ECONOMIC AND FINANCIAL ANALYSIS

A. Introduction

1. The proposed project involves capacity augmentation and rehabilitation of the AH 02 (Nepal border to Bangladesh border) and AH 48 (Bhutan border to Bangladesh border) corridors to improve key international road sections passing through the state of West Bengal in India. The goals of these improvements are to encourage regional socioeconomic development, trade, and tourism between the countries. Various measures in transit and trade agreements are also being taken up to promote regional trade between India, Bangladesh, Nepal, and Bhutan, as well as international trade for the landlocked countries of Nepal and Bhutan under the South Asia Subregional Economic Cooperation program. The success of these initiatives requires good road connectivity and a good level of service along the road corridors.

2. The project road sections have an operational two-lane carriageway. The traffic levels on these roads indicate the requirement for a minimum of two standard lanes with paved shoulders and for some sections of standard four-lane carriageway. There is no segregation of slow-moving vehicles and pedestrians in the urban sections, adding to the congestion. The project road sections have a bituminous surfacing but poor pavement structure, which results in rapid pavement failure and road roughness above desirable levels, means that pavement reconstruction is required every few years. The road sections selected need both capacity augmentation and pavement reconstruction or rehabilitation to provide an acceptable level of service.

3. An economic evaluation of the proposed project components was undertaken. The project road improvement consists of improvement of an existing road, which is already travelled by motorized traffic but has capacity constraints and is in poor condition. The proposed project will augment traffic capacity, improve the geometry, and remove major bottlenecks such as congested urban sections and level crossings. The improvement of road corridors will result in savings to road users and society as a whole in the form of reduced vehicle operating and time costs for passengers and freight traffic. There will also be reduced costs in the form of reduced road maintenance costs as well as reduced vehicle emissions and possibly road accidents. These reduced costs, calculated over the project life, are compared with construction costs for the road improvement option (including the cost of environmental and social impact mitigation measures). The Highway Development and Management (HDM)-4 model is used to estimate the costs and benefits associated with both the with- and without-project scenarios in order to establish the economic viability of the proposed project.

B. Demand Analysis

4. The base-year traffic assessment and forecast are made based on traffic studies carried out in 2013. The analysis identified six homogenous traffic sections along AH 02 and five homogenous traffic sections along AH 48. The economic analysis has been carried out considering the homogenous traffic sections with data input given by homogenous sections and the output is then combined for each corridor. The base-year traffic obtained from the traffic surveys constitutes the normal traffic. In addition, two other types of traffic—diverted and generated and/or induced—are also considered. The study of the road network indicates no potential for any diverted traffic on AH 02, but in the case of the AH 48, the development of national highway 31D through Alipurdwar will provide an alternate shorter route and will result in traffic diversion from AH 48. The network development planned for 2015-2025 has been considered and the traffic likely to be diverted has been considered in the analysis. The project road corridors are well-established routes and provide connectivity although at present they suffer from capacity constraints and poor condition in some

sections. No additional traffic generation is anticipated as a result of the proposed upgrading, apart from normal traffic growth. However, without augmentation, traffic growth will be constrained in some sections where the ultimate capacity is reached in the analysis years in the without-project scenario. The base-year traffic volume adopted for the economic analysis is given in Table 1. The large variation of traffic along the AH 02 corridor is due to major urban sections along the corridor.

Table 1: Base-Year Traffic Volume along Project Road Sections

Road Corridor	Homogenous Traffic Section and Length	AADT (Motorized Vehicles)	Percent of Passenger Vehicles	Percent of Goods Vehicles	AADT (Nonmotorized Vehicles)
AH02	1 (1.53 km)	9,119	88.1	11.9	10,603
	2 (16.7 km)	5,992	74.3	25.7	2,942
	3 (5.42 km)	27,081	75.9	24.1	2,821
	4 (7.09 km)	6,811	73.4	26.6	1,123
	5 (4.24 km)	18,024	61.1	38.9	3,505
	6 (2.29 km)	2,099	79.1	20.9	2,160
AH 48	1 (20.4 km)	3,921	38.7	61.3	961
	2 (17.4 km)	5,347	50.5	49.5	2,465
	3 (8.0 km)	7,022	59.6	40.4	2,069
	4 (27.1 km)	5,196	59.7	40.3	1,853
	5 (17.7 km)	4,910	77.4	22.6	1,382

AADT = annual average daily traffic, AH = Asian Highway, km = kilometers.
Source: ADB Consultant.

