

SUMMARY ENVIRONMENTAL IMPACT ASSESSMENT

**SOUTHERN YUNNAN
ROAD DEVELOPMENT PROJECT**

IN

THE PEOPLE'S REPUBLIC OF CHINA

February 1999

CURRENCY EQUIVALENTS

(as of 1 January 1999)

Currency Unit	-	Yuan (Y)
Y1.00	=	\$0.1208
\$1.00	=	Y8.2789

ABBREVIATIONS

EIA	-	Environmental impact assessment
GMS	-	Greater Mekong Subregion
GDP	-	Gross Domestic product
HIV/AIDS	-	Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome
Lao PDR	-	Lao People's Democratic Republic
LTEP	-	Leading Team for Environmental Protection
MPDP	-	Minority People's Development Plan
MTE	-	Medium Truck Equivalent
NH	-	National Highway
PRC	-	People's Republic of China
RRP	-	Report and Recommendation of the President to the Board of Directors
TVE	-	Township and Village Enterprises
XNR	-	Xishuangbanna Nature Reserve
YMEC	-	Yunnan YuanMo Expressway Company
YPCD	-	Yunnan Provincial Communications Department

WEIGHTS AND MEASURES

°C	-	Degrees Celsius
dB(A)	-	Decibels A (audible decibel)
ha	-	Hectare
km	-	Kilometer
m	-	Meter
NOx	-	Nitrogen Oxides

GLOSSARY

Expressways	Annual average daily traffic (AADT) greater than 25,000 private car units (PCU)
Class I highways	AADT from 15,000 to 30,000 PCU
Class II highways	AADT from 6,000 to 15,000 PCU
Class III highways	AADT from 2,000 to 8,000 PCU
Class IV highways	AADT less than 3,000 PCU

NOTE

In this report, the symbol "\$" refers to the US dollar.

CONTENTS

	Page
MAPS	ii
I. INTRODUCTION	1
II. DESCRIPTION OF THE PROJECT	1
III. DESCRIPTION OF THE ENVIRONMENT	2
A. Physical Resources	2
B. Ecological Resources	3
C. Human and Economic Development and Quality of Life Values	3
IV. ALTERNATIVES	5
A. Overall Expressway	5
B. Expressway Segments	5
V. ANTICIPATED ENVIRONMENTAL AND SOCIAL IMPACTS, AND MITIGATION MEASURES	6
A. Health and Safety	6
B. Topography, Geology, and Soils	6
C. Groundwater and Surface Water	8
D. Flora and Fauna	9
E. Land Acquisition and Resettlement	10
F. Ethnic Minorities	10
G. Feeder Roads	12
H. Other Social Considerations	12
I. Expected Positive Project Impacts	12
VI. ECONOMIC ASSESSMENT	13
VII. INSTITUTIONAL REQUIREMENTS, AND ENVIRONMENTAL AND RESETTLEMENT MONITORING PROGRAMS	14
A. Environmental Aspects	15
B. Land Acquisition and Resettlement Aspects	15
VIII. PUBLIC INVOLVEMENT	16
IX. CONCLUSIONS	17

I. INTRODUCTION

1. This summary environmental impact assessment (EIA) outlines the principal findings and recommendations of environmental impact studies on the proposed Project as of the end of October 1998. The information in this summary EIA relies on analyses prepared for the Yunnan Provincial Communications Department (YPCD) of the People's Republic of China (PRC) in four substantial volumes, which are English language translations of detailed reports in the Chinese language: (i) the *Engineering Feasibility Study Report: Yuanjiang-Mohei Motorway Project* prepared by the Yunnan Provincial Highway Planning, Survey and Design Institute, September 1996; (ii) the *Environment Assessment Statement: Yuanjiang (Ertangqiao)-Mohei Grade 1 Motorway* prepared by the Highway Research Institute of the Ministry of Communications, October 1996; (iii) the *Supplementary Engineering Feasibility Study Report* prepared by Yunnan Provincial Highway Planning, Survey and Design Institute, April 1998; and (iv) the *Supplementary Social and Environment Assessment: Yuanjiang-Mohei Expressway Project* prepared by Highway Research Institute, July 1998. The EIA prepared for the Project was approved by the Government on 26 June 1997.

2. The information presented in these documents was supplemented and verified by site inspections and extensive dialogue with local officials and residents by international consultants in September and October 1998. Site visits included travel along the entire length of National Highway (NH) 213 from Kunming to Simao. During this trip, the consultant (i) observed construction work ongoing to improve the roadway to expressway standard between Kunming and Yuxi, (ii) studied current conditions as well as the proposed new expressway alignment between Yuanjiang and Mohei, and (iii) investigated new traffic patterns in the Mohei-Simao corridor on the recently opened (1996) class 2 toll road and on the older, longer alignment that is maintained at class 3 and class 4 standard.

II. DESCRIPTION OF THE PROJECT

3. The principal objective of the Project is to promote the economic and social development of the southern part of Yunnan Province by removing serious congestion and improving safety on a key section of NH213. As a secondary objective, the Project will improve access to poor and disadvantaged communities in designated poverty counties and townships. The Project will also commercialize expressway operations, collect sufficient toll revenues to ensure cost recovery, enhance operations, enhance highway design standards and construction quality, and improve road safety. A long-term objective of the Project is to support regional cooperation in the Greater Mekong Subregion (GMS) by improving a section of the road link between Kunming in Yunnan Province of the PRC and Chiang Rai in Thailand. Project implementation is expected to begin in September 1999 and will take about four years to complete.

4. The Project scope includes (i) constructing a new controlled access toll expressway between Yuanjiang and Mohei in Yunnan Province (see Map 1); and (ii) upgrading feeder roads in designated poverty areas in Yuanjiang, Mojiang, and Pu'er counties (see Map 2). The Project is comprised of the following components:

- (i) civil works for (a) constructing about 147 kilometers (km) of four lane controlled access toll expressway, including nine interchanges, large and medium bridges totaling about 25,300 meters (m), tunnels totaling about 12,300 m, and five service areas; (b) upgrading about 540 km of feeder roads; and (c) procuring equipment for traffic engineering and surveillance, toll collection, road maintenance and safety, communications, and power supply;

- (ii) acquisition of about 870 hectares (ha) and resettlement of about 1,570 people in 338 households; and
- (iii) consulting services for project management, construction supervision, training, and benefit monitoring and evaluation.

