

SUMMARY ENVIRONMENTAL IMPACT ASSESSMENT

GUANGXI ROADS DEVELOPMENT II PROJECT

IN THE

PEOPLE'S REPUBLIC OF CHINA

June 2004

CURRENCY EQUIVALENTS

(as of 1 June 2004)

Currency Unit	–	yuan (CNY)
CNY1.00	=	\$0.1208
\$1.00	=	CNY8.2769

ABBREVIATIONS

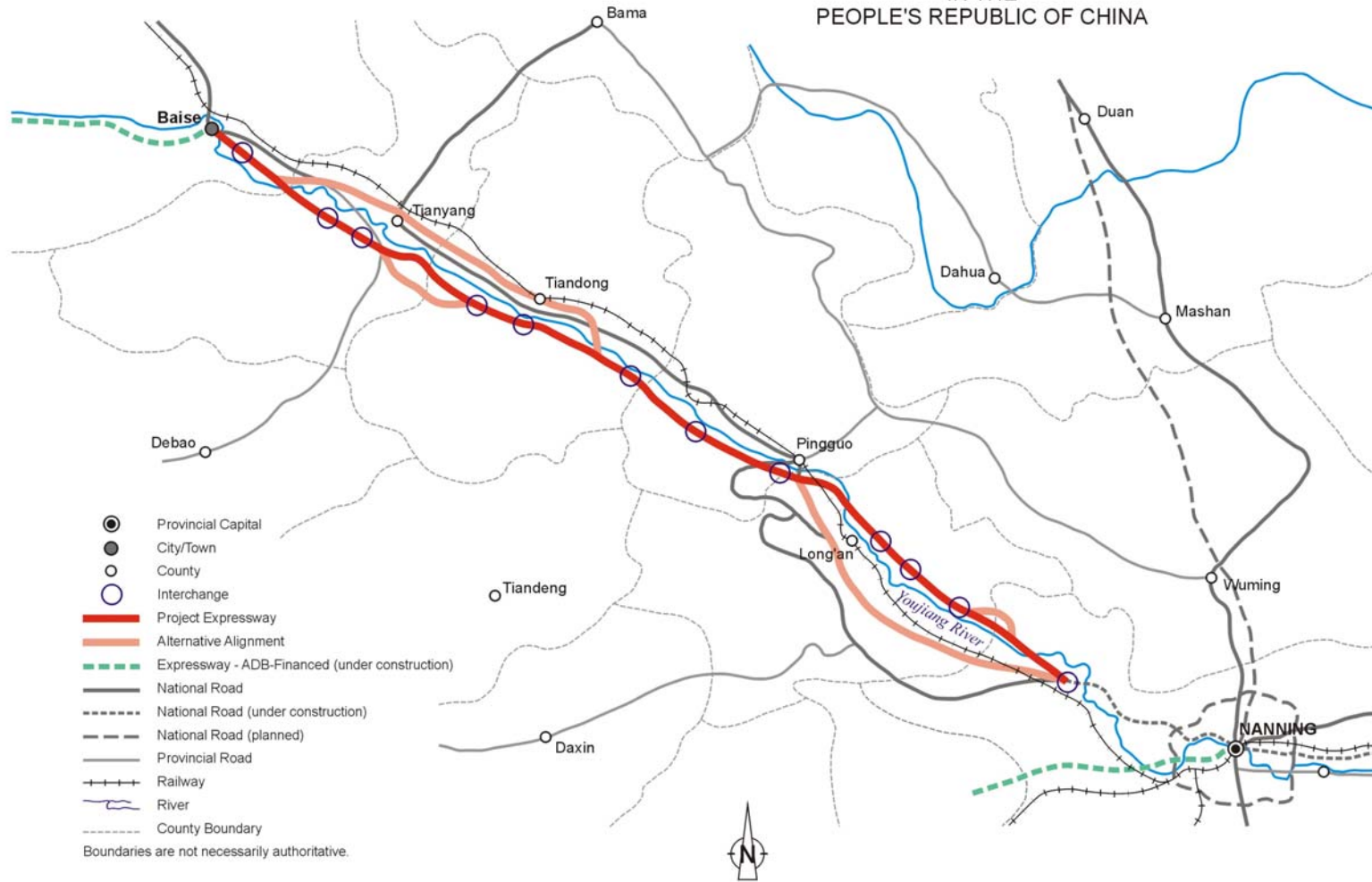
ADB	–	Asian Development Bank
CO	–	carbon monoxide
COD	–	chemical oxygen demand
dB(A)	–	decibel (absolute)
EIA	–	environmental impact assessment
EMP	–	environment management plan
EPB	–	Environmental Protection Bureau
G324	–	current class II road from Nanning to Baise
GCD	–	Guangxi Communications Department
GHCB	–	Guangxi Highway Construction Bureau
GZAR	–	Guangxi Zhuang Autonomous Region
HC	–	hydrocarbon
I/M	–	inspection and maintenance
mg/kg	–	milligram per kilogram
mg/l	–	milligram per liter
mg/m ³	–	milligram per cubic meter
MOC	–	Ministry of Communications
mu	–	unit for area commonly used in the People's Republic of China; 15 mu = 1 hectare
NBECO	–	Nanning-Baise Expressway Construction Office
NO ₂	–	nitrogen dioxide
NO _x	–	nitrogen oxide
O&G	–	oil and grease
PPTA	–	project preparatory technical assistance
RAP	–	resettlement action plan
SEIA	–	summary environmental impact assessment
SEPA	–	State Environmental Protection Agency
SO ₂	–	sulphur dioxide
SS	–	suspended solids
t	–	ton
TSP	–	total suspended particulates

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GUANGXI ROADS DEVELOPMENT II PROJECT PREFERRED ALIGNMENT AND ALTERNATIVE ALIGNMENT IN THE PEOPLE'S REPUBLIC OF CHINA



I. INTRODUCTION

1. This Summary Environmental Impact Assessment (SEIA) report is based primarily on information contained in the project Environmental Impact Assessment (EIA) Report.¹ Additional information from a technical assistance² (TA) report was obtained through a series of meetings with local environmental, socioeconomic, and resettlement specialists; with project planners and design engineers; and with officers from the Guangxi Communications Department (GCD) and Guangxi Highway Construction Bureau (GHCB). GCD and GHCB together act as the Executing Agency for this project. Direct observations during site visits to the project area improved understanding of the general project setting and physical conditions of the surrounding environment. The SEIA also draws information from the preliminary resettlement action plan³ (RAP) (Appendix 1); project preliminary design documents;⁴ project social and poverty assessment reports;⁵ project cultural relics study reports;⁶ soil conservation plan⁷ prepared by local specialists; and reports, review, and assessment by the TA consulting team. Data in the EIA and other reference reports were updated, where appropriate, during SEIA preparation, following Asian Development Bank (ADB) safeguard policies and environmental assessment guidelines.

2. The EIA report was prepared using methodologies and standards consistent with relevant guidelines established by the State Environmental Protection Administration (SEPA) and the Ministry of Communications (MOC), as well as in compliance with applicable laws and regulations. The project EIA was approved by SEPA on 4 December 2003. The completed EIA report for the complementary roads was reviewed and approved by the environmental authority of Guangxi Zhuang Autonomous Region (GZAR) in April 2004.

II. DESCRIPTION OF THE PROJECT

3. The Project contains three main physical works components: 187.5 kilometers (km), of four-lane, controlled-access Nanning-Baise expressway; 25 km of two-motor-vehicle-lane connector roads, which will be Grade II highway segments connecting the expressway with four counties; and multisegment complementary roads providing access to poor townships and villages in the project area. The complementary road comprises 245 km of Baise-Napo intercounty highway and 500 km of ethnic minority village roads. In addition, the Project will acquire required land and right-of-way for the physical works and will finance a technical assistance program including road safety improvement, construction supervision, capacity building, institutional strengthening, and human resources development. Key features of the project components are summarized in Table 1 and the location of the project is shown in Map 1.

¹ Highway Science Research Institute, Ministry of Communications. 2003. *Environmental Impact Assessment Report, Nanning-Baise Highway*. Beijing.

² ADB. 2003. *Technical Assistance to the People's Republic of China for Preparing the Guangxi Roads Development II Project*. Manila.

³ Guangxi Social Science Academy. 2003. *Resettlement Action Plan, Nanning-Baise Highway*. Nanning.

⁴ GZAR Communications Planning, Survey and Design Research Institute. 2003. *Preliminary Design, Nanning-Baise Highway*. Nanning.

⁵ Guangxi Social Science Academy. 2003. *Social Assessment Report and the Assessment Report Poverty Alleviation in Project Area, Nanning-Baise Highway*. Nanning.

⁶ GZAR Cultural Relics Brigade. 2003. *Nanning-Baise Highway Cultural Relics Investigation Report, September*; and 2003. *Nanning-Baise Highway Cultural Relics Re-investigation Report, December*. Nanning.

⁷ Highway Science Research Institute, MOC. 2003. *Water and Soil Conservation Plan Report, Nanning-Baise Highway*. Beijing.

