

**ASIAN DEVELOPMENT BANK**

SUMMARY ENVIRONMENTAL IMPACT ASSESSMENT

FOR

GUIZHOU SHUIBAI RAILWAY PROJECT

IN THE

PEOPLE'S REPUBLIC OF CHINA

February 1998

**CURRENCY EQUIVALENTS**  
(as of January 1998)

Currency Unit	—	Yuan (Y)
Y1.00	=	\$0.120788
\$1.00	=	Y8.2789

As of 1 January 1994, the PRC's dual exchange rate system was unified. The exchange rate of the yuan is now determined under a managed floating exchange rate system.

**ABBREVIATIONS**

BOD	-	Biochemical Oxygen Demand
COD	-	Chemical Oxygen Demand
EIA	-	Environmental Impact Assessment
GEPB	-	Guizhou Environmental Protection Bureau
GSRC	-	Guizhou Shuibai Railway Company
GSSA	-	Guizhou Social Sciences Academy
LEPB	-	Liupanshui Environmental Protection Bureau
MOR	-	Ministry of Railways
NEPA	-	National Environment Protection Agency
NO <sub>x</sub>	-	Nitrogen Oxides
PRC	-	People's Republic of China
SEIA	-	Summary Environmental Impact Assessment
SO <sub>x</sub>	-	Sulfur Dioxide
SRCO	-	Supporting Railway Construction Office
SSDI	-	Second Survey and Design Institute
TSP	-	Total Suspended Particles

**WEIGHTS AND MEASURES**

°C	-	degree Celsius
ha	-	hectare
kg	-	kilogram
km	-	kilometer
km <sup>2</sup>	-	square kilometer
m	-	meter
kPa	-	kilo pascals
m <sup>3</sup> /sec	-	cubic meter per second
mg/l	-	milligram per liter
mg/Nm <sup>3</sup>	-	milligram per normal cubic meter
pH	-	hydrogen ion concentration

**NOTE**

In this Report, "\$" refers to US dollars.

**CONTENTS**

	<b>Page</b>
A. Introduction	1
B. Description of the Project	1
C. Description of the Environment	2
D. Anticipated Environmental Impacts and Mitigation Measures	5
E. Alternatives	10
F. Cost Benefit Analysis	11
G. Institutional Arrangements and Environmental Monitoring and Management	11
H. Public Participation	12
G. Conclusions	13
Appendixes	

## A. Introduction

1. The Government of the People's Republic of China (PRC) has requested assistance from the Asian Development Bank to finance the construction of the Guizhou-Shuibai Railway Project. The Project railway will be constructed and operated by the Guizhou Shuibai Railway Company (GSRC), which has been established as a joint venture by Guizhou Province, the Ministry of Railways (MOR), and the Ministry of Coal Industry. This Summary Environmental Impact Assessment (SEIA) has been prepared by consultants<sup>a</sup> as an evaluation and summary of an Environmental Impact Assessment (EIA) prepared for the Project, and has been reviewed and updated again based on comments received from Bank staff during the Fact-finding Mission (1-14 October 1997), including visits to and interviews with people in the Project area. The preparation of the EIA report was carried out by the Second Survey and Design Institute (SSDI) of MOR from June to December 1993 and was approved by the National Environmental Protection Agency (NEPA) on 2 September 1994. The EIA report covers a number of key environmental issues, including spoil disposal, terrestrial ecology, ecology, noise pollution, air pollution, water pollution, electromagnetic interference, solid waste, public safety, land acquisition, resettlement, and induced impacts as well as mitigation measures on the environment, management plan, and monitoring system.

2. The SEIA has been reviewed and updated based on (i) relevant Project reports, particularly the EIA report; the Project feasibility study report; and the resettlement plan; (ii) comments from MOR; the Guizhou Environmental Protection Bureau (GEPB); the Liupanshui Environmental Protection Bureau (LEPB); SSDI; and various experts from universities, environmental organizations, and other Government organizations; (iii) discussions with local residents and field visits in the proposed Project area; and (iv) a sample survey of affected households carried out from 3 to 7 August 1997.<sup>b</sup>

## B. Description of the Project

3. The proposed railway between Liupanshui and Baiguo with a length of approximately 121 kilometers (km) is located within the City of Liupanshui, west of Guizhou Province (see Maps 1 and 2). With a north-to-south orientation, the line starts at the west end of the south marshaling station of Liupanshui hub; passes through Zhongshan District, Shuicheng County, and Panxian Special District; and ends at Baiguo station on the Panxi Railway. The Project, together with Nanning-Kunming Railway and Neijing-Kunming Railway, makes another new trunk line in the north-to-south network. Construction of the Project is forecast to take about five years, commencing around mid-1998 and finishing by December 2002 to become operational by early 2003.

4. The Project is designed as a state trunk line of class I, single track with standard gauge (1.435 meters [m]), and average right-of-way of 30 m. Electric locomotives will be used for the railway operations. The Project includes 13 stations (between Liupanshui and Baiguo on the existing national railway network), 118 bridges with a total length of 20,757 m, and 72 tunnels with a total length of 57,186 m. Freight traffic includes coal, petroleum, steel, metallic and nonmetallic ores, building materials, and some grain. Coal represents a major part of total

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<sup>a</sup> International consultants from Canada in association with domestic consultants from the PRC engaged by the Bank under TA No. 2799-PRC: *Guizhou Shuibai Railway Project*, for \$400,000, approved on 22 May 1997, assisted the Government and GSRC to prepare this SEIA.

<sup>b</sup> This SEIA meets the requirements set forth in the Bank's *Environmental Assessment Requirements and Environmental Review Procedures (1993)*.

traffic, and coal transport is the main justification for the Project. The coal traffic forecast is based on a detailed review of actual and planned coal production in the Project area, i.e., 25.31 million tons in 2006 and 28.38 million tons in 2011. Coal production will be stabilized thereafter, estimated at 28.85 million tons in 2022. Freight traffic for coal, transit, and others is forecast at a combined 18.2 million tons in 2006 and 25.26 million tons in 2011, comprising mainly coal. The annual volume of local and transit passengers is forecast to be 1.33 million in 2006 and to increase to 2.13 million by 2011.