5. NH213 is a single carriageway two-lane class II to IV highway, and is the only road linking Kunming to the Lao People's Democratic Republic (Lao PDR) and Myanmar. It was originally constructed in 1952. Part of NH213 between Kunming and Yuanjiang, north of the project area, is being upgraded to expressway standards. The section between Mohei and Simao, south of the project area, was upgraded to a class II highway in 1997. The Yuanjiang-Mohei link between these two sections is narrow and carries nonvehicular and agricultural traffic as well as vehicular traffic. As a result, traffic is heavily congested and accidents occur frequently. The average daily traffic volume of more than 3,000 medium truck equivalent units (MTEs) recorded on some sections of the road in 1998 is above the road design of 2,800 MTEs. Travel time to cover the 214 km between Yuanjiang and Mohei is approximately 7-8 hours. The proposed Project will increase the road capacity to about 20,000 MTE and reduce the distance between Yuanjiang and Mohei to 147 km and the travel time for medium trucks to less than three hours.

6. The 540 km of feeder roads under the Project include about 100 km of unclassified roads to be upgraded to class IV or class II, and 440 km of class IV highways to be overlaid or upgraded to class III or II. These were selected in collaboration with YPCD and the communication departments of Mojiang, Pu'er, and Yuanjiang counties to extend the benefits of the expressway into 11 adjacent poverty townships. In selecting the feeder roads, consideration was given to the socioeconomic status of townships and villages, the results of interviews with local residents, and the type and condition of existing access.

III. DESCRIPTION OF THE ENVIRONMENT

A. Physical Resources

7. Yunnan is the southernmost province of western PRC, and borders the Lao PDR, Myanmar, and Viet Nam. Yunnan's terrain is largely mountainous, rising to 2,400 m in the Ailao Mountains, one of three ranges the expressway crosses. Parallel to the mountains in a northwest to southeast direction are three major river systems: (i) the Yuanjiang River, which far to the southeast of the expressway flows into Viet Nam as the Red River; (ii) the Amojiang River to the southwest; and (iii) the Babianjiang River. Since river flows vary greatly throughout the year, navigation for commercial traffic is not possible to any significant extent.

8. The climate is tropical to subtropical. Summers are hot and rainy, and winters are mild. The average annual rainfall varies from 805 to 1,406 millimeters (mm), of which 86 percent is concentrated in the May-September rainy season. There is a distinct dry season from October to April. The annual average temperature range is 17.8-23.7 degrees Celsius (°C). The average high temperatures range from 21.9-28.5°C, and the coldest range from 11.5-16.5°C. Steep altitude changes produce pronounced climate differences over short horizontal distances. Frost and occasional snowfall occur in the highest elevations. However, more than 320 days each year have no frost.

9. Although the expressway will be in the Mojiang fold-fault zone, the area is judged to be seismically rather stable. There have been no major earthquakes in Yuanjiang and Mojiang counties, but neighboring parts of Yuxi and Simao prefectures have recorded more than a dozen

earthquakes of a magnitude of 6 or greater on the Richter scale. Moreover, when combined with erodable metamorphic and volcanic soil formations, the several faults in the area are thought to be responsible for occasional landslides. Taking all these considerations into account, the expressway has been designed to meet anti-seismic requirements.

B. Ecological Resources

10. The Project area has been inhabited for centuries. Agriculture was developed in all valleys and on hillsides suitable for terracing. Consequently, only a few evergreen and semi-deciduous broadleaf forests remain. Adjacent lands have been extensively planted, primarily with commercial species of pine (e.g., *Pinus yunnanensis* and *P. armand*) and agriculture crops such as tea and fruit trees.

11. Although Yunnan Province is noted for its wildlife, major wildlife populations are not found in the Project area. The Project does not cross national protected areas or ecologically sensitive sites.

12. Because the proposed Project is a segment of the GMS Chiang Rai to Kunming Road via Lao PDR, impacts likely to be associated with the other GMS road segments from the end of the project area to the PRC-Lao PDR border were investigated. These include the Mohei-Simao, Simao-Xiaomengyang, and Xiaomengyang-Mohan segments. The Simao-Xiaomengyang segment (expressway) will cross Xishuangbanna Nature Reserve (XNR) for either 19 km or 23 km under current planning options, and the Xiaomengyang-Mohan segment (class II highway) will cross XNR for approximately 10 km. XNR is near Xiaomengyang, about 150 km south of the Project.

13. XNR was established in 1983 by the provincial government, and was declared a national nature reserve by the State Council in 1984. XNR is considered to be of international value for biodiversity conservation, and provides habitat for more than 200 wild elephants. XNR also contains 33 other nationally endangered wildlife species and about 30 nationally endangered plant species. Construction of a major new roadway through XNR can be expected to have highly significant impacts on the biodiversity.

C. Human and Economic Development and Quality of Life Values

14. The Project crosses three counties, Mojiang and Yuanjiang in Yuxi Prefecture, and Pu'er in Simao Prefecture. Yuxi Prefecture has 1.9 million people, and Simao has 2.4 million. Table 1 shows the current and projected populations of the three counties.

Table 1: Populations of the Project Counties

County	Population	
	Current	2020 (Projected)
Mojiang	353,000	432,000
Pu'er	185,000	217,000
Yuanjiang	187,000	217,000

15. The proportion of people engaged in agriculture in the three counties ranges from 83 percent in Pu'er county to 92 percent in Mojiang county. Principle crops in Yuxi prefecture include grains, rapeseed, tobacco, and sugar cane, while those in Simao prefecture include grains, oil-seed, sugarcane, tea, tobacco, fruits, and vegetables. The main subsistence crops are rice, wheat, maize, potatoes, and beans. The per capita area of cultivated land is low, only 0.09 ha for

Yuanjiang, 0.15 ha for Mojiang, and 0.16 ha for Pu'er. Mineral resources are abundant in Yuxi Prefecture, and include iron, phosphorus, coal, silver, gold, copper, magnesium, and nickel.

