from this, the difference also lies in the inconsistent expression of a small number of words.

In the 1950s and 1960s, the Zhuang language and Mandarin are used in the school teaching in Tiandeng County and Daxin County. The textbook used by students was written in Chinese characters, and teachers used the Zhuang language to explain things in the textbooks to help students understand. Lather, with the frequent migration of population and the increase of external contacts, young people communicated with each other in Mandarin, and school teachers no longer need to teach in the Zhuang language. Since then, mandarin has been adopted for teaching in all schools. Middle-aged and elder people over 50 or 60 years old, especially the rural elderly, mainly use the Zhuang language in their daily communication. Besides, not only the Zhuang elderly, but also the Han and Yao elderly can basically speak the Zhuang language. Due to the going out for study, work, or business, the intermarry with people from other places, the frequent migration of population, and the increase of the cultural exchange among middle-aged and younger Zhuang, most of them are used to using local Mandarin to communicate. Since the new generation born in the 1990s and the 2000s only used Mandarin to communicate at school and the Mandarin holds a dominant place in the linguistic environment in which they grew up, most of them only master the listening rather than the speaking of Zhuang language. For those younger Zhuang who grew up in other places, they even cannot understand the Zhuang language by listening.

4. The official created Zhuang characters for the Zhuang nationality, but Zhuang characters are not widely used among the people

Zhuang characters are divided into ancient Zhuang characters and Zhuang alphabetic characters (called the “Zhuang characters” for short). Ancient Zhuang characters, also known as folk characters, originated in the Tang Dynasty. They were created from Chinese characters or their radicals by some Zhuang literati educated in Chinese culture background. However, they are not widely used, and they are mostly used by the Zhuang folk people for writing place names, compiling folk songs and keeping records. No one has used these folk characters in modern times.

In 1955, the Chinese government created official Zhuang characters, namely Zhuang alphabetic characters based on Latin alphabet, which was based on the northern dialect and took the intonation of Wuming County as standard. They were finalized in December 1955, and approved by the Government Affairs Council and promulgated for execution in 1957.

They were partially modified in 1982. The Zhuang characters were based on the northern dialect, but Chongzuo is part of the region where the southern Zhuang dialect is popular. Due to the differences between these two dialects, the Zhuang characters have not been widely used in this region, and they have never been used in school teaching. In Chongzuo city, except that both Chinese characters and Zhuang characters must be used on official seals and plaques in accordance with the Regulations on the Work of Minority Languages and Characters in Guangxi Zhuang Autonomous Region, there are basically no occasions where Zhuang characters are used, and most of the local people do not recognize or use the Zhuang characters except those who have received special training.

5. The production and lifestyle of the local Zhuang people are roughly the same as those of the Han people, and they do not have their own unique culture

Guangxi is one of the origins of rice cultivation in China. In history, Zhuang people are good at using abundant water resources to grow rice, and they are one farming ethnic group with rice cultivation culture as its core, which is roughly the same as the production mode of the Han ethnic group in central China, and both are of the same economic type. It is this similar farming culture that makes it easier for the Zhuang people and the Han people to approach psychologically and learn & accept each other's culture. After Qin and Han Dynasties unified Lingnan, a unified country was formed in Ancient China, and the central government set up prefectures and counties in Lingnan to govern. A large number of Han people went south to mix with the Zhuang people, and the economic and cultural exchanges between the ancestors of Zhuang and Han people became increasingly close. Through long-term natural exchanges, the Zhuang and Han people show a state in which their production and lifestyle are basically the same and their ideology and culture identify with each other. Traditionally, Zhuang practices monogamy, and women and men are both family laborers. The diet, residence and most customs and cultures of the Zhuang people are basically the same as those of the Han people. Spring Festival, a major festival of the Han people, is also a major festival of the Zhuang people. The traditional festivals of Zhuang people include Gexu Festival, Kaigeng Festival, Changxin Festival and Niuhun Festival, among which Gexu Festival is the most popular and famous. Gexu Festival is usually held on the third day of the third lunar month every year. Now, the "March 3rd" Song Festival has developed into a unique regional festival celebrated by people of all ethnic groups in Guangxi. Other festivals of Zhuang people are the same as those of Han people. The folk culture, production and living habits of the Zhuang people and other local ethnic minorities are basically the same as those of the local Han people, without their own unique culture. In the local area, the Zhuang people and the Han people are in a state of cultural integration.

6. The local Zhuang people have diversified sources of livelihood and have no collective attachment to the land and other natural resources in the village

The local Zhuang people have the same mode of production and life as the Han people in other places, and earn their income mainly by migrant work and non-agricultural business. Both men and women, middle-aged and young laborers are in a state of mobility, not dependent on local land and agricultural resources for living, nor do they have a collective attachment to the land and other natural resources in their villages.

7. The local Zhuang people have no political, economic and cultural systems independent of the mainstream society

The local political, economic, cultural and educational systems in the project area are consistent with those in other regions of the country, and there is no independent systems different from the mainstream society.

17.3 The Project and Indigenous Peoples

It is stipulated on the Indigenous Population in Article 33 of the *Environmental and Social Policy* of AIIB that the Bank shall screen each project to determine whether it will affect indigenous peoples. If the project will have an impact on indigenous peoples, AIIB will require the Client to formulate an indigenous peoples development plan or IPPF.

Through the analysis of the basic situation and status of Zhuang people in the project area, it can be made clear that the local Zhuang people do not conform to the definition of indigenous peoples of AIIB, so ESS 3: Indigenous Peoples is not applicable to the Project, and there is no need to prepare the *Indigenous Peoples Development Plan*.

18 Working Conditions and Community Health and Safety

By ensuring that the staff is treated fairly, the project unit provides them with a safe and healthy working environment and takes measures to prevent accidents, injuries, diseases, and employment of child labor, promotes the establishment of a good relationship between staff and management, and promotes the development benefit of the project. Project units should also ensure the health and safety of local communities in the project area.

18.1 Classification of Project Staff

Project staff: personnel directly employed by the Client (full-time, part-time, temporary, seasonal or immigrant) who are specialized in project work, Contractor's personnel employed by the Client who work for the Project, and subcontractor's personnel employed by these contractors who are engaged in project work.

18.2 Staff Management Procedure

The Project Team shall, as required, formulate and implement the following labor management procedures for staff, which conform to the requirements of the national *Labor Law*, *Labor Contract Law* and AIIB's *Environmental and Social Standards*.

18.2.1 Terms and Conditions of Employment

An enterprise shall build labor relationships with its employees An enterprise shall build labor relationships with its employees by concluding written labor contracts. The enterprise shall establish a roster of employees for checking.

When recruiting staff, the enterprise shall truthfully inform them of the work content, conditions, place, possible occupational hazards, work safety status, remuneration and other information required by the staff.

A labor contract shall be agreed upon by the enterprise and an employee through consultation, and shall take effect after being signed and stamped by both parties hereto. The enterprise and the employee shall each hold one copy of the labor contract.

The labor contract shall have the following clauses: (1) the name, address and legal representative or principal responsible person of the enterprise; (2) the employee's name, address and ID card or other valid ID number; (3) the term of the labor contract; (4) work content and place; (5) working hours, rest and vacation (including weekly rest, annual leave, sick leave, maternity leave and personal leave); (6) labor remuneration and overtime pay; (7) social insurance and social welfare; (8) labor protection, labor conditions and occupational hazard protection; (9) other matters that shall be included in the labor contract according to laws and regulations.

The enterprise shall pay its employees on time in accordance with labor contracts and state regulations. Only when allowed by national laws can employees' wages be reduced, and employees shall be informed of the conditions for wage deduction.

If the enterprise defaults or fails to pay the labor remuneration in full, the employees may apply to the local people's court for a payment order according to law.

The enterprise shall strictly implement the wage standards stipulated in the contract and shall not force the staff to work overtime. If the enterprise arranges its employees to work overtime, it shall pay overtime wage in accordance with the contract and the relevant provisions of the state.

The labor contract may be terminated if agreed by the enterprise and the staff.

During or before the termination of the labor relationship, the enterprise shall pay all unpaid wages and other benefits directly to the employees or, where appropriate, in a manner beneficial to the employees. If payment has been made in a way that benefits the employees, the employees shall be provided with payment vouchers.