## **C. Description of the Environment**

### **1. Physical Resources**

5. The proposed railway line is located in the western region of Guizhou Province. The elevation of the Project area is between 1,800 m and 2,500 m, rising from southeast to northwest. The Project area is located in the eastern part of the Yungui Plateau featuring high mountains and lofty peaks, and with complex geological conditions. Due to its long history of denudation and erosion, the plateau has been broken and has formed the present landform of mountain ranges. The proposed rail route runs through numerous steep mountains and deep valleys. The geological structures along the proposed rail line are complex, containing a combination of multistructural systems. The commonly seen main structural characteristics include karst, landslides, collapses, rock accumulation, mud flows, soft soil, artificial coal pits, and gases. There are three types of notable geomorphologic features, including karst, erosion, and erosion corrosion. Karst landscape is especially well developed and has such forms as valleys, funnels, sink holes, subterranean rivers, and limestone caves. The main strata where the line passes are limestone, dolomite, sandstone, shale, and basalt. Formations from top to bottom consist of devonian, carboniferous, permian, triassic, jurassic, and quaternary systems. The most widely distributed soil types include yellow and brown soil, yellow soil, purple soil, and paddy rice soil. Because of its brittle nature and weak capacity to resist weathering, the sand shale and purple sand shale of strata are often weathered and lost layer by layer. The exposed tuffs and basalt also have very weak weathering resistance; landslides and debris flows often occur.

6. The Project area belongs to the subtropical climate zone: dry and cold in winter and spring, wet and mild in summer and autumn. The average annual temperature is 13-14 °C. The annual rainfall is 1200 to 1500 millimeters. The prevailing wind blows from the southwest to northeast, with a mean velocity at 1.6-2.5 meters per second. Due to the topology, vertical differentiation of the climate in the Project area is apparent. Three rivers, namely the Xiangshui, Beipan, and Balang, flow through the Project area. They belong to two major river systems, namely the Zhujiang (Pearl) and the Changjiang (Yangtze). Deep riverbeds and large head drops characterize these mountain rivers, providing abundant hydropower reserves. The Xiangshui River is 18.5 km in length, has a drainage area of 180 square kilometers (km<sup>2</sup>), and has a 3.4 cubic meter per second (m<sup>3</sup>/s) annual average flow rate. It is seriously polluted by domestic sewage and industrial wastewater from Liupanshui City. The Beipan River is 442 km long, has a drainage area of 2,188 km<sup>2</sup>, and has an annual average flow rate of 489 m<sup>3</sup>/s. The rail line will cross the Beipan River at Maogeduo. The Balang River is 50 km long, has a 432 km<sup>2</sup> drainage area, and has a 7.9 m<sup>3</sup>/s annual average flow rate. The line will cross this river at Siyincun Village.

7. According to recent statistics, the Xiangshui River at Liupanshui receives about 80,000 tons/day of wastewater, or 0.9 m<sup>3</sup>/s, whereas the flow rate of the river is only 3.4 m<sup>3</sup>/s. This gives a sewage/flow rate ratio of 1:3.8. Among the largest contributors are industries such as steel, power, chemical, food and beverage, and textile, and domestic sewage. Monitoring of six water quality parameters was conducted at four cross-sections in September 1993. The six parameters included hydrogen ion concentration (pH), suspended solids (SS), chemical oxygen demand (COD), biochemical oxygen demand (BOD), oil/grease, and lead (Pb), which were chosen in view of the characteristics of the wastewater from railway operations. Monitoring data indicated that the oil/grease content of the Xiangshui River exceeded the permissible limits (Standards for Surface Water Quality, GB 3838-88) by 17 percent and Pb by 4 percent. Other pollutants COD, BOD, and pH were below the limits. The results of monitoring are presented in Appendix 1.

8. Monitoring of the existing quality of the ambient atmospheric environment was carried out during 11-15 August 1993. Sampling points were set up in selected sensitive spots at the Liupanshui locomotive depot, marshaling yard, maintenance section, and the Second Middle School of Mine Bureau. The pollutants monitored were nitrogen oxides (NO<sub>x</sub>), sulfur dioxide (SO<sub>2</sub>), and total suspended particles (TSP). The levels of NO<sub>x</sub> and SO<sub>2</sub> were well below the permissible limits at all monitoring points, but the levels of TSP were high and in some cases exceeded the established standards in the municipal city of Liupanshui. The levels of TSP along the railway line can meet Standard II. The air quality monitoring results and standards are given in Appendix 2.

9. The noise baseline was monitored at sensitive areas between September and October 1993. Forty-eight monitoring points were set up near the Liupanshui Station; the Baiguo Station; eight points each near the four planned stations (Yushe, Faer, Songhe, and Daying stations); and three points near the Shaomi school. The measurements were 24-hour equivalent and day-night equivalent sound levels. The results showed that the existing noise levels at the monitoring points near the Liupanshui Station were close to the permissible limits, while those at the Baiguo Station, at the four planned stations, and at the school were much lower. When the noise from the Project is overlaid, the noise levels near the Liupanshui and Baiguo stations will be close to the prescribed standards. The monitoring results are presented in Appendix 3.

## **2. Ecological Resources**

10. Along the Project line, land of lower gradient (with slope of less than 10 degrees) accounts for only 25 percent of the total dry cultivated land area, whereas that with higher gradient (with slope of 10 degrees and above) makes up 75 percent. Due to the predominantly high gradients, soil erosion is widespread, resulting in a generally thin arable stratum. In fact, over 63 percent of the cultivated land area has less than 0.15 m of arable soil. Bare, steeply sloping cultivated land with marginal farming has been prevalent for decades.

11. In the Project area, land degradation in general and soil erosion in particular are further aggravated by rapid population growth, unsustainable agricultural activities, and resource extraction. Deforestation and improper agricultural practices, including the expansion of cultivated land onto steep slopes, exacerbate soil loss. The forest cover is only 3.9 percent of the total land area. Common tree species include pine, China fir, cypress, birch, and poplar. The area prone to water loss and soil erosion in the Project area is large, amounting to over 60

percent of the total land base. Agricultural crops are the most common vegetation along the proposed railway line. Crops are distributed in terraced fields in valleys, low-lying lands in the mountains, and mountain foothills. The main crops are rice, corn, potato, wheat, and bean. Scrub is widely seen on slopes and mountain foothills, including grass species and herbs.