16. Yuxi is a rapidly growing prefecture. The gross output value of industry and agriculture has increased at annual rates of 14 - 19 percent during 1989-1994. In 1996, Yuxi Prefecture registered a gross domestic product (GDP) of Y29.104 billion, or a 21 percent growth over 1995. The number of industrial enterprises increased from 16,217 in 1996 to 18,104 in 1997, employing more than 81,000 people. Only 168 of these enterprises were state owned. The number of township and village enterprises grew from 69,000 in 1994 to 86,000 in 1996, employing 335,000 people. The prefecture has had a steady increase in tourism, from 2.18 million visitors in 1996 to 2.25 million visitors in 1997. The emerging market economy of the prefecture continues to show signs of healthy expansion.

17. Simao Prefecture has, on the Lancang (Mekong) River, two ports that are important for regional commerce. The Project will be an essential link in the expansion of this regional commerce. Between 1995 and 1996, the output of primary, secondary, and tertiary industries increased by 7.2, 5.9, and 16.5 percent, respectively, a sign of strong growth in the service sector.

18. The county economies, measured in terms of GDP, have been growing recently at annual rates of about 10 percent. Although rates of growth may be lower in future, the prospects for further high economic growth in this region are reflected in traffic forecasts for the expressway. Traffic is projected to grow from a daily average of well under 3,000 MTE in 1997 to over 8,000 in 2010 and 16,000 in 2020.

19. Literacy is above 95 percent in all three counties, but school completion rates are uneven. In Yuanjiang County, for example, the proportion of students who finish middle school (grades 7-9) is significantly lower than those who complete primary school (grades 1-6). Education expenses can be a significant part of household expenses, often second only to food. The enrollment rate for primary school-age children is over 98 percent.

20. Poverty is pervasive along much of the expressway corridor and its associated feeder roads. Sixteen poverty townships are in the immediate area to be served by the expressway and its associated feeder roads. The expressway passes through only one of these townships, illustrating the importance of the feeder road network in extending benefits to the communities in greatest need of support for poverty alleviation programs.

21. Malaria is cited as a leading cause of morbidity in the project area, along with measles, hepatitis, and pulmonary tuberculosis. Vehicle accidents are a leading cause of mortality. Incidence of HIV/AIDS is increasing in Yunnan province because of its close proximity to Thailand and Myanmar. Tourism, personal travel, and the entertainment industry are growing with the rest of the economy as free market forces prevail. The expressway will bring increasing numbers of domestic travelers from southern Yunnan to other parts of the PRC.

22. Sanitation practices need improvement throughout the project area. Only 60 percent of townships in Mojiang County have piped water systems, while 67 percent of the population of Yuanjiang County have piped water. Basic waterseal trap design toilets have not yet been widely introduced.

23. Yunnan Province is home to 26 of the PRC's 56 ethnic groups. Minority groups, make up one third of the province's total population. The largest groups are the Yi, Hani, and Dai, which

comprise 10.8, 3.3, and 2.8 percent of the total provincial population, respectively, while 22 smaller ethnolinguistic groups together make up an additional 19 percent of the provincial population.

24. Most of the people who live in the three project counties are of minority ethnolinguistic backgrounds. In Yuanjiang County, ethnic populations comprise 78 percent of the total, in Mojiang County, they comprise 72 percent, and in Pu'er County they comprise almost 50 percent. Regulations provide that the chief administrative officers or their deputies must be members of minorities. The heads of courts, township mayors, and all government departments follow this pattern.

IV. ALTERNATIVES

25. Alternatives were explored for the expressway as a whole, and for specific segments of the expressway.

A. Overall Expressway

26. The "without Project" alternative was found to be unacceptable from a social and environmental point of view. NH213 is already extremely congested in this region. The rapid growth of traffic demand is continuing. There is a very real danger of choking off further social and economic improvement needed to overcome poverty if the current transport infrastructure bottleneck is not relieved soon. The congestion also is a source of pollution and ever-increasing risks of traffic accidents.

27. The second alternative considered was upgrading the existing road, including widening and other radical improvements. This alternative was judged unacceptable primarily given the nature of the terrain, the impossibility of using the old alignment to shorten travel distance, and the difficulty of significantly improving the gradient. Even if significant upgrading were possible, any attempt to dramatically improve the existing alignment would be costly in terms of environmental damage and disruption of social and economic life along the route. Upgrading also could not be expected to meet the future traffic demands.

28. A third alternative considered was a smaller, less ambitious expressway, for example mostly three lanes with occasional widening to four. This alternative would cause only minor reduction in the negative environmental impacts of the proposed construction and would be outgrown within a few years, given the expected rapid growth of economic activity and traffic in the region served.

B. Expressway Segments

29. Moving from the "macro" alternatives to more specific situations, two or more possibilities have been analyzed for each of the major interchanges along the expressway. First, approximate alignment proposals, based on engineering-cum-cost considerations, were discussed with local residents and analyzed in terms of their social and environmental impacts before final choices were made. As a result, five interchanges were incorporated into the project design in direct response to requests from affected communities.

30. At points along the proposed expressway the approximate alignment required removal of houses or the displacement of farmland and orchards. Engineers planning the expressway have discussed alternatives with local officials and residents, adjusting alignments whenever possible at reasonable cost in order to accommodate local needs and preferences. During 1997-1998, nine

major alternative alignments along five sections of the route were considered based on budgetary, environmental, and socioeconomic criteria.

31. Avoidance of ecologically and culturally sensitive areas has also been a central design feature. As a result, no old-growth forest will be affected by the Project, and important cultural sites have been avoided. This fine-tuning is ongoing in connection with a possible additional interchange near Mohei at the southern end of the Project.

32. The normal standard for expressway construction in the PRC allows longitudinal gradients of not more than 4 percent. In mountainous terrain, however, grades of up to 6 percent can be considered for a variety of engineering, cost, and environmental reasons. The project designers used the steeper gradients where necessary, but limited the length of steep gradients to: 1,500 m for a 5 percent gradient and 600 m for a 6 percent gradient.

V. ANTICIPATED ENVIRONMENTAL AND SOCIAL IMPACTS, AND MITIGATION MEASURES

A. Health and Safety

1. Disease Transmission and Sanitation

33. During construction, significant health hazards could result from bringing thousands of construction workers to the area, many unaccompanied by families. The risks of spreading disease will be minimized by (i) a clear definition of contractors' responsibility for the health, safety, and behavior of their work crews, including the preparation and implementation of health and safety plans by the contractors; and (ii) active public health programs. Labor camps will be constructed and maintained in accordance with strict standards spelled out in construction contracts and rigorously enforced, including sanitation facilities adequate to serve the entire population of the labor camps. The contractor will be responsible for cleaning up campsites as soon as construction is completed, and for restoring the sites to their original use.

34. The most serious health risk associated with the Project during construction, and especially during operation, is the potential for HIV transmission. Yunnan has half of the PRC's known HIV-positive cases. Mitigation will be addressed through training, especially for high-risk groups, including contract construction workers and service providers, on how to minimize the risk of transfer. Information, education, and communication materials on HIV/AIDS will be developed and distributed.

2. Road Safety

35. To minimize traffic disruption and the potential for increased accidents during construction due to the presence of project vehicles and machinery, the contractors will provide traffic control staff, and speed limits will be strictly enforced. The PRC's 1996 road fatality rate, at 77 deaths per 10,000 vehicles, was the highest in Asia. Learning from experience gained in past PRC road projects, the Yunnan YuanMo Expressway Company (YMEC), an autonomous agency formed to construct and manage the Project, will provide the following measures to improve road safety: (i) axle weighing stations at the expressway entrances; (ii) internationally accepted road signs, reflective land markings, and other traffic delineation features; (iii) safety barriers on embankments and central reservations; (iv) emergency telephones along the alignment; and (v) training for YMEC staff in road safety and traffic engineering. Additionally, a high-standard expressway normally reduces the number of road accidents. For example, the Shenyang-Dalian expressway

accident rate is 0.50 accidents per million vehicle-kilometers, which is less than half that (1.23) on the parallel NH202.

3. Air Quality and Noise

36. During construction, air quality will be affected primarily by concrete plants, asphalt plants, and mining and transport of aggregates. Air quality will also be affected by heavy machinery and truck traffic. These impacts will be mitigated by (i) using dust suppression equipment at the aggregate and concrete plants, and regularly watering construction roads; (ii) siting asphalt plants at least 300 m from the nearest community; (iii) covering the beds of trucks transporting aggregates; and (iv) properly maintaining machinery and vehicles.

37. Air quality during project operation was investigated during the EIA. The anticipated levels of nitrogen oxides (NO_x) and carbon monoxide 10 m from the roadway were determined for the years 2000, 2010, and 2020 in each of the three counties along the expressway. Estimates were made for peak levels and daily average levels. Anticipated NO_x and carbon monoxide levels were also investigated for nine sensitive areas (residential areas and schools located near the expressway). In general, the investigation determined that the level of these pollutants will be within the PRC ambient air quality standard. However, due to the local topography, occasional temperature inversions may cause NO_x levels to temporarily exceed the standards. Overall impacts on air quality are therefore expected to be of minor significance, in part due to the limited and scattered population in the area of the expressway. Similarly, lead emissions are not expected to be of major significance.

38. To mitigate impacts on air quality during project operation, a 100 m strip on each side of the expressway will be declared a highway protection area (see para. 40). Regular air quality monitoring will be undertaken, especially at sensitive spots. In addition, Yunnan Province has a four-point strategy for decreasing vehicle emissions and improving air quality, three of which are expected to affect air quality along the expressway: (i) requiring all vehicles to have emission control devices installed; (ii) encouraging the use of natural gas as a cleaner alternative to petroleum, and establishing natural gas outlets on a trial basis; and (iii) closing factories that produce cars with substandard emission control devices. The provincial government plans to adopt the use of unleaded petroleum and catalytic converters within the next few years, after lessons are learned from the pilot unleaded petroleum program in Beijing.

39. Major types of machinery were tested to determine noise levels during project construction. These ranged from 80 to 100 audible decibels (dB[A]) within 5 m, and up to 65 dB(A) at 100 m. Due to the comparatively sparse population along the expressway, this impact will not be as severe as in many other road projects. Nonetheless, noise impacts will be significant for construction crews and people residing within 50 m of the expressway. Mitigation measures will include (i) cessation of work with heavy machinery between 9:00 pm and 6:00 am, (ii) provision of sound protection equipment to laborers and/or restriction of the number of working hours in areas of high noise, (iii) public information and coordination with local residents, and (iv) proper maintenance of heavy machinery.

40. Noise levels anticipated during project operation were determined using a United States model that forecasts traffic noise in three operational stages (initial, midterm, and longterm). Of ten sensitive areas investigated, one is expected to exceed national noise standards by 0.9-1.6 dB(A) during daytime operation, and 0.5-1.1 dB(a) during nighttime, seven are expected to exceed the standards by 0.1-9.9 dB(A) during daytime, and two are not expected to exceed the standards. Mitigation measures will include (i) creation of 100 m wide highway protection strips on each side

of the expressway within which no residential buildings, enterprises, institutions, or other environmentally sensitive development will be allowed; and (ii) planting of a 20-30 m vegetation barrier at sensitive areas, or construction of sound retarding walls where needed.