Table 1: Key Features of the Project

Item	Expressway	Connector Road	Complementary Roads	
			Intercounty Road	Village Road
Total Length (km)	187.6	24.0	251.0	500.0
Land Occupied (ha)	1,434.0	103.0	213.0	–
No. of Culverts	693.0	–	–	–
No. of Bridges	44.0	–	–	–
House Demolition (m ²)	41,021.0	–	6,779.0	–
Design Speed (km/hr)	120.0	80.0	40.0	20.0–40.0
Road Surface Width (m)	28.0	12.0	6.5–7.5	3.5
Operation Services	5.0	None	None	None
Costs (CNY million)	5,543.3	215.3	193.4	74.4
Construction time (yr)	3.0	3.0	2.0	2.0

– no data available.

CNY = Chinese Yuan; ha = hectare; hr = hour; km = kilometer; m = meter; yr = year.

Source: Lea International, Ltd., 2004. *Final Report for Project Preparation for TA 4119-PRC.*

4. The proposed expressway alignment is located in GZAR, beginning at Tanluo town in the west suburb of the capital city Nanning municipality, extending west through four counties in two municipalities (Nanning and Baise) and finally ending at Luocunkou town in Baise city (Map 1). The expressway will be approximately parallel to the existing east-west national highway G324, while the connector roads are roughly perpendicular feeders to the expressway linking four poverty counties. The complementary roads will be in the poverty areas.

5. The proposed expressway and connector roads will be constructed on new alignments, mostly on agricultural land. The complementary roads are mostly low-grade existing roads in poor condition and will be upgraded to higher grades through this project.

6. The expressway will be a trunk road in the GZAR highway network, as well as a segment in a key passageway for western and southwestern China to the port on the South China Sea coast. Together with the connector roads and the complementary roads, the expressway will greatly improve the transportation infrastructure of GZAR, promote sustainable economic development in the region, and contribute significantly to poverty reduction through improved transportation efficiency and better access to markets and urban centers. In addition to the increased transport capacity, the technical assistance and other project components will contribute to improved highway traffic safety, reduced motor vehicle emission, institutional capacity building for highway management and operation, and human resources development in the GZAR transportation system.

7. Construction of the expressway and connector roads is scheduled to start before the end of 2004 and to be completed 3 years later. The complementary roads will be constructed by the end of 2005.

III. DESCRIPTION OF THE ENVIRONMENT

A. Landform and Geology

8. The project area is mountainous karst of northwest Guangxi, with elevations of 90–200 meters (m) above sea level for most of the expressway (about the first 175 km northwest from

Nanning) and about 250–500 m for the remaining 12 km. The area is mostly low hills, karst (limestone) hills and mountains, and diluvial terrain along Youjiang River valley. The area is characterized by Quaternary, Tertiary, and Triassic structures with complex fracture zones and sharp breccia in roughly two parallel faults. The soil in the area is mostly clay, sandy clay, and gravel while the bedrock is mainly mudstone, conglomerate, shale, and sandstone.

9. On the basis of the relevant state and GZAR seismological intensity maps and guides, the project area is classified as Degree VI to VII on the earthquake intensity scale. The road and bridge designs are based on this anti-earthquake design specification scale.

10. The area is characterized by concealed water and springs, mostly imbedded in the shallow aquifers underneath the Baise Valley. Because of its shallow nature, groundwater is highly responsive to weather conditions, which are the primary source for replenishing groundwater.

B. Aquatic Resources

11. The project area is part of the Pearl River (Zhujiang) basin with abundant rivers, canals, creeks, ponds, and reservoirs. Youjiang River is the dominant river that flows from west to east through all five counties and the two municipalities of the project region. The project area has 6 Youjiang river tributaries and 10 major reservoirs. The hydrology of surface water bodies in the region comprises low flows of total average runoff of 1.45 billion cubic meters (m³) in the 4-month period December-March the next year to relatively high water flows of total average runoff of 6.43 billion m³ in the four summer months of June-September each year.

12. The surface water bodies are used for flood discharge, irrigation, navigation, and water supply. Youjiang River has a navigation classification of VI and is capable of carrying 120-ton (t) barges year-round. Rural residents in the project corridor, particularly near the project bridges, rely on wells for water supply and do not use river water. Two water intakes near two of the bridges supply industrial water.

13. Freshwater fishery resources in the Baise Valley rivers and creeks have carps, grass fish, chub, etc. Among them are two species of fish on the national protection list (salamander and mountain terrapin) and one on the GZAR protection list; however, the field study shows that these protected species are not in the rivers directly affected by the Project.

14. The area's surface water bodies receive some industrial and domestic water discharges, but the large river flow provides sufficient assimilative and dilution capacity.⁸ A water sampling and analysis program in the Youjiang River during the EIA confirmed this. The measured permanganate index readings of all samples ranged from 1.4 to 3.7 milligram per liter (mg/l), within the applicable national standard of 6 mg/l for Class III, which applies to the project area water bodies. Other parameters are also within this class standard, such as suspended solids (less than 80.9 mg/l), petroleum hydrocarbons (not detected), and pH (7.4–8.5), compared with the applicable standards for these parameters of 150 mg/l, 0.05 mg/l, and 6–9, respectively.

⁸ SEPA. 2002. *Surface Water Quality Standards, GB 3838-2002*. Beijing; Ministry of Agriculture. 1992. *Agricultural Field Irrigation Water Quality Standards, GB5084-92*. Beijing.

C. Atmospheric Resources

15. The project area has a subtropical wet climate, with hot and long summers and mild winters. The extreme cold is 1°C, the extreme hot temperature in summer is 42.5°C, while the annual average temperature is about 18–22°C. The annual average precipitation is 1,200–1,400 millimeters (mm), 73–77% of which falls in April–September. The prevailing wind direction is southeast year-round, with annual average wind speed of 1.5–2.8 meters per second.

16. Except for two factories, there is no source of industrial air emission in the area along the expressway alignment. Existing area air emission comes from rural households, some agricultural activities, and traffic on the rural roads. The air monitoring program in the EIA for this Project shows that hourly average nitrogen dioxide (NO₂) concentrations in two locations near the expressway alignment was 0.006–0.016 mg/m³; daily average NO₂, 0.002–0.009 mg/m³; and daily average total suspended particulates (TSP), 0.108–0.160 mg/m³, respectively. These results of ambient air quality monitoring are far below the applicable standards of 0.24, 0.12, and 0.30 mg/m³, respectively,⁹ indicating good ambient air quality in the project area under present conditions.

D. Acoustic Environment

17. Fifty receptors along the expressway alignment and connector roads have been identified as sensitive to increased noise because of their nature and close proximity to the proposed expressway. These are 47 villages with 3,136 households and 15,836 people, three schools with 2,305 students and teachers along the expressway alignment, and 40 additional sensitive receptors along Baise to Napo road, all of which are within 200 m of the proposed expressway. Villages and other facilities beyond the 200 m range are considered less sensitive to noise from expressway traffic because noise intensity is attenuated over distance.

18. A 1-day noise monitoring program was conducted at the 13 noise-sensitive receptors near the expressway (10 villages and three schools) as part of the EIA. The results were 43.5–56.8 decibel (absolute) dB(A) during the day, 41.4–67 dB(A) during the night for villages, and 50.3–61.6 dB(A) during daytime for schools. The daytime noise levels were well below applicable national noise standards¹⁰ of 70 dB(A) for villages, although noise at one school was slightly higher than the standard. At night, most noise levels monitored exceeded the applicable standards of 50–55 dB(A). Site observations during the monitoring program showed that the primary noise sources at night were insects and amphibians in rural areas; otherwise, acoustic quality is good under existing conditions.

E. Ecosystem and Agricultural Resources

19. Main agricultural resources in the project region include:

⁹ SEPA. 1996. *Air Environment Quality Standard, GB 3059-96*. Beijing.

¹⁰ SEPA. 1993. *Urban Area Environmental Noise Standard, GB 8978-1996*. Beijing.

Table 2: Agricultural Resources of the Project Area

Item	Quantity/Type
Total Agricultural Land (ha)	854,867
Cultivated Land (ha)	261,024
Forest/Wood/Fruit Land (ha)	594,843 of mostly secondary forest and economic trees
Main Crops	Rice, corn, sweet potato, bean, sugarcane, cassava, sesame, etc.
Fruits	Mango, biantao, lichee, chestnut, banana, aniseed, grapefruit
Tree Species	Pine, fir, birch, eucalyptus, ceiba, broadleaf banyan, bamboo, etc.
Livestock and Poultry	Pigs, cows, horses, sheep, chickens, geese, ducks

ha = hectare.

20. The main species of wildlife in the project area are summarized in Table 3.

Table 3: Main Wildlife Species in the Project Area

Type	Species
Mammal	Boar, hedgehog, marmot, hare, and otter (Class II protection species)
Crawler	Snake, lizard, giant salamander (Class II protection species), mountain terrapin (Class II protection species)
Insect	Bee, hornet, dragon fly, butterfly, ant
Birds	Owl (protected species), turtledove (protected species), magpie, cuckoo, sparrow, pheasant, swallow, mountain sparrow, crow
Amphibian	Frog, hoptoad, tree frog

21. Because of the long history of intensive human activities in the project alignment area, wildlife activity is limited. Large mammals may be found only in areas over the ridge of mountains on both sides of the Youjiang River. The field survey during the project EIA found no protected and endangered species in the area immediately adjacent to the expressway alignment area.