5. In the absence of historical traffic data on the project road corridors, vehicle registration growth in the project influence area and economic parameters such as net state domestic product, per capita income, and population were analyzed to estimate vehicle growth elasticity in relation to these parameters and was adopted for traffic projection. The adopted traffic growth rate projections are given in Table 2.

Table 2: Adopted Traffic Growth Rates
(%)

Vehicle Type	2013–2015	2016–2020	2021–2025	2026–2030	2031–2035	2036–2040
AH 02 Corridor						
Car/van/jeep	6.3	5.4	4.6	3.9	3.3	2.7
Two-wheeler	6.0	5.1	4.4	3.7	3.2	2.5
Bus	4.4	3.7	3.2	2.7	2.3	1.9
Goods vehicle	6.0	5.1	4.3	3.7	3.1	2.6
AH 48 Corridor						
Car/van/jeep	5.7	4.9	4.1	3.5	3.0	2.4
Two-wheeler	6.0	5.1	4.4	3.7	3.2	2.5
Bus	4.4	3.7	3.2	2.7	2.3	1.9
Goods vehicle	5.9	5.0	4.3	3.6	3.1	2.7

Source: ADB Consultant.

C. Economic Analysis

6. **Road characteristics.** The inventory and condition survey and the material and pavement investigation data and analysis provide the required HDM input data for the existing road characteristics.

7. **Vehicle characteristics and costs.** The HDM model takes as input the vehicle technical and operational characteristics and prices, tire prices, fuel price, maintenance costs, and vehicle operation staff costs. The technical and vehicle operating characteristics are adopted from other similar studies. The vehicle and tire price excluding taxes and labor cost for vehicle maintenance and operation were collected from Siliguri and adopted for the study. Economic fuel prices have also been derived excluding taxes and duties.

8. **Value of time for passengers and freight.** For passenger-carrying vehicles, values of passenger working and nonworking time were calculated based on per capita income in the state. The per capita income per employed person is worked out and average hourly income is derived assuming 2,080 hours of work per year. The value of time in private passenger vehicles is equated to the income level of owners of these vehicles, which is substantially higher than for the average population. The hourly cost for passengers in public transport vehicles in rural areas may, at the lowest, be equated with the opportunity cost of labor, or minimum wage levels. The work time for passengers is valued at 0.5 times the average hourly income for bus passengers, 1.0 times the average hourly income for two-wheeler passengers, and 2.0 times the average hourly income for car passengers, estimated considering the likely income range of such passengers. The value of nonwork time is taken as 25% of the value of work time. The value for the state gross domestic product per capita was obtained from the Economic Survey of India 2012–13 and projected for 2013–2014. A summary of the calculated values of time for each passenger-carrying vehicle is presented in Table 3.

Table 3: Adopted Values of Passenger Working and Nonworking Time

State	Estimated Net State GDP per capita at current prices, 2013–2014 (Rs)	Bus (Rs per hour)		Car (Rs per hour)		Two- and Three-Wheelers (Rs per hour)	
		Working	Non-working	Working	Non-working	Working	Non-working
West Bengal	70,370	31.7	7.9	126.9	31.7	63.4	15.9

GDP = gross domestic product.
Source: ADB Consultant.

9. For goods-carrying vehicles, a value of time for cargo was calculated using the method suggested in the HDM manual—taking the value of cargo and the opportunity cost. The value of time for freight is calculated as time value of goods in transit, i.e., the value of the goods carried times the commercial interest rate paid by the owners as an inventory cost. Considering the predominance of regional trade and main goods carried, a cargo value of Rs60,000 per ton is assumed and the opportunity cost of cargo delay or value of time for cargo is estimated at Rs1.65 per ton per hour, considering 75% of cargo to be benefited and an interest rate of 12%.

10. **Salvage value.** A straight-line depreciation method is used to calculate the salvage value of project elements at the end of the analysis period. Among the project elements, bituminous components are assumed to have a life of 20 years or less with periodic renewal as needed and will have no salvage value. The pavement structure below bituminous layer in the widening portion is assumed to have a 30-year life for salvage value calculation. Bridges and cross-drainage structures can have a life of more than 40 years. Assuming a 40-year life for all structures, the salvage value was calculated on a straight-line depreciation method. The salvage value estimated is 28.4% for AH 02 and 16.4% for AH 48 at the end of the analysis period.

11. **Other parameters.** Other parameters used, such as analysis period, discount rate, construction period, and the year of opening of the road for traffic after construction, are presented in Table 4.

Table 4: Other Input Parameters Used for the Highway Development and Management Model-4 Analysis

Item	Value
Analysis period from opening year (years)	20
Discount rate (%)	12
Construction period (years)	3
Construction start year	2014
Opening year for traffic	2017

Source: ADB Consultant.

12. **Construction and maintenance alternatives.** The construction and maintenance alternatives for the HDM analysis have been defined based on the improvement options identified. Based on the traffic and capacity assessment, four-lane cross-section is adopted for homogenous traffic sections 3 and 5 of AH 02 corridor, and two-lane configuration with paved shoulders for all other sections. The construction cost estimate for project options is derived based on detailed design and bill of quantities. The cost estimate includes the civil works cost; environmental, land acquisition, and resettlement costs; utility shifting costs; and physical contingencies. The economic costs of construction were derived from the financial construction cost by applying the shadow exchange rate factor of 1.037 for tradables and shadow wage rate factor of 0.75 for unskilled labor. The periodic maintenance unit costs adopted are based on the unit cost estimates for the project. The routine maintenance cost is assumed at Rs90,000 per km for existing two-lane roads, Rs200,000 per km for upgraded two-lane roads, and Rs300,000 per km for four-lane roads.

13. On the benefit side, only vehicle operating cost savings and travel time savings are quantified and included in the economic analysis. Other benefits include accident cost savings and environmental benefits. The improved geometry, road signs and markings, and layout in town sections are likely to reduce accidents. At the same time, the increase in speed resulting from improvement may increase the severity of accidents. The main environmental benefit will be from capacity augmentation and the reduced congestion and vehicle emissions. Overall, the impact will be positive but reduced accident benefits and vehicle emissions were not quantified or included in the analysis.

14. The results of the economic analysis using the HDM-4 model for the project road are summarized in Table 5. The first-year rate of return is also reported in the table. The results indicate that the project development options have a rate of return well above the opportunity cost of 12%. The first-year rate of return is also above the opportunity cost, indicating that the project proposal is timely. The cash flow streams for both corridors are given in Table 6.

Table 5: Results of Economic Analysis

Corridor	EIRR (%)	NPV (Rs million)	FYRR (%)
AH 02	22.4	3289.7	21.7
AH 48	16.3	1727.2	13.4
Both corridors	19.0	5016.9	16.9

EIRR = economic internal rate of return, FYRR = first year rate of return, NPV = net present value.
Source: ADB Consultant.