4. Transport of Toxic and Hazardous Materials.

41. Hazardous and toxic materials transport in Yunnan are likely to include chemicals, explosives, and petroleum products. After construction of the expressway, such substances could be released as a result of speeding and other forms of careless driving. Statistics are unavailable for the volume of toxic and hazardous materials transported through Yunnan or for accidents involving vehicles carrying such materials. However, the number of accidents that involve hazardous materials and occur between Changchun and Harbin in northern PRC has been estimated at 7-10 annually, 1-2 of which may involve unconfined spills and serious contamination. Although the number of accidents may be low, they can cause potentially serious impacts, especially on water sources.

42. In addition to general road safety measures to be implemented by YMEC (see para. 35), other measures to minimize the risk of toxic and hazardous spills will include (i) strict monitoring and adherence to national regulations as detailed in "Transportation Norms on Dangerous Goods by Vehicles"; and (ii) preparation and support for a toxic waste spill contingency plan that specifies actions to be taken, by whom, and clean-up procedures to be used.

B. Topography, Geology, and Soils

43. The most direct and obvious impact during construction will be the large scale excavation and fill of solid material (mainly earth and rock), both along the surface to provide a 22.5 m wide foundation for the expressway, and through extensive tunneling. An estimated 35.5 million cubic meters of material is to be moved. Of this, approximately 60 percent will be used for constructing the road bed. The remaining 14 million cubic meters of spoil will require disposal. Without proper siting and engineering procedures, there is a clear risk of significant erosion impacts on water courses and farmland, and large-scale acquisition of farmland and other productive land. These risks are especially prevalent in steep land areas.

44. A number of measures will be taken to minimize the impacts of quarries and borrow pits. PRC law prohibits contractors from siting quarries and borrow pits on productive land in all but exceptional cases. Consequently, few sites are expected to require land acquisition or loss of productive agricultural land. Before quarry and borrow pit sites are selected, extensive consultations will be undertaken with local residents to determine the most appropriate sites that will limit damage to local assets. Material will be excavated using erosion control methods such as benching. Where explosives are used at quarries, the blasting schedule will be widely distributed to local residents and access near blasting sites will be strictly controlled. Dust and noise will be controlled as described in paras. 36-40.

45. All borrow sites will be cleaned up, stabilized, and planted, including terracing where appropriate. Where feasible, topsoil will be reapplied to the site to allow cultivation. This work will be guided by rehabilitation plans to be prepared by the contractor and approved by YMEC. Quarries will be similarly rehabilitated except where contractors propose to maintain them in proper operating order to service future local construction needs. All of these measures are being specified in construction contracts, and will be monitored throughout the construction period.

46. The Project will require approximately 150 spoil disposal sites. All spoil disposal sites have been selected and mapped. Most sites are on wasteland, but a few occupy cultivated land. Negotiations with the landowners have been completed and followed the land acquisition procedures described in paras. 59-64.

47. Specifications and drawings have been prepared showing retaining walls and slope protection measures. These include a wide range of stabilization techniques suited to the slope and soil conditions at any particular site, including plantings (sometimes held in place by concrete lattice or diamond works), masonry walls, and gabion walls (often reenforced with concrete spray). Protection engineering will begin together with or, in the case of retaining walls, before road subgrade construction. Spoil sites will be protected with vegetation cover. Drainage structures and other standard engineering measures will be employed to reduce erosion.

48. In general, to ensure good construction quality and avoid or minimize environmental impacts, YMEC will (i) minimize subcontracting of civil works, thereby reducing the risk of involvement of smaller inexperienced contractors; (ii) schedule sufficient time for raising and compaction of embankments and ensuring adequate compaction behind abutments and retaining walls; and (iii) carefully survey the soil quality at excavation faces of tunnels to adopt adequate excavation techniques.

49. Erosion control measures during project operation will include monitoring and maintenance of slope stabilization structures, and maintenance of drains.

C. Groundwater and Surface Water

50. To avoid disruption of local water sources, communities near the expressway have been interviewed to determine the locations of water sources. This information has been used to site approximately 152 bridges and 567 culverts that will ensure that irrigation works and potable water supply systems are not affected. Temporary disruptions to water supplies will be mitigated through the provision of temporary water pipes, irrigation canals, etc.

51. Groundwater and surface water can be affected primarily through (i) pollution generated by labor camps, (ii) contamination by hazardous materials used during construction, (iii) erosion from road preparation and excavation of borrow pits and quarries, (iv) fouling of water due to the release of construction area contaminants, (v) construction of bridges, and (vi) construction of tunnels. To mitigate these potential impacts, all labor camps will be equipped with sanitation facilities for liquid and solid wastes. Standard precautions will be taken in the use and storage of hazardous materials, which include storage away from waterways, oil separation facilities, and other measures such as bunding to contain accidental spills. Settling ponds will be used to prevent the release of construction area contaminants into watercourses. Although many bridges will be constructed, only the Babianjiang bridge will require placing foundations into the river. Bridgework in the riverbed and riverbank stabilization will be done during the dry season to minimize erosion. Dumping of spoil directly into waterways will not be permitted. Major tunnels have been designed so as not to affect the direction or flow of groundwater.

52. During project operation, the normal passage of vehicles over water bodies is not expected to contaminate surface waters. (The issue of toxic and hazardous spills is discussed in paras. 41-42). Monitoring data at the Maobian bridge over Xiaoshao Reservoir (on the Chuxiong-Dali highway), which has been operating for more than 20 years, showed negligible levels of lead and oil.

53. Risks to the Xuli Reservoir (near km 266) are of concern, since the most recent design proposed that the expressway pass near and several meters above the reservoir area: recently, a reservoir near Pu'er was fouled by an oil spill during construction of the Mohei-Simao toll road. Furthermore, construction of this stretch of expressway will encroach on the existing provincial highway 538. Local officials have voiced their concern about this situation. In response, YPCD is adjusting the alignment to minimize the risk of reservoir contamination.

54. Serious interference with the operations of Babianjiang township's micro-hydro station is to be avoided by tunneling. The contractor will be required to expedite construction in the relevant short stretch, so that any interruption of power supply can be kept to a minimum.