The enterprise shall provide the certificates on the dissolution or termination of the labor contract when canceling or terminating the labor contract with the staff, and manage the transfer procedures of the files and social insurance relationships for the staff withinin 15 days.

18.2.2 Non-discrimination and Equal Opportunity

The enterprise shall allow all qualified personnel to take the examination for the recruiting positions, and decide whether to employ them according to the skill level of the personnel taking the examination. The wages, bonuses and other forms of subsidies paid to the employees shall be determined according to the working conditions of the employees. The principle of equal pay for equal work shall be observed. The employees shall not be unfairly treated for their nationalities, races, genders, religions and backgrounds.

When hiring employees, except for jobs or posts that are not suitable for women as stipulated by the state, the Contractor must not refuse to hire women, or raise the employment standards for women on the grounds of gender. The enterprise shall employ the disabled in accordance with a certain proportion, and provide them with appropriate types of jobs and posts.

The enterprise shall set up suggestion boxes, and the employees can prepare written materials about discrimination, unequal opportunities, etc. and put them into the suggestion boxes. HR supervisor shall handle incidents of discrimination or humiliation of employees. If the situation is true, the discrimination and humiliation shall be corrected and the relevant personnel shall be punished, and the results shall be notified to the employees.

18.2.3 Staff Organization

The enterprise shall support employees to establish a labor union according to law. Employees shall have the right to join and form a labor union regardless of nationality, race, gender, occupation, religion and degree of education. The basic duty of the labor union is to safeguard the legitimate rights and interests of employees. The labor union shall implement the system of equal consultation and collective contract to coordinate labor relationship and protect the labor rights and interests of employees.

The daily working body of the labor union is the labor union committee. The members of the labor union committee shall be democratically elected by the general meeting or the member representative conference. The labor union committee shall have women members.

The labor union assists and guides employees to sign labor contracts with the enterprises. The labor union shall negotiate and sign a collective contract with the enterprise on behalf of its employees. The draft collective contract shall be submitted to the employees' congress or all employees for discussion and approval.

If the enterprise violates the collective contract or infringes upon the labor rights and interests of its employees, the labor union may require the enterprise to bear the responsibility according to law; if a dispute arises over the performance of the collective contract and cannot be settled through negotiation, the labor union may submit it to the labor dispute arbitration organization for arbitration. If the arbitration organization refuses to accept it or anyone is not satisfied with the arbitral decision, it may bring a lawsuit to the people's court.

When the enterprise unilaterally terminates the labor contract with its employee, it shall notify the labor union in advance of the reasons. When the labor union believes that the enterprise violates laws, regulations and relevant contracts and requires a re-study of the handling, the enterprise shall study the opinions of the labor union and notify the labor union in writing of the handling results.

If the enterprise violates labor laws and regulations, embezzles employees' wages, fails to provide labor safety and health conditions, arbitrarily extends working hours, infringes upon the special rights and interests of female employees and severely infringes employees' labor rights and interests, the labor union shall negotiate with the enterprise on behalf of the employees and require the enterprise to take measures to correct them. The enterprise shall study and deal with these issues and give a reply to the labor union. If the enterprise refuses to correct, the labor union may request the local people's government to make the handling decisions according to law.

The main responsibilities of the female workers' committee under the labor union are as follows: (1) carry out trade union activities according to the characteristics of female workers, carry out "four selves" education of self-esteem, self-confidence, self-reliance and self-improvement for female workers, guide female workers to establish a correct morality, correctly deal with romantic relationship, marriage relation and family relation, and be new women in the new era; (2) encourage and guide female workers to study scientific and cultural knowledge, and continuously improve their cultural and skill quality, so as to better adapt to the needs of market-oriented economy; (3) assist and urge the administration to establish and improve the labor protection facilities and labor protection system for female workers, and sign a special collective contract for the protection of special rights and interests of female workers; (4) cooperate with relevant departments to carry out frequent education on maternal and child health knowledge for female workers to enhance their self-protection ability; (5) care about the physical and mental health of female workers, and actively organize cultural and sports activities that are conducive to enhancing the physical fitness of female workers and enlivening their spare time life; (6) manage family planning.

18.3 Labor Protection

The enterprise is not allowed to recruit minors under the age of 16.

The enterprise, which recruits minors who have reached the age of 16 but less than 18 in accordance with the relevant provisions of the state, shall implement the provisions of the state on types of work, working hours, labor intensity and protective measures, and shall not arrange them to engage in heavy, toxic, harmful and other labor or hazardous operations that endanger the physical and mental health of minors.

The enterprise shall prohibit any servitude, forced labor, corporal punishment, imprisonment and threats of violence, to ensure that employees participate in work or labor on a voluntary basis.

The recruitment of employees by the enterprise must be based on fairness and voluntariness, and it is forbidden to recruit employees by means of coercion or deception. During recruitment and after employees enter the enterprise, the employees' ID cards and other valid documents shall not be detained. No deposit or security deposit shall be collected, and no guarantee or contract is required for employees to enter the enterprise. No one is allowed to ask for referral fees from employees or charge fees for other reasons.

18.4 Work Safety

The Owner, the Project Implementation Organization and the Contractor shall strictly abide by the national *Regulations on Work Safety Management of Construction Projects* (Decree No. 393 of the State Council), the *Regulations of Guangxi Zhuang Autonomous Region on Work Safety* (Announcement No. 86 of the 10th CPC Standing Committee of Guangxi Zhuang Autonomous Region) and other relevant laws and regulations on work safety, ensure work safety in construction projects, assume responsibility for work safety in construction projects in accordance with the law, and ensure the safety of workers and related people's lives and property.

The major person-in-charge of the Owner shall shoulder full responsibilities regarding the work safety of the unit; the person in charge of work safety shall assist the major responsible person in performing the administration duties in work safety and other responsible persons shall shoulder the work safety responsibilities within their respective scope of business.

The project implementation organization shall meet the following work safety conditions:

(1) Production and business premises and equipment and facilities shall conform to the provisions of relevant laws and regulations on work safety and the requirements of national standards or industry standards;

(2) A sound responsibility system for work safety shall be established, and rules and regulations for work safety and relevant operating procedures shall be formulated;

(3) Establish management organizations for work safety or provide management personnel for work safety in accordance with regulations;

(4) Persons in charge and work safety management personnel shall have work safety knowledge and management ability matched with the production and operation activities;

(5) Employees shall pass the work safety education and training. Special operators shall receive operation safety training by relevant national regulations, and shall acquire special operation qualification certificates;

(6) Employees should be provided with labor protection articles in line with national or industry standards.

(6) Employees shall be provided with labor protection articles in line with national or industry standards.

The project implementation organization shall establish and improve the investigation, regulation and reporting system for potential hazards of accidents. Any potential hazard found shall be eliminated immediately. If the potential hazards of major accidents cannot be eliminated immediately, an emergency plan shall be formulated, a remediation scheme shall be prepared and remediation funds shall be in place to complete the elimination within the prescribed time limit. If safety cannot be guaranteed before or during the elimination of potential hazards, the production and operation shall be suspended or relevant devices shall be shut down temporarily, and all operating personnel within the dangerous area shall be evacuated.

When the construction contractor carries out dangerous operations such as blasting, hoisting of large-scale equipment (components), overhaul of equipment, disassembly and assembly for buildings or structures, loading and unloading of dangerous goods, super-high stacking of articles, operations near high-voltage wires, and operations in confined spaces, it shall arrange special personnel to conduct on-site command and safety monitoring to ensure compliance with operating procedures and implementation of safety measures.

18.5 Occupational Health and Work Safety Guarantee System

The safety and health management organization of the enterprise is responsible for the occupational health and work safety of employees and the daily inspection of the working environment. Governments at all levels have established a sound management and inspection system to ensure work safety in enterprises and the safety of workers.

Enterprises shall establish and improve the investigation and regulation system of potential hazards of work safety accidents, adopt technical and management measures, and timely discover and eliminate hidden dangers of accidents. The investigation and control of hidden dangers of accidents shall be truthfully recorded and notified to staff. The safety and health management organization regularly maintain, preserve and inspect safety equipment to ensure its normal operation. A record of maintenance, preservation and inspection shall be kept and signed by the relevant personnel.

Employees finding hidden dangers of accidents or other unsafe factors shall report to the on-site work safety management or the director of the organization immediately, and the person receiving the report shall deal with it timely.