22. The average forest cover in the project area is 35.8%; in the upper mountain area, coverage can reach 70–80%. Because of the fairly good vegetation coverage, soil erosion is well controlled and is in the light category on the soil erosion intensity scale. In the lower Youjiang valley area where the expressway is to be constructed, wildlife including wild fish has been scarce as a result of human disturbance and overfishing. Large wildlife species have moved to higher mountain areas. There is no natural reserve and other protected area in the project region.

F. Cultural Resources

23. The proposed expressway alignment passes a total of 17 Paleolithic (old stone age) and Neolithic (new stone age) sites, including national level, one city/county level, six important and nine regular sites totalling 220,000 m² in Baise, Longan, Tiandong, and Tianyang counties, which are part of the Paleolithic ruins in the Baise Basin. Steps were taken in selecting the alignment that will minimize occupation of such sites, but the Paleolithic ruins are scattered across the entire basin and an expressway to Baise cannot completely avoid some sites. A detailed site survey by professional archaeologists during the project EIA shows that the

expressway alignment will pass through the Controlled Construction Zone in the national-level site, avoiding occupation of the Core Zone. Most affected sites have been identified but not yet excavated at this time. There are several other cultural or historical sites in the affected counties, but they are not expected to be impacted directly by the expressway due to their distance (1.3 km and beyond) to the alignment.

G. Socioeconomic Resources

24. The project area's key social and economic indicators by city/county are in Table 4.

Table 4: Project Area Key Social and Economic Indicators

City/ County	Population (‘000)	Rural Labor Force (‘000)	Average Cultivated Land (ha/person)	GDP (CNY million)	Per Capita GDP (CNY/person)	Average Rural Labor Income (CNY/person)
Nanning	1,375	251	0.0073	21,522	16,121	2,348
Longan	371	194	0.0893	908	2,464	1,870
Pingguo	452	221	0.0520	1,893	4,203	1,168
Tiandong	389	205	0.0673	1,716	4,412	1,312
Tianyang	327	200	0.0687	1,519	4,630	1,342
Baise	325	194	0.0773	2,500	7,465	1,328

CNY = Chinese Yuan, GDP = gross domestic product, ha = hectare.

25. The Nanning area has enjoyed an economic growth of 10.9% per year on average since 2000, while that of the Baise area is 11.9% higher by up to 2% than the average economic growth in the entire GZAR. The growth has been propelled primarily by outside investment (state, out of province, and foreign), modern agriculture, increased trade, and tourism.

26. The primary socioeconomic services in the project area are in Table 5.

Table 5: Main Socio-economic Services of the Project Area

Services	Scale/Level
Education	99% enrollment to primary schools and 90% to middle schools
Medical Care	1.7–11 medical staff/1,000 people, 1.28–7.27 hospital beds/1,000 people
Telephones	11.7–65.9% of households have telephones; 91.5% of the villages are connected by phone (GZAR)
Transportation	Nan-Kun railway (same project corridor) and local rail lines; 2,394 km of grade highways and county roads (the four counties and Baise city)
Tourism	Three provincial tourist sites (10 km or longer to the alignment); 1.25 million visitors and \$262 million foreign tourist income (GZAR)

GZAR = Guangxi Zhuang Autonomous Region, km = kilometer.

27. The economic development levels directly impacted areas vary significantly. While the city of Nanning is well developed, many rural areas along the expressway are still seriously underdeveloped. By 2001, there were 270 poverty villages and over 330,000 poor people mostly in Longan, Pingguo, Tiandong, and Tianyang counties. Besides the lack of cultivated land and other resources, unfavorable terrains for agriculture, and lack of employment and

income opportunities, isolation and insufficient transportation in the area are some of the major reasons for its underdevelopment and poverty.

28. As with other regions of GZAR, which is one of the four autonomous regions in the People's Republic of China (PRC) for ethnic minorities, the project area is dominated by the Zhuang ethnic minority. Within the four project counties, the ethnic Zhuang nationalities comprise about 96%, 93%, 77%, and 45% of their respective total populations.

IV. ALTERNATIVES

29. Within the same transportation corridor between Nanning and Baise are other alternative transportation modes, including a railway line and Youjiang River (water navigation), as well as an existing Class II highway. The railway line currently runs 48 sets of trains per day, close to its design capacity. A further increase in transportation demand will require a major expansion involving large capital investment and major environmental and socioeconomic impacts. However, railway transportation has its limitations mainly related to convenience, frequency of services, double handling, and lack of capacity for door-to-door delivery. Water navigation along Youjiang River is mainly for transport of bulk materials, with very limited capacity for other goods and passengers. Water transportation capacity is also affected by the seasons and generally has low efficiency. The current Class II highway (G324) is limited by its capacity and by its low design standards/grade for the increased transportation needs forecast for the future, as well as by its low efficiency, frequent traffic accidents, and poor road conditions. In comparison, construction of an expressway between Nanning and Baise is the optimal alternative to satisfy the rising transportation demand within this corridor.

30. Within the transportation corridor, alternative expressway alignments were contemplated and evaluated at the planning stage of the Project. Alternative A, which is the selected alignment, is compared with the alternative alignments—alternatives A1, A2, B1, B2, and B3—in four sections of the expressway. Using the G324 is also an alternative (A3), but converting the only main road in the corridor used by local residents into an expressway would be inadvisable because it would be inaccessible for non-agricultural and motorized vehicles and would seriously reduce the transportation service for local residents. Key features of the alternatives are summarized in Table 6 and shown in Map 2.

Table 6: Comparison of Alternatives

Item	Unit	Selected Alignment	Alternative Alignment
Dinglin Bridge Location			
		A	A1
Length	km	6.739	6.772
Land Area Required	ha	47.4	48.181
Earthwork	m ³	0.474 million	0.482 million
Nature of Land		More woodland	More cane and paddy fields
Housing Relocated	m ²	335	320
Tanlou to Pingguo Section			
		A	A2
Length	km	64.887	67.063
Land Occupation	ha	506.75	521.5
Earthwork	m ³	6.64 million	9.06 million
Nature of Land		More cane and woodland	More paddy
Housing Relocation	m ²	1185	850
North vs South at Silin			
		A	B1
Length	km	75.60	78.613
Land Area Required	ha	558.18	553.63
Earthwork	m ³	977.458	824.22
Nature of Land		More woodland	More cane and paddy fields
Housing Relocation	m ²	2700	4750
Nanpo to Shangsong Section			
		A	B3
Length	km	30.76	40.24
Land Area Required	ha	234.38	280.09
Earthwork	m ³	3.94 million	6.84 million
Nature of Land		More paddy field	More woodland and cane
Housing Relocation	m ²	900	1700

ha = hectare, km = kilometer, m² = square meter, m³ = cubic meter.

31. Key environmental factors were used in comparing the alternatives, including the amount of earthwork (related to vegetation disturbance, soil erosion potential, etc.); house relocation; land, particularly cane and paddy fields and woodland occupation, etc. With all factors considered, including engineering and investment factors, Alternative A is better on balance and thus was selected as the final alignment for the expressway.

V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

A. Land Resources

32. **Mitigation of Impact on Agricultural Land and Residual Impact.** The proposed expressway will occupy 1,434 ha of land including 1,184 ha of agricultural or otherwise productive land. Considering the normal agricultural yields, land acquisition will result in loss of 2,700 t of grain production per year. Land to be occupied represents about 0.12% of the total cultivated land in the project area. While the impact from county-wide perspective is small (generally less than 0.5% as shown in Table 7), it is significant to the villages that directly suffer land loss. Typically agricultural land is jointly owned by all farmers in a village. If such land is converted for other uses, the remaining agricultural land will be redistributed among all farmers in the village, i.e., the whole village shares the impact of the land loss collectively.

Table 7: Agricultural Land Affected by the Project

City/County	Total Land (ha)	Average Cultivated Land (ha/person)	Cultivated Land Lost to Project (ha)	Land Loss (%)
Nanning (Yongxin)	23,011	0.0927	84.2	0.37
Longan	227,734	0.1147	373.0	0.16
Pingguo	247,359	0.0520	241.9	0.10
Tiandong	280,633	0.0727	378.9	0.14
Tianyang	45,737	0.0767	221.7	0.48
Baise (Youjiang)	370,187	0.0740	134.0	0.04

ha = hectare.

33. With the planned 10 m of green areas on each side of the expressway, the total green area created by the project will be 376 ha. This represents about 24% of the total land occupied and 31% of the total vegetated land occupied by the expressway. In addition, open space at interchanges, borrow pits, disposal sites, and other project-impacted places will also be landscaped to create additional green land. As the lost cultivated land cannot be recovered elsewhere, affected farmers will be compensated at CNY136,620–155,265 for dry cropland to CNY174,420–212,220 for paddy land per ha. The money is expected to be used to increase the unit output on the remaining farmland (such as improving existing irrigation systems, converting part of the land to high-yield cash crops, etc.) to offset the lost production and agricultural income.