D. Flora and Fauna

55. Approximately 420 ha of woody vegetation, primarily shrubs and secondary growth, will be removed during expressway construction. No old-growth forest or protected area is along the proposed alignment. Similarly, the fauna along the alignment is already depleted and will not be significantly affected.

56. Because the expressway will offer improved access to forests and to markets for forest products, lumber companies could increase logging operations in Yunnan Province's substantial forest areas. However, this is unlikely to occur because of the current regulatory situation. Logging is strictly regulated, especially under recently promulgated rules, and public support for the rules is very strong and widespread as a result of devastating floods elsewhere in the PRC during 1998. Large state enterprises in Yunnan Province have already been instructed to cease cutting and to divert their entire labor force to replanting programs. Logging has not been a problem in recent years along the existing highway.

57. Some expansion of tourism will result from improved road transport. Tourist services are expected to provide significant economic opportunities in future. Some travelers may wish to hike into the attractive mountain areas of the two prefectures through which the expressway passes or trek to some of the nature preserves of the region, which, though distant from the expressway, will be more accessible through improved trunk road transport. However, large numbers of tourists are not expected to be involved in such excursions. Moreover, the development of a modest ecotourism sector is more likely to help improve conservation programs than to cause significant negative impacts.

58. The proposed road segments traversing XNR could have highly significant impacts on biodiversity, including the loss of old-growth forest and degradation of nationally and internationally endangered wildlife and plant populations. YPCD is currently discussing with the Bank the implications for these segments, in regard to the Bank's *Policy on Forestry*. Alternative alignments and road grades are being considered. Additional information is being gathered to support the dialogue, and the results of the dialogue will be reported in the Report and Recommendation of the President (RRP) for the proposed Project.

E. Land Acquisition and Resettlement

59. The expressway will require permanent acquisition of more than 870 ha, of which about 483 ha are farmland. Temporary land acquisition will also be required during construction. Permanent and temporary land acquisition will directly affect more than 5,200 people along the expressway corridor. Of these, 1,569 people in 338 households will lose their housing. The primary resettlement impacts will include permanent loss of farmland, which includes paddies,

dryland, vegetable land, sugarcane fields, tea gardens, and orchards. Fishponds, commercial forest lands, and wastelands will be affected. Several households will be indirectly affected as each village adjusts farmland agricultural contracts to accommodate productive land losses and to replace housing. Some villages, especially near interchanges, will lose a significant part of their agricultural land, necessitating transfer of workers to nonagricultural occupations. Several hundred people will require compensation for land and assets related to the upgrading of feeder roads.

60. Efforts to minimize resettlement effects included careful siting of the expressway to avoid the most densely populated land and socially or culturally sensitive areas. A resettlement plan is being prepared to deal with unavoidable impacts in an equitable and timely way so that the affected people attain equal or better livelihoods and living standards than they now have. The draft plan was prepared before the new Land Law became effective on 1 January 1999, and provincial guidelines are being updated to accommodate the changes. The plan will be approved by the provincial government.

61. The resettlement strategy includes compensation to replace lost assets and restoration of livelihoods. People losing housing will receive direct compensation based on the provincial guidelines for housing replacement according to the class and type of house. Most of these people can be relocated into their original village, which will provide a replacement house site free of tax with road, electricity, and water. Most people losing farmland will receive replacement farmland nearby through adjustment of the village land use contracts. The production teams affected will use the land acquisition fee to intensify agricultural production or develop village enterprises. Where land is borrowed temporarily during construction, YPCD will sign an agreement to compensate for losses and restore the land to its original condition within two years. Those losing other assets will receive direct compensation based on provincial compensation standards. Where people must move out of agriculture, they will be given the choice of a job in TVEs or self-employment. All land acquisition and resettlement compensation will be provided to the affected people in advance of their loss of the assets.

62. Vulnerable households include those headed by women, the elderly, the poor, and minority ethnic groups. Vulnerable households identified during the final resettlement planning stage will receive village assistance for house construction. They also will be entitled to basic welfare support provided by the village and be eligible to negotiate a higher compensation rate for their assets than the other households.

63. The new land law provisions for disclosure of the Resettlement Plan to the affected people, and arrangements for addressing their concerns are being negotiated and will be finalized at the time of Project appraisal. Each household will have the opportunity to negotiate on a valuation contract, and be able to select a house site from several options. In the case of grievance, affected people can go first to the village administration committee or the township resettlement office. If their complaint is not settled within two weeks, they can go to the county or municipal level for redress. If still unresolved, the provincial land management bureau will try to achieve a solution, or the company can attempt to achieve a solution. Final redress will be sought, if necessary, in the civil courts.

64. The estimated cost for land acquisition and resettlement is \$22 million. This includes the costs of providing nonagricultural work, supervision, management, and a small allowance for monitoring and evaluation. Contingencies will be added, as the baseline survey and full census of assets is not yet complete. The cost estimates will be adjusted annually based on the inflation rate for the past year, and compensation rates will be similarly adjusted.

F. Ethnic Minorities

65. Ethnic minorities comprise two thirds of the population in the three project counties. There is significant diversity among these groups, and many minority people have traditional patterns of resource use and of social and economic organization that are distinct from the mainstream. Additionally, there is a high correlation in Yunnan Province between poverty and minority status. For these reasons, special consideration will be given to the needs of minorities in the project area through preparation of a minority peoples' development plan (MPDP).

66. The MPDP is currently under preparation, and will be completed by March 1999. Results will be reported in the RRP to meet the Bank's requirements. The MPDP is being prepared to review the likely impacts on minorities, and to specify measures to maximize positive impacts and reduce negative impacts, in close consultation with the affected people. The MPDP is intended to (i) clarify and complement the resettlement plan and other measures by focusing on the preferences and priorities of minority peoples, and (ii) provide the framework for participation of minority peoples in project planning and implementation, and draw upon consultations with minority people and their representatives. Other impacts have been avoided where possible during the design stage. For example, consultations with minority villagers led to realignments to avoid ceremonial sites, and the foot of a sacred mountain. Consultations have helped to finalize the placement of underpasses and overpasses for people, vehicles, and livestock.

G. Feeder Roads

67. Feeder roads were not included as a Project component at the time the EIA was prepared. Therefore, an environmental assessment in 1998 was directed specifically at the feeder roads proposed for inclusion under the Project.

68. The same issues that pertain to the expressway are relevant to the feeder roads, but due to the smaller scope of work, the magnitudes of the impacts are expected to be less. The major concerns are land acquisition and resettlement; treatment of borrow pits, quarries, and spoil areas; and erosion risks during construction and operation. These impacts will be treated in the same manner as discussed for the expressway component. Transmission of communicable diseases, especially HIV, is not considered to be significant for the feeder roads as most work will be done by laborers from the province, and the roads will serve primarily local traffic.

H. Other Social Considerations

69. NH213 will continue to be maintained for local traffic by YPCD with funding from the provincial government. NH213 requires fairly continuous maintenance, to clear drainage ditches and the roadway, after mud slides during the rainy season. Were maintenance to be less prompt than in the past or otherwise inadequate, erosion could accelerate and the roadway would deteriorate rapidly. Proper planning and budgeting will minimize these risks.

70. Access across the alignment will be disrupted during construction and operation. During construction, contractors will be responsible for providing temporary relief measures, such as foot bridges. An estimated 282 underpasses and 19 overpasses will be built to provide access across the completed expressway. These are being sited in consultation with the affected communities to ensure that the access points meet their needs.

71. Businesses that depend on the traffic along NH213 will suffer after through traffic is diverted to the expressway. Approximately 600 small rest stops and repair facilities along the current alignment will lose up to 90 percent of their customers and their average monthly profits of Y1,000. Because of the expressway's limited access, not all of these entrepreneurs will be able to relocate to the expressway. YPCD is currently considering how additional assistance can be provided to these businesses. Among the options being considered are (i) the TVE program may offer assistance, primarily training, to equip these entrepreneurs with skills that will allow them to compete in the new market situation; and (ii) YMEC may give special preference for local entrepreneurs to participate in the five service center operations. These issues and solutions will be elaborated further in the resettlement plan and MPDP.

I. Expected Positive Project Impacts

72. The expressway will improve transport along the mountainous stretch of NH213 between Yuanjiang and Mohei, and (i) greatly reduce transportation times and costs; (ii) increase economic growth at local, provincial, and regional levels; (iii) increase external trade; and (iv) boost commercial investment in the region.

73. The expressway will broaden the options for commerce and employment among the people along the route. Inputs for production should become cheaper, and outputs will find wider markets.

74. Opportunities for training and education will expand as the road reduces the isolation of communities in the area. Innovation is expected to increase with greater exposure to other areas and ideas.

75. Seasonal and migrant laborers will have easier access to and from jobs. Economic choices will increase, and ties to home villages will be easier to maintain.

76. People along the old NH213 will be subjected to less noise, vibration, exhaust, and debris from traffic. Vehicular deaths and injuries are expected to decline, and local traffic will be freed from congestion created by long-haul vehicles. Representatives of official and nongovernment agencies will have more rapid access to the people they serve.

VI. ECONOMIC ASSESSMENT

77. The total cost of the Project is estimated at \$787 million, of which \$349 million, or 44.4 percent, is the foreign exchange cost. Local currency costs are estimated at \$438 million equivalent, or 55.6 percent of the total project cost. The financial internal rate of return is estimated at 8.1 percent, covering a construction period of 4 years and 20 years of operation. The economic internal rate of return is estimated at 17.6 percent.

78. Table 2 provides details on environmental mitigation costs related to project construction and annual costs during project operation, excluding costs for resettlement. These costs are included in the total project cost.

Table 2: Estimated Environmental Mitigation Costs

Item	Estimated Cost	
	Y(10,000)	\$(1,000)
A. Lump Sum Costs		
1. Environmental Design Work	214	258
2. Revegetation	1,473	1,775
3. Spoil Disposal	494	595
4. Protection Engineering	5,046	6,080
5. Construction of Pedestrian Passes	5,333	6,425
6. Emergency Vehicles	60	72
7. Sanitation at Service Areas	350	422
Total	12,970	15,627
B. Annual Costs		
1. Equipment Operation, Maintenance and Depreciation	29	35
2. Vegetation Maintenance	16	19
3. Technical Innovations	20	24
4. Environmental Monitoring	10	12
5. Salaries for Environmental Protection Staff	7	8
6. Training of Laborers in Environmental Protection	1	1
7. Others	10	12
Total	93	111

Source: EIA and updated information from YPCD.

79. The total environmental mitigation cost during project construction is expected to be approximately \$15.6 million, or about 2 percent of the total project cost. The inclusion of resettlement costs of \$22 million, brings the total estimated mitigation cost to \$37.6 million, or about 5.5 percent of the total project cost.

80. The project EIA presents a preliminary and tentative analysis of environment benefit-cost related to the expressway. The EIA found that the benefit/cost ratio would be about 1.5. Major quantified costs included compensation for lost land and other assets, as well as the costs indicated in Table 2. Major benefits were associated with social improvements, such as decreased travel costs, improved safety, and time savings.

81. In addition to quantifiable benefits, the Project is expected to produce significant environmental benefits that are not amenable to quantification. The expressway will provide substantial benefits through reduced noise, dust, and vibration in the major population settlements through which NH213 now passes. The Project is also likely to create viable alternatives to destructive agricultural practices such as shifting cultivation.

VII. INSTITUTIONAL REQUIREMENTS, AND ENVIRONMENTAL AND RESETTLEMENT MONITORING PROGRAMS

82. The expressway has been planned and will be built and later maintained under the general supervision of YPCD, operating in accordance with general guidelines promulgated by PRC authorities for expressways that form part of the national highway system. To manage construction, an autonomous corporation has been formed, the YMEC, following the pattern of other major highway construction projects. During construction, YMEC will be assisted by independent international consulting engineers. Upon completion of construction, the tollway will

continue to be maintained and managed by YMEC or by a successor entity of similar status and authority.

A. Environmental Aspects

83. Execution of the environmental management plan, including monitoring programs, will be a responsibility shared between YMEC and their engineering consultants. Both entities will appoint senior environment officers, who will give full time attention to environmental and community relations concerns. YMEC will establish within its organization an engineering and environment office that will report to the YMEC deputy manager and have ultimate authority over environmental matters related to the Project. During construction, the Project will include within the office of the supervising engineer a three-person leading team for environmental protection (LTEP) to monitor environmental compliance. This team will include a senior environmental engineer and experts on social development and soil stabilization. The team will also arrange for orientation and training courses necessary for other construction supervision personnel who have less experience in environmental matters. LTEP will receive initial guidance and training from a short-term international environmental engineer. Additionally, training abroad will be offered to environmental staff during the construction period.

84. LTEP will prepare written environmental compliance reports to YPCD and YMEC each month. Compliance reports will be based on site inspections and on monthly reports submitted to LTEP by the chiefs of environmental units to be established by each of the Project contractors. Each contractor will be responsible for assigning approximately 5-7 environmental engineers to carry out environmental supervision and monitoring at site. The construction contract documents will play an important role in environmental management, and will impose strict obligations on the contractors regarding environmental management of the Project.

85. A detailed environmental management plan is currently under preparation, and is expected to be completed by the end of January 1999, well before the start of construction. During the construction period, environmental monitoring is expected to include (i) construction noise, (ii) air quality, (iii) water quality, (iv) erosion protection, (v) sewage treatment, and (vi) dust suppression. During the operation period, environmental monitoring is expected to include (i) noise, (ii) air quality, (iii) lead content in soils and crops, (iv) water quality, (v) erosion, and (vi) sewage and water. Communicable diseases are to be monitored by local and provincial health offices, which will receive cooperation and guidance from the Project as needed.

B. Land Acquisition and Resettlement Aspects

86. YMEC will assume the lead responsibility for implementing the resettlement plan. YMEC will establish a division for land acquisition and resettlement, staffed with five officers. Resettlement offices comprising at least three staff will be established in Yuxi and Simao prefectures, and in the three affected counties, with responsibility for the coordination and mobilization of land acquisition and resettlement. Staff of the Land Management Bureau will train the new staff in land acquisition and resettlement.

87. YMEC will finance the costs and take responsibility for resettlement monitoring, evaluation, and reporting. An international specialist will be engaged to assist YMEC in developing the resettlement monitoring and evaluation system, and in developing a methodology for the socioeconomic assessments, including participatory rural appraisal studies. In addition, YPCD has agreed to engage the services of an external agency experienced in conducting external evaluations to assess the extent to which incomes and living standards have been restored.

VIII. PUBLIC INVOLVEMENT

88. Consultation with local officials and residents has been frequent throughout nearly three years of intensive planning for the expressway. For the initial environmental assessment in March 1996, groups of villagers, teachers, officials from many departments and levels of local government, and experts from the national Highway Research Institute in Beijing traveled extensively along the proposed route. In addition to many informal conversations with residents along the route, the study team convened five symposiums with a total attendance of nearly 150 people, including engineers, doctors, teachers, farmers, students, shopkeepers, state enterprise managers, and several dozen local government officials at county, township, and village levels of authority. As reports were drafted, they were sent back to local officials and residents for comment.

89. As engineering design work continued through the rest of 1996, 1997, and into 1998, local residents and officials continued to meet with engineers and other highway planners. Again in June and July of 1998 additional fieldwork was done. Written questionnaires were used in many consultations with villagers, transport operators, restaurant owners, and a wide cross-section of other local interests, including representatives of all ethnic groups resident in the expressway corridor. Income and spending habits of a cross-section of farm households were studied, partly to determine how an improved transportation infrastructure might affect agriculture activities.

90. The findings of this research were verified by an environment consultant who visited the area in September 1998, and held wide-ranging interviews and meetings with more than 150 local residents and officials. More intensive studies were conducted by the team of consultants focusing on social and economic impacts and working throughout the area from early September until late November 1998. An important component of the consultation and participation process was provided by the surveys undertaken by the participatory rural appraisal (PRA) specialists from the Rural Development Research Center of the Yunnan Institute of Geography in six villages in the Project area in October and November 1998. The PRA methodology was useful to determine the villagers' perceptions of the impact the expressway will have on their lives and communities.

91. Public involvement has resulted in numerous project design changes. For example, five additional interchanges were incorporated into the project design in direct response to requests from the affected communities. The role of public involvement has been especially pronounced in terms of impacts on houses and other household assets. In Dalubian Village, for example, the original design would have taken over a local access road and a school building, required removal of 22 houses, and taken 2 ha of rice fields. Working with local people, the expressway was realigned to the west, saving the rice fields, the school, and all but 2 of the houses.

92. The people affected by land acquisition and resettlement were notified about the resettlement plan on several occasions during surveys, interviews, symposiums, and PRA surveys. Arrangements to provide copies of the resettlement plan to the peasant economic collectives have been negotiated with the YMEC. The resettlement offices are responsible for receiving the comments of the affected people and addressing their concerns. Public involvement will continue into the construction phase of the Project, particularly as pertains to resettlement.

IX. CONCLUSIONS

93. The proposed expressway and associated feeder roads are justified on social and economic grounds. The major anticipated or potential impacts are loss of land and other assets, involuntary resettlement, HIV transmission, erosion impacts on waterways and productive land, and disproportionate impacts on ethnic minorities. Environmental and social impacts associated with project construction and operation can be mitigated through known design solutions presented in the EIA and other environmental documents, the resettlement plan, and the MPDP. To ensure faithful implementation of these solutions, a comprehensive environmental management plan is being prepared, including provisions for compliance monitoring. Resettlement will be monitored by YMEC and by independent monitors. Project contracts will contain specific clauses and conditions for implementation of social and environmental mitigation measures.

94. Issues related to the road segments passing through XNR are currently under discussion. The results of the discussion will be reported in the RRP.