

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)  
NATIONAL CAPITAL REGION PLANNING BOARD (NCRPB)  
GOVERNMENT OF INDIA

**THE FEASIBILITY STUDY  
ON THE CONSTRUCTION OF EXPRESSWAYS  
IN THE NATIONAL CAPITAL REGION IN INDIA**

**FINAL REPORT**

**MAIN REPORT**

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**The following foreign exchange rate is applied in the study:**

**US\$ 1.00 = Rs. 42.50 (as of August 1999)**

## PREFACE

In response to the request from the Government of India, the Government of Japan decided to conduct the Feasibility Study on the Construction of Expressways in the National Capital Region in India and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to India a study team headed by Mr. GUNJI Isamu, Pacific Consultants International Co., Ltd., four times between November 1998 to March 2000.

The team held discussions with the officials concerned of the Government of the Republic of India, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of India for their close cooperation extended to the team.

March 2000

A handwritten signature in black ink, appearing to read 'Kimio Fujita', written over a horizontal line.

Kimio Fujita  
President  
Japan International Cooperation Agency

March 2000

Mr. Kimio Fujita  
President  
Japan International Cooperation Agency

**Subject: Letter of Transmittal**

Dear Sir,

We are pleased to submit herewith the Final Report of "The Feasibility Study on the Construction of Expressways in the National Capital Region in India".

The report contains results of the study which was carried out by Pacific Consultants International between December 1998 and March 2000. The report consists of three volumes of Summary, Main Report and Drawings.

The Summary briefly illustrates the findings of the entire study. The Main Report is comprised of 14 Chapters and presents current transport profiles, feasibility and implementation studies on the Project. It recommends that the Project should be implemented at the earliest opportunity, and necessary policy measures and actions should be taken so as to realize the "down-to-earth" blueprint in a timely manner. The Drawings compiles plans and details associated with the preliminary design of the expressways, bridges and other structures.

We wish to express grateful acknowledgement to the personnel of your Agency, Ministry of Foreign Affairs, Advisory Committee, Ministry of Construction and Embassy of Japan in India, and also to officials of National Capital Region Planning Board, Government of India for their assistance extended to the Study Team. The Study Team sincerely hopes that the result of this study will contribute to the development of expressway network in India.

Yours faithfully,

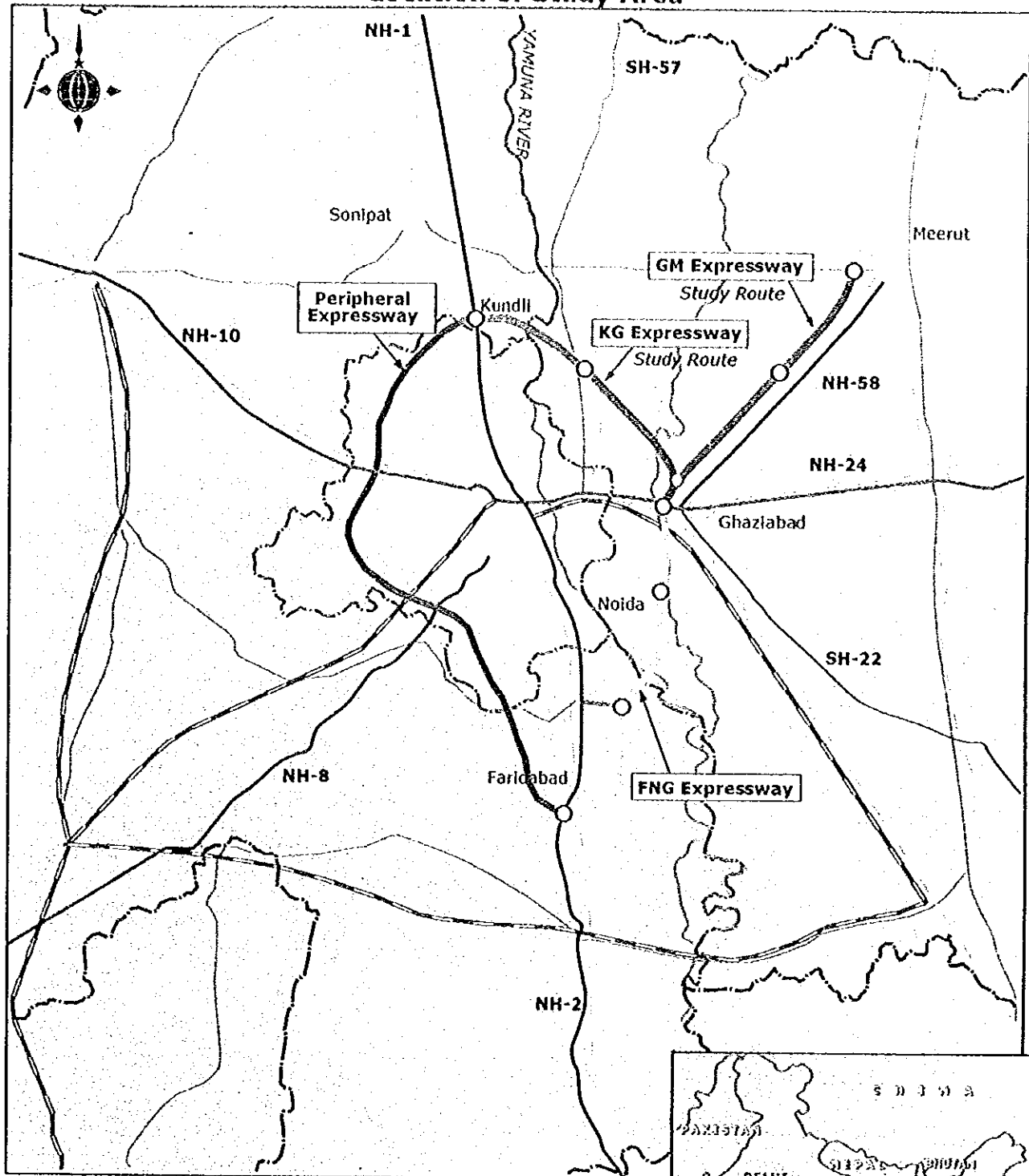


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







Isamu Gunji  
Team Leader, JICA Study Team  
The Feasibility Study on the Construction  
of Expressways in the National Capital  
Region in India

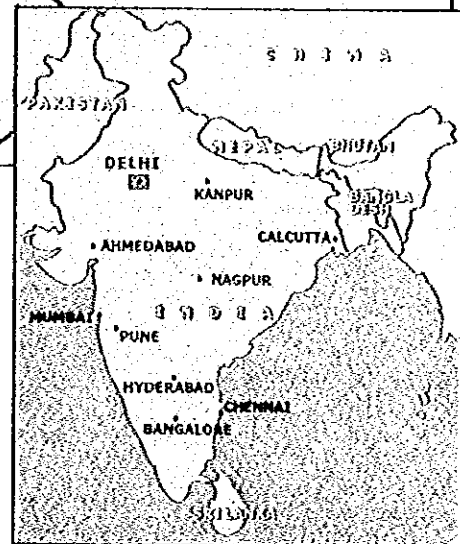


## Location of Study Area



### LEGEND

-  Study Routes
-  FNG Expressway
-  Peripheral Expressway
-  National Highway
-  State Highway
-  Railway
-  State Boundary
-  NCR Boundary





## DEFINITIONS AND ABBREVIATIONS

### (1) Agencies

AASHTO	American Association of State Highway and Transportation Officials
ADB	Asian Development Bank
CPWD	Central Public Works Department
CIDA	Canadian International Development Authority
DDA	Delhi Development Authority
DTC	Delhi Transport Corporation
GDA	Ghaziabad Development Authority
GOI	Government of India
IBRD/WB	International Bank for Reconstruction and Development / World Bank
IDFC	Infrastructure Development Finance Corporation
IL&FS	Infrastructure Leasing & Financial Services
IMD	Indian Meteorological Department
IRC	Indian Road Congress
JICA	Japan International Cooperation Agency
JBIC	Japan Bank for International Cooperation
MDA	Meerut Development Authority
MOEF	Ministry of Environment and Forests
MOF	Ministry of Finance
MOST	Ministry of Surface Transport
MOUD	Ministry of Urban Development
NCRPB	National Capital Region Planning Board
NHAI	National Highway Authority of India
PWD	Public Works Department

### (2) Technical Terms

AADT	Average Annual Daily Traffic
AC	Asphalt Concrete
ADT	Average Daily Traffic
B/C	Benefit Cost Ratio
BOD	Biochemical Oxygen Demand
BOOT	Build-Operate-Own-Transfer
BOT	Build-Operate-Transfer
CBD	Central Business District
CBR	California Bearing Ratio
DBM	Dense Bituminous Macadam
DDTV	Design Daily Traffic Volume
DNB	Delhi-Noida Toll Bridge
DUT	Delhi Union Territory
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ESAL	Equivalent Single Axle Load
EIRR	Economic Internal Rate of Return
FIRR	Financial Internal Rate of Return
FNG	Faridabad-Noida-Ghaziabad
GDP	Gross Domestic Product
G-M or GM	Ghaziabad - Meerut