The employees of the enterprise shall be entitled to know the dangerous elements that exist in the site or position of work as well as the corresponding prevention measures and emergency measures; they shall be entitled to criticize, expose or institute legal proceedings on the ground of the problems that exist in the work safety of the enterprise concerned and have the right to refuse to follow directions contrary to rules and regulations or conduct work at risk. Enterprises shall not lower wages, welfare and other welfares or invalidate labor contracts with the employees because they criticize, report, accuse work safety of the entity or refuse to command against regulations or in a way that forces them to take risks.

The government's work safety supervision and management department and other departments responsible for the supervision and management of work safety shall carry out administrative enforcement of work safety for enterprises in accordance with the law, supervise and inspect the implementation of laws, regulations and national or industry standards related to work safety by production and business units, and exercise the following functions and powers: (1) make inspections at the production and business operation entities, gather relevant materials, and inquire relevant entities and persons; (2) correct the acts violating the statutory provisions of law related to work safety discovered during the inspection or demand for correction within a prescribed time limit; make decisions of administrative penalties according to the provisions of the present law and other relevant laws and regulations to those acts that shall be subject to administrative penalties according to law; (3) order to remove the accident potentials found in the inspection; in case that safety cannot be guaranteed before the major potential hazards are removed or when the major potential hazards are being removed, evacuate the operating personnel from the dangerous areas and order to suspend the production and operation or stop using any equipment; permit the production or business operation or use only after hazards are removed, reviewed and agreed; (4) seize up or detain the facilities, equipment and apparatuses that are believed as not meeting the national or industrial standards for guaranteeing work safety; seize the workplaces where dangerous goods are illegally produced, stored, used or operated, and make decisions according to law. Enterprises shall cooperate with the work safety supervision and inspection personnel in performing their supervision and inspection duties according to law, and shall not refuse or obstruct them.

In the course of supervision and inspection, the government's work safety supervision and management department shall timely transfer the safety problems existing in the enterprise to other relevant departments for handling, and form records for future reference. The departments that accept the transferred cases shall handle them without delay.

The government supervision authorities shall, according to the provisions concerning administrative government supervision, be responsible for supervising the execution of duties of work safety supervision and administration by the departments responsible for the supervision and administration of work safety and the personnel thereof.

The institutions undertaking the work of safety appraisal, certification, detection, and test shall be equipped with the qualifications as required by the state, and shall be responsible for the results of safety appraisal, certification, detection and test.

The departments responsible for the supervision and administration of work safety shall establish a system of reporting violations, making public the telephone numbers, mail boxes or email addresses for reporting violations, and accept the reports for violations relating to work safety. Any reported violation that has been accepted shall be put down in writing after it has been verified through investigations. If any measure of rectification or improvement has to be taken, it shall be reported to the relevant person-in-charge for execution after the person-in-charge has affixed his signature.

People's governments at all levels and their relevant departments shall reward meritorious persons reporting hidden dangers of major accidents or activities against laws of work safety.

18.6 Occupational Health and Safety of Communities

There are nearly 3000 households and 10,000 people in 7 villages (communities) in the affected areas of the Project, as well as some enterprises and institutions, including schools. After the construction of the Project begins, the implementing agency shall ensure the health and safety of the people in the affected areas of the Project.

18.6.1 Strict Epidemic Prevention and Control to Ensure Community Residents' Health

In view of COVID-19, the project implementation organization shall timely and accurately grasp the staff situation, especially the flow of personnel from high and medium risk areas and overseas, establish and improve the staff health archives, and strengthen the staff health management; Carry out regular body temperature testing for staff, and supervise and urge the implementation of personal protection requirements and the reduction of personnel gathering and collective activities; Further improve the sanitary conditions in the workplaces and living places, especially the cleaning and disinfection of workplaces, staff canteens and tableware.

Contractors working in the project area shall cooperate with their communities to prevent and control the epidemic; Properly carry out staff health education, environmental hygiene control around the residence, and management of staff renting local houses to prevent possible epidemics among staff from being introduced into the community. At the same time, staff renting local houses shall observe various management regulations of tenants and floating population in their communities and villages, and cooperate with epidemic detection and prevention measures in their communities and villages to protect the health of the people in their communities.

18.6.2 Strict security measures shall be taken during construction to ensure the safety of the staff and the community residents.

The Contractor shall take strict protection measures at all stages of the Project to ensure the safety of the staff, the local community residents, pedestrians and vehicles.

(1) Construction preparation stage

Before construction, “supply of water, electricity, accessible roads and ground leveling” shall be implemented for the construction site. If temporary access roads are to be built, the safety of passing vehicles and pedestrians must be ensured, and clear signs and traffic control measures must be provided. The temporary water use on the construction site should be provided with health and safety guarantee, safety education on water and electricity use shall be conducted for all the staff, and the system for special operation personnel working with certificates shall be strictly implemented.

State-stipulated safety signs, hazardous warning signs and other symbols and slogans shall be hung in construction areas to prevent the community residents from entering the scope of construction protection and dangerous areas.

(2) Subgrade construction stage

Prepare the strict construction management plan, construction specifications, safety technology operation specifications, and determine one -site dispatching personnel, so that safety technical disclosure can be delivered to all staff. Set up safety protection facilities on the construction site, and provide safety protection articles required by staff. Subgrade construction can only be started when everything is ready.

During subgrade construction, special personnel be assigned to carry out traffic management in the construction area, and unified command shall be exercised over personnel, vehicles and machinery, so as to avoid personal and mechanical accidents. During excavator construction, a certain construction site must be ensured, and personnel are not allowed to enter within the radius of gyration. Special personnel must be assigned to direct the earthmoving vehicles entering the construction site to ensure safety. Pedestrians are prohibited from passing through the construction sites. When piling up soil, necessary sidewalks must be left in the soil piling area, and soil piling against the wall should be avoided as far as possible. When soil piling is necessary, the height should not exceed 1 m, and good drainage ditches should be set up. During roller compaction, an enough safe distance shall be kept at the edge to prevent accidents. If the manual operation is combined with the mechanical operation, a certain safe distance shall be kept between people and machines.

(3) Construction stage of base and surface course

During the construction of tabia of base course, fences shall be set up to prevent environmental pollution and not affect the physical and mental health of residents in the community. No one is allowed to stand around the machine. It shall be ensured that the machinery can move forward and backward freely, and special personnel must be assigned for commanding at site to prevent personal casualty accidents. During paving construction, construction personnel shall pay attention to avoiding construction machinery in time and obey the on-site command. At the end of the construction, the site must be cleaned in time, and the remaining materials shall not be dumped on the side of the road, affecting the safety of pedestrians.

Before surface course construction, traffic in the construction area must be closed with “wooden horses”, barrier ropes, etc., clear red flags or red lights and other warning signs must be set on barrier railings, and special personnel shall be assigned to manage the traffic. Before construction, the integrity of machines, tools and equipment shall be carefully checked and warranty work shall be done. In the construction of asphalt concrete pavement, attention shall be paid to check the safety of transportation vehicles and electricity utilization at any time. When passing vehicles roll over the road surface, traffic management must be carried out and attention must be paid to avoiding passing vehicles at any time.

18.7 Appeal Mechanism

The enterprise shall set up a complaint mechanism for its employees so that they can protect their legitimate rights and interests, When recruiting employees, the appeal mechanism shall be clearly informed. Contract workers employed by the Contractor can use this appeal mechanism.

The main contents of the complaint mechanism are:

Stage 1: When the legitimate rights and interests of employees of the enterprise are infringed upon, they shall first appeal to the labor union of the enterprise. Employees can report to the labor union on the violation of the collective contract, improper handling by the enterprise, deduction of wages, failure to provide labor safety and health conditions, illegal command by the enterprise, forcing workers to work at risk, arbitrary extension of working hours, infringing of the special rights and interests of female workers and underage workers, and other matters that seriously infringe upon the labor rights and interests of employees. After receiving the report, the labor union shall organize personnel to conduct an investigation. If the situation is true, the labor union shall negotiate with the enterprise on behalf of the employees and require the enterprise to take measures to correct them. The enterprise shall study and deal with these issues and give a reply to the labor union.

Stage 2: If the enterprise refuses to correct or the employees are not satisfied with the results of the enterprise's handling, the employees may request the local people's government to make the handling decisions according to law.