12. There is a nature reserve in Yezhong Township, about 7.8 km from the Project line, for the protection of Francois' leaf monkey (*Presbytis francoisi francoisi*). The reserve covers an area of 13.62 km<sup>2</sup>, including a core area of 4 km<sup>2</sup>. The border of the nature reserve and the Project railway alignment are separated by a series of mountains. The reserve, about 1,200 m above sea level, with subtropical climate and favorable geographical surroundings, provides good conditions for protected species, particularly the Francois' leaf monkey, which is in State Protection Class I (endangered). Also inhabiting the reserve are 13 other protected animal and bird species under State Protection Class II (precious species). They include the rhesus macaque (*Macaca mulatta mulatta*), stump-tailed macaque (*Macaca thibetana*), small Indian civet (*Viverra zibetha*), forest musk deer (*Moschus berezovskii*), goral (*Naemorhedus*); Chinese copper pheasant (*Chrysolophus amherstiae*), black kite (*Milvus korschun lineatus*), eagle owl (*Bubo bubo kiautschensis*), sparrow hawk (*Accipiter nisus nisosimilis*), collared pigmy owl (*Glaucidium brodiei brodiei*), barred owl (*Glaucidium cuculoides whiteleyi*), kestrel (*Falco tinnunculus saturatus*), and Guizhou wart newt (*Tylototriton kweichowensis*). LEPB has a specific budget and personnel (3 regular staff and 3 part-time rangers) to manage the reserve. Based on a 1997 survey, the population of the protected species has been stabilized in the past decade. The EIA and the consultants' report have confirmed that the Project will not have any impact on the reserve. As a measure of added caution, the use of explosives for Project construction will be minimized in the vicinity of the reserve.

### 3. Human and Economic Development

13. The proposed railway line will pass through Zhongshan District, Panxian Special District and Shuicheng County, which are under the jurisdiction of Liupanshui Prefecture. The total population in these three districts/counties in 1997 was 2.1 million, with a predominantly rural focus at 84 percent. The population who could directly or indirectly benefit from the Project was estimated at 1.9 million. Minority nationalities constitute about 38 percent of the total population. The Project will directly affect 27 towns and villages with an aggregate population of 624,600. There are minority nationalities (mainly Yi, Buyi, Miao and Bai) living in small communities and distributed in 22 towns and scattered villages on the hill slopes. The population density of the affected towns and villages is approximately 234 persons per km<sup>2</sup>. The natural population growth rate stands at 1.13 percent. About 95.7 percent of the population, or 597,700 persons' livelihood, is based on agriculture.

14. The Project area is rich in resources. There are various kinds of minerals such as coal, iron, lead, marble, and gypsum. The main industry of Liupanshui is coal mining. Other major industries include metallurgy, electrical power, building materials, and chemicals. The production of existing large- and medium-sized coal mines is heavily dependent on transport capacity. Lack of transportation restricted new mines from being built and existing mines from being expanded. The area is largely inaccessible and can be reached only by poor and narrow mountain paths. As a result, the Project area is generally poor, with a low economic development level even compared with the provincial average. Guizhou is officially considered a poverty province, which makes it eligible for special assistance from the Central Government for

poverty reduction. In the Ninth Five-Year Plan (1996-2000), the Central Government is aiming at upgrading the province's infrastructure and education levels to reduce poverty.

#### **4. Living Standards**

15. The population in the directly affected towns and villages is predominantly rural with heavy dependence on agriculture. The agricultural productivity is very low. For example, the annual grain production per capita was only 136-316 kilograms (kg), compared with the national average of 385 kg and the Guizhou average of 321 kg. Guizhou is one of the six poorest provinces in the PRC with a per capita gross domestic product (GDP) in 1996 of Y2,025, or 36 percent of the national average of Y5,568. The net average income was Y434 per capita, with the lowest being Y100. Within the directly affected towns and villages, 229,600 persons or 37 percent of the total population live under the State Poverty Line (Y 580). As such, the Project area is very poor and is classified as a priority area for poverty reduction in Guizhou Province.

### **D. Anticipated Environmental Impacts and Mitigation Measures**

#### **1. Spoil Disposal**

16. The construction of the new railway line will generate a large amount of spoil, which will need to be carefully disposed of. This is due to an imbalance between cut (65 percent) and fill (35 percent). The amount of spoil to be disposed of is estimated at 2.67 million m<sup>3</sup>. Due to a shortage of available land for disposal, spoil will need to be disposed of either on mountain sides or in valleys. Mitigation measures include haulage of the spoil from the Project site to available mountain sides and building of retaining walls to contain the deposits. In consultation with the local people, spoil could be used to develop level areas near villages for facilitating community livelihood and cultural activities. Costs associated with this measure are estimated at more than Y 22.6 million, which is included in the Project cost estimates. These mitigation measures, if adequately employed, will provide for appropriate containment of spoil and residual impacts will thus be minimal.

#### **2. Terrestrial Ecology**

17. Except for degraded forest which consists of individual and small groups of trees along the Project route, no primary forest area will be affected by the Project. The forests in the area are generally in poor condition, as they are regularly encroached upon by the marginal farming of local people. The loss of trees will be fully compensated for by planting trees of the same species along the railway corridor and at stations at a cost of Y654,000, which is included in the Project cost estimates. In accordance with the environmental management plan, temporarily occupied forest land will be restored to its original state as soon as construction activities are completed. Flora to be lost in the Project area are considered to be common species in the PRC, and thus the residual ecological impacts are anticipated to be minimal.

#### **3. Soil Erosion**

18. The Project will pass through soil erosion-prone regions, which account for over 63.3 percent of the total Project area. Project activities, especially at the construction stage may aggravate the situation if not carefully planned. Soil erosion can result in decreased soil fertility and denuded earth surface. Improper protection of slopes can increase the risks of landslides,

rock and mud flows, and siltation and blocking of waterways. Several mitigation measures will be employed, including the following: (i) preparing, revegetating and reforesting exposed areas (slopes) upon completion of the earthworks; (ii) building ditches and culverts dimensioned and judiciously located; and, where slopes are too steep, (iii) building retaining walls to prevent landslides. These measures are adequate to effectively confine soil erosion to acceptable levels and are normally undertaken when building a railway as sound engineering practices. They will also be applied to the construction of access and linkage roads as necessary. The costs associated with them are included in engineering costs. Their monitoring will be implemented regularly by a domestic consultant with adequate experience in environmental monitoring and management.