34. **Mitigation of Soil Erosion and Residual Impact.** Among the expressway, borrow pits, disposal sites, and temporarily occupied land for the Project, the total disturbed land will be 313 ha, resulting in a soil erosion area of 1,756 ha. Increased soil erosion will occur during heavy rainfall, as surface vegetation is removed and bare soil exposed, particularly in areas of deep cut, high fill, ditches, and other forms of slopes. A mathematical model predicts that soil erosion intensity in the disturbed areas will increase from the current 770–1,440 tons per kilometre squared per year ($t/km^2\text{-a}$) to 6,170–8,610 $t/km^2\text{-a}$ in the first year of construction, 3,700–4,800 $t/km^2\text{-a}$ in the second year, 2,000–2,640 $t/km^2\text{-a}$ in the third year, and back to 1,500–2,000 $t/km^2\text{-a}$ in the first year of operation. Soil erosion intensity is expected to further drop to the baseline level or lower as the vegetation in the disturbed area reclamation program matures during operation. Total soil erosion due to the Project, or the incremental increase in soil lost to erosion, is estimated to be about 945,000 t during the 3-year construction period, assuming no specific control measures are adopted. High soil erosion will increase the solid contents in the project area rivers and will affect water quality, change the topography and conditions for vegetation growth, and cause land instability.

35. Numerous measures will be implemented during construction to minimize the potential for soil erosion, including retaining walls in disposal areas and drainage interception ditches near slopes. Once the construction/borrowing/disposal operation is completed, the disturbed areas will consist of permanent interception ditches, pavement, recultivation and landscaping with grass, shrub, and/or trees. Implementation of these measures will be monitored by an independent supervision body. The total costs of mitigation and monitoring for the Project are estimated at CNY26.4 million. Soil erosion intensity is expected to be reduced if these measures are appropriately implemented, but the incremental increase in soil erosion cannot be completely avoided. However, such an increase will be limited to the construction period and impact will be negligible a few years following completion of construction.

36. **Mitigation of Impact from Construction Materials and Residual Impact.** The earth and gravel required for expressway construction is 27.7 million m³, to be obtained mostly from areas near the expressway alignment. In addition, the construction will also generate 4 million m³ of waste materials requiring disposal, again in areas near the expressway alignment. Both borrow pits and disposal sites will occupy mostly waste but stable land, according to the project feasibility study. Besides the disturbance to surface vegetation and topography, the land at these sites will be temporarily occupied.

37. Borrow pits and disposal sites will be properly selected to minimize impacts to surrounding areas, and properly designed to ensure stability and minimize erosion. These sites will be reclaimed through landscaping or recultivation once the borrowing and disposal operations are completed. Bottom ash recycled or reused from power plants will be watered to 40% moisture and covered during transportation. The residual impact related to borrow pits and disposal sites will be limited to the construction period only, while the residual impact of bottom ash will be insignificant.

B. Aquatic Environment

38. **Mitigation of Impact on Water Quality and Residual Impact.** During the construction stage, bridge construction will disturb the benthic ecosystem as well as increase suspended solids (SS) in the river. Seven expressway excavation sections totaling 16.5 km will be near the Youjiang River. Surface runoff and soil erosion will affect water quality in these sections and those immediately downstream, and this result in turn can affect the irrigation systems and farmland using Youjiang River water. In addition, each of 18 construction camps will discharge an estimated domestic wastewater of 10 m³/day. Without proper control, direct discharge of the wastewater into surface water bodies could result in increased chemical oxygen demand (COD), oil and grease, and SS. During the operation stage, the four service areas and three parking areas will generate 18 m³ wastewater/day from each area, with pollutant strengths of 250–1,000 mg/l in COD, 50–150 mg/l in oil and grease, and 100–350 mg/l in SS. Discharging the wastewater without any treatment will result in deterioration of the quality of the receiving water.

39. Cofferdam methods will be used in constructing the bridge pier and foundation, and the contractors will be requested to pump slurry to shore and dispose of it properly. This will reduce the disturbance of sediments and surface, and the residual impact to water quality will lead to short-term increases in SS concentrations in the rivers immediately downstream from the bridge construction sites. Increased SS may drive the fish population, if any, in the Youjiang River away from the impacted area; but the impact will dissipate soon after the construction ends. All contractors will be required contractually to build septic tanks at their construction camps; that will remove approximately 40–50% of the COD and 50–70% of the SS. Also, all contractors will be required to have sound environmental management programs for the storage of hazardous materials, solid waste collection and disposal, and environmental contingency plans, as well as wastewater handling. For the operation phase, a wastewater treatment plant in each service area will consist of an equalization tank, sedimentation tank, and accelerated field percolation, costing CNY4.25 million. By this treatment, the effluent is expected to meet the Class I wastewater discharge standards¹¹ (COD: 150 mg/l, petroleum oil: 10 mg/l and SS: 70 mg/l). At those concentrations, the effluent impact on the quality of the receiving water is expected to be minimal. Water quality in the Youjiang River will be monitored during

¹¹ SEPA. 1996. *Integrated Wastewater Discharge Standards*, GB8978-1996. Beijing.

construction and operation for SS, COD, and oil and grease (O&G) to confirm the result of the impact assessment.

40. Mitigation of Risks from Transport of Hazardous Materials and Residual Impacts. According to a probability model based on statistics for accidents involving vehicles containing hazardous waste in the project area, traffic forecast, and expressway length, the frequency of accidents involving container trucks with hazardous materials is estimated to be 0.02/year in 2007, 0.03/year in 2013, and 0.05/year in 2021. Such accidents could result in release of hazardous materials into Youjiang River and cause potentially catastrophic impacts on water quality, aquatic ecosystem, and users of Youjiang River water.

41. The bridge guardrails will be designed to be sufficiently strong to withstand the impact of impinging trucks. Catchbasins on the bridge will be connected with holding tanks on both ends of the bridge to drain the hazardous liquid released from trucks in accidents into the tanks to prevent it from flowing into the river directly and to allow time for emergency staff to contain and clean up the accidental spills. This will further reduce the probability of impacting water quality directly even during accidents. In addition, the following mitigating measures will also be adopted to further minimize the potential risks related to transportation of hazardous materials.

- (i) Individuals involved in transporting hazardous materials (drivers, etc.) will be examined when entering the expressway to ensure the possession of appropriate operation permits, and vehicles will be inspected to ensure appropriate signage and equipment.
- (ii) Vehicle operators will be forbidden to smoke cigarettes while with the vehicles, and will be warned through appropriate signs for traffic safety while passing rivers, villages, and other sensitive areas.
- (iii) When accidents occur, vehicle operators will be required to report immediately to public security (the police) and the environmental authority and implement appropriate emergency measures according to relevant guides to minimize potential spread of the spilled materials.
- (iv) An emergency response team will be established to deal with accidents involving hazardous materials. The team will comprise fire departments, police, and environmental specialists. They will be trained to properly handle these accidents and to be familiar with necessary emergency measures such as prompt evacuation of nearby residents as needed.
- (v) An emergency phone system will be installed along the expressway for prompt reporting of environmental emergencies, as well as other accidents. The telephone number for the environmental emergency teams will be posted in each of the phone booths.

42. Despite the above measures, potential dangers remain and accidents involving hazardous materials could threaten the safety of people and pollute waterways and soils in the accident areas.

C. Noise

43. Mitigation of Noise and Residual Impact During Construction. The main noise sources during construction are construction machinery that generates noise from 82 dB(A) to 93 dB(A) as measured 5 m from running machines. At about 50 m, the noise levels are expected to reduce to levels within the daytime national noise standards of 70 dB(A) or below.

The noise will impact mostly construction workers and residents living within 50 m from the construction sites.

44. No machines will be allowed to work at night at sites 100 m from residential areas. Well maintained machinery with low noise level will be used where possible. Construction workers will be provided with personal protective apparatuses for noise protection. With the above measures, the residents living within 50 m from the project sites, excluding those who will be relocated, will still be affected by noise sometimes at levels exceeding the national standards. The impact however, will be limited to daytime and will completely disappear once construction activities end.

45. **Mitigation of Noise Impact and Residual Impact During Operation.** Using a mathematical model recommended by relevant highway EIA guides, noise levels in two expressway sections with district traffic projections were forecast for three phases: short, medium, and long term. The national noise standards (Classes II and IV for schools/hospitals and residential areas, respectively) of 60–70 dB(A) for daytime and 50–55 dB(A) for nighttime were used as threshold values for significant noise impact. The distances where these noise thresholds will be exceeded along the expressway are shown in Table 8.

Table 8: Distance from the Project Where Noise is at the National Thresholds (m)

Future Operational Year	Tanlou to Liutang		Liutang to Shangsong	
	Day	Night	Day	Night
Short-term	20	50–100	20	20–40
Medium-term	20–30	60–150	20	20–60
Long-term	20–50	80–180	20–30	40–80

m = meters.