Stage 3: Employees who are not satisfied with the government's handling results may bring a lawsuit to the people's court. If an employee brings a lawsuit to the court, the labor union shall provide support and assistance.

19 Organizational Structure and Responsibilities

The organizations responsible for the relevant matters of the Project include the Project Management Organization, the LA Compensation and Resettlement Organization, and the Monitoring and Evaluation Organization.

19.1 Organizational Structure

The Project Management Organization mainly consists of the project leading group, the project management office and the project implementation office; The LA Compensation and Resettlement Organization mainly includes the leading team for resettlement of Guangxi Chongzuo Border Connectivity Improvement Project, the project implementation office of Guangxi Chongzuo Border Connectivity Improvement Project, the land acquisition and demolition sub-headquarters of Tiandeng for Guangxi Chongzuo Border Connectivity Improvement Project, the land acquisition and demolition sub-headquarters of Daxin, Natural Resources Bureau, Housing and Urban-Rural Construction Bureau and Human Resources and Social Security Bureau of Tiandeng County and Daxin County, People's Governments of Fuxin Town, Tiandeng County and Shuolong Town, Daxin County, and villagers' committees of affected villages along the route; The Monitoring and Evaluation Organization shall be an experienced third-party organization recruited by the Employer in a public way.

19.2 Composition and Responsibilities of Project Management Organization

19.2.1 Project Leading Group

Under the leadership of Chongzuo Municipal People's Government, a project leading group was set up, headed by the mayor of Chongzuo Municipal People's Government and joined by representatives of other government agencies in Chongzuo, including Transportation Bureau, Finance Bureau, Development and Reform Commission, Ecological Environment Bureau, Land Resources Bureau, Water Conservancy Bureau, Forestry Bureau, Audit Bureau and the governments of Daxin County and Tiandeng County. The project leading group provides comprehensive support for the implementation of the Project, especially in terms of high-level policy and strategic instructions, inter-departmental communication and coordination, and consultation and solution of key issues, so as to ensure the smooth implementation and successful completion of the project.

19.2.1 Project Management Office

A project management office was set up under the leadership of the project leading group. It is located in Chongzuo Municipal Transportation Bureau, with the Director General of Transportation Bureau as the director. The project management office is responsible for the overall management and supervision of the implementation of all components of the Project, and ensures that the project implementation complies with national laws, AIIB policies and project legal agreements. During the preparation and implementation of the Project, the project management office (PMO) will be the main body of communication with AIIB.

19.2.2 Project Executive Office

Under the project management office, a project executive office was set up by Guangxi Chongzuo City Construction Investment Development Group Co., Ltd.. The project executive office, composed of experienced experts or consultants, is a special team responsible for engineer management, procurement, contract management, financial management and the implementation of environmental and social security measures of the Project.

19.3 Composition and Responsibilities of Resettlement Organization of the Project

19.3.1 Leading Team for Resettlement of Guangxi Chongzuo Border Connectivity Improvement Project

The main responsibilities of the leading team are: to implement the decisions and arrangements of the central government and the autonomous region government on LA, HD and resettlement, and to study and formulate policies on LA, HD and resettlement under the Project; to coordinate and handle the LA, HD and resettlement under the Project as required; to study and solve major issues related to LA, HD and resettlement of the Project and major disputes arising therefrom, and to make overall plans and coordinate and deal with the difficulties and problems encountered in LA, HD and resettlement under the Project; to supervise and guide the people's governments of Daxin, Tiandeng and other counties and relevant agencies directly under the municipal government to properly carry out LA, HD and resettlement, social insurance, later support and other work.

The office of the leading team is located in Chongzuo Municipal Transportation Bureau. The director of the office is held by the director of the Bureau, while the deputy directors are held by the deputy county heads in charge of transportation of Tiandeng and Daxin counties. The members of the office include personnel drawn from relevant entities directly under the municipal government and of Daxin County and Tiandeng counties, and are responsible for the resettlement of Wuzhou (Longyanzui)-Shuolong Highway (Chongzuo–Jingxi Expressway to Shuolong Port section) and Detian-Shuolong Highway.

The main responsibilities of the office of the leading team are: to undertake the daily work of the leading team and implement the matters decided by the leading team; to take charge of organization and preparation of important work and major activities of the leading team, and supervision of the implementation, evaluation and other work of the targets and responsibilities of LA, HD and resettlement; properly carry out overall coordination, comprehensive management, supervision, inspection and other work of LA, HD and resettlement; to promptly submit major problems and matters encountered in the work to the leading team for study and decision-making; to complete other matters assigned by the leading team.

The leading team for resettlement of Guangxi Chongzuo Border Connectivity Improvement Project has the responsibilities of leading, guiding and coordinating the Project construction to ensure that the construction tasks of the Project are completed on schedule as required for quality. The specific responsibilities are as follows:

(1) Complete the relevant work assigned by superior leaders, relevant agencies and AIIB;

(2) Coordinate, supervise and implement other related work.

19.3.2 Project Implementation Office of Guangxi Chongzuo Border Connectivity Improvement Project

The project implementation office is located in Guangxi Chongzuo City Construction

Investment Development Group Co., Ltd., and its personnel are transferred from relevant departments and offices of Guangxi Chongzuo City Construction Investment Development Group Co., Ltd. and relevant departments of its subsidiaries and appointed from universities and the society to form the comprehensive team, technical team, social environment monitoring team, finance team, procurement team and information team.

The project implementation office shall assume the following responsibilities in the land acquisition compensation and resettlement of the Project:

(1) Submit materials to natural resources bureaus of Tiandeng County and Daxin County for issuing the pre-announcement of land acquisition in a timely manner; coordinate with Tiandeng County headquarters and Daxin County headquarters for land acquisition and demolition of Guangxi Chongzuo Border Connectivity Improvement Project, and implement the investigation of the current land use; entrust a qualified unit to carry out potential risk assessment after issuance of the pre-announcement of land acquisition; pay resettlement-related expenses of the loan project to relevant departments; arrange resettlement funds for compensation for permanent LA, temporary land occupation and house demolition for Component A; ensure that the *Resettlement Action Plan* of the loan project is fully implemented and that the rights of land-expropriated farmers are safeguarded.

(3) Accept the entrustment of the people's governments of Tiandeng County and Daxin County, communicate and contact with the Tiandeng County Sub-headquarters and Daxin County Sub-headquarters of Land Acquisition and Demolition for Guangxi Chongzuo Border Connectivity Improvement Project, timely review the detailed data of Component A land acquisition compensation submitted by Tiandeng County Sub-headquarters and Daxin County Sub-headquarters of Guangxi Chongzuo Border Connectivity Improvement Project, and timely allocate the land acquisition compensation and house demolition compensation to the bank accounts of the stakeholders, and promote resettlement of the project.

(4) Handle the social security procedures, impact compensation and resettlement and other related work for the land-expropriated farmers, in conjunction with the natural resources bureaus, labor and social security bureaus, Daxin County and Tiandeng County governments;

(5) Employ support experts with corresponding qualifications and experience to help deal with environmental issues and resettlement issues so as to ensure legal compliance and submit progress reports

and support monitoring reports to AIIB.

(6) Ensure the full implementation of the Environmental and Social Impact Assessment Report and Environmental and Social Management Plan, coordinate the appeal mechanism, and report the compliance of environmental and social development in quarterly progress report and annual environmental and social monitoring report.

(7) To coordinate and deal with other related work.

The social environment team of the Executive Office is responsible for the progress supervision of environmental monitoring work such as environmental impact, hydrology, water and soil conservation and humanity required for project approval, and reporting to relevant authorities for obtaining the approval documents of various environmental impact reports of the Project; for communication and contact with the sub-headquarters of each county for land acquisition and demolition, the women's federations at all levels, the county civil affairs bureau, the poverty alleviation office, natural resource authorities, ecological environment authorities, forestry authorities, water conservancy authorities, hydrology authorities, town governments and other authorities, and preparing the resettlement plan, environmental and social impact assessment report and environmental and social management plan required by AIIB with the help of the technical assistance organization; for communication and contact with relevant departments of land acquisition and demolition of the Project, reviewing and confirming the appropriation information of land acquisition and demolition, and promoting the land acquisition and demolition of the Project; for the internal monitoring of the resettlement action plan, and providing relevant monitoring conditions to the external monitoring organization; for coordinating and implementing environmental management with the competent authorities of ecological environment; for the environmental and social protection management of the project; managing and supervising the environmental and social work during the construction period, and accepting and handling public complaints; tracking the implementation of the environmental and social management plans and reporting to relevant authorities regularly; regularly organizing the training arranged in the resettlement action plan and environmental and social management plan.