#### 4. Air Quality Impacts

19. The main existing sources of air pollution are the coal mining, coke making, thermal power, steel, cement, textile, food, and beverage industries as well as mobile sources. Air pollution from the construction and operation of the Project will include dust from earthworks, emissions from boilers in the railway stations, and fly ash from the transport of coal. Water sprinkling of exposed earth surfaces during construction will greatly reduce dust. Additional measures planned include locating concrete mixing sites in isolated areas, enclosing material stockpiles, storing bulk construction materials in closed silos with appropriate dust-preventing filters, shrouding the aperture for dry mix batching, and confining construction vehicles to designated routes. Flying dust during the loading, transit, and unloading of coal will be controlled by water sprinkling and providing covers as appropriate. Most of the coal-burning boilers to be used in the railway stations are under one ton in volume. Cyclone dust collectors and desulfurization devices will be installed, which will reduce the fumes by over 85 percent. With the proposed control measures, the emissions are expected to meet the standards. For comparison, without dust control and desulfurization devices, TSP will be less than or equal to 1,500 milligrams per normal cubic meter ( $\text{mg}/\text{Nm}^3$ ) (standard of TSP is  $250 \text{ mg}/\text{Nm}^3$ ). With dust control and desulfurization devices (with 85 percent of dust reduction and 75 percent of desulfurization), TSP will be less than  $225 \text{ mg}/\text{Nm}^3$  and  $\text{SO}_2$  will be less than  $1,250 \text{ mg}/\text{Nm}^3$  (standard for  $\text{SO}_2$  is  $1,800 \text{ mg}/\text{Nm}^3$ ).<sup>a</sup>

#### 5. Water Quality

20. The Xiangshui River will be affected by wastewater discharged from the railway facilities. The total amount of wastewater discharge will be  $382,000 \text{ m}^3$  per year, comprised of  $16,200 \text{ m}^3$  of industrial wastewater and  $365,800 \text{ m}^3$  of domestic wastewater. An industrial wastewater treatment facility at the Liupanshui Locomotive Depot has been operational since 1985 with a treatment capacity of  $60 \text{ m}^3$  per hour. Its capacity will be able to accommodate the requirements of the planned expansion of the railway station. After treatment, the concentrations of COD, BOD, oil/grease, and TSS will be 57.3 milligram per liter ( $\text{mg}/\text{l}$ ), 12.7  $\text{mg}/\text{l}$ , 4.07  $\text{mg}/\text{l}$ , and 35  $\text{mg}/\text{l}$ , respectively, which are all within discharge standards (100  $\text{mg}/\text{l}$ , 30  $\text{mg}/\text{l}$ , 10  $\text{mg}/\text{l}$ , 10  $\text{mg}/\text{l}$  and 70  $\text{mg}/\text{l}$ , respectively). Domestic sewage is presently collected in septic tanks and used for irrigation after treatment.

21. The industrial wastewater treatment process in the Liupanshui Locomotive Depot consists of seven major steps. First, industrial wastewater flows into a storage pool through a

<sup>a</sup>

Based on the *Air Pollutants Discharge Standards from Boiler*. GB 13271-91.

screen, which collects large floating materials. The large volume of the storage pool results in a stabilized flow, whereby suspended substances settle. In the oil collection pool, large beads of oil are skimmed through the self-adjusting collection pipe. Then, the wastewater flows through the tilted board oil collection pool, where a set of tilted boards increases the contact area and the probability of collision for small drops of oil to form larger beads on the water surface, to be collected by the collection pipe. The wastewater then passes through two aerated floatation collection pools, where emulsified oil is brought to the surface and collected. At the final step, remaining oil is coagulated into larger beads, which floats to the surface to be collected. The total oil contents at the discharge outlet will not exceed the national discharge standard at 10 mg/l.

22. During construction, some waterways will need to be temporarily diverted. They will be restored to their original state upon completion of construction. No irreversible impacts are predicted. In addition, construction camps and maintenance of construction machinery will produce liquid and solid wastes. The impacts on water quality will be temporary and will disappear when construction is completed. Meanwhile, the construction contractors will be required to ensure the proper disposal of the wastes. Such requirements will be ensured by GSRC under the contracts with the construction agencies.

## **6. Noise and Vibration**

23. Tests showed that the existing noise levels at the school and several stations were much lower than the permissible limit of 70 decibels. The final selection of the railway alignment avoided passing through the sensitive points, such as Shuicheng County Hospital, Xiaoshan Middle School, Shuitie Middle School, and Shuitie residential quarters. In addition, the railway will pass through the isolated mountainous area. It is thus expected that its noise impact will be acceptable.

24. The noise mitigation measures proposed entail the establishment of greenbelts by planting bushes and evergreen trees with height of over 5 m. Green belts or sound barriers will be established for several such sensitive areas such as railway stations and the Shaomi Primary School. Municipal plans will restrict the expansion of the existing schools and residential quarters, and prohibit the construction of new schools and residential quarters within 200 m of the railway line. Although there will be noise impact during the construction stage, the duration will be relatively short. In addition to employing equipment with low noise and vibration, construction activities with operation of noisy equipment near schools will be scheduled to avoid school class hours (09:00-12:00 and 13:30-15:00) and those near residential areas will avoid operation at night (22:00-06:00).

## **7. Solid Waste**

25. There are four kinds of solid waste along the alignment, estimated to be 557 tons per year of slag from boilers, 2,769 tons per year of domestic refuse from railway staff and their families, 0.8 ton per year of metallic scrap from railway repairs, and 15 tons per year of sludge from sewage treatment facility at the Liupanshui Locomotive Depot. The solid waste will be disposed of in several ways. The slag will be used as filler for pavement of roads or the railway line. Refuse will be used as farm manure after further treatment. Metallic scrap will be recycled. Sludge that contains nontoxic substances will be disposed of in landfills or used as organic fertilizer. The residual impacts will be insignificant.

## **8. Electromagnetic Interference**

26. Within the scope of the railway line, an overhead contact system will be installed along the main line, and at station yards and on arrival and departure tracks. A 50 hertz alternating current system with single-phase industrial frequency will be adopted along the line. Rated voltage will be 25 kilovolts. The annual consumption of electricity along the line will be 84.42 million kilowatt-hours. During the operation of the Project, the electromagnetic interference will mainly come from the overhead contact system when the electric locomotives operate and from radiation from the operation of the substation.

27. In the Project area, communication facilities are poor and few residents have televisions, except in major cities and towns, such as Liupanshui, Yangmei-Faer, and Baiguo. Within 200 m of both sides of the line, there are no TV transmission stations and no communication facilities. Research and measured results indicate that electromagnetic interference of an electrified railway with television receivers does not extend more than 40 m on both sides of the right of way, which will be followed by the city planning department as the limit for planning to construct any residential buildings and TV transmission stations to avoid interference by the electrified railway.

## **9. Land Acquisition and Resettlement**

28. Construction of the Project will involve land acquisition, removal of buildings, and resettlement of affected populations. Total land acquisition will be about 434.47 hectares (ha), which includes the land required for construction of the railway line, railway stations, yards, bridges, tunnels, road construction, nursery, and 124.13 ha for temporary use. About 37,774 m<sup>2</sup> of buildings will be removed, and 615 households comprising 2,466 persons will be affected by the construction of the Project (including the relocation of an estimated 350 households' buildings or 1,469 persons). These household numbers have been estimated based on the preliminary survey and design drawings and have been verified by local officials. A final list of affected households will be prepared after the completion of the final location survey, which is not expected to significantly change the estimated numbers.

29. Land acquisition and resettlement for the Project will be undertaken as per the resettlement plan agreed upon with the Bank. The resettlement plan is based on the Land Administration Law of the PRC, State Council's Regulations on Removing Urban Housing, Guizhou Provincial Land Administration Regulations, Liupanshui Municipal Land Administration Regulations, public consultation, consultants' review, sample survey, and discussions with and field visits by Bank staff. Implementation of the land acquisition and resettlement plan will be carried out by the Liupanshui local government under contract with GSRC, and will be monitored by the Guizhou Social Sciences Academy (GSSA), which will be contracted by GSRC. The progress of implementation of the resettlement plan will be reported by GSRC through the quarterly progress reports to be submitted to the Bank, an annual report to be prepared by GSRC, as well as a final report to be prepared by GSSA one year after the completion of resettlement and to be submitted to the Bank. The compensation and resettlement will be guided by the principal objectives that the affected persons will have their former living standards and income earning capacity improved or at least restored. The affected persons will be provided with adequate support during the transition period.

30. Compensation for land acquisition covers (i) lost agricultural and tree crops, (ii) removal of houses and construction of new houses and other assets, and (iii) costs of land acquisition for and resettlement of affected persons. The compensation and resettlement program incorporates an appropriate consultation process. The standards for compensation in the case of green crops or uncultivated land will be determined jointly by the Liupanshui local government with assistance from the leading group, which consists of representatives from the Liupanshui Land Office, Liupanshui Poverty Reduction Office, Liupanshui Minority Affairs Committee, counties, and townships, and will be based on replacement of annual output values.

31. The compensation for both private houses and public buildings will be calculated based on replacement rates. The compensation for land acquisition is calculated by taking 2-6 times the value of the average output over the three years prior to acquisition, while the resettlement subsidy per person is 3-10 times the value of the average output of the cultivated land over the three years prior to acquisition. Income restoration measures to be implemented will include redistribution of land, intensification, diversification, reclamation, and alternative employment. In particular, new township and village enterprises will be set up using a portion of the compensation and resettlement funds to absorb surplus labor. Adjustment of agricultural taxes will also be considered when appropriate. Farmers who accept alternative employment will be given vocational training.

## **10. Public Safety**

32. As a mode of transport, railway travel is much safer than local highway travel in high mountainous areas. Consequently, the Project will have net benefits in terms of traffic safety. Public consultation has indicated that people living in the isolated parts of the Project area will need to be familiarized with safety issues related to railway through proper education programs. The results of the sample household survey conducted indicate that less than 44 percent of the local population is somewhat aware of railway safety issues, while the rest have little or no knowledge.

33. The Project will therefore require a railway safety education campaign to minimize risks to the communities. GSRC will collaborate with local government authorities, schools, and community leaders to devise an appropriate campaign through media, public announcements, household contacts, and education in school to integrate railway safety into school curricula and local living practices. Meanwhile, prominent advance warning signs will be erected at all intersections. Manned safety booths with barricades will be set up at major intersections. During construction, measures will also be taken to prevent humans and animals from climbing fences along the electrified section of the Project line.

34. As part of the Project design, it is proposed that 11 of the culverts be equipped with pedestrian walkways for use by people and animals to avoid risks of accidents.

## **11. Induced Impacts**

35. The Project area is rich in mineral resources. The new transport capacity made available by the Project will facilitate the development of the secondary and tertiary sectors that are based on local resources. The new railway line together with the network of local roads will provide better access for the local population to market their agricultural produce in other towns

and villages and to thus obtain higher prices than before. The growth of town and village enterprises in the area will also be fostered by the Project.

36. The Project railway will promote the development of mineral resources, including expansion of coal production, particularly the large-scale Yushe, Yangmei-Faer, and Songhe mines, and allow the transportation of mineral resources to markets. The economic analysis of the Project includes the benefits of the expansion of coal production attributable to it, and the corresponding costs for mine development, coal production, and coal transport. These costs include mitigation measures required to reduce the detrimental impacts of coal development to sustainable levels. Since the induced development of mining and other industries may entail environmental problems, every project proposal will undergo rigorous environmental assessment (including the preparation of an EIA report) and review under the PRC's environmental regulations to ensure minimal environmental impacts. National emission standards will also be met by the new and expanded industries. Samples of EIAs<sup>a</sup> and environmental monitoring for similar past mining and industrial projects in the Liupanshui area have been reviewed by Bank staff and found to meet the requirements of the Government, which are satisfactory to the Bank. Future compliance with such requirements will be ensured. After Project completion, most of the polluting small-scale mining, coal washing, and coking industries will be phased out and replaced by larger and more integrated modern plants with improved environmental management measures. The Liupanshui City Government has also promulgated guidelines to modernize and control polluting coking and mining operations in 1997.<sup>b</sup> Better environmental management of industries and improved environmental qualities in the Project area are expected.

## **E. Alternatives**

### **1. Alternative Mode of Transport**

37. The "no build" scenario was considered as an alternative to the Project. In particular, accommodating the forecast growth in freight and passenger traffic through improvement of the existing highway system was examined. This alternative was found to be less environmentally friendly, less energy efficient and less cost effective, since the class and technical standards of highways are restricted in mountainous areas, and the prime function of the Project will be to transport energy resources, especially coal. It was also noted that highways do not represent a real alternative mode for the transportation of large quantities of bulk commodities such as coal.