Table 6: Cash Flow Stream for AH 02 and AH 48 Corridors
(Rs million)

	Increase in Road Agency Costs		Decrease in Road User Costs		
Year	Capital Costs	Maintenance Costs	Vehicle Operating Costs	Time Costs	Net Benefits
2014	2,696.40	0.00	0.00	0.00	(2,696.40)
2015	3,595.20	0.00	0.00	0.00	(3,595.20)
2016	2,462.10	0.00	0.00	0.00	(2,462.10)
2017	0.00	(58.08)	1,034.70	376.40	1,469.00
2018	0.00	(49.78)	1,090.80	423.00	1,563.50
2019	0.00	14.12	1,192.20	458.10	1,636.20
2020	0.00	15.82	1,387.30	521.50	1,893.10
2021	0.00	2.54	1,529.00	561.30	2,087.80
2022	0.00	429.67	1,707.50	618.60	1,896.40
2023	0.00	248.42	1,558.80	665.20	1,975.70
2024	0.00	10.22	1,773.50	701.40	2,464.60
2025	0.00	(76.98)	1,873.20	712.10	2,662.30
2026	0.00	13.72	1,995.00	742.80	2,724.20
2027	0.00	0.72	2,156.20	772.90	2,928.40
2028	0.00	424.00	2,347.80	810.20	2,734.10
2029	0.00	(22.78)	2,247.10	857.40	3,127.30
2030	0.00	293.12	2,361.60	890.30	2,958.80
2031	0.00	3.72	2,534.90	893.30	3,424.60
2032	0.00	(50.68)	2,678.30	911.40	3,640.50
2033	0.00	(19.47)	2,811.30	930.80	3,761.70
2034	0.00	423.69	2,970.10	951.90	3,498.40
2035	0.00	(4.08)	2,744.40	973.70	3,722.10
2036	(1,932.70)	11.92	2,886.80	997.80	5,805.40
				EIRR (%)	**19.0**
			NPV @ 12%		**5,016.9**

( ) = negative value, EIRR = economic internal rate of return, NPV = net present value.
Source:

15. Sensitivity analyses were carried out to investigate the robustness of the economic viability of the project to cost overruns and benefit reductions. The cases analyzed are (i) base cost and benefits, (ii) 15% increase in capital costs and base benefits, (iii) 15% decrease in benefits and base cost, and (iv) 15% increase in capital costs and 15% decrease in benefits.

16. The results of the sensitivity analyses for the road corridors are given in Table 7. As shown, with a 15% increase in capital costs and a 15% reduction in benefits, both project corridors still have an economic internal rate of return of more than 12%. Based on the economic analysis of the project options, as well as on the engineering and traffic assessment, the proposed project is recommended for implementation.

Table 7: Sensitivity Analysis Results

	Sensitivity Scenario							
	Case (i)		Case (ii)		Case (iii)		Case (iv)	
Corridor	EIRR (%)	NPV (Rs million)	EIRR (%)	NPV (Rs million)	EIRR (%)	NPV (Rs million)	EIRR (%)	NPV (Rs million)
AH 02	22.4	3,289.7	20.2 (+216%)	2,879.3	19.9 (–53%)	2,382.7	17.8 (+/–36%)	1,945.0
AH 48	16.3	1,727.2	14.5 (+41%)	1,103.7	14.2 (–29%)	839.0	12.5 (+/–17%)	222.8
Both Corridors	19.0	5,016.9	17.0 (+71%)	3,983.1	16.6 (–41%)	3,221.6	14.8 (+/–26%)	2,167.7

EIRR = economic internal rate of return, NPV = net present value.
Note: Figures in brackets give the switching value for the variable(s) considered. In case (iv), the +/– indicates the percentage by which costs increase and benefits decrease to give a result of NPV = 0.
Source:

D. Financial Analysis

17. Incremental recurrent operation and maintenance costs associated with all possible subprojects under tranches 1 and 2 are estimated at about 1.5% of the current Ministry of Road Transport and Highways maintenance budget and 3.3% of the Manipur Public Works Department maintenance budget on an annual basis, which will be required after construction completion in 2017. The initial 5-year maintenance has been budgeted under the investment program. The additional operation and maintenance expenditure is a small percentage of the current allocation and an examination of budget allocation trends indicate that the maintenance budget allocation increase is well above the annual inflation. Therefore, the additional operation and maintenance expenditure from the project is expected to be covered by the maintenance budget allocation.