The finance team is fully responsible for the financial work of the project and establishment of the project financial management system; implementing domestic matching funds, reviewing withdrawal and reimbursement materials, and paying related expenses such as resettlement and environmental monitoring, as well as project payment work; preparing financial reports, cooperating with audit work, carrying out financial management and supervision, and preventing potential risks.

19.3.3 Tiandeng County Sub-headquarters of Land Acquisition and Demolition for Guangxi Chongzuo Border Connectivity Improvement Project

The main responsibilities of Tiandeng County Sub-headquarters of Land Acquisition and Demolition for Guangxi Chongzuo Border Connectivity Improvement Project in the land acquisition compensation and resettlement work of the Project are as follows: Under the leadership of the county Party committee and the county government, under the entrustment of the People's Government of Tiandeng County, and according the requirements of the resettlement leading team and the Executive Office of Guangxi Chongzuo Border Connectivity Improvement Project, be responsible for the land acquisition and demolition for Component A of Guangxi Chongzuo Border Connectivity Improvement Project within Tiandeng County, and ensure that the project land acquisition and demolition is completed on schedule with good quality. The specific responsibilities are as follows:

(1) Complete the relevant work assigned by the superior leaders and the leading team for resettlement of Guangxi Chongzuo Border Connectivity Improvement Project and the Guangxi Chongzuo Border Connectivity Improvement Project Implementation Office;

(2) After the county people's government issues the pre-announcement of land acquisition, contact the project owner, determine the organizations for survey, counting and measurement, and arrange to carry out the current land use investigation. The current land use investigation shall include the land ownership, land type and land area, as well as the ownerships, types and quantities of rural villagers' houses, other ground attachments and young crops. The Land Acquisition Questionnaire shall be filled timely after the investigation.

(3) Select a professional evaluation company, calculate the compensation standard, quantity and amount of the houses to be demolished according to law, and disclose and publicize the purpose, location, compensation standard, resettlement route, the insured objects of the land-expropriated farmers, the insured objects of the households to be resettled, the standard and the cost raising method of the households to be resettled;

(4) Organize the registration and confirmation of land acquisition compensation for Component A in Tiandeng County; calculate and verify the number of land-expropriated

farmers and the number of households to be resettled according to law, preliminarily select the resettlement site together with the local township (town) government and the land-expropriated organizations, plan the resettlement site, formulate the resettlement plan, and coordinate the "three supplies and one leveling" of the resettlement site;

(5) Sign contracts with relevant units such as Water Resources & Electric Power Group Co., Ltd., China Telecom, China Mobile, China Unicom, and China Broadcast Network, as well as enterprises and public institutions affected by land acquisition, villagers' groups, villagers and residents, and timely transfer the compensation details of land acquisition, demolition and temporary land occupation to the Executive Office of Guangxi Chongzuo Border Connectivity Improvement Project.

(6) Publicize and acquisition purpose of the Project to the masses affected by the environmental and social impacts of the Project, receive, record and handle the appeal events;

(7) Be responsible for implementing the land acquisition compensation and resettlement plan in Tiandeng County, and handle impact compensation and resettlement and other related work in conjunction with the natural resources bureaus, labor and social security bureaus, township governments and village committees;

(8) Take charge of supervising the contractor to complete the land reclamation work after temporary land occupation as required, and organizing the acceptance of the land reclamation results;

(9) Coordinate and deal with other related work.

19.3.4 Daxin County Sub-headquarters of Land Acquisition and Demolition for Guangxi Chongzuo Border Connectivity Improvement Project

The main responsibilities of Daxin County Sub-headquarters of Land Acquisition and Demolition for Guangxi Chongzuo Border Connectivity Improvement Project in the land acquisition compensation and resettlement work of the Project are as follows: Under the leadership of the county Party committee and the county government, under the entrustment of the People's Government of Daxin County, and according the requirements of the resettlement leading team of Guangxi Chongzuo Border Connectivity Improvement Project and the requirements of the Executive Office of Guangxi Chongzuo Border Connectivity Improvement Project, be responsible for the land acquisition and demolition for Components

A, B and C of Guangxi Chongzuo Border Connectivity Improvement Project within Daxin County, and ensure that the project land acquisition and demolition is completed on schedule with good quality. The specific responsibilities are as follows:

(1) Complete the relevant work assigned by the superior leaders and the leading team for resettlement of Guangxi Chongzuo Border Connectivity Improvement Project and the Guangxi Chongzuo Border Connectivity Improvement Project Implementation Office;

(2) After the county people's government issues the pre-announcement of land acquisition, contact the project owner, determine the organizations for survey, counting and measurement, and arrange to carry out the current land use investigation. The current land use investigation shall include the land ownership, land type and land area, as well as the ownerships, types and quantities of rural villagers' houses, other ground attachments and young crops. The Land Acquisition Questionnaire shall be filled timely after the investigation.

(3) Select a professional evaluation company, calculate the compensation standard, quantity and amount of the houses to be demolished according to law, and disclose and publicize the purpose, location, compensation standard, resettlement route, the insured objects of the land-expropriated farmers, the insured objects of the households to be resettled, the standard and the cost raising method of the households to be resettled;

(4) Organize the registration and confirmation of land acquisition compensation for Components A and B in Daxin County; calculate and verify the number of land-expropriated farmers and the number of households to be resettled according to law, preliminarily select the resettlement site together with the local township (town) government and the land-expropriated organizations, plan the resettlement site, formulate the resettlement plan, and coordinate the "three supplies and one leveling" of the resettlement site;

(5) Sign contracts with relevant units such as Water Resources & Electric Power Group Co., Ltd., China Telecom, China Mobile, China Unicom, and China Broadcast Network, as well as enterprises and public institutions affected by land acquisition, villagers' groups, villagers and residents, and timely transfer the compensation details of land acquisition, demolition and temporary land occupation of Component A to the Executive Office of Guangxi Chongzuo Border Connectivity Improvement Project; apply to the People's Government of Daxin County for the land acquisition, demolition compensation and resettlement funds of Component B, and timely allocate the compensation for land acquisition, demolition and temporary land occupation of Component B to the bank accounts of all stakeholders;

(6) Publicize and acquisition purpose of the Project to the masses affected by the environmental and social impacts of the Project, receive, record and handle the appeal events;

(7) Be responsible for implementing the land acquisition compensation and resettlement plan in Daxin County, and handle impact compensation and resettlement and other related work in conjunction with the natural resources bureaus, labor and social security bureaus, township governments, village committees and forest farm;

(8) Take charge of supervising the contractor to complete the land reclamation work after temporary land occupation as required, and organizing the acceptance of the land reclamation results;

(9) Coordinate and deal with other related work.

19.3.5 County Natural Resources Bureau

There are 2 counties affected by the Project construction. The responsibilities of each county natural resources bureau are as follows:

(1) To take charge of the acceptance, review and approval of LA;

(2) Apply to the government for issuing the pre-announcement of land acquisition according to the application materials submitted by the project owner. According to laws, calculate the compensation standards for land acquisition;

(3) Approving temporary land occupation;

(4) Issuing planning permits for construction land (including temporarily used land and resettlement land).

19.3.6 County Housing and Urban Rural Development Bureau

The responsibilities of county housing and urban and rural construction bureaus are as follows:

(1) Be responsible for providing file query service for investigation on the ownership, type and quantity of attached houses on the land to be requisitioned or temporarily occupied.

19.3.7 Construction Office of Detian-Shuolong Class II Highway

Construction Office of Detian-Shuolong Class II Highway is proposed to be established by Daxin County People's Government in the near future.

Main responsibilities of the construction office: the land acquisition and demolition work of Components B and C of Guangxi Chongzuo Border Connectivity Improvement

Project, the leadership, guidance and coordination for the project construction, and ensuring completion of the project construction on schedule with good quality under the leadership of the county party committee and the county government, in accordance with the requirements of the leading team for resettlement of Guangxi Chongzuo Border Connectivity Improvement Project. The specific responsibilities are as follows:

(1) Complete the relevant work assigned by the superior leaders and the leading team for resettlement of Guangxi Chongzuo Border Connectivity Improvement Project;

(2) To apply for compensation for LA and HD and resettlement funds, to sign contracts with Water Resources & Electric Power Group Co., Ltd., county branches of China Telecom, China Mobile, Unicom, and China Broadcast Network, relevant entities of scenic areas, wood farms, etc., and to timely allocate compensation for LA, HD and temporary land occupation to the county natural resources bureaus, bureaus of housing and urban-rural development responsible for the LA and HD work and compensation for the relocation of proprietary facilities such as poles and wires and water conservancy facilities to the corresponding ownership entities;

(3) To publicize the purposes and uses of LA of the Project to the LEFs;

(4) To handle impact compensation and resettlement and other related work in conjunction with the natural resources bureaus, labor and social security bureaus, township governments and village committees;

(5) To take charge of properly coordinating and carrying out the "supply of water, electricity, accessible roads and ground leveling" of the homesteads for resettlement;

(6) To take charge of supervising the contractor to complete the land reclamation work after temporary land occupation as required, and organizing the acceptance of the land reclamation results;

(7) To coordinate and deal with other related work.

19.3.8 County Natural Resources Bureau

There are 2 counties affected by the Project construction. The responsibilities of each county natural resources bureau are as follows:

(1) To take charge of the acceptance, review and approval of LA;

(2) Investigating the ownership, type and area of the land to be acquired or temporarily occupied, and the ownership, types and quantities of ground attachments, calculating LA compensation rate and the number of land-expropriated farmers (LEFs) and HD affected households to be resettled, and drafting a resettlement action plan together with the township government and affected entities;

(3) Applying to the sub-headquarters (construction office) for allocation of land acquisition compensation;

(4) Handling the social security procedure for LEFs in coordination with the administrative authority for labor and social security;

(5) Disclosing the use, location and compensation rate of the land to be acquired, resettlement mode, security subjects and standards of LEFs, and fundraising method, etc.;

(6) Registering and confirming LA compensation;

(7) Selecting the resettlement site and planning the site for reconstruction and resettlement together with the township government;

(8) Implementing the LA compensation and resettlement action plan;

(9) Approving temporary land occupation;

(10) Issuing planning permits for construction land (including temporarily used land and resettlement land).

19.3.9 County Housing and Urban Rural Development Bureau

The responsibilities of county housing and urban and rural construction bureaus are as follows:

(1) Investigating the current situation of ownership, type and quantity of houses attached to the land to be requisitioned or temporarily occupied, hiring professional appraisal companies, calculating compensation rate, quantity and amount according to law, and reviewing, filing and submitting them for approval;

(2) Applying to the sub-headquarters (construction office) for allocation of demolition compensation;

(3) Disclosing the use, location, compensation rate, quantity and compensation amount of the houses to be demolished, security subjects and standards of owners of the demolished

houses, and fundraising method, etc.;

(4) Registering and confirming demolition compensation;

(5) Implementing the demolition compensation scheme.

19.3.10 County Labor and Social Security Bureau

There is 1 wood farm affected by the Project. The responsibilities of the wood farm resettlement task force are as follows:

(1) Participating in the investigation of the ownership, type and area of the land to be acquired or temporarily occupied, and the ownership, types and quantities of ground attachments and young crops;

(2) Organizing staff representative meetings to publicize the policies of LA compensation and resettlement;

(3) Participating in resettlement;

(4) Reporting the progress of resettlement implementation to higher authorities;

(5) Paying compensation for ground attachments and young crops to be removed to the affected staff according to the LA compensation and resettlement action plan, and disclosing relevant information;

(6) Reporting comments and suggestions on LA compensation and resettlement action plan of affected staff to higher authorities.

19.3.11 External M&E Agency

The external M&E agency is an experienced third party agency appointed by the project implementation office of Guangxi Chongzuo Border Connectivity Improvement Project, responsible for monitoring RAP implementation, and submitting resettlement M&E reports to AIIB through the project implementation office of Guangxi Chongzuo Border Connectivity Improvement Project.

19.3.12 Personnel Allocation

In order to carry out the resettlement work smoothly, all the implementing agencies are equipped with special staff, forming a smooth information transmission channel from top to bottom. Implementing agencies at all levels are mainly composed of administrative personnel and professional and technical personnel, all of whom have certain professional level and management quality, and have long-term working experience. See Table 19.3-1 for the staffing of resettlement agencies in the Project.

Table 19.3-1 Staffing of Resettlement Agencies

Authority(ies)	Agency staffing	Staff Composition
Leading Team for Resettlement Work of Guangxi Chongzuo Border Connectivity Improvement Project	1 team leader	Vice Mayor of Chongzuo Municipal Government
	2 deputy team leaders	Deputy Secretary General of Chongzuo Municipal Government; Director of the Municipal Transportation Bureau
	7 members	Deputy Director of the Municipal Development and Reform Commission; Deputy Director of the Municipal Finance Bureau; Deputy Director of the Municipal Labor and Social Security Bureau; Deputy Director of the Municipal Natural Resources Bureau; Deputy Director of the Municipal Natural Resources Bureau; Deputy Head of Daxin County; Deputy Head of Tiandeng County
	Several office workers	Composed of personnel drawn from relevant entities directly under the municipal government and in Daxin County and Tiandeng County
Project Implementation Office of Guangxi Chongzuo Border Connectivity Improvement Project	Director (1 person)	Party Secretary and Chairman of Guangxi Chongzuo City Construction Investment Development Group Co., Ltd.
	3 deputy directors	Vice Chairman and General Manager of Guangxi Chongzuo City Construction Investment Development Group Co., Ltd., Deputy Secretary of Party Committee of Guangxi Chongzuo City Construction Investment Development Group Co., Ltd., Chairman and General Manager of Chongzuo Communications Investment Co. Ltd., and

Authority(ies)	Agency staffing	Staff Composition
Tiandeng County Sub-headquarters of Guangxi Chongzuo Border Connectivity Improvement Project, Daxin County Sub-headquarters of Guangxi Chongzuo Border Connectivity Improvement Project		Deputy General Manager of Zuojiang Huashan Investment Co., Ltd. of Guangxi Chongzuo City Construction Investment Development Group Co., Ltd.
	2 persons of the general affairs team	Allocated from relevant departments of GCCCIDG and Chongzuo Communications Investment Co. Ltd., 2 bridge and tunnel experts, 1 social environment purchasing officer, 1 financial consultant and 1 procurement expert are hired
	Technical group: 8 persons	
	4 persons of the social environment team	
	Financial group: 4 persons	
	3 persons of the procurement team	
	1 commander	County head
	1 deputy standing commander	Deputy county head
	4 deputy commanders	Secretary of the County Politics and Law Committee, Deputy Director of the Standing Committee of the National People's Congress, Vice Chairman of CPPCC, Political Commissar of the Public Security Bureau
	21 heads of relevant entities	County Government Office, Performance Office, Legitimate Affairs and Mediation Office, Complaint Handling Bureau, Development and Reform Bureau, Justice Bureau, Finance Bureau, Natural Resources Bureau, Transportation Bureau, Water Conservancy Bureau, Aquatic Veterinary and Animal Husbandry Bureau, Natural Resources Bureau, Forestry and Grassland Bureau, Work Safety Bureau, Public Security Bureau, Town Government, Water Resources & Electric

Authority(ies)	**Agency staffing**	**Staff Composition**
		Power Group Co., Ltd., County Branches of China Telecom, China Mobile, Unicom, and China Broadcast Network
	9 office workers	Personnel appointed by County Government, Transportation Bureau, Natural Resources Bureau, Land Acquisition Office and Legitimate Affairs and Mediation Office, and Deputy Town Chief of Town Government
	8 persons of land acquisition and resettlement mediation section	Personnel appointed by County Legitimate Affairs and Mediation Office, Natural Resources Bureau, Land Acquisition Office and Town Government
	5 persons of social stability task force	Personnel appointed by County Public Security Bureau, Complaint Handling Bureau and Town Police Station
Commerce and Port Administration Bureau of Chongzuo City	3 persons	Leaders, section heads and staff
County Natural Resources Bureaus	3 persons	Leaders, section heads and staff
County Housing and Urban Rural Development Bureaus	3 persons	Leaders, section heads and staff
County Labor and Social Security Bureaus	3 persons	Section heads and staff
Local Township Governments	5 persons	Leaders and staff
Affected village committees	5 persons	Village officials and villager representatives, statisticians
Aijiang Wood Farm resettlement task force	5 persons	Wood farm leaders and staff
External monitoring agency	5 persons	Staff

20 Environmental Management and Monitoring Plan

Environmental supervision and management refers to putting forward specific environmental management requirements for different working conditions, different environmental impacts and environmental risk characteristics according to different stages such as project construction stage and production operation stage. Environmental monitoring mainly covers the impacts on the environment on both sides of the road during the construction period and the operation period. It aims to ensure the implementation of various environmental protection measures and suggestions given in the environmental impact report and to control the environmental impact caused by the project construction within the scope stipulated by relevant regulations.

According to the relevant laws and regulations of the state and Guangxi Zhuang Autonomous Region, the *Environmental and Social Framework* issued by AIIB, and the characteristics of the Project, the key points of the environmental management requirements of the Project refer to the implementation of environmental protection facilities during the construction and operation period of the road section crossing the water source area, and the supervision and management of the operation situation. The environmental monitoring mainly focuses on the sensitive points around the mixing stations and spoil grounds and the water intake of the water source area where the route crosses. The environmental management and monitoring plan of the Project is shown in the *Report on Environmental and Social Management Plan for Guangxi Chongzuo Border Connectivity Improvement Project*.

21 Monitoring and Evaluation of Resettlement Action Plan

In order to ensure the successful implementation of the Resettlement Action Plan, the Project will monitor the whole process of compensation and resettlement. Monitoring is divided into internal and external monitoring. The resettlement action plan monitoring and evaluation of the Project is shown in the *Report on Environmental and Social Management Plan for Guangxi Chongzuo Border Connectivity Improvement Project*.

22 Mitigation Measures, Conclusions and Suggestions

22.1 Mitigation Measures

22.1.1 Environmental Protection Objectives and Alleviate Measures

1. Environmental Protection Objective

There are 12 environmental protection objectives (2 schools and 10 villages) within the evaluation scope of Component A, 12 environmental protection objectives (1 school and 11 villages) within the evaluation scope of Component B, and 1 village within the evaluation scope of Component C. In Component A, Neitun Hub Interchange passes through Bukan Water Source Conservation Area in Liliang Village, Fuxin Town (planned for relocation, not involved after relocation); in Component B, the K0 + 460 - K5 + 360 section passes through Class II conservation area of Aitun Drinking Water Source Conservation Area in Shuolong Town, and the K9 + 400 - K10 + 000 section passes through Class II conservation area of Shuolong Community Drinking Water Source Conservation Area in Shuolong Town. The Project involves 2 ecologically sensitive areas (Xialei Autonomous Region Nature Reserve and Huashan National Scenic Area in Guangxi). Within the evaluation scope, there are 3 national Class II protective plants (Excentrodendron tonkinese, Cibotium barometz and Zenia insignis Chun), 4 Guangxi Autonomous Region protective plants (Acampe rigida, Cymbidium bicolor Lindl, Cheirostylis chinensis Rolfe and Spiranthes sinensis) and 12 ancient trees.

2. Mitigation Measures

The construction period and operation period of the Project may have certain adverse impacts on the above environmental protection objectives. It is proposed to take the following measures for the Project to alleviate the impact on the environmental protection objectives:

For the sensitive spots with the noises exceeding the standard, ventilated soundproof windows and other protective measures shall be taken during the operation period. Road runoff collection systems, oil separation sedimentation tanks and warning signs are arranged along the sections crossing water source conservation areas. The number of culverts and passages shall be increased for the sections crossing the Guangxi Xialei Nature Reserve and the Huashan Scenic Area, the construction red line shall be strictly controlled, and construction enclosures and scenic spot reminders be made; high baffles or dust screens shall be provided, water spraying for dust control be intensified and the environmental awareness education and legal publicity be strengthened for the construction personnel. For the protected plants and ancient trees in the occupied area, design shall be optimized to avoid them as much as possible, and if they cannot be avoided, it is necessary to report to the forestry department for approval to transplant. Other protected plants and ancient trees within the evaluation scope shall be transplanted nearby or protected in situ.

22.1.2 Social Impact Alleviate Measures

When the Project is under construction and after it is put into operation, it will have certain adverse effects on some relevant interest groups. The Employer shall take various measures to eliminate these adverse effects or reduce them to the lowest degree, compensate for the interest losses of the affected parties, and effectively resettle the peasants and households whose land or houses are occupied or demolished.

1. Strengthen ideological education for foreign construction personnel. The following items are mainly included:

(1) Understand and respect the local customs, especially the taboos of Zhuang nationality;

(2) The Project is located in the border area. It is not allowed to run around, and it is not allowed to spread information indiscriminately;

(3) The temporary land and houses shall be kept clean, the environment shall be protected, and construction waste and domestic waste shall not be thrown at will. Don't touch the villagers' things without consent. Respect the surrounding people, understand each other and tolerate each other.

(4) Respect women, help the weak and provide assistance and care as much as possible.

2. Land acquisition and relocation shall strictly follow the national and local laws, regulations and policies, and resettlement work shall be carried out efficiently

Permanent land acquisition shall be conducted in strict accordance with the procedures and compensation standards for land acquisition stipulated by national and local laws and regulations, and adhere to the principles of openness, fairness and justice. The impact of land acquisition and demolition shall be mitigated through multi-option comparison and selection as far as possible. For the compensation for income and resettlement of the people affected by permanent land acquisition in the Project, monetary compensation is adopted. Those land-expropriated farmers who meets the qualifications stipulated in the *Trial Measures of Guangxi Zhuang Autonomous Region for Social Security for Land-expropriated Farmers* and are approved by the villagers' committee can also obtain compensation in the form of social security. It ensures that the original living standard of land-expropriated farmers will not be lowered and their long-term livelihood will be guaranteed. For the households to be demolished, the resettlement method is mainly monetary compensation and replacement of homesteads with an equal area. After signing an agreement with the relocated households, the Employer shall build temporary pre-fabricated houses next to or behind the original sites (new sites) of the houses according to the actual situation on site. The Employer can demolish the original houses after the relocated households transfer all their belongings to the temporary pre-fabricated houses, and shall properly implement the "supply of water, electricity, accessible roads and ground leveling" for the adjusted homestead. As far as possible, the households shall be resettled in the original place. People affected by temporary land occupation are mainly compensated through the payment of compensation for land occupation, above-ground affiliated structures and land reclamation after the completion of construction. The Contractor shall sign contracts with the affected parties by temporary land use before land requisition, and the details like what the original land type is, what the land type is after restoration and what standards the occupied roads need to be restored, shall be clearly indicated in the contracts. Temporary land occupation shall be coordinated with local township governments, with reference to relevant compensation standards formulated by local governments. The compensation standards shall be determined through consultation with affected villagers' committees and farmers or evaluation by the third party. The compensation fees shall be paid in full before the construction commences.

3. Removal of special structures shall be planned in advance

As to the commercial buildings affected, in the principle of respecting the wishes of the affected people, the Employer can help them to rent suitable houses for them to continue with their commercial operation, or give them the sites for housing reconstruction. After the affected people move out of their old houses, the Employer can demolish these houses.

For the tombs and other special above-ground affiliated structures to be relocated, the Contractor shall communicate with the villagers in advance to determine the time and place for relocation. Before removing water conservancy facilities, the Employer shall help villagers complete the water improvement in advance or give compensation. For the relocation of power pipeline and telecommunication pipeline, site selection and comprehensive investigation shall be properly conducted to prevent the power and telecom towers from being too close to residential houses or residential areas after relocation. Before the demolition and relocation, the planned power outage and network disconnection that may be caused by the demolition shall be publicized in advance.

4. Take various measures to mitigate impacts during construction

Construction shall be carried out before spring sowing and after autumn harvest in rural areas, so that even if farmland is occupied, it will not affect farmers' spring harvest; The scope of land acquisition shall be strictly controlled through reasonable planning design and coordinate mapping, warning signs and billboards shall be set up at the boundary of construction area and protected area, the activity range of construction personnel and vehicles shall be strictly restricted, and the construction influence area shall be minimized; Measures, such as horn prohibition, speed restriction, and strong light shutdown, shall be taken near the construction site; Soil and water conservation and environmental protection shall be properly done, without littering, dumping waste and discharging sewage at will, and topsoil shall be protected.

5. Reasonably select site for temporary land occupation and guarantee the quality of land reclamation after the land occupation is completed

The amount of land occupied shall be reduced by renting local houses and building them in permanent occupation areas. When it is necessary to occupy new land, the sensitive areas such as basic cultivated land, cash crop area and forest land shall be avoided as much as possible through reasonable site selection, and wasteland, abandoned land or hard-to-use land shall be occupied as much as possible. Well-developed natural vegetation shall be avoided as much as possible. The construction site shall be located as far away as possible from residential areas along the route. The top soil shall be stripped for cultivated land and wood land to be excavated and occupied, and the stripped top soil shall be piled up properly and used for land reclamation to ensure the quality of land reclamation. The land occupied shall be reclaimed in strict accordance with the reclamation plan approved by the natural resources bureau to ensure its return to the original cultivation conditions.

6. Prevention of the impacts of noise and vibration on the life of local inhabitants

During the construction period, the impacts on and protective measures for acoustic environment in villages close to the highway shall be considered. Solid barriers with a height of 2.5m shall be installed at the construction boundary near sensitive points. It is prohibited to carry out construction at 12: 00-14: 30 and 22: 00-6:00 a.m. the next day. Continuous operation shall be announced in advance. Measures such as installing sound barriers and sound insulation windows shall be taken for buildings along the route with noise exceeding the standards. When blasting operation is required for tunnel construction, the blasting quantity shall be controlled to reduce the burst noise. Announcement shall be posted before blasting, especially for villages within 500m of the tunnel blasting point, relevant villagers shall be informed before blasting. Blasting operation at night is prohibited.

22.2. Conclusions and Suggestions

22.2.1 Conclusions of Environmental Impact Evaluation

Component A - The construction of the proposed Wuzhou (Longyanzui) - Shuolong Highway (Chongjing Expressway - Shuolong Port Section) conforms to the *Expressway Network Planning of*

Guangxi (2018-2030). After the Project is completed and put into operation, the social and economic benefits are obvious. It greatly improves the level of the road network transportation infrastructure in scenic spots and improves the service functions of tourism industry of Chongzuo City. It is of great significance to accelerate the development of China-ASEAN Free Trade Area, promote the regional economic and social development, upgrade the international corridor of Shuolong Port, and develop the tourism in counties and cities along the route. The main line and connecting line of the Project pass through the experimental area of the Xialei Autonomous Region Nature Reserve, with a total length of 3.83km, and pass through Class II conservation area of Huashan National Scenic Area, with a total length of 6.179km. The passing through topics have been approved by the Forestry Bureau of the Autonomous Region, and the Project does not involve areas prohibited by laws and regulations. For the Bukan water source conservation area in Liliang Village involved in the K0 + 000 - K1 + 320 section of the main line of the Project, the People's Government of Tiandeng County plans to relocate it, which will not be involved after the relocation. The project section passing through the water source area shall be constructed after the relocation of the water source area is completed. With the above measures, the impact of the Project on the Bukan water source in Liliang Village, Fuxin Town is relatively small. The construction of the Project mainly poses impacts to ecological, acoustic, atmospheric and water environments. Under the condition that the environmental protection measures and investment proposed in the Assessment are effectively implemented, the adverse environmental impact caused by construction and operation of the Project can be effectively controlled and reduced, so the Project is feasible from the perspective of environmental protection.

Component B - The construction of Detian-Shuolong Highway is conducive to improving the transportation infrastructure in the project area, directly promoting the development of transportation, tourism, commerce and related industries, and resulting in economic development, social prosperity of the project area and improvement of people's living standards and . However, when the Project is under construction and after it is put into operation, it will have certain adverse effects on some relevant interest groups. The Contractor shall take various measures to eliminate these adverse effects or reduce them to the lowest degree, compensate for the interest losses of the affected parties, and effectively resettle the peasants and households whose land or houses are occupied or demolished.

The construction of Component C: Shuolong Port (Phase II of Shuolong Gate) is conducive to improving the port travel inspection services and management of customs clearance vehicles and personnel in the project area. However, during the construction and after the operation of the Project, adverse environmental impacts on the surrounding environment, such as ecological environment, acoustic environment, atmospheric environment and water environment, will be generated. After various measures are taken, these adverse environmental impacts will be minimized and accepted by the environment. The Project is feasible from the perspective of environmental protection.

22.2.2 Conclusions and Suggestions of Social Impact Assessment

The construction of the Project is conducive to improving the transportation infrastructure in the project area, directly promoting the development of transportation, tourism, commerce and related industries, and resulting in economic development, social prosperity of the project area and improvement of people's living standards and . However, during the implementation of the Project, it is necessary to take protective measures in some specific matters to safeguard the current interests of the local people.

1. Guarantee the rights to know and participation rights of relevant interest groups

Strengthen communication with the affected people to protect their rights to know and participation rights. While strengthening the publicity and transparency of information, actively collect the public's attitudes, opinions and their demands towards the Project, especially pay attention to the demands and opinions of vulnerable groups and protect their rights.

2. The design and site selection of bridges and culverts shall not affect the local irrigation system

Reasonably select the culvert location and determine the pore size of culvert to ensure that the culvert can meet the requirements of farmland irrigation, restoration of water conservancy irrigation system. Provide independent drainage system on the highway to avoid pollution to water sources. Prevent encroaching effective flood control area. Bridges and culverts shall meet flood discharge and flood control requirements.

3. Arrange the time nodes for repair of road system and water system

When entering the pavement laying stage, the Contractor shall start the road system and water system repair work. The case that repair work has not been carried out due to the demobilization of the construction teams after the completion of the Project shall be avoided. The Owner shall strengthen the supervision to the construction contractor and shall not accept the works where the damaged roads and water systems have not been repaired. If the road or water system is damaged due to nonconforming design, the Owner shall be responsible for rectification to ensure the smooth flow of the road system and water system. If the Contractor damages the farmland, irrigation ditches, roads, etc., the Owner shall require the Contractor to compensate or recover the damaged places.

4. Strengthen the protection of water sources

Before the adjustment of Bukan Water Source is completed, construction within the affected area of the water source is prohibited to avoid pollution to Bukan Water Source. During the construction of this road section, the rainy season shall be avoided as much as possible. Temporary drainage ditches and sedimentation tanks shall be provided on both sides of the construction area, and geotextile shall be used for filtration at the sedimentation outlet. The drainage shall be used for sprinkling water to reduce dust as much as possible. In addition, the bare surfaces in the construction area shall be protected in strict accordance with the water and soil conservation plan. The earthwork and stonework from construction shall be transported away in time and shall not be piled up in the water source protection area to avoid earthwork and stonework entering into the water body by rainwater scouring, resulting in water pollution. During the construction of pile foundation for viaducts in this section, mud from boring shall be recycled and not discharged. After settling, the boring slag shall be stacked in the designated place and transported away in time. Temporary sites such as bridge precast yard and construction camp shall not be within the areas passing through water source protection areas. Strengthen maintenance to construction machinery to avoid oil running, spilling, dripping; it is forbidden to discharge sewage in the protected area. Regularly check the sewage discharge and treatment of service facilities such as service areas, maintenance work areas and toll stations to ensure that the sewage treatment system is in good working condition. Construction such as excavation and filling of the subgrade may damage related decentralized drinking water facilities and water pipelines, so relevant preliminary investigation work shall be carried out in details, and protection or reconstruction schemes shall be made for possible impacts. Before removing pools, help villagers complete the water improvement in advance or give compensation.

5. Prevent the impacts on the surrounding traffic conditions

The Owner and the Contractor shall formulate targeted construction traffic organization plans. The Owner shall improve and supplement relevant traffic signs according to the actual conditions, provide guidance signs at the intersection with local roads and make full use of variable message signs, cable broadcasts and other methods to guide traffic to prevent traffic congestion in the operation section. The construction access roads constructed by the Owner shall be combined with the local highway system, and constructed and maintained according to the village road standard. Those roads shall be accessed by the public during the construction period to improve the traveling conditions of the public and reduce the impact on the traveling of the public caused by the project construction.