### **2. Project Alternatives**

38. Alternative alignments at several locations along the route of the Project were considered in the feasibility study. For each alternative, due consideration was given to the potential impacts on (i) the natural environment; (ii) socioeconomic conditions, especially the magnitude of population displacement; and (iii) regional development. Two alternatives, namely

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<sup>a</sup> Samples include EIA report (April 1992) and GEPB review and approval documents (May 1992) for the proposed Guizhou Shuichen Cement Expansion Project, and EIA report (March 1988) for the Dahebien Area Coal Development Project .

<sup>b</sup> Liupanshui City Government promulgation of Guidelines regarding reforming traditional coking industries. January 1997.

the east route and the west route, were examined. The east route was selected for its better geological conditions and to avoid impact on the Wanjiakouzi dam and reservoir. In fact, the presence of the dam renders the west route alignment nonfeasible. Moreover, the west alternative involves a 52 km traverse concentrated in poor geological conditions along the Qingshui River Valley, which could cause difficulties when disposing of the large amounts of spoil during construction. On the east route at the Dayingtou Bridge-Ninadu Tunnel section, a slightly higher cost alternative was chosen to bypass Ninadu Village, thus avoiding greater population displacement and noise impacts. At the Sanjiazhai section, the Baiguo Tunnel (length: 1,020 m) alternative was selected in order to bypass the Sanjiazhai coal-washing factory and to minimize farm land and population displacement.

## **F. Cost-Benefit Analysis**

39. The incremental costs of the proposed environmental mitigation measures and monitoring program, estimated at Y29.11 million were included in the Project cost estimates. Details are provided in Appendix 4. The benefits of the mitigation measures, which may include environmental improvement, higher energy efficiency, and public health enhancement, are difficult to quantify in monetary terms. The measures include (i) maintenance of terrestrial ecology and protection against soil erosion, (ii) maintenance of water quality standards for receiving surface waters, (iii) maintenance of air quality within PRC standards, and (iv) protection against noise and vibration for sensitive receptors. The costs and benefits of the mitigation measures have been included in the overall economic analysis of the Project. The global cost-benefit analysis results of this analysis indicate that the Project yields an economic internal rate of return of about 17 percent.

## **G. Institutional Arrangements and Environmental Monitoring and Management**

40. NEPA and its local bureaus in the provinces, cities, and counties have principal responsibility for monitoring and managing the quality of the environment. In addition, MOR and its local offices have their own requirements for environmental protection relating to the construction and operation of railways. For the Project railway, environmental monitoring will be undertaken by a suitably qualified agency with adequate experience,<sup>a</sup> which will be contracted by GSRC before the beginning of construction work.

41. During the construction phase of the Project, actual field environmental monitoring of air, water quality, and noise parameters will be carried out regularly on a seasonal basis by the contracted entity. While the mitigation measures for spoil disposal, protection of terrestrial ecology, soil erosion control, and methane gas checking will be implemented by the contractors, their regular supervision and random checking will be conducted by both the engineering supervisors and the contracted environmental entity, to ensure compliance. GEPB will review the data submitted by the monitoring entity as quality control of the results before submission to GSRC and the Bank. Land acquisition and resettlement will be carried out by GSRC with assistance from the Liupanshui local government and representatives from counties and townships. GSSA will be contracted by GSRC and be responsible for monitoring the resettlement and social aspects of Project implementation.

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<sup>a</sup> The selection will be limited to the Liupanshui Environmental Protection Science Society and Guizhou Environment Sciences Academy, whose capabilities and experiences were reviewed by GSRC and the Bank and found satisfactory.

42. During operations, the contracted environmental entity and GSSA will continue their monitoring work until one year after the completion of railway construction. GSRC will take over the job afterwards and will be responsible for the implementation of all environmental management and regular monitoring activities. Specific staff of GSRC will be devoted to such tasks. LEPB and its Environmental Monitoring Station will continue to conduct regular environmental monitoring for both the Project line and other potential pollution sources in the area. LEPB has been part of the national integrated monitoring and information system network for acid rain air emission, and the data base has been adequately updated.

43. Monitoring results during the construction and operation of the Project, after their quality control by GEPB, will be reported to GSRC. Assistance will be sought from NEPA and the Environmental Protection Office of MOR when needed. GSRC will report the results of environmental monitoring through quarterly progress reports and annual reports on environmental monitoring of the Project through the Project construction period; and a final report one year after Project completion, prepared by the selected environmental monitoring entity, will be submitted to the Bank.

44. Major environmental factors to be monitored will include spoil disposal, terrestrial ecology, soil erosion, electromagnetic interference, air quality, water quality, noise and vibration, solid waste, public safety, and population resettlement and compensation. Environmental monitoring will be done regularly. Details of parameters to monitor, their locations, and frequency are presented in detail in Appendix 5.

## **H. Public Participation**

45. The public consultation process began in early 1993 and was followed through the initial survey and EIA study phases. Local government officers and SSDI held a series of meetings in the affected villages and townships to inform the residents of the area and to consult with the affected households. Local inputs were considered in the selection of the Project route. A detailed log of this process is given in Appendix 6.

46. The Supporting Railway Construction Office (SRCO), established by the Liupanshui City Government, conducted several information campaigns in 1996 through the local media such as radio, television, and daily newspapers. SRCO made specific attempts to inform the minority nationalities and to seek their inputs in the planning process through village and township meetings. Minority leaders also visited the local SRCO office for railway station site selection in their areas, which reflect their interests and involvement in the Project. The results indicated that most Project-affected people strongly favor the Project. They also believe the Project will bring about improved access to travel and will boost economic development of the region, thereby benefiting them directly. Moreover, GSRC held initial public consultation with local governments in Liupanshui City.

47. In addition to previous formal and informal interviews and meetings with leaders and residents of local communities, the consultants conducted a random sample survey of 125 households among the 615 directly affected ones along the railway line during 3-7 August 1997. The results of this survey show universal support for the Project. A large portion of those interviewed were already aware of the Project (78 percent). The interviewed residents saw it as an opportunity to improve accessibility, the local economy, and their living standards. They expressed the wish that the railway be built as early as possible. While the affected people

were understandably concerned about displacement, they appreciated the assurances that all those affected would receive adequate compensation for losses at replacement value and would be relocated within the vicinity of their previous homes.

48. Public views in regard to the environmental impacts of the Project were solicited during the household survey. Concerns focused on potential socioeconomic impacts and land acquisition and resettlement compensation. The responses demonstrated that the loss of agricultural land is the most critical concern to the affected people (82.4 percent of the respondents). That is followed, in descending order, by noise (12.0 percent), spoil (5.6 percent), electromagnetic interference (4.0 percent), soil erosion (2.4 percent), devegetation (0.8 percent), and solid waste (0.8 percent). No respondents were concerned about the damage to wildlife or about water or air pollution. In summary, no additional issues arose from the household survey other than those already identified and addressed in the full EIA report.

## **I. Conclusions**

49. Potential environmental impacts of the Project may include those related to spoil disposal, soil erosion, air pollution, water pollution, noise and vibration, electromagnetic interference, solid waste, and public safety as well as land acquisition and resettlement. Detailed mitigation measures were adequately prepared for all these aspects. Project alternatives were carefully examined including the no-build option, and an environmentally friendly alternative was chosen. An environmental monitoring program was developed and will be rigorously implemented. Responsible institutions for implementation of the mitigation measures and the environmental monitoring program were identified, and will be contracted for with specifically committed budget. The costs of impact mitigation and environmental monitoring were identified and included in the overall Project budget.

50. The adverse environmental impacts of the Project could be minimized to acceptable levels through a set of clearly identified and costed mitigation measures. It will in fact constitute a more environmental friendly and energy-efficient mode of transport of coal and other goods. It will take away a portion of the traffic from the road system, which is more damaging to the environment and human health. The Project will also indirectly contribute to better management of local mining and coking industries thereby reducing water and air pollution. Additionally, the Project will promote the growth of the local economy and create additional employment opportunities, and will greatly contribute to poverty reduction in local communities.

**APPENDIXES**

<b>Number</b>	<b>Title</b>	<b>Page</b>	<b>Cited on (page, para.)</b>
1	Xiangshui River Water Quality Monitoring Data	15	3,7
2	Air Quality Monitoring Data	16	3,8
3	Existing and Forecast Noise Levels	17	3,9
4	Cost Estimates of Environmental Protection and Monitoring	18	11, 39
5	Environmental Monitoring Program	19	12, 44
6	Public Consultations for the Project	20	12, 45

**XIANSHUI RIVER WATER QUALITY MONITORING DATA**  
(mg/l except pH)

<b>Item</b>	<b>PH</b>	<b>SS</b>	<b>COD</b>	<b>BOD</b>	<b>Oil Grease</b>	<b>Pb</b>
Upper Stream from Convergence Site of Depot Wastewater	7.71	17.47	7.43	1.29	0.472	0.048
Excess Above Standard	-	-	-	-	-	-
Lower Stream from Convergence Site of Depot Wastewater	7.75	22.1	9.18	2.06	0.585	0.052
Excess Above Standard	-	-	-	-	17%	4%
Standard <sup>a</sup>	-	150	20	6	0.5	0.05

--= magnitude zero; mg/l=milligram per liter; ph-hydrogen ion concentration; SS=suspended solids; COD=chemical oxygen demand; BOD=biochemical oxygen demand; Pb=lead.

<sup>a</sup> Based on the Environmental Quality Standard of Surface Water, GB3838-88.

Source: Consultant's Report.

## AIR QUALITY MONITORING DATA

Item	SO <sub>2</sub> Average Result of 20 Samples for Every Location Each Day	NO <sub>x</sub> Average Result of 20 Samples for Every Location Each Day	TSP Average Result of 20 Samples for Every Location Each Day
Liupanshui Locomotive Depot (including residential districts)	0.048	0.034	0.16
Marshalling Yard	0.047	0.039	0.23
Maintenance Section (including residential, commercial & cultural districts)	0.042	0.035	0.22
Second Middle School of Mine Bureau	0.038	0.020	0.31
Average of the Area	0.044	0.032	0.23
Daily Average of Concentration Standard	0.15 mg/Nm <sup>3</sup>	0.10 mg/ Nm <sup>3</sup>	0.30 mg/Nm <sup>3</sup>
Concentration Standard for Each Discharge <sup>a</sup>	0.50 mg/Nm <sup>3</sup>	0.15 mg/Nm <sup>3</sup>	1.00 mg/Nm <sup>3</sup>

SO<sub>2</sub>=sulfur dioxide; NO<sub>x</sub>=nitrogen oxides; TSP=total suspended particles; mg/ Nm<sup>3</sup>=milligram per normal cubic meter.

**Note:** Except for the one TSP sample at the marshalling yard and three TSP samples at the south of Liupanshui Station that exceeded the standard, all the others can meet it.

<sup>a</sup> Based on the Atmospheric Environmental Quality Standard, GB3095-82.

Source: Consultant's Report.

## EXISTING AND FORECAST NOISE LEVELS

Monitoring Point	Distance from Railway (m)	Present Noise Level (day)	Present Noise Level (night)	Forecast Noise Level	Standard (dB[A])
Shaomi Primary School	130	51.2	49.8	55.4 <sup>b</sup>	60 (day) 50 (night)
Liupanshui Station	30		67.8	68.0 <sup>a</sup>	60 (day) 50 (night)
Baiguo Station	30		49.8 <sup>b</sup>	56.7 <sup>a</sup>	65 (day) 55 (night)
Yushe Station	30		42.5 <sup>b</sup>	53.0 <sup>a</sup>	60 (day)
Faer Station	30		45.6 <sup>b</sup>	54.5 <sup>a</sup>	50 (night)
Songhe Station	30		43.7 <sup>b</sup>	54.3 <sup>a</sup>	
Daying Station	30		46.6 <sup>b</sup>	55.2 <sup>a</sup>	

<sup>a</sup> Within 30 m of the railway line: 70 dB(A) is used according to the Noise Standard of Railway Boundary & its Measurement Method, GB2525-90.

<sup>b</sup> Beyond 30 m of the railway line: 65 dB(A) during the day and 55 dB(A) at night are used for the Baiguo Station, as it is classified as an industry-Concentrated District. 60 dB(A) during the day and 50 dB(A) at night are used for other stations, as they are classified as Confined District Class II according to the Environmental Noise Standard in Urban District, GB 3096-82.

Source: Consultant's Report.

### ENVIRONMENTAL MONITORING PROGRAM

Environmental Factor	Parameter	Location	Frequency	
			Construction	Operation
Air	TSP, NO <sub>x</sub> , SO <sub>2</sub> , CO	Sensitive areas	3 consecutive days at appropriate intervals	At least twice a year
Surface Water	SS, COD, BOD, DO, Ph, oil, phenol	Downstream railway effluent outlets	At least twice a year	At least twice a year
Noise	DB(A)	Sensitive areas	3 consecutive days at appropriate intervals	At least four times a year
Solid Waste	Slag, domestic refuse, metallic scrap, sludge	Disposal sites	Twice a year	Twice a year for the first two years, then once a year thereafter
Methane Gas in Tunnel	Methane gas	Coal-bearing tunnels	Weekly	Quarterly
Electromagnetics	TV receiver, communication facility	Entire railway line		Once a year for the first two years, then once every two years thereafter
Spoil	Visual inspection	Entire railway line	Biweekly	Twice a year at the start and end of the rainy season
Soil erosion	Visual inspection	Entire railway line	Biweekly	Twice a year
Public Safety	Signs, culverts, public safety records	Entire railway line		Once every three months for the first year, then once a year thereafter
Population Resettlement and Compensation	Income, housing, employment, social adaption	Relocated families and receiving communities	During the first two years after resettlement, each family will be visited twice a year	Community survey once a year in first 5 years; once every 2 years in first 10 years

TSP=total suspended particles; NO<sub>x</sub>=nitrogen oxides; SO<sub>2</sub>=sulfur dioxide; CO=carbon monoxide; SS=suspended solids; COD=chemical oxygen demand; BOD=biological oxygen demand; DO=dissolved oxygen; pH=hydrogen ion concentration; dB(A)=decibel.

Source: Consultant's Report.

### PUBLIC CONSULTATIONS FOR THE PROJECT

Date	Agency	Participants	Number of People	Objective	Response from Participants
9/1991	SSDI, Guiyang	Related departments from Guizhou Province and from Liupanshui Prefecture counties and districts	46	Opinions on Project route were sought	Participants gave opinion that the east-line alternative passing through three major coal fields is more helpful to the development of resources and local economic development
11/1991	Liupanshui Government	Leaders from the counties and townships along the railway	72	Introduce the significance of project railway to the local economic development	People feel that the railway is the road to development and hoped the construction would begin early
1/1992	Shuicheng County	Representatives of the counties and townships along the railway	68	Introduce the significance of the railway and seek support of the people along the railway	Representatives expressed support for the construction of the railway
1/1992	Panxian County	Representatives of the counties and townships along the railway	47	Introduce the significance of the railway and seek support from people along the railway	Representatives supported the construction of the railway
4/1993	SSDI, Panxian	Villagers near Yinshan Tunnel, Nijiaodu, and Sanjiazhai Coal Dressing Plant	21	Seek opinions of affected persons on alternatives	Yinshan Tunnel should be built straight and less land acquired; expand earthwork in Nijiaodu to reduce demolition of houses; for Sanjianzhai, industrial zone should be avoided
9/1993	SSDI, Liupanshui	Leaders from LPS Gov., Environmental Protection Bureau and Nature Reserve and villagers nearby	12	Review the effects of the railway on environment and ecology	Agreement with environment protection measures, use of explosions during construction will have no effects on black leaf monkey
3/1994	Liupanshui Government	Affected persons along the project railway		Introducing further significance of the railway and protection measures	People along the railway supported the project
6/1995	SSDI, Liupanshui	Representatives of the counties and towns along the railway	44	Providing details of the railway to avoid the building of houses within the scope of railway	Participants think it necessary and agree with the design alternative
7/1996	SDB, Liupanshui	Representatives of counties and towns along the railway	52	Obtain information about public participation in the project railway	Participants were well aware of the railway and sought ADB's support for early construction
11/1996	GSRC, Liupanshui	Leaders from Liupanshui as well as districts and counties	27	Introducing land acquisition and resettlement of affected persons	Suggested monitoring land acquisition and resettlement, and agreed with the

					resettlement plan
2/1997	GSRC, Liupanshui	Representatives of the counties and towns of Liupanshui	71	Introducing resettlement policy of Bank Loan project	Representatives supported efforts for the improvement of affected persons' living standards
4/1997	Liupanshui	Representatives of affected persons along the railway	65	Seek opinions and sample survey of affected households	Sample households were satisfied with the proposed arrangements
4/1997	Liupanshui	People along the railway		To survey type and area of land acquisition and number of affected persons	People cooperated actively
8/1997	GSRC, LPS	LPS RCSO, Poverty Reduction Office, Minority Com. And State Land Bureau, EPB and Coal Bureau	12	Introduced Bank's resettlement policy and sought opinions on the railway construction from all the departments	Support for and satisfaction with the Bank's Policy
8/1997	GSRC	Affected persons	125	Detailed survey of affected persons' family situation, land, and income	Affected persons supported the construction of the railway
8/1997	Provincial Planning Commission, Guiyang	Related departments	9	Discuss ways for land acquisition and resettlement	Necessary preparations are being made satisfactorily
9/1997	Provincial Planning Commission, LPS	Leaders from all departments	49	Introduce the significance of the railway, the way for land acquisition and resettlement	Prefecture officials making necessary preparations
9/1997	GSRC, LPS	Affected persons in Yuge- Songhe section	34	Introduce the implementation of land acquisition and resettlement, compensation to affected persons	Affected persons support the construction of the project railway

## COST ESTIMATES OF ENVIRONMENTAL PROTECTION AND MONITORING

Item	Y (million)
<b>A. Construction/Installation</b>	
(i) Tree Planting	
Along Right of Way	0.470
Along Stations	0.184
(ii) Noise Protection	0.369
(iii) Residence Wastewater Treatment	0.213
(iv) Operation Facilities Wastewater Treatment	0.483
(v) Additional Haulage for Soil Disposal	10.104
(vi) Masonry for Soil Disposal	12.486
(vii) Construction Supervision	0.464
(viii) Engineering Design	0.580
<b>Subtotal</b>	<b>25.353</b>
<b>B. Consulting Services for Monitoring</b>	
Environment Monitoring	<b>0.857</b>
<b>C. Management</b>	<b>0.251</b>
<b>D. Physical Contingencies</b>	
(i) On Construction	2.431
(ii) On Consulting Services	0.190
(iii) On Management	0.025
<b>Subtotal</b>	<b>2.646</b>
<b>Total</b>	<b>29.107</b>

Source: Consultant's Report