46. The noise levels exceeding the applicable standards and the number of sensitive receptors exposed to higher-than-standard noise levels are shown in Table 9.

Table 9: Extent of Noise Impact by Expressway

Operational Time	Noise Exceeding Standards by dB(A)		No. of Sensitive Receptors	
	Day	Night	Day	Night
Short-term	2.2	0.4–12.2	1	18
Medium-term	2.4	0.3–14.4	1	25
Long-term	2.3–2.8	0.2–16.8	2	48

dB(A) = decibel (absolute).

47. In addition, noise levels in 65 sensitive receptors along the connector roads are predicted to exceed day and night noise standards by 0.5–11.5 dB(A).

48. Mitigation measures will be adopted for sensitive receptors where the noise levels are projected to exceed the applicable standards by 5 dB(A) or higher in the short term. After available mitigating measures are compared, the following will be undertaken, all during project construction: relocation of Xincun village, 150 m noise barrier at Nanwu village, and 100 m noise barrier for Shanglangxing village at a total capital cost of CNY1.9 million. Following these mitigating measures, noise at these impacted villages will be within the applicable standards. There will still be impacts at 15 other locations where no mitigating measures are planned, but

the impact levels will be 5 dB(A) or less for the short term. Noise monitoring will be in place to confirm the noise projection results and provide a basis for further mitigating actions. For impacts along the complementary roads, mitigating measures will include tree planting, increasing the heights of perimeter walls, and installing noise insulation windows. These measures will reduce noise impact by 3–15 dB(A) to acceptable levels.

49. **Positive Impact.** Much of the through traffic and the long distance regional traffic on the existing Nanning to Baise Class II road, which is approximately parallel to the proposed expressway, will be attracted and diverted to the expressway once it is completed. As a result, the noise level from this existing road is expected to be lower than the present level and the noise increase will be less than the without-project scenario, benefiting a large number of residents, as well as nine schools, four hospitals, etc. located near the road.

D. Atmospheric Environment

50. **Mitigation of Impact on Air Quality and Residual Impact During Construction.** The primary air emissions during project construction will be airborne dust from earthwork and handling of bulk materials, air emission from construction machinery and other motor vehicles, and air emission from pug mills. Air monitoring from another Guangxi highway project indicated that at 200 m from the source, TSP concentration is 0.47 mg/m³, exceeding applicable standards by 56%. At about 50 m from the construction machinery sources, the concentrations of CO and NO₂ are expected to meet applicable standards. Bitumen fumes from pug mills, containing total hydrocarbons, TSP and benzo-(α)-pyrene, is expected to be 8.4 mg/m³ at 50 m leeward, based on monitoring results from other projects, meeting applicable standards.

51. Pug mills will be located at least 300 m from residential and other sensitive receptors. The residual impact of pug mill emissions will be negligible except to construction workers. During dry season and in sensitive areas, disturbed soil, bulk materials, and truck roads will be watered to suppress dust. The residual impact of airborne dust will be limited to small areas close to these sites and will stop shortly after the end of materials-handling activities and truck traffic.

52. **Air Impact during Operation.** A Gaussian equation-based model was applied to forecast NO₂ from traffic on the expressway for Class D atmospheric stability, which is dominant in the project area. The results under calm (worst) conditions for 60 m from the expressway are shown in Table 10.

Table 10: NO₂ Concentrations during Expressway Operation
(mg/m³)

Operation Year	Tanlou to Liutang		Liutang to Shangsong	
	Peak Hour	Daily Average	Peak Hour	Daily Average
2007	0.051	0.034	0.030	0.045
2013	0.052	0.081	0.044	0.068
2021	0.082	0.127	0.067	0.104

mg/m³ = milligrams per cubic meter.

53. Compared with the applicable Class II ambient air quality standards for NO₂—0.24 and 0.12 mg/m³ hourly and daily averages, respectively—the ambient air quality will meet the standards, indicating low impacts of expressway traffic on air quality. Model for all sensitive

receptors under different climate conditions also confirmed this finding, as none of the receptors will exceed the applicable air quality standards. However, the forecast NO₂ concentrations are higher than the baseline and there will be increased emissions to the ambient air due to anticipated increased motor vehicle traffic, following the opening of the expressway.

54. **Positive Air Quality Impact.** Although air quality will be impacted adversely in areas immediately adjacent to the expressway, which now have little emission sources, the total motor vehicle emission will be reduced from a regional perspective. According to an MOC technical guides,¹² light passenger vehicles driven at 100 km/h, the likely average speed on the expressway, will reduce CO emission by over 75% and hydrocarbons (HC) by about 51% compared with vehicles driven at 50 km/h which may be the typical average speed on the present Class II G324. Although NO_x emissions may increase with increased speed on the expressway, greatly reduced acceleration/deceleration on the expressway would reduce NO_x emissions more than enough to offset the increase in speed. In addition, much of the motor vehicle emissions will be moved from the G324 corridor to the less populous expressway corridor. As a result, air quality is expected to improve along the more densely populated G324 alignment.

55. **Motor Vehicle Emission Control.** Motor vehicle emission control is a multisector, policy-sensitive, and regional measure for mitigating increased air emission on the expressway. GZAR has in place a motor vehicle emission control program including a GZAR-wide inspection and maintenance (I/M) system, cleaner fuel, and mandatory retirement of old vehicles. The I/M program, operated by the GZAR traffic police, covers 100% of motor vehicles registered in GZAR annually (biannually for those 6 years old or newer). But the cleaner fuels including compressed natural gas and liquefied petroleum gas are implemented mostly in large cities including Nanning and Baise. Motor vehicles run between cities rarely convert to these fuels due mainly to the lack of a network of fueling stations along all expressways. GCD may initiate a study in the TA program during project implementation. This will study further options and the feasibility of motor vehicle emission control measures that can be adopted by the expressway company, besides the general support to GZAR efforts for motor vehicle emission control, through participation of its own motor vehicle fleet and facilitation of initiatives such as roadside spot tests at the expressway.

E. Socioeconomic Impacts

56. **Mitigation of Land Severance and Residual Impact.** The fully fenced, limited-access expressway will separate some farmland from farmers and some villages from one another on both sides of the alignment. It would limit the access of some farmers to their fields and some rural residents to schools, markets, services, and relatives and friends. About 70 villages will be affected by the severance. A large number of irrigation systems and other rural infrastructures will also be divided by the expressway.

57. A total of 383 grade-separate crossings, including underpasses, overcrossings, and interchanges will be constructed along the expressway at an average of 1 per 0.49 km. The majority of the crossings are designed to be at existing roads and are based on location of the affected communities and the need for agricultural and social activities. The Project will also include 41 bridges above waterways and other roads, and 693 culverts to minimize the impacts of divided irrigation systems and storm water drainage systems. As residual impacts, rural pedestrians who otherwise could walk to their destinations through fields will have to walk not

¹² MOC. 1996. *Specifications for Environmental Impact Assessment of Highways JTJ 005-96*. Beijing.

more than 0.25 km on average to one of the crossings. Also some farmland originally cultivated as one parcel will be split into two.

58. **Mitigation of Navigation Impact and Residual Impact.** The Youjiang River presently carries 670,000 t of material and some passenger traffic each year, and there have been no major navigation traffic accidents since the 1980s. The expressway, which will cross the river seven times could narrow the navigation channels and increase the risk to barges and ferry vessels.

59. All seven bridges will be designed to Class III navigation standard, which is the current navigation classification on Youjiang River. Navigation stations to be constructed in front of the bridges will provide better navigation guides to passing vessels. Other navigation marks will be provided for water traffic. With these measures properly implemented, the impact to navigation will be minimal.

60. **Mitigation of Visual Impact and Residual Impact.** The expressway and intercounty roads in the complementary road components will cut through the natural landscape or farmland and destroy some vegetation. Interchanges and other large structures will stand out in the rural and mountainous background. The borrow pits will need clear cutting and will slice into the mountains, while disposal sites will create dumps that will have adverse impacts on the local landscape and scenery.

61. The expressway and intercounty road alignments were selected in such a way that they will, to the extent possible, harmonize with the topography, terrain, and landscape of the project area. Disturbed areas such as expressway side slopes, cut areas, borrow pits, disposal sites as well as large open areas near the interchanges will all be landscaped with local species of vegetation. Project architecture, including the alignment itself, bridges, interchanges, toll plazas, service area buildings, etc. were designed to integrate them into the surrounding environment and for environmental aesthetics. The roadside curbs in the mountain areas will be gradually and naturally connected with the natural hill slopes. While modern structures may intrude in the natural setting of the project area, the disturbance to overall aesthetics and the scenery will be minimized.

62. **Mitigation of Cultural Relics Impacts and Residual Impact.** The expressway will pass 17 Paleolithic ruins and sites in the Baise valley, including the controlled construction zone of a national site as well as part of one county-level site, six important sites, and nine normal sites. In total, the expressway will occupy 196,000 m² of the 17 Paleolithic sites, accounting for 0.6% of the total area of those sites. For some individual sites, the occupied proportion is larger—up to 1–1.3%. The national-level site is in this category. The cultural relics sites, particularly those at the higher protection levels, have significant values in the study of human origin and early tools used by people in ancient times and the evolution of human beings and human history. In addition, two areas where the expressway will pass are suspected to have potential cultural relics or value based on the initial site survey by professional archaeologists. Constructing the expressway on these sites will destroy the area it directly occupies and may irreversibly destroy stone tools and other Paleolithic relics at or underneath the occupied areas. It will split the site, which may also have archaeological and cultural value and affect the site's integrity. In addition to the 17 Paleolithic sites, the expressway may also encounter and occupy during construction similar Paleolithic sites that are currently unknown to the authorities or specialists since a large proportion of the expressway alignment will be going through the Baise Paleolithic Region, an area 100 km long and 15 km wide along the Youjiang riverbanks across Baise, Tiandong, and Tianyang cities/counties. Further impacts could result if inappropriate measures are used to

protect relics and sites in a chance find during construction. Constructing the expressway at those sites is not prohibited by law (not going through any core zone of the protected sites), but it does require review and approval by the cultural authority, especially the high-value sites at the national and county levels. No known major cultural relics sites have been found at the time of this EIA.

63. The most effective mitigating measure is to avoid occupation of cultural relics sites in the first place. The EIA and archaeological teams worked with the design engineers during the feasibility study and alignment selection stages in an attempt to avoid the occupation of such sites. Through this effort, six sites were spared through changes in alignment, and the affected sites were reduced from 23 to 17. For the 17 sites that could not be avoided, protective excavation will be carried out before construction starts in accordance with applicable cultural relics protection laws and regulations. The excavation will unearth cultural relics from the occupied areas, and remove and preserve them in the local museums. The initial archaeological study of the expressway alignment area by a professional team of archaeologists indicates that the area requiring protective excavation will be 65,800 m² at an estimated cost of CNY19 million. With protective excavation, the cultural relics will be preserved. The sites will still be split and occupied, but the occupied area may not have any Paleolithic pieces. Archaeological exploration will be conducted at the two suspended sites before construction to determine their value, if any. With regard to chance finds during construction of the expressway and complementary roads, a strict protection procedure will be developed and implemented according to applicable laws and regulations. This procedure will immediately stop all construction activities at the site where cultural relics may be found. Relevant cultural authority and specialists will be called to inspect and study the sites and cultural relics discovered and adopt necessary protective measures. Construction activities will not resume without the cultural authority's approval. Contractors will be trained provided to familiarize them with the applicable cultural relics protection laws and regulations and the procedures for chance finds.

64. **Economic Development.** The Project will improve the infrastructure in the region to attract outside investments for the exploration of the abundant agricultural, mineral, and hydro resources in the region. Economic benefits will include higher efficiency in transporting local raw materials and finished goods to local and outside markets. More tangible and immediate benefits will be the increased employment opportunities directly related to construction and operation. Of an estimated 900,000 person-months of unskilled labor required for expressway construction, 50% will come from the local labor force. A higher proportion of the labor required from the connection and complementary roads will be from the local markets. Indirect employment related to services, vendors, etc. will generate additional income during the construction period. In the operational stage, an estimated 200 permanent employment positions related to highway maintenance, toll station operation, policing, cleaning, etc. and additional indirect employment positions from increased tourists and economic expansion will be created in the region.

65. **Poverty Reduction.** Poverty can be defined broadly as a complete lack or inadequacy of some or all social, physical, human, financial, and natural resource assets as well as lack of money. Lack of money, however, is not the cause, but rather a manifestation of poverty. The construction and operation of the expressway, connector roads, and complementary rural roads will reduce poverty in many of the above listed assets as well as increase income. The contribution will be achieved through income and employment opportunities created during construction and operation, improved transportation infrastructure, easier access to services and marketplaces, and improved conditions to attract outside investments. More important, the expressway will expose farmers in the remote and isolated region to modern infrastructure that

will help boost their confidence in their ability to improve their own life quality and change their attitude toward opportunities, challenges, and their integration into the fast-growing economies.

VI. ECONOMIC ASSESSMENT

66. Total environmental management and impact mitigation costs are estimated at CNY399 million (including CNY327 million for soil erosion control, which has already been included in the project civil work budget). Details are in Table 11. Besides the mitigation costs, the costs for all environmental monitoring programs, estimated to be CNY0.9 million for the 3-year construction period, are included in the total costs. This is approximately 5.6% (1.2%, excluding soil erosion control measures) of the total capital costs (CNY5.88 billion) for the Project. In addition, the Project will compensate for the land acquired for the expressway and houses and other rural facilities dismantled to minimize the impact of the resettlement. The total resettlement compensation costs are estimated to be CNY625 million (\$75.5 million).

Table 11: Project Impacts, Mitigation Measures, and Monitoring Requirements

Impacts		Pollution Sources	Pollutant or Parameter	Mitigation Measures and Estimated Costs	Applicable Standards	Monitoring Frequency and Responsible Party
Noise	Construction Period	Heavy equipment operations; truck movements	82-93 dBA (5 m)	Routine maintenance; location of noisy machinery such as power generators away from sensitive receptors; selection of access roads; temporary noise barriers if necessary Estimated costs: at contractors' expenses	GB 12523-90	Daily monitoring by contractors; Quarterly monitoring by environmental monitoring institutions
	Operational Period	Traffic on expressway	50-80 dBA (road side)	Relocate sensitive receptors Estimated budget: CNY1 million (included in the project resettlement budget) Erect a total of 250 sections of noise barriers Estimated costs: CNY0.9 million	GB3096-93	Annual inspections by environmental monitoring institutions
Wastewater	Construction Period	Surface runoff and in-water construction; Domestic and industrial wastewater from construction camps	SS, COD, BOD, petroleum, etc.	Septic tanks and environmental management systems at construction camps; Cofferdam methods for bridge pier construction; Estimated costs: at contractors' expenses	GB8978–1996 Grade III standards	Annual monitoring by environmental monitoring institutions
	Operational Period	Domestic and industrial wastewater from service and administration areas; Hazardous materials spills or truck overturn to rivers from traffic accidents involving tanker trucks loaded with hazardous materials.	COD, BOD, petroleum, hazardous materials.	Septic and other primary treatment Reinforced guardrails and catchbasins on bridges to diverted any spilled materials to holding tanks for further treatment; Hazardous materials transportation management; Emergency response plans Estimated costs: CNY4.25 million	GB8978–1996 Grade III standards	Twice yearly monitoring by environmental monitoring institutions
Air Pollution	Construction Period	Dust and exhaust air emission from construction machinery and vehicles and hog mills	TSP, NO ₂ , SO ₂ .	Water sprays regularly, good maintenance of machinery and maintenance Estimated costs: at contractors' expenses	GB3059-1996	Twice annually by environmental monitoring institutions

Impacts		Pollution Sources	Pollutant or Parameter	Mitigation Measures and Estimated Costs	Applicable Standards	Monitoring Frequency and Responsible Party
	Operational Period	Motor vehicle emissions	TSP, NOx, CO	Motor vehicle emission control action plan	Vehicle emission standards	-
Soil Erosion and Vegetation	Construction Period	Damaged vegetation Disturbed surface soil Borrow pits and disposal sites	t/km ² a of soil lost	Retaining walls, interception ditches, pavement, re-cultivation, landscaping, restoration and reclamation Estimated costs: CNY327 million (included in the project civil works budget)	Good engineering practice	Regular inspection by GZAR EPB
		Lost trees, wood land, grass and other green areas	No. of trees Green areas	Re-vegetation and landscaping Estimated costs: CNY46.2 million (included in the project civil works budget)	Good landscaping practice	Regular inspection by GZAR EPB
Cultural relics	Construction period	Occupying paleolithic sites	Site occupation	Protective excavation Estimated costs CNY19 million	Good archaeological practice	Regular inspection by GZAR Cultural Bureau

BOD = biochemical oxygen demand, CO = carbon monoxide, COD = chemical oxygen demand, dBA = decibel acoustic, EBP = Environmental Protection Bureau, GB = *guojia biaozen* (national standard), GZAR = Guangxi Zhuang Autonomous Region; NO₂ = nitrogen dioxide, NO_x = nitrogen oxides, SEPA = State Environmental Protection Administration, SO₂ = sulfur dioxide, SS = suspended solid, t/km²a = tons per kilometre squared per year, TSP = total suspended particulate.

67. The direct environmental and socioeconomic benefits of this Project include improved air quality in the region—assuming the same amount of traffic with or without the project—due to improved motor vehicle operation efficiency on the expressway, reduced environmental impacts near G324, creation of a large number of short- and long-term jobs in the local economy, and improved traffic safety on G324. The investments in environmental management and impact mitigation will also benefit the natural and socioeconomic environment by minimizing and offsetting the adverse impacts from the project and ensuring environmental control standards will be met despite disturbances from expressway construction and operation.

VII. ENVIRONMENTAL MANAGEMENT PLAN

68. This environmental management plan (EMP) was prepared for this Category A type Project in accordance with relevant government requirements and ADB policies. The executing agency will ensure and monitor the implementation of the EMP and will prepare monitoring reports twice a year to summarize EMP implementation. An organizational chart for EMP was developed for this Project. It involves the:

- (i) GZAR Communication Department (GCD);
- (ii) Environmental Protection Bureau (EPB), GZAR;
- (iii) Nanning to Baise Expressway Construction Commanding Office;
- (iv) design institutes for the expressway and various environmental control facilities;
- (v) local environmental supervision organizations; and
- (vi) construction supervision companies and contractors.

69. Environmental staff will be in the project construction management office of the GCD for environmental management during the construction phase, and their duties will be transferred to the expressway company to be established during the operation stage. Environmental monitoring will be carried out by a qualified environmental monitoring institution during construction and operation. The technical, and some management staff will be trained in environmental monitoring, interpreting monitoring results, planning mitigation, environmental policy making, and other environmental management techniques, to enhance environmental management and assist with capacity building.

70. At the project feasibility and design stage, the environmental supervision engineers ensured that environmental protection was fully considered in designing and selecting the alignment. Environmental engineers will be engaged to supervise project design and construction, and implementation of all mitigating measures requested by the project EIA and EMP and in accordance with ADB's safeguard policies and environmental guidelines. The major task of the environmental supervision engineers will be at the construction stage when they will be on site full-time. Their duties will be to (i) supervise the execution of the environmental protection and impact mitigating measures by the contractors, (ii) supervise construction activities to ensure minimum impacts to the surrounding natural and socioeconomic environments, (iii) assist in monitoring the impacts of the construction works and prepare remedial actions as may be necessary, and (iv) supervise implementation of the reclamation plan.

71. Table 11 summarizes the mitigating measures, costs of mitigation, as well as environmental monitoring programs. Results of monitoring at both construction and operational stages will be submitted first to the responsible organizations: the Project Commanding Office during construction and GCD or the expressway company during operation. The Project Management Office and the expressway company will review the monitoring results and, if

necessary, decide on further mitigating actions during construction and operation, respectively. All results, including additional mitigating actions taken and action results, will also be copied to EPBs of each county/city involved, as well as GZAR EPB, and ADB. These institutions may also request that actions for environmental mitigation be taken as they see necessary.

VIII. PUBLIC INVOLVEMENT AND DISCLOSURE

72. The first round of public participation in the expressway project consisted of a series of interviews, household visits, and an opinion survey through a questionnaire in September 2002 when 250 copies of the questionnaire were distributed. The focus of public consultation was on the people who will be directly affected by project construction and operation, including peasants, township and village heads, doctors, teachers, and vendors in the communities along both sides of the proposed expressway alignment. Other stakeholders, including local governments and agencies responsible for environmental protection, agriculture, forests, etc., were also consulted for their opinions on the expressway impact and inputs in environmental management and impact mitigation.

73. During October 2003-January 2004, the project preparatory technical assistance (PPTA) consultants together with the local EIA, social assessment, RAP, and GCD staff conducted another round of public consultation. This round involved household interviews, and visits to project-affected farmers and other members of the local communities. Besides environmental concerns, the second round of consultation also sought public opinion on social issues and project resettlement impacts and compensation practices.

74. There have also been many rounds of consultation with government agencies, local governments, various organizations, and other stakeholders to discuss expressway alignments, location of the interchanges and entrances/exits, environmental and socioeconomic concerns, and environmental management and mitigation plans. A detailed summary of all public participation programs is presented in Appendix 2.

75. From the results of the household visits, interviews, and completed questionnaires, major public opinion and concerns about the Project can be summarized as follows:

- (i) About 86% of the people who responded to the questionnaire supported the expressway project and considered it a necessity to promote economic development and poverty reduction in the region and wanted construction to start soon.
- (ii) The affected farmers expressed their demand for minimal occupation of cultivated land. The bridges and culverts will be reasonably constructed to minimize soil erosion and disruption of the local irrigation systems.
- (iii) The vast majority expressed their willingness to accept the land acquisition and resettlement plan so as to provide the required land for the expressway. However, those who would be affected wanted the compensation and land acquisition costs to be fair, to comply with relevant state and provincial policies, and to be paid on time and in full to the head of the households that will be demolished and relocated.
- (iv) The primary environmental concern expressed by the public is noise, followed by motor vehicle emissions and dust. Traffic safety is also a concern and local rural residents have requested that adequate crossings over the expressway be constructed for convenience in everyday life and agricultural activities and to minimize risks in attempting to cross fences.

- (v) The interchange location and design should comply with the city plans of the counties and townships to enable the local communities to best utilize the expressway and promote local economic development.

76. The issues and concerns raised by the public through the public participation program have been appropriately addressed during the EIA and mitigation planning. Specific mitigating measures were designed to avoid or minimize the adverse impacts. The public is most concerned about specific implementing time tables and budgets. Concerns that are beyond the scope of the EIA, such as a resettlement plan and protection of existing infrastructure during construction, have been conveyed to relevant authorities.

IX. CONCLUSIONS

77. The fully fenced, limited-access Nanning (Tanluo)-Baise expressway will lower transportation cost and reduce travel time. The complementary roads will significantly aid the poor in the poverty villages by greatly improving their access to marketplaces. The expressway will serve as part of the national highway network and, together with the connector and complementary roads, significantly improve the regional transportation infrastructure, making the region more attractive to further development and outside investments. The construction and operation of the expressway will bring a large amount of direct and induced employment and other income opportunities to the local economy.

78. From the regional perspective, the Project will reduce motor vehicle emissions as a result of improved motor vehicle engine efficiency when operating on the expressway, compared with the without-project scenario. As much of the traffic on G324 will be diverted to the expressway, noise levels, air emissions, and traffic accidents along the existing road are expected to decline, benefiting a large number of people, as well as schools, hospitals, and other sensitive receptors near G324.

79. The adverse impacts generated by the expressway will be avoided or reduced to acceptable levels through appropriate mitigation and compensation measures. Main measures include a reforestation and landscape program along the project alignments to compensate about 24% of green field lost to the project; construction of 383 grade separated crossings over or under the expressway to mitigate agricultural field and rural community separation; construction of wastewater treatment facilities in service areas; construction of noise barriers to attenuate noise levels; development of sound environmental programs during construction to mitigate such impacts as noise, dust, and soil runoff during construction and operation phases; and establishment of an environmental emergency plan to minimize impacts of motor vehicle accidents involving hazardous materials.

80. Some adverse impacts, while mitigated to acceptable levels, are still noticeable even after the mitigating measures. These include permanent loss of about 1,430 ha of land, loss of 1,188 ha of farmland, increased noise and air emissions that affect mostly rural residents living near the expressway alignment, and accidental releases of hazardous materials from tanker trucks on the expressway.

81. To protect the environment from anticipated adverse impacts and to decide whether to take further actions to mitigate impacts where needed, noise, air quality, and water quality will be monitored during construction and operation. The monitoring stations will be located in sensitive areas such as villages, schools, and rivers along the alignment.

SUMMARY RESETTLEMENT ACTION PLAN

1. The Guangxi Roads Development II Project will finance the construction of 187.6 kilometers (km) expressway between Nanning City and Baise City, 25 km of connector roads, 245 km of intercounty roads, and 500 km of village roads. Upgrading the intercounty roads and village roads is not expected to require much, if any, land acquisition or resettlement. The Guangxi Zhuang Autonomous Region (GZAR) Government has assured the Asian Development Bank (ADB) that if additional farmland is required for the local roads, the affected people will receive compensation and other assistance as stipulated in the resettlement plan.
2. The Guangxi Communications Department (GCD) is the Executing Agency and the Nanning Baise Expressway Construction Office (NBECO) will be the Implementing Agency. The Nanning and Baise governments will implement the resettlement plan supervised by NBECO. The resettlement plan is expected to be approved by GCD, on behalf of the Guangxi government in May 2004.
3. The proposed expressway and its connector roads will affect 18 townships, 70 administrative villages, and 503 village groups in Nanning City's Yongxin District and Long'an county, and Baise City's Pingguo county, Tiandong county, and Tianyang county in Youjiang District. The Project will adversely affect about 9,000 persons. Nearly 1,430 hectares (ha) of land will be acquired, 83% of which will be farmland, 11% forestland, and 6% wasteland. Farmland comprises paddy land (22.9%), vegetable land (0.05%), sugarcane land (27.4%), other dry land (24.7%), fishpond (1.3%), and orchards (23.6%). Land acquisition will directly affect the equivalent of 2,358 households. Another 313 ha will be occupied temporarily during the construction phase.
4. A total of 41,021 square meters (m²) of houses will be demolished and 360 households relocated. About 19.9% of the affected houses are brick concrete structures and 77.3% are brick timber structures. Relocation will give relocated households the opportunity to improve current housing conditions. These households will be moved a short distance to another site within their original village. Other affected assets include telecommunications and electrical infrastructure, tombs, and trees. All land, housing, and other assets will be compensated at replacement value.
5. For people unavoidably affected, the resettlement objective is to achieve equal, or better, income and living standards in line with the Land Administration Law (1998) of the People's Republic of China and ADB's policy on involuntary resettlement and indigenous people's policy. GCD will ensure that any people losing land, housing, other assets, or income source will be helped to fully restore their income and living standards. The resettlement plan stipulates entitlements for land compensation, resettlement subsidies, crop compensation, house compensation, and resettlement measures. Given the poverty in the region and the compensation standards used for other expressway projects, GCD has proposed higher standards: CNY11,628–24,759/mu for paddy land, CNY10,681–23,680/mu for sugarcane land, and CNY9,108–18,820/mu for other dry land. For structures to be demolished, replacement value to the affected households will be CNY300/m² for brick concrete structures and CNY210/m² for brick timber structures. Those who lose their houses will be given free new housing with roads, electricity, and water. Housing compensation will not be reduced for depreciation, and people will be allowed to salvage materials from their old houses.
6. Resettlement effects were minimized by consulting with local officials during selection of alignment in the initial feasibility study. The impacts of land acquisition are spread among 70

administrative villages, so the losses are not significant and can be replaced. Most of the affected people will remain in native rural areas and will receive replacement land and cash compensation based on the feedback from more than two thirds of villagers surveyed in each village group. If the compensation for land acquisition is used collectively, village groups will use the funds to improve farms, develop cash crops, and invest in various nonfarm activities.

7. Of 503 affected village groups, 10 were identified as seriously affected. The decision to restore and improve the agricultural economy was based on consultation with the affected people. New employment and income-generating opportunities will also arise once the expressway is constructed and the local roads improved. The people generally felt confident that this strategy would lead to faster economic growth, higher incomes, and better living conditions.

8. Resettlement regulations have standard provisions for moving allowances to help affected people during the transitional period. GCD will request expressway contractors to give priority to households affected by resettlement in the allocation of unskilled jobs during construction. This will be arranged through consultation with local leaders.

9. The Guangxi government will assume overall responsibility for implementing resettlement. A resettlement office within NBECO will coordinate the planning, implementation, financing, and reporting of land acquisition and resettlement for the expressway, connector roads, intercounty roads, and village roads. Leading groups for resettlement were established at city and county or district levels. The county or district resettlement offices have primary responsibility for resettlement consultation, implementation, and timely delivery of entitlements.

10. The vulnerable people affected by the Project include (i) the ethnic minorities other than Zhuang; and (ii) the economically vulnerable households—those with incomes below the poverty line, the elderly living alone, the disabled, and households headed by women. For those people, special measures will be provided to restore their livelihoods and living conditions in the traditional manner (e.g., to maintain their settlement pattern and building style, larger housing plots will be permitted). Ethnic minority officials were selected to handle resettlement matters, and the local minority affairs administration will be involved, thereby enhancing the participation of ethnic minority households. Ethnic minority committees will be another channel in voicing possible grievances of minorities.

11. For economically vulnerable people, the Project will provide additional financial and physical support. Those households will receive (i) physical help to build their houses and relocate, and (ii) special measures to enable them to maintain their living standards while building houses. The resettlement plan includes a special fund of 1% of the total resettlement budget to directly help vulnerable people.

12. The 1998 Land Law requires disclosure and consultation with affected people. The affected people were notified about the key elements of the resettlement plan during meetings and interviews. Before implementation, township and village officials will arrange further consultations to discuss specific impacts in each village group and how they will be addressed. People losing their houses will be offered a choice of housing sites, and those losing agricultural land will have a choice of suitable income replacement alternatives. All villagers will help decide how to utilize the collective compensation funds.

13. In mid-March 2004 a resettlement information booklet was distributed to all affected townships and villages, and was discussed with households. The information booklet contains

the resettlement scope, project schedule, compensation rates for land and other assets, other assistance to replace assets, relocation and economic rehabilitation strategies, and the grievance redress mechanisms.

14. In case of a grievance, affected people will submit their oral or written complaint first to the village committee or the township resettlement office. If their complaint is not settled in 2 weeks, they can seek redress at the county resettlement office within 1 month. If the grievance is still unresolved, NBECO will try to solve the problem. Final redress will be sought, if necessary, in the civil courts, in accordance with the Civil Procedures Act.

15. NBECO will engage the services of an independent monitoring agency to ascertain that the affected people have (i) received their full entitlements on time; and (ii) fully restored their livelihoods, income levels, and living standards. The monitor will conduct a baseline survey before resettlement, semiannual investigations during resettlement, and annual survey updates for 2 years after resettlement is completed.

16. NBECO will establish a reporting system and report to ADB on the progress of land acquisition and resettlement through quarterly reports. NBECO will provide ADB with copies of the semiannual independent monitoring and evaluation reports. NBECO and ADB will established a set of resettlement supervision milestones.

17. The resettlement plan budget is CNY575 million (\$69.4 million equivalent). GCD has guaranteed to supplement the resettlement budget, if necessary, to meet any shortfall in achieving the resettlement objectives.

18. The resettlement implementation schedule was prepared based on the project construction timetable. Land acquisition will start in September 2004 and will be completed in early 2005. Households will be relocated from July to December 2004, providing time to develop some new agricultural land and readjust farmland in early 2005, and to fully restore livelihoods and living conditions by 2006.

SUMMARY PUBLIC CONSULTATION AND PARTICIPATION ACTIVITIES

Agencies/Groups	Form	Date	Main Issues Discussed
Villages along expressway Farmers, doctors, teachers, merchants, officials and other local residents along expressway	Group meetings Household interview Questionnaire	September 2002	General opinions on the project Opinions on resettlement Major environmental concerns from construction and operation Suggestions from the public on mitigation measures
Environmental, agriculture, forest agencies of Longan, Pingguo, Tiandong, Tianyang counties; governments of towns along expressway	Meetings	September 2002	Expressway alignment and interchange locations Major environmental concerns from construction and operation Suggestions from the public on mitigation measures
Guangxi Forest Bureau	Meetings, interviews	29 March 2003	Wildlife distribution in the project area Selecting the alignment with considerations to protecting special species of plants and animals
Guangxi Forest Bureau, Water and Soil Conservation Division	Interviews	30 March 2003	Soil erosion baseline and control measures Project soil erosion impacts Erosion control measure for expressway construction
Pingguo County government; Pingguo environmental, state land, forest, statistics, agricultural, cultural, construction bureaus	Meetings	1 April 2003	Selecting the alignment Potential impacts on water, land, agriculture, forest Project coordination Major project impacts
Tiandong County government; Tiandong environmental, state land, forest, statistics, agricultural, construction, cultural bureaus	Meetings	1 April 2003	Selecting the alignment Potential impacts on water, land, agriculture, forest Project coordination Major project impacts
Agricultural, forest, hydrology, planning, communications, commerce bureaus of Baise	Meeting	3 April 2003	Consultation on alignment selection Stakeholder interests Expressway construction impacts Interchange locations
Tianyang county government; Tianyang environmental, state land, forest, statistics, agricultural, construction, cultural bureaus	Meetings	4 April 2003	Selecting the alignment Potential impacts on water, land, agriculture, forest Project coordination Major project impacts
Longan county government; Longan environmental, state land, forest, statistics, agricultural, construction,	Meetings	5 April 2003	Selecting the alignment Potential impacts on water, land, agriculture, forest Project coordination Major project impacts

Agencies/Groups	Form	Date	Main Issues Discussed
cultural bureaus			
Guobei Middle School	Meetings	10 April 2003	School baseline Impacts of construction (noise, safety, access, air quality, etc.) Mitigation measures
Yongan village	Meetings	10 April 2003	Village conditions Impacts to village life (noise, air, separation, irrigation, resettlement, etc.) Mitigation measures
Guangxi Environmental Protection Bureau (EPB)	Meeting	December 2003	General Guangxi Zhuang Autonomous Region (GZAR) policies and regulations on motor vehicle emission control Key emission control programs in GZAR Expressway project involvement in the motor vehicle emission control programs
Guangxi Traffic Police Brigade	Meeting	January 2004	GZAR-wide motor vehicle inspection and maintenance (I/M) programs and old vehicle scrap programs Opinions and suggestions on the role of expressway project in the I/M programs
Guangxi Culture Bureau Guangxi Archaeological Investigation Brigade	Meeting	January 2004	Impacts of the expressway on the Paleolithic ruin sites Results of cultural relics impact study and mitigation plans Government policies and positions on cultural relics protection Additional concerns State and provincial review and approval procedure Archaeological investigations
Tiandong county government; Tiandong county communications bureau, Tiandong county museum	Meeting and interviews	February 2004	Visit to the national-level Paleolithic site Potential concerns for cultural relics impact and protection Selecting the alignment
Guangxi EPB	Interviews	February 2004	Project review and approval of environmental impact assessment (EIA) Motor vehicle emission control policies, programs, initiatives Possible programs for the expressway project for motor vehicle emission control