GMBA	Ghaziabad-Meerut Expressway Borrow Area
GRDP	Gross Regional Domestic Product
HCM	Highway Capacity Manual
HFL	High Flood Level
HWL	High Water Level
IC	Interchange
IDC	Interest During Construction
IEE	Initial Environmental Examination
IRR	Internal Rate of Return
IS	Indian Standard
ISBT	Inter-State Bus Terminal
JCT	Junction
K-G or KG	Kundli - Ghaziabad
KGBA	Kundli-Ghaziabad Expressway Borrow Area
kip	Kilo-pounds
LAA	Land Acquisition Act
LCV	Light Commercial Vehicles
LWL	Low Water Level
NCR	National Capital Region
NCTD	National Capital Territory of Delhi
NH	National Highway
NPV	Net Present Value
O-D	Origin-Destination
ODA	Official Development Assistance
O&M	Operation and Maintenance
PAP	Project Affected Persons
PC	Pre-stressed Concrete
PCU	Passenger Car Unit
PLR	Prime Lending Rate
PMU	Project Management Unit
PPP	Private-Public Partnership
PSI	Pavement Serviceability Index
RC	Reinforced Concrete
ROE	Return on Equity
ROW	Right of Way
Rs.	Indian Rupee
SC	Scheduled Caste
SH	State Highway
SPCB	State Pollution Control Board
SPD	Suspended Particulate Matters
SPT	Standard Penetration Test
SPUR	Spatial Priority Urbanization Regions
SPV	Special Project Vehicle
Sta.	Station
STRADA	System for Traffic Demand Analysis
TP	Toll Plaza
TSP	Total Suspended Particles
U.P.	Uttar Pradesh
USD	US Dollar
VOC	Vehicle Operating Cost

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**TABLE OF CONTENTS**

PREFACE

LETTER OF SUBMITTAL

PROJECT LOCATION MAP

DEFINITIONS AND ABBREVIATIONS

PROJECT SUMMARY

EXECUTIVE SUMMARY

	Page
<b>CHAPTER 1: INTRODUCTION</b>	
1.1 Study Background .....	1-1
1.2 Study Objective .....	1-2
1.3 Study Area .....	1-3
1.4 Study Approach and General Work Flow .....	1-3
1.5 Study Organization .....	1-6
<b>CHAPTER 2: EXISTING SOCIAL AND ECONOMIC CONDITIONS</b>	
2.1 Population .....	2-1
2.2 Employment .....	2-2
2.3 Economic Activities .....	2-4
2.4 Social Characteristics .....	2-8
2.5 Motorization .....	2-10
<b>CHAPTER 3: URBAN AND REGIONAL DEVELOPMENT CONTEXT</b>	
3.1 Administrative Structure and Jurisdiction .....	3-1
3.2 Current Urban and Regional Development Trends .....	3-5
3.3 Existing Land Use in NCR .....	3-8
3.4 Delhi Union Territory .....	3-8
<b>CHAPTER 4: PROFILE OF EXISTING TRANSPORT MODES AND TRAFFIC</b>	
4.1 Transport Sector Development in India .....	4-1
4.2 Existing Road Network and Functions within NCR .....	4-2
4.3 Existing Railway Network and Functions .....	4-3

4.4	Review of Transport System in NCR	4-4
4.5	Traffic Survey and Analysis Results	4-5

## **CHAPTER 5: URBAN AND REGIONAL DEVELOPMENT PLANS**

5.1	Urban and Regional Development Policies	5-1
5.2	Existing Urban and Regional Development Plans in NCR	5-2
5.3	Future Social and Economic Development Framework	5-14

## **CHAPTER 6: INITIAL ENVIRONMENTAL EXAMINATION**

6.1	Regulatory Procedure of Environmental Clearance	6-1
6.2	Land Acquisition Act	6-10
6.3	Initial Environmental Examination	6-17
6.4	Social Survey	6-39

## **CHAPTER 7: OPTIMUM ROUTE SELECTION**

7.1	Natural Conditions in the Study Area	7-1
7.2	Control Factors in Route Selection	7-8
7.3	Alternative Routes and Engineering Comparison	7-11
7.4	Comprehensive Evaluation of Alternative Routes	7-21

## **CHAPTER 8: TRAFFIC DEMAND ANALYSIS**

8.1	Overview	8-1
8.2	Socio-economic Data	8-1
8.3	Development of Transport Model	8-5
8.4	Estimation of Future Traffic on Project Expressway	8-22
8.5	Scenario Analysis	8-29

## **CHAPTER 9: PRELIMINARY ENGINEERING DESIGN AND CONSTRUCTION PLANNING**

9.1	Design Policy	9-1
9.2	Design Standards	9-2
9.3	Toll Levy System and Interchange Type	9-11
9.4	Highway Capacity and Number of Lanes	9-21
9.5	Preliminary Engineering Design	9-24
9.6	Construction Planning	9-49
9.7	Project Cost Estimation	9-61

## **CHAPTER 10: EXPRESSWAY OPERATION AND MAINTENANCE PLAN**

10.1	Expressway Operation and Maintenance Works	10-1
10.2	Organization for Expressway Operation and Maintenance	10-11
10.3	Facilities and Equipment for Operation and Maintenance	10-13
10.4	Operation and Maintenance Costs	10-14

## **CHAPTER 11: ECONOMIC ANALYSIS**

11.1	Vehicle Operating Cost and Time Cost .....	11-1
11.2	Project Network and Cost .....	11-10
11.3	Estimation of Benefit .....	11-16
11.4	Economic Evaluation of the Project .....	11-23

## **CHAPTER 12: FINANCIAL AND IMPLEMENTATION STUDY**

12.1	Introduction .....	12-1
12.2	Policy Objectives Framework and Strategy at National Level --	12-4
12.3	National Level Development Needs and Investment Requirements .....	12-6
12.4	The Structure of the Overall Enabling Environment .....	12-8
12.5	Summary Appraisal of the Overall Enabling Environment ---	12-10
12.6	Summary Conclusions on and Recommendations for the Legal and Regulatory Framework .....	12-11
12.7	Summary Conclusions on and Recommendations for the Concession Agreement .....	12-14
12.8	Summary Conclusions on and Recommendations for the Institutional Framework .....	12-17
12.9	Summary Observations on "Best International Practice" ----	12-19
12.10	Financial Analysis .....	12-28
12.11	Improving the FIRR .....	12-51
12.12	The Equity Holder's Point-of-View .....	12-51
12.13	Conclusion, Recommendations & Guidelines for Governmental Position in Project Negotiations .....	12-52
12.14	Recommended Implementation Plan and Timetable .....	12-58

## **CHAPTER 13: ENVIRONMENTAL IMPACT ASSESSMENT**

13.1	Introduction .....	13-1
13.2	Existing Environmental Status .....	13-7
13.3	Environmental Impact Assessment .....	13-26
13.4	Environmental Management Plan .....	13-45
13.5	Land Acquisition and Resettlement .....	13-51

## **CHAPTER 14: CONCLUSION AND RECOMMENDATIONS**

14.1	Conclusions .....	14-1
14.2	Recommendations .....	14-4

## **APPENDIX:**

## LIST OF TABLES

	Page
Table 1.1	Participants of the Study ----- 1-7
Table 2.1.1	NCR Population and Growth Rate ----- 2-1
Table 2.1.2	Migration of Delhi ----- 2-2
Table 2.2.1	Work Participation Rate ----- 2-3
Table 2.2.2	Worker Distribution in the Study Area ----- 2-3
Table 2.3.1	Macro Economic Development in India ----- 2-4
Table 2.3.2	GSDP at Factor Cost by Kind of Economic Activities at Constant Rate ----- 2-5
Table 2.3.3	Agricultural Production in the State Level in 1995-96 ----- 2-6
Table 2.3.4	Industrial Establishment in the Study Area ----- 2-7
Table 2.3.5	Net National Product Per Capita Income of the Study Area ----- 2-8
Table 2.4.1	Scheduled Cast (SC) and Scheduled Tribe (ST) Population ----- 2-9
Table 2.4.2	Literacy Rate ----- 2-9
Table 2.4.3	Sex Ratio ----- 2-9
Table 2.4.4	Urban and Rural Sex Ratio ----- 2-10
Table 2.4.5	Birth and Death Rate ----- 2-10
Table 2.5.1	Registered Vehicle in Delhi ----- 2-11
Table 3.1.1	Development Authority in NCR ----- 3-3
Table 3.2.1	Urbanization of the NCR ----- 3-6
Table 3.2.2	Infrastructure Requirement in Delhi ----- 3-7
Table 3.3.1	Existing Landuse of NCR 1986-1987 ----- 3-8
Table 3.4.1	Population Distribution within Delhi ----- 3-9
Table 4.1.1	Traffic Growth in the Delhi-Ghaziabad Corridor ----- 4-2
Table 4.1.2	Traffic Growth in the Delhi-Faridabad Corridor ----- 4-2
Table 4.4.1	Motor Vehicles on Delhi Roads ----- 4-4
Table 4.4.2	Public Buses in Delhi in 1997 ----- 4-4
Table 4.5.1	Traffic Counts - 24 Hours ----- 4-8
Table 4.5.2	Directional Proportional Flow at Margin ----- 4-9
Table 4.5.3	Road Side Interview Sample ----- 4-10
Table 4.5.4	Trip Destination of Survey Vehicles ----- 4-11
Table 4.5.5	Trip Purpose of Drivers ----- 4-12
Table 4.5.6	Home State of Interviewee ----- 4-12
Table 4.5.7	Distribution of Goods by Tonnage Carried ----- 4-13
Table 4.5.8	Average Axle Load ----- 4-13
Table 4.5.9	Distribution of Trucks ----- 4-14
Table 4.5.10	Travel Time Speeds on Various Corridors ----- 4-14
Table 4.5.11	Breakdown of Bus Vehicle Trips ----- 4-16
Table 4.5.12	Breakdown of Commercial Vehicle Trips ----- 4-16
Table 4.5.13	Percentage Diversion to Toll Road ----- 4-17
Table 5.2.1	List of Existing Plan ----- 5-2
Table 5.2.2	List of Regional Centers in the NCR ----- 5-4



Table 5.2.3	Population of the Priority Towns .....	5-5
Table 5.2.4	List of Industrial Areas .....	5-14
Table 5.3.1	Division of India .....	5-15
Table 5.3.2	Existing Population Estimate .....	5-17
Table 5.3.3	Future Population Projection in India .....	5-18
Table 5.3.4	NCR Urban Rural Population by State .....	5-18
Table 5.3.5	Economic Activities in the Study Area .....	5-20
Table 5.3.6	Future Economic Activities in India .....	5-21
Table 5.3.7	Existing Employment Estimate .....	5-22
Table 5.3.8	Work Participation Rate .....	5-22
Table 5.3.9	Future Employment Projection .....	5-23
Table 5.3.10	Employment in India and the NCR .....	5-24
Table 5.3.11	Summary of Social and Economic Framework .....	5-24
Table 6.3.1	Showing Regional Traffic Estimates .....	5-20
Table 6.3.2	Water Quality of the Yamuna River at Okhla .....	5-24
Table 6.3.3	Water Quality of the Hindan River at Ghaziabad .....	5-24
Table 6.3.4	CPCB Priority Water Quality Criteria .....	5-25
Table 6.3.5	Ambient Air Quality at Delhi .....	5-27
Table 6.3.6	Ambient Air Quality at Utter Pradesh .....	5-28
Table 6.3.7	Showing Ambient Noise Standards .....	5-28
Table 6.3.8	Showing Field Noise Sampling .....	5-29
Table 6.4.1	Basic Data of Villages in the Survey Area and 17 Villages Selected by Different Criteria .....	5-41
Table 6.4.1(C)	Basic Data of Villages in the Survey Area and 17 Villages Selected by Different Criteria .....	5-42
Table 6.4.2	Infrastructure .....	5-43
Table 6.4.3	Population, Caste, Community Dominance and Land for Religious Purposes .....	5-45
Table 6.4.4	Literacy Rate (%) in the Survey Area Villages .....	5-47
Table 6.4.5	Health & Sanitation Facilities, and Fair & Festivals .....	5-48
Table 6.4.6	Cropped Area, Area Under Orchards, Major Crops and Their Productivity .....	5-49
Table 6.4.7	Salient Features of Villages Selected for Detailed Investigation .....	5-53
Table 6.4.8	Sourcewise Irrigated Area .....	5-58
Table 7.1.1	Cross Sections Survey Length .....	7-5
Table 7.1.2	Hydrological Observation Stations .....	7-5
Table 7.1.3	Major Flood Records of Yamuna River .....	7-5
Table 7.1.4	Major Flood Records of Hindan River .....	7-6
Table 7.1.5	Design HFL of Yamuna River .....	7-6
Table 7.1.6	Design HFL of Hindan River .....	7-6
Table 7.1.7	Affluxed HFL of Yamuna Bridge .....	7-7
Table 7.1.8	Affluxed HFL of Hindan Bridge .....	7-7
Table 7.3.1(1)	Comparison of Alternative Routes (1) .....	7-18
Table 7.3.1(2)	Comparison of Alternative Routes (2) .....	7-19
Table 7.3.2	Alternatives and distance for Analysis of Route Priority .....	7-20
Table 7.3.3	Indicative Priority Order Among Alternative Plans .....	7-20
Table 7.4.1	Comparison of Alternative Routes .....	7-21

Table 8.2.1	Population Projection by Sector (Millions of People) -----	8-3
Table 8.2.2	Employment Opportunities Projection by Sector (Millions of People) -----	8-3
Table 8.2.3	Monthly Per Capita Income ('99 Rupees) -----	8-4
Table 8.3.1(1)	Description of Traffic Zones -----	8-12
Table 8.3.1(2)	Description of Traffic Zones -----	8-13
Table 8.3.2	Trip Generation Equation Co-efficient -----	8-14
Table 8.3.3	Percentage Modal Split by Sector within NCR -----	8-16
Table 8.3.4	Traffic Assignment Results -----	8-18
Table 8.3.5	Daily Screen Line Comparison in PCU for Motorised Vehicles -----	8-21
Table 8.4.1	Major Road Network Assumptions -----	8-23
Table 8.4.2	Daily Revenue ('99 Thousand Rupees) as a Function of Time and Toll -----	8-23
Table 8.4.3	Daily Entrance Traffic (pcu) on KG GM Expressway as a Function of Time and Toll -----	8-25
Table 8.4.4	Growth in Trips for NCR -----	8-28
Table 8.4.5	Estimated Traffic Volumes on Project Expressway -----	8-28
Table 8.5.1	Daily Entrance Traffic (pcu) on KG GM Expressways as a Function of Network Configuration for the Toll of 1.5 Rs per pcu-km -----	8-31
Table 9.2.1	Relation between e and R for 120 km/hr -----	9-3
Table 9.2.2	Relation between "e" and "R" for Ramps -----	9-6
Table 9.2.3	Recommended Geometric Design Standard for Expressway -----	9-7
Table 9.2.4	Concrete Types -----	9-8
Table 9.2.5	Types of Reinforcement -----	9-9
Table 9.2.6	PC Cable Types -----	9-9
Table 9.2.7	Dead Loads -----	9-9
Table 9.3.1	List of Interchanges -----	9-16
Table 9.4.1	A Summary of Traffic Demand Forecast -----	9-21
Table 9.4.2	Design Daily Traffic Volume for the Expressways -----	9-22
Table 9.5.1	Summary of Design Features of Horizontal Alignment of the Projects -----	9-25
Table 9.5.2	Summary of Design Features of Vertical Alignment of the Projects -----	9-26
Table 9.5.3	Required Number of Toll Gate Lanes (Year 2026/2016) -----	9-27
Table 9.5.4	Required Number of Toll Plaza Lanes (Year 2026/2016) -----	9-34
Table 9.5.5	Parking Lot Numbers for Rest Area (Year 2026/2016) -----	9-35
Table 9.5.6	Location of Borrow Materials -----	9-38
Table 9.5.7	Summary of Test Results for Borrow Materials -----	9-39
Table 9.5.8	Value of Soil Layers for Analyzing Embankment Stability -----	9-40
Table 9.5.9	Safety Factors -----	9-40
Table 9.5.10	The Number of Bridges and Culverts by Category -----	9-42
Table 9.5.11	Comparison of Characteristics of Flexible and Rigid Pavements ---	9-44
Table 9.5.12	Load Equivalency Factors by Axle Load Survey -----	9-46
Table 9.6.1	Construction Segments for Preliminary Construction Planning -----	9-50
Table 9.6.2	Estimated Working Efficiency for Construction in the Study Area ---	9-52
Table 9.7.1	Construction Cost (Initial Stage Construction) -----	9-56
Table 9.7.2(1)	Widening and Overlay Costs (K-G Expressway; Segment 1,2,3) ---	9-57

Table 9.7.2(2)	Widening and Overlay Costs (G-M Expressway; Segment 4,5)	9-58
Table 9.7.3	Summary of Investment Costs	9-59
Table 9.7.4	Yearly Cash Flow of the Project	9-60
Table 10.1.1	The Scope of Inspection Works	10-4
Table 10.4.1	Annual Operation and Maintenance Cost	10-15
Table 10.4.2	Summary of "Non-initial Project Cost" of the Expressways	10-15
Table 11.1.1	Calculation of Financial/Economic Price of Vehicles	11-3
Table 11.1.2	Input Data for Unit Vehicle Operating Cost at Base Speed	11-4
Table 11.1.3	Summary of Running Cost Per km by Base Speed (Economic Price)	11-5
Table 11.1.4	Summary of Fixed Costs per Km at Base Speed (Economic Price)	11-6
Table 11.1.5	Distribution of Annual Income by Groups of Study Area in 1999	11-7
Table 11.1.6	Unit Working Time Value by Income Level (Economic)	11-8
Table 11.1.7	Working Time Value by Type of Vehicle Users	11-8
Table 11.1.8	Travel Time Value by the Type of Vehicle User	11-9
Table 11.2.1	Component of Construction Cost of Sections	11-10
Table 11.2.2	Shadow Exchange Coefficient for Non-Tradable Goods	11-12
Table 11.2.3	Economic Price of Right of Way of the Expressway	11-13
Table 11.2.4	Summary of Conversion from Financial Costs to Economic Cost	11-14
Table 11.2.5	Yearly Allocation of Investment Cost (Economic Cost)	11-15
Table 11.3.1	Amount of Financial Users Benefits in 2006	11-17
Table 11.3.2	Level of Toll and Users Surplus in 2006	11-18
Table 11.3.3	Kinds of Benefit of Expressway Project	11-19
Table 11.3.4	Benefit of the Vehicle Operating Cost Saving by Vehicle Types	11-19
Table 11.3.5	Time Cost Saving Benefit of the Project	11-20
Table 11.3.6	Estimation of the Cost of A Fatal Road Accident	11-21
Table 11.3.7	Fatal Road Accident Saving of the Project	11-22
Table 11.4.1	Cost Benefit Analysis for Investment Justification	11-23
Table 11.4.2	Sensitivity Analysis of the Project	11-25
Table 12.10.1	Underlying Project Structures of Case Study 1 to Case Study 4	12-30
Table 12.10.2	Simple Pre-tax IRR And Basic Appraisal Results	12-35
Table 12.10.3	Net Cashflow After Long-term Debt Service During The First 5 Operational Years (in constant 1999 prices)	12-36
Table 12.10.4	Comparison of Total Project Cost	12-43
Table 12.10.5	Total Project Cost by Local & Foreign Cost Components "SPV" Implementation Scheme: Case Study 4	12-44
Table 12.10.6	Total Project Cost by Local & Foreign Cost Components "Concessionaire" Implementation Scheme: Case Study 3	12-45
Table 12.10.7	System's Annual Toll Revenue Estimations 2006 T 2033	12-48
Table 12.10.8	Total Cashflow & Debt Service Analysis "SPV" Implementation Scheme: PPP/Public	12-49
Table 12.10.9	Total Cashflow & Debt Service Analysis "Concessionaire" "BOOT" Implementation Scheme (Case Study 3)	12-50
Table 13.1.1	Environmental Attributes Covered under Field Studies	13-4
Table 13.1.2	Environmental Attributes Covered with Secondary Data	13-5
Table 13.1.3	Key Environmental Legislation	13-6

Table 13.2.1	Meteorology Parameters Monitored at Site -----	13-8
Table 13.2.2	Summary of the Meteorological Data Generated at Site (Nandgram) -	13-8
Table 13.2.3	Ambient Air Quality Monitoring Results -----	13-12
Table 13.2.4	Ambient Noise Level Monitoring Results -----	13-14
Table 13.2.7	Standard Soil Classification -----	13-17
Table 13.2.8	Reserved or Protected Forest Land in the Project Area -----	13-21
Table 13.2.9	Settlement Pattern -----	13-23
Table 13.2.10	Demography -----	13-23
Table 13.2.11	Density of Population -----	13-24
Table 13.2.12	Availability of Infrastructure -----	13-24
Table 13.2.13	Occupational Structure -----	13-24
Table 13.3.1	Potential Environmental Impacts of Expressway Projects -----	13-26
Table 13.3.2	Speed Corrected Emission Factors -----	13-30
Table 13.3.3	Predicted Ambient Noise Level at Residential Area - dB(A) -----	13-36
Table 13.3.4	Potential Environmental Impacts by the Proposed Expressway Project -----	13-44
Table 13.4.1	Environmental Management Plan -----	13-49
Table 13.4.2	Budgetary Cost Estimates for Environment Protection for Each Section -----	13-50

## LIST OF FIGURES

	Page
Figure 1.1 Flow Chart .....	1-3
Figure 4.2.1 State Boundaries & Major Roads Outside National Capital Territory of Delhi .....	4-6
Figure 4.3.1 State Boundaries & Railway Lines Outside National Capital Territory of Delhi .....	4-6
Figure 4.5.1 Survey Sites within National Capital Territory of Delhi .....	4-7
Figure 4.5.2 Survey Sites Outside National Capital Territory of Delhi .....	4-7
Figure 5.2.1 Future Settlement Pattern in the NCR .....	5-7
Figure 5.2.2 Development of Transportation Network in the NCR .....	5-10
Figure 6.1.1 Procedures for Obtaining Environmental Clearance .....	6-8
Figure 6.1.2 Procedures for Forest Clearance .....	6-9
Figure 6.2.1 Procedures for Land Acquisition .....	6-16
Figure 6.3.1 Survey Locations for Kundli-Ghaziabad Expressway and Ghaziabad-Meerut Expressway .....	6-18
Figure 6.3.2(1) Scoping Check List .....	6-37
Figure 6.3.2(2) Scoping Check List (Continue) .....	6-38
Figure 6.4.1 Survey Locations for Kundli-Ghaziabad Expressway and Ghaziabad-Meerut Expressway .....	6-52
Figure 7.1.1 Sub-Surface Geological Sections .....	7-2
Figure 7.2.1 Interchange Locations for G-M, K-G & FNG Expressways .....	7-10
Figure 7.3.1 Alternative Routes for Kundli-Ghaziabad Expressway and Ghaziabad-Meerut Expressway .....	7-15
Figure 7.3.2 Alternative Routes of Project Expressway .....	7-21
Figure 8.2.1 Sectors in the National Capital Region of India .....	8-2
Figure 8.3.1 The Urban Transport Database .....	8-9
Figure 8.3.2 Model Flowchart .....	8-9
Figure 8.3.3 Zoning System Within National Capital Territory of Delhi .....	8-11
Figure 8.3.4 Zoning System Outside National Capital Territory of Delhi .....	8-11
Figure 8.3.5 Road Network Within National Capital Territory of Delhi .....	8-15
Figure 8.3.6 Road Network Outside National Capital Territory of Delhi .....	8-15
Figure 8.3.7 Speed Flow Curves .....	8-19
Figure 8.3.8 Location of Traffic Count Screenlines .....	8-20
Figure 8.4.1 Proposed Expressways within NCR .....	8-24
Figure 8.4.2 Daily Revenue as a Function of Time .....	8-26
Figure 8.4.3 Daily Revenue as a Function of Toll Rates .....	8-26
Figure 8.4.4 Toll Revenue vs Toll Rate (KG GM Expressways) in 2006 .....	8-26
Figure 8.4.5 Daily Entrance Traffic as a Function of Toll Rate .....	8-27
Figure 8.5.1 Scenario Testing for KG GM Expressways .....	8-30
Figure 9.2.1 Class "A" Loading by IRC .....	9-10

Figure 9.3.1	Alternatives for Toll Levy System	9-15
Figure 9.3.2(1)	Interchange Type Alternatives (1)	9-19
Figure 9.3.2(2)	Interchange Type Alternatives (2)	9-20
Figure 9.4.1	Typical Methods of Stage Construction	9-23
Figure 9.5.1	Interchange Layout (1)	9-28
Figure 9.5.1	Interchange Layout (2)	9-29
Figure 9.5.1	Interchange Layout (3)	9-30
Figure 9.5.1	Interchange Layout (4)	9-31
Figure 9.5.1	Interchange Layout (5)	9-32
Figure 9.5.2	Junction Layout	9-33
Figure 9.5.3(1)	Typical Cross Sections of Throughway (Inner Lane Method)	9-36
Figure 9.5.3(2)	Typical Cross Sections of Ramps	9-37
Figure 9.5.4	A Typical Slope Failure and Ground Failure	9-40
Figure 9.5.5	Pavement Life Cycle	9-45
Figure 9.6.1	Overall Construction Time Schedule	9-52
Figure 9.6.2	Implementation Schedule	9-52
Figure 10.1.1	Flowchart for Inspection and Repair Works	10-5
Figure 10.1.2	Diagram for Centralized Traffic Management & Accident Measures	10-7
Figure 10.1.3	Distance-based Toll Collection System	10-10
Figure 10.2.1	Organization Chart of Head Office and Operation and Maintenance Office	10-12
Figure 11.1.1	Vehicle Classification for Vehicle Operating	11-1
Figure 11.1.2	Diagram of Vehicle Operating Cost Estimation Procedure	11-2
Figure 12.1.1	General Schematic Step-by-Step Approach	12-3
Figure 12.2.1	The National Level Policy Objective Framework	12-4
Figure 12.2.1	Highway Development Strategy Adopted At National Level	12-5
Figure 12.3.1	Expressways To Be Developed Up To 2020	12-7
Figure 12.3.2	Investment Needs Into The National Highway Network, Including Expressway Development	12-8
Figure 12.5.1	Point Based Appraisal Matrix for the Overall Enabling Environment	12-12
Figure 12.5.2	Incentive System For Private Sector Participation In National Highway/Expressway Development	12-13
Figure 12.5.3	Recommended Policy Actions for Overall Regulatory Framework	12-15
Figure 12.5.4	Key Features of NCRPB's Model Concession Agreement	12-16
Figure 12.5.5	Comments on and Recommendations for the Concession Agreement	12-18
Figure 12.5.6	Comparative Summary Overview on NCRPB and NHAI	12-20
Figure 12.5.7	Issues Pertaining to NCRPB Needing Review and Adjustments	12-21
Figure 12.5.8	Advantages and Disadvantages of Alternative Toll Road Opening Facilities	12-23
Figure 12.5.9	Advantages and Disadvantages of Common Government Support Measures for Toll Road Development (Part 1)	12-24
Figure 12.5.9	Advantages and Disadvantages of Common Government Support Measures for Toll Road Development (Part 2)	12-25
Figure 12.5.10	Selected Examples of Toll Adjustment Procedures	12-26
Figure 12.5.11	Essential Elements of Toll Road Concession Contracts	12-27
Figure 12.10.1	Methodological Steps Used In the Fundamental Approach	12-29

Figure 12.10.2	Procedure Adopted for “Base Case” Selection	12-32
Figure 12.10.3	IRR And Alternative Phasing In Construction Implementation	12-38
Figure 12.10.4	Total Project Cost & Implementation Schedule “SPV” Implementation Scheme: PPP/Public	12-46
Figure 12.10.5	Total Project Cost & Implementation Schedule A “BOOT” Implementation Scheme: PPP/Private	12-47
Figure 12.13.1	Policy-objective Hierarchy	12-53
Figure 12.13.2	Policy Related Functional Criteria	12-54
Figure 12.13.3	Timing for Privatization	12-56
Figure 12.13.4	Recommended Negotiation Attitude for the GOI/NCRPB (Part 1)	12-59
Figure 12.13.4	Recommended Negotiation Attitude for the GOI/NCRPB (Part 2)	12-60
Figure 12.14.1	Proposed Implementation Schedule & Timetable	12-61
Figure 13.1.1	Setting up of Project Road	13-2
Figure 13.1.2	Basic Methodology Adopted for Environmental Assessment	13-4
Figure 13.2.1	Location of Monitoring Stations	13-11
Figure 13.2.2	Geological Map of Study Area	13-20
Figure 13.2.3	Socio-economic Map of Study Area	13-25
Figure 13.3.1	CO Concentration at NH-58	13-33
Figure 13.3.2	CO Concentration at SH-57	13-33
Figure 13.3.3	CO Concentration at SH-14	13-33
Figure 13.3.4	CO Concentration along Ghaziabad IC and Ghaziabad JCT	13-33
Figure 13.3.5	CO Concentration along Ghaziabad JCT and Modinagar IC	13-33
Figure 13.3.6	CO Concentration along Ghaziabad JCT and Khekra IC	13-33
Figure 13.3.7	NO Concentration at NH-58	13-34
Figure 13.3.8	NO Concentration at SH-57	13-34
Figure 13.3.9	NO Concentration at SH-14	13-34
Figure 13.3.10	NO Concentration along Ghaziabad IC and Ghaziabad JCT	13-34
Figure 13.3.11	NO Concentration along Ghaziabad JCT and Modinagar IC	13-34
Figure 13.3.12	NO Concentration along Ghaziabad JCT and Khekra IC	13-34
Figure 13.3.13(A1)	Noise Level at NH-58 During Daytime	13-38
Figure 13.3.13(A2)	Noise Level at NH-58 During Nighttime	13-38
Figure 13.3.14(A1)	Noise Level at SH-57 During Daytime	13-38
Figure 13.3.14(A2)	Noise Level at SH-57 During Nighttime	13-38
Figure 13.3.15(A1)	Noise Level at SH-14 During Daytime	13-38
Figure 13.3.15(A2)	Noise Level at SH-14 During Nighttime	13-38
Figure 13.3.16(A1)	Noise Level at Ghaziabad IC and Ghaziabad JCT During Daytime	13-38
Figure 13.3.16(A2)	Noise Level at Ghaziabad IC and Ghaziabad JCT During Nighttime	13-38
Figure 13.3.17(A1)	Noise Level at Ghaziabad JCT and Modinagar IC During Daytime	13-38
Figure 13.3.17(A2)	Noise Level at Ghaziabad JCT and Modinagar IC During Nighttime	13-38
Figure 13.3.18(A1)	Noise Level at Ghaziabad JCT and Khekra IC During Daytime	13-38
Figure 13.3.18(A2)	Noise Level at Ghaziabad JCT and Khekra IC During Nighttime	13-38

## PROJECT SUMMARY

1. COUNTRY	The Republic of India
2. NAME OF STUDY	Feasibility Study on the Construction of Expressways in the National Capital Region
3. COUNTERPART AGENCY	National Capital Region Planning Board
4. OBJECTIVE OF STUDY	To carry out the feasibility study for K-G and G-M Expressways

1. STUDY AREA: North and Northeast vicinity of Delhi in the NCR and in the states of Haryana and U.P.

### 2. FUTURE TRAFFIC VOLUME

Section	Kundli - Khekra	Khekra - Junction	Meerut - Modinagar	Modinagar - Junction	Junction - Ghaziabad
Section Length	14.2 km	26.6 km	16.35 km	15.0 km	8.6 km
Traffic Volume (PCU/day)	Year 2006	41,200	30,900	24,300	27,700
	Year 2016	67,000	52,900	40,400	50,700
	Year 2026	112,800	98,100	75,200	101,300

### 3. NUMBER OF LANES AND STAGE CONSTRUCTION

Section	Kundli - Khekra	Khekra - Junction	Meerut - Modinagar	Modinagar - Junction	Junction - Ghaziabad
Number of Lanes	Year 2006	2 + 2	2 + 2	2 + 2	3 + 3
	Year 2022	3 + 3	3 + 3	3 + 3	4 + 4

### 4. PROJECT COST

Item	K-G Expressway (Kundli-Ghaziabad)		G-M Expressway (Junction - Meerut)		Total
	Local	Foreign	Local	Foreign	
Initial Project Cost	7,023	484	3,605	237	11,349
Widening Cost	1,476	147	732	57	2,412
Overlay (for Initial width)	422	46	294	32	794
Overlay (for Ultimate width)	590	65	381	42	1,080

- Unit: million Rs.  
- August 1999 Prices  
- US\$1.0 = Rs.42.50

### 5. IMPLEMENTATION SCHEDULE

Description	1999	2000	2001	2002	2003	2004	2005	2006
Feasibility Study	■							
Final Engineering Design		■	■					
Land Acquisition			■	■	■			
Construction				■	■	■	■	■
Opening to Traffic								▼

### 6. ECONOMIC AND FINANCIAL INDICATORS

Section	EIRR
K-G and G-M	26.37 %
K-G Only	27.05 %
G-M Only	25.30 %

Section	FIRR *
K-G and G-M	10.4 %
K-G Only	9.6 %
G-M Only	8.9 %

\* at a toll rate of Rs.1.5/pcu-km

### 7. RECOMMENDATIONS

- 1) The results of the Study indicate that the Projects are technically sound and economically highly feasible.
- 2) The financial viability of the Projects is not satisfactory considering the prevailing Indian financial environments.
- 3) In these circumstances, the Projects should be implemented by PPP (Private-Public Partnership).
- 4) GOI/NCRPB should consider recourse financing or positively guaranteeing returns for private equity holders.
- 5) Public equity holders should not expect a high ROE to ensure a reasonable ROE to the private equity holders.
- 6) GOI/NCRPB should consider obtaining ODA funds with sovereign guarantee to improve the cash flow.
- 7) A toll rate of Rs.1.5/pcu-km is recommended, but reasonable periodic toll increase should be considered.



## **EXECUTIVE SUMMARY**

### **The Feasibility on the Construction of Expressways in the National Capital Region in India**

- Study Period: December 1998 - March 2000
- Counterpart Agency: National Capital Region Planning Board,  
Ministry of Urban Development

#### **1. Study Background**

In response to the request of the Government of India, the Government of Japan decided to conduct "The Feasibility Study on the Construction of Expressways in the National Capital Region in India" (hereinafter referred to as "the Study").

Accordingly, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the cooperation programs of Japan, undertook the execution of the Study, and selected Pacific Consultants International, Japan, as the consulting firm to organize the JICA Study Team for the actual conduct of the Study.

#### **2. Study Objective**

The purpose of the study is to carry out the feasibility study for the proposed Ghaziabad-Meerut Expressway and Kundli-Ghaziabad Expressway, the total length of which is approximately 80 km. The study also aims to conduct technical transfer to the Indian counterpart personnel in the course of the Study.

#### **3. Study Area**

The study area includes such a direct influence area of the project as the north and northeast vicinity of National Capital Territory of Delhi (NCTD, which is generally referred as "Delhi"), and the National Capital Region (NCR) as a whole. NCR is comprised of four states, which are Uttar Pradesh (UP), Haryana, Rajasthan and NCTD.

#### **4. Existing Conditions of Study Area**

##### **4.1 Social and Economic Conditions**

###### **(1) Population**

The population of NCR increased from 19.0 million in 1981 to 26.4 million in 1991 at an annual growth rate of 3.3 percent, and it is estimated to be 34.2 million in 1999. Sub-regional population in NCR in 1999 is estimated at 13.3 million, 8.3 million, 10.8 million and 1.8 million persons for Delhi, Haryana, U.P. and Rajasthan respectively.

In NCR, the urbanization level has reached 52 per cent in 1991 and expected to reach 58% in 2001. The population density of NCR is estimated at 11.3 persons/hectare and that of Delhi at 89.3 persons/hectare in 1999.

## **(2) Land Use**

A total land area of NCR is 30,211 km<sup>2</sup>, in which Delhi occupies 1,483 km<sup>2</sup>, sub-regions Haryana 13,413 km<sup>2</sup>, U.P. 10,823 km<sup>2</sup> and Rajasthan 4,492 km<sup>2</sup>.

The existing land use of NCR in 1986-87 shows that the cultivated and non-agricultural land uses in Delhi account for 64% and 24% of the total land area respectively, whereas in Haryana 81% and 10%, in U.P. 82% and 11% and in Rajasthan 74% and 4%.

## **(3) Economic Activities**

NCR generates 4.6% of the India's Gross Domestic Product (GDP) in 1996, despite it shares only 1.0% of the total land area of India or 3.1% (in 1991) of the total population of India.

According to the World Development Report 1998/1999, India's GNP per capita in 1997 is US\$390 and it has increased at an average growth rate of 3.2% during 1996-1997. Available information about income in the Study area is the Net National Product (NNP) per capita, and which is Rs.6,049 at 1980-81 constant price in 1995-96 for Delhi, Rs.3,670 for Haryana and Rs.1,666 for U.P., while Rs.2,573 as the national average at 1980-81 constant price or Rs.12,097 at current price.

## **4.2 Transport Mode and Traffic**

In Delhi there is currently no mass transit system, although a mass transit system is under construction. Delhi has a high urban population in comparison with other cities in India. It also has one of the highest per capita incomes in India and as a result has the largest number of motorized vehicles.

Early in the last decade Delhi was known for having the highest number of cycles of any city in India. This tendency towards personalized transport has continued and now has resulted in the replacement of the bicycle by private motorized transport in the form of cars and two wheelers. Between 1980 and 1995 the car fleet in Delhi increased at a rate of nearly 10 % per annum. In 1995, the number of two wheelers in Delhi is 1.7 million, three wheelers are 78 thousand, and cars are 763 thousand.

Non motorized transport still plays an important role in Delhi with over 1 million cycles in the city and a large number of rickshaws. These however are principally used for short distance trips.

The present traffic between Delhi and Ghaziabad shows the highest volumes in the Delhi area. The results of the traffic counts show that NH24 and its bypass carries 85,000 vehicles/day. NH58 between Ghaziabad and Modinagar carries 21,000 vehicles/day.

## 5. Project Outline

### 5.1 Future Socio-economic Framework and Traffic Demand Forecast

#### (1) Future Socio-economic Framework

The analysis of the socio-economic framework predicts that the NCR population in 2011 and 2021 will be 1.43 times and 1.71 times the 1999 population, respectively, and the NCR economic growth in 2011 and 2021 will be 1.79 times and 2.87 times that of 1999, as shown in Table 5.1.

**Table 5.1: Estimated Future Socio-Economic Framework in NCR**

Year	1999	2006	2016	2026
Population(x1000)	34,220	42,681	53,756	66,308
NSDP* (in Bill. Rs.)	636	926	1,482	2,371
Employment (x1000)	7,577	10,741	14,741	18,527

Note: \*Net State Domestic Product

Source: JICA Study Team

#### (2) Future Traffic Demand Projection

Based on the future socio-economic framework, future traffic demand was forecast in 5-year cycles for each of the years of 2006, 2011, 2016, 2021 and 2026.

Table 5.2 shows a summary of traffic demand forecast.

**Table5.2: Summary of Traffic Demand Forecast**

	2006 <sup>1)</sup>	2016 <sup>2)</sup>	2021 <sup>2)</sup>	2026 <sup>2)</sup>
<b>K-G Expressway</b> (pcu/day)				
Kundli IC	41,200	67,000	87,400	112,800
Khekra IC	30,900	52,900	76,100	98,100
JUNCTION				
<b>G-M Expressway</b> (pcu/day)				
Meerut IC	24,300	40,400	56,700	75,200
Modinagar IC	27,700	50,700	75,500	101,300
JUNCTION	43,100	74,400	102,600	132,300
GhaziabadIC				

Note: 1) with FNG Expressway

2) with FNG, Peripheral and G-M Expressway Meerut Extension

Source: JICA Study Team

## **5.2 Technical Aspects**

### **(1) Route Selection**

A total of nine alternative route combinations was established, and these were examined from engineering and economic viewpoints. As a result of the comparison, the optimum route was selected for K-G and G-M Expressways from the aspects of engineering, environmental impacts, regional development, and economic feasibility.

The total route length of K-G Expressway (Kundli IC - Ghaziabad IC) is 49.00 km, and that of the G-M Expressway (Ghaziabad North Junction - Meerut IC) is 39.55 km.

### **(2) Major Design Features**

- a) A 120 km/hr design speed was applied for the entire expressway sections.
- b) Based on the traffic demand forecast, initial 4-lane/ultimate 6 lane stage construction was applied for Kundli - Junction and Junction - Meerut sections. Initial 6-lane/ultimate 8 lane stage construction was applied for the common section (Ghaziabad - Junction).
- c) A distance-based toll levy system was recommended for the expressways. Five interchanges, Kundli IC, Khekra IC, Meerut IC, Modinagar IC and Ghaziabad IC will be provided as either double trumpet or single trumpet type.
- d) A throughway toll plaza will be provided at the north of Ghaziabad IC, if Ghaziabad IC adopts the original partial cloverleaf type, as proposed in the FNG Feasibility Study. The toll plaza will not be necessary, if Ghaziabad IC adopts the trumpet type as recommended in this study.
- e) The total length of bridge and viaduct is 1.54 km taking up 1.9 % of the total length of the expressways. Precast PC I girders were recommended as the general superstructure type, because of the economy and ease of construction.
- f) Most of the earth work section is embankment. Total volume of embankment with borrow material is estimated to be 12 million m<sup>3</sup>.
- g) Flexible pavement was recommended with a view to lower initial investment cost, which contributes to a lower life cycle cost, than in the case for rigid pavement.

## **5.3 Project Cost**

The project cost (the initial project cost) is Rp.11,349 million in 1999 prices as shown in Table 5.3.

**Table 5.3: Summary of Initial Project Cost**

[Unit: Rs. million]

Construction Cost	7,323
Land Acquisition & Compensation Cost	1,649
Engineering Cost	897
Administration Cost	449
Contingency	1,031
<b>Total</b>	<b>11,349</b>

• Source: JICA Study Team

## 5.4 Implementation Schedule

The total implementation schedule including construction time schedule in the earliest case is presented in Figure 5.1.

**Figure 5.1: Implementation Schedule**

	1999	2000	2001	2002	2003	2004	2005	2006
Feasibility Study	■							
Final Engineering Design		■	■					
Land Acquisition			■	■	■			
Construction				■	■	■	■	
Opening to Traffic								▼

Source: JICA Study Team

## 6. Project Evaluation

### 6.1 Results of Economic Analysis

The economic analysis for determining the EIRR was carried out by using the conventional discounted cash flow method. The economic benefits quantified were the savings in vehicle operating cost, time costs and accident costs. The results indicated that the project is highly feasible from economic viewpoints.

	Length	EIRR
K- G and G-M	80.75 km	26.37 %
K-G Only	49.00 km	27.05 %
G-M Only	39.75 km	25.30 %

The sensitivity test shows that even the most severe case of -20 % benefit and +20 % cost still maintains an EIRR of 21.20 %.

## **6.2 Results of Financial Analysis and Implementation Study**

The financial analysis was carried out by performing case studies for setting possible financial structures for the project. The pre-tax FIRR for K-G and G-M Expressways in constant 1999 prices is 10.4 % which is much lower than acceptable commercial project implementation level. The result shows that a 100 % private sector concessionaire approach cannot meet long-term debt-service during the first 5 operational years even with 100 % off-shore financing, which could substantially reduce the financial cost as compared to domestic financing.

The possible implementation scheme would be a private or public sector dominated PPP approach, which should be able to reduce the project cost by risk sharing between private and public sectors, such as treating the land acquisition and compensation cost as “sunk” cost, or introducing ODA financing mechanism with some forms of government guarantee.

## **7. Environmental Aspects**

Maximum attention was paid in the process of optimum route selection to minimize adverse environmental impacts, in particular such social impacts as displacement of residents.

An Environmental Impact Assessment was carried out to identify possible adverse impacts and examine their mitigation measures. The EIA suggests that most of the possible adverse impacts can be mitigated, if the design is carefully prepared and proper construction methods are adopted. The most significant environmental problems will be displacement of residents and farms in the pre-construction phase, and noise/vibration/air quality impacts in the operational phase. Displaced families should be sufficiently compensated or resettled to suitable areas. Farms and factories acquired for the right of way should be sufficiently compensated. Noise/vibration/air quality problems are related to various factors, some of which can be mitigated by careful design for the roadside, and suitable construction methods.

## **8. Conclusion and Recommendations**

### **8.1 Implementation of the Project**

The results of the Study indicate that the projects are technically sound (no serious technical difficulty is anticipated for construction) and economically highly feasible. Taking into account the direct and enormous indirect benefits towards regional development in addition to the quantified savings in travel costs, the projects should be implemented at the earliest opportunity.

However, when the estimated constant pre-tax FIRR is compared with the prevailing interest rates and financial environment in India or even with possible off-shore financing

opportunities, the financial viability of the Projects is not satisfactory. It is necessary to consider the following measures and strategies toward implementation.

***Recourse/Non-recourse Financing:*** A recourse financing approach would strengthen the confidence of private investors and considerably reduce the private sector risk. If recourse financing is not possible, however, the GOI/NCRPB should consider positively guaranteeing returns for financing institutions and private equity investors.

***Equity Structure:*** If a public sector dominated PPP is established first, the shareholders of the Central and State Governments as well as NCRPB have to invest in the equity without expecting a high ROE to ensure a reasonable ROE to the private equity holders. In the case of a private sector dominated PPP, the GOI/NCRPB may also need to assume measures to safeguard the ROE for the private investors

***Debt Structure:*** India's financial market offers long-term funds at around 16 % interest for up to 10 to 12 years. The GOI/NCRPB should consider obtaining ODA funds from international funding institutions. This would involve a sovereign guarantee to the lender and assumption of the exchange rate risk. It would, however, provide a positive impact on private sector confidence and ease the burden on the project's cash flow.

***Toll Rate:*** The recommended toll rate of Rs.1.5/pcu-km should not exceed user benefits. However, the GOI/NCRPB should consider allowing periodic toll increase, perhaps in line with real per capita income increase, which would keep constant the toll impedance to expressway users in real prices.

## **8.2 Issues for Further Consideration**

### **(1) Making A Success Story**

It is seriously important to create a "success story" at the early stage of private sector led development. The GOI/NCRPB should do everything necessary to realize a success.

### **(2) Master Plan Formulation**

The NCR needs an integrated transport sector master plan to establish an appropriate future modal share and network plan based on reliable traffic data. It is recommended that such study be performed as soon as possible.





# **CHAPTER 1:**

## **INTRODUCTION**

---

### **1.1 Study Background**

Delhi has a high urban population, being estimated at 13 million persons, in comparison with other cities in India. It also has one of the highest per capita incomes in India and as a result has the largest number of motorized vehicles.

Early in the last decade Delhi was known for having the highest number of cycles of any city in India. This tendency towards personalized transport has continued and now has resulted in the replacement of the bicycle by private motorized transport in the form of cars and two wheelers. Between 1981 and 1997 the car fleet in Delhi increased from 567,000 to 2,848,000 at a rate of nearly 11% per annum. In 1997, the number of two wheelers in Delhi is 1.9 million, three wheelers are 80 thousand, buses are 30 thousand, trucks are 141 thousand, and cars are 721 thousand.

Delhi has been achieving rapid urban growth with increasing population and economic development. This has created many urban problems caused by the concentration, and the needs for transport infrastructure development are getting more importance. In the current absence of an effective rail based transit mode, bus is the principal mode of public transport. Approximately 70% of daily commuter use bus in Delhi. Even among those persons travelling between Delhi and the neighboring towns in the NCR, which are about 1.6 million trips per day, 63% are depending on bus services.

To cope with these urban problems, the Government of India established the National Capital Region Planning Board (NCRPB) in 1985 to manage sustainable development plans of the National Capital Region (NCR). The existing regional plan gives the highest priority to transport development for the regional development, and plans to develop expressway network to connect urban growth centers in the NCR.

As a part of the expressway network development, the Government of India requested

the Government of Japan to conduct a feasibility study for priority expressway projects. In response to the request of the Government of India, the Government of Japan decided to conduct "The Feasibility Study on the Construction of Expressways in the National Capital Region in India" (hereinafter referred to as "the Study") for the proposed Kundli-Ghaziabad (K-G) Expressway and Ghaziabad-Meerut (G-M) Expressway.

Accordingly, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the cooperation programs of Japan, undertook the execution of the Study, and selected Pacific Consultants International, Japan, as the consulting firm to organize the JICA Study Team for the actual conduct of the Study.

## **1.2 Study Objective**

The purpose of the study is to carry out the feasibility study for the proposed Ghaziabad-Meerut Expressway and Kundli-Ghaziabad Expressway, the total length of which is approximately 80 km. The study also aims to conduct technical transfer to the Indian counterpart personnel in the course of the Study.

## **1.3 Study Area**

The study area is the north and north-east vicinity of Delhi Union Territory within the NCR in the states of Haryana and Uttar Pradesh, which are related to the proposed expressway locations.

## **1.4 Study Approach and General Work Flow**

The Study was carried out based on the scope of work which was agreed upon between National Capital Region Planning Board and JICA Preparatory Study Team in July 1998. The Study commenced in December 1998 and ended in March 2000, and which was divided into four (4) study phases. The respective study phases are comprised of the following major work items and of which work flows are presented in Figure 1.1.

### ***Phase I: Optimum Route Selection (Technical/Environmental Views)***

- (1) Collection and Analysis of Relevant Data and Information
- (2) Road and Planned Area Investigation
- (3) Formulation of Socio-economic Framework
- (4) Establishment of Design Standard
- (5) Transport Demand Analysis (1)
- (6) Set-up of Alternative Routes

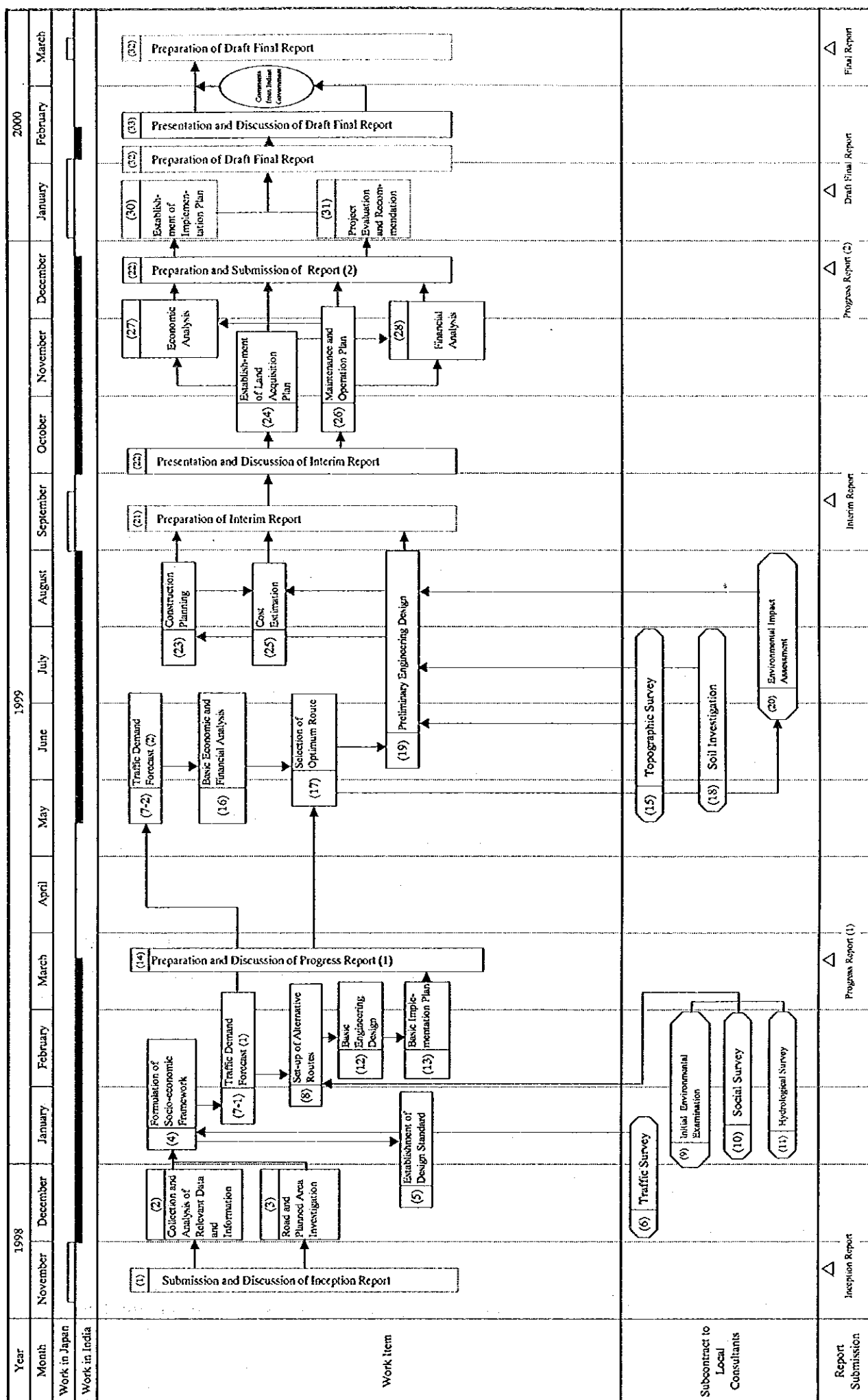


Figure 1.1: Flow Chart

- (7) Basic Engineering Design, and
- (8) Basic Implementation Plan

Other than the above, several sub-contracts with Indian consulting firms were made to execute the following surveys:

- Traffic Survey (STUP Consultants Limited)
- Initial Environmental Examination (Intercontinental Consultants and Technocrats Pvt. Ltd.)
- Hydrological Survey (Consulting Engineering Services (India) Ltd.)
- Social Survey (MDP Consultants (Private) Limited)

The above surveys were finished by mid March 1999.

The Steering Committee Meeting was held on 16 March 1999, followed after the Working Group Meeting on 15 February 1999, and where the following subjects were discussed:

- Proposed optimum route selection;
- Future socio-economic framework;
- Outline results of traffic survey and market demand of traffic;
- Interchange locations; and
- Toll levy system and interchange types.

As the consequence of the above two meetings, the proposed expressway routes were generally agreed, pending that the northern terminal point of G-M Expressway should be determined after the comparative analysis was made as to whether or not the said expressway be extended another 15 kilometers to meet the NH-58. As the result of comparison, the Study Team recommended to further extend to the north the G-M Expressway after the year 2013 to make the extension economically feasible. Details of the meetings were summarized in the minutes as attached in the Appendix.

***The Phase 2 Study: Preliminary Engineering Design***

- (1) Traffic Demand Forecast (2);
- (2) Preliminary Economic and Financial Analysis;
- (3) Selection of Optimum Route;
- (4) Preliminary Engineering Design;
- (5) Construction Planning; and
- (6) Cost Estimates.

During the Phase 2 Study, subcontracts to Indian consultants were made for the following surveys:

- Topographic Survey (Consulting Engineering Services (India) Ltd.),
- Soil Investigation (Consulting Engineering Services (India) Ltd.),
- Digital Design Drawing (CAD Plus Infosys Limited), and
- Environmental Impact Assessment (MDP Consultants (Private) Limited).

The above surveys were finished during by August 1999, except for Environmental Impact Assessment that was finished in December 1999. The results of those surveys are made use of in the preliminary design and the environmental study of the project.

***Phase 3 Study: Economic and Financial Evaluation:***

- (1) Land Acquisition Plan
- (2) Expressway Operation and Maintenance Plan
- (3) Detailed Traffic Demand Forecast
- (4) Economic Analysis
- (5) Financial and Implementation Planning Study, and
- (6) Environmental Impact Assessment.

The Progress Report (2) was prepares as results of the above tasks, and the economic feasibility of the project expressway was confirmed with a high EIRR (Economic Internal Rate of Return) of 26.4%.

A toll rate to maximize the revenue was found to be Rs.1.5/pcu-km at the threshold of the expressway operation, and which was also proved to fall within the benefit of expressway users.

The primary discussion focuses then on the key issues related to financial analysis and the implementation study. It was established as a consequence of the simple FIRR analysis resulting in a FIRR of 10.4% that the project could not attain easily the level of financial viability needed within the implementation framework of commercial practices.

***Phase 4 Study: Implementation Plan and Recommendations***

- (1) Establishment of Implementation Plan
- (2) Project Evaluation and Recommendations
- (3) Preparation of Draft Final Report
- (4) Presentation and Discussion of Draft Final Report
- (5) Seminar on Expressway Development in India

Private sector participation is an overriding strategy for India's infrastructure

development, but both, such development schemes and the related practical experience are still in an infant stage in India. Hence, the Government will have to display not only a strong political will in support of that direction, but it will also have to enhance the investment climate toward that end under both institutional and financial aspects.

The Public Private Partnership (PPP) mechanism will be a principal policy for KG-GM Expressway implementation and operations. However, there may be a need for the Government to function as a facilitator by kick-starting the process through the initial establishment of a public sector dominated PPP for project implementation. Such a move would not only demonstrate the Government's political will and commitment to the necessary burden and risk sharing, but it would also ensure the Government's guidance perhaps needed in the early stages of such endeavors, and quite importantly, it would send a psychological signal to the private sector. Picking a "winner", i.e. creating right from the onset a success story is most important in such schemes. Needless to say, that the PPP mechanism should be converted, as soon as possible, in a private sector dominated entity.

The Draft Final Report, in which all the study results were incorporated, was submitted to NCRPB on 24<sup>th</sup> January, 2000, and the presentation was held at the Steering Committee meeting on 1<sup>st</sup> February, 2000 at NCRPB Headquarters.

A seminar was also held on "Expressway Development in the NCR with Special Reference to the K-G and G-M Expressways" on February 3, 2000 in Delhi. The seminar was attended by Mr. Jagmohan, the Honorable Minister of Urban Development, Mr. Bandaru Dattatraya, Honorable Minister of State for Urban Development, Mr. Lal Ji Tandan, Minister of Urban Development, Government of Uttar Pradesh and His Excellency Hiroshi Hirabayashi, Ambassador Extraordinary and Plenipotentiary, Embassy of Japan, and other 130 interested people from both public and private sectors, and successfully conducted.

The Final Report reflecting comments from JICA Headquarters and the Steering Committee is completed and submitted to JICA Tokyo in March 2000.

## **1.5 Study Organization**

The Study was conducted by the JICA Study Team being composed of members of Pacific Consultants International as presented in Table 1.1. Aside from the Study Team, JICA organized an Advisory Committee in Japan, which members are listed also in Table 1.1, in order to help the Team carry out the Study in a smooth and satisfactory manner. NCRPB, as the counterpart agency to the Study Team,

organized a Steering Committee and Working Group. The former was chaired by Ms. Sarita J. Das, Member Secretary of NCRPB, and functioned for inter-ministerial or inter-state coordination and dealt mostly with policy matters. The latter was organized to cope with problems that might occur in the course of the Study, ranging from cooperation for data and information collection, hearing of authorities concerned, arrangements required for various survey, to assistance and comments on study results. The Working Group members were nominated as part time counterparts to the Study Team, and listed in Table 1.1.

**Table 1.1: Participants of the Study**

***Steering Committee:***

(1)	Member Secretary NCR Planning Board	Chairman
(2)	Director General (Roads) Ministry of Surface Transport	Member
(3)	Team Leader JICA Study Team	Member
(4)	Director (Delhi Division) Ministry of Urban Development	Member
(5)	Secretary (Housing) Gov't of Uttar Pradesh	Member
(6)	Commissioner & Secretary Town & Country Planning, Gov't of Haryana Haryana Civil Sectt.	Member
(7)	General Manager National Highway Authority of India	Member
(8)	Engineer-in Chief PWD, (B&R), Gov't of Haryana	Member
(9)	Engineer-in-Chief PWD, (B&R), Gov't of Uttar Pradesh	Member
(10)	Chief Administrator Haryana Urban Development Authority	Member
(11)	Chief Coordinator Planner (NCR Cell) Town and Country Planning Deptt. Haryana	Member
(12)	Chief Coordinator Planner (NCR Cell) Town and Country Planning Deptt. Ghaziabad	Member
(13)	Vice Chairman Ghaziabad Development Authority	Member
(14)	Vice Chairman Meerut Development Authority	Member
(15)	Secretary (PWD) B&R Land and Building Deptt.	Member
(16)	Chief Regional Planner NCR Planning Board	Member-Convenor

**Working Group:**

(1)	Chief Regional Planner NCR Planning Board	Chairman
(2)	Chief Engineer (Min. of Surface Transport)	Member
(3)	General Manager, National Highway Authority of India	Member
(4)	Chief Engineer (Meerut Division)	Member
(5)	Chief Engineer (Roads), PWD, Haryana	Member
(6)	Engineer-in-Chief, PWD (GNCT-Delhi)	Member
(7)	Chief Coordinator Planner, (U.P.)	Member
(8)	Chief Coordinator Planner, (Haryana)	Member
(9)	Chief Architect Planner, Ghaziabad Dev. Authority	Member
(10)	Chief Architect Planner, Meerut Dev. Authority	Member
(11)	Senior Research Officer, NCRPB	Member
(12)	Associate Planner, NCRPB	Member
(13)	Research Officer, NCRPB	Member
(14)	Project Officer, NCRPB	Member
(15)	Regional Planner, NCRPB	Convenor

**JICA Advisory Committee:**

(1)	Yusuke Kajiura	Chairman
(2)	Isao Sugie	Member
(3)	Shiro Nakasone	Former JICA Coordinator
(4)	Susumu Yuzurio	Current JICA Coordinator

**JICA Study Team:**

(1)	Isamu Gunji	Team Leader/Transport Planner
(2)	Mitsuyoshi Asada	Deputy Team Leader/Highway Planner
(3)	Ichiro Kobayashi	Land use/Regional Planner
(4)	Kazuo Mizukoshi	Highway/Structure Planner
(5)	Ueno Toshio	Structure Engineer
(6)	Len Johnstone	Traffic Demand forecast
(7)	Yoichi Enokido	Traffic Engineer
(8)	Shogo Shibata	Soils, Geological and Topographical Specialist
(9)	Takeshi Arakaki	Environmental Specialist
(10)	Sato Koji	Social Development Specialist
(11)	Schneider Klaus Dieter	Implementation Plan/Maintenance & Operation Specialist
(12)	Torao Tokozumi	Construction Plan/Cost Estimation Specialist
(13)	Masamitsu Toriyama	Economic and Financial Analyst
(14)	Toda Yoichiro	Administrative Coordinator
(15)	Shrestha Robinson	Administrative Coordinator

**Local Staff:**

(1)	Ratul Talukdar	Civil Engineer
(2)	Dinesh Arora	Transport Planner
(3)	Shipra Manglik	Urban/Transport Planner
(4)	Shruti Munjal	Office Manager



## CHAPTER 2:

### EXISTING SOCIAL AND ECONOMIC CONDITIONS

#### 2.1 Population

The National Capital Region (NCR) is comprised of four states, which are Uttar Pradesh (UP), Haryana, Rajasthan and National Capital Territory of Delhi (NCTD, which is generally referred as "Delhi"). The population of the NCR increased from 19.0 million in 1981 to 26.4 million in 1991 at an annual growth rate of 3.3 percent. The population growth rate in the region is higher than that of national average of 2.1 percent per annual growth rate. The population of NCR accounts for about 3.1 percent of the total population in India and it consists of 6.5 per cent of the Uttar Pradesh population, 40.3 per cent of Haryana and 3.1 per cent of Rajasthan and all population in NCTD. The population of NCR and its growth rates is shown in Table 2.1.1.

**Table 2.1.1 NCR Population and Growth Rate**

Constituent	Population of NCR				Growth Rate(%)		
	1961	1971	1981	1991	1961-71	1971-81	1981-91
Delhi	2,658,612	4,065,698	6,220,406	9,420,644	4.25	4.25	4.15
U.P	4,450,172	5,440,296	6,968,646	9,001,704	2.01	2.48	2.65
Haryana	2,893,365	3,798,228	4,867,846	6,643,604	2.72	2.48	3.11
Rajasthan	584,204	757,399	962,011	1,380,228	2.60	2.39	3.61
Total (NCR)	10,586,353	14,061,621	19,018,909	26,446,180	2.84	3.02	3.30
India	439,234,771	548,159,652	683,329,097	846,302,688	2.24	2.23	2.16

Source: Census of India and NCRPB

Especially, the population growth of Delhi is more than 4 percent in the last three decades, which is partly because of in-migration to the capital city. In fact, the migrants to Delhi during 1981-1991 are estimated at 1.6 millions or 160 thousands annually and it contributes about 50 per cent of total population increase in Delhi. The migrants comes from surrounding states, of which Uttar Pradesh shares 50 per cent of the total migrants to the Delhi followed by 12 per cent of Haryana (see Table 2.1.2).

**Table 2.1.2 Migration to Delhi**

Name of States	Migrants to Delhi 1981-91	Percentage of Migrants
Bihar	169,609	11%
Haryana	182,547	12%
Himachal Pradesh	22,416	1%
Kerala	24,909	2%
Madhya Pradesh	41,916	3%
Maharashtra	22,897	1%
Panjab	83,806	5%
Rajasthan	95,282	6%
Tamil Nadu	24,057	2%
Uttar Pradesh	765,914	50%
West Bengal	43,219	3%
Others	67,387	4%
Total	1,543,959	100%

Source: NCRPB

Note: Other states include Bihar, Rajasthan and Panjab and those states share 22 percent of the total migrants to Delhi in 1991

It is therefore conceived that the NCR, especially Delhi, will attract migrants over a long time of the future horizon from surrounding states.

## **2.2 Employment**

### **(1) Employment Data in India**

The information about employment is very limited in the study area, especially outside Delhi. The census data of workforce is the only available data on employment. The Indian Census data categorizes workforce into main worker, marginal worker and non-worker. According to the census classification, if a person had worked for more than 183 days of the year proceeding the date of census, he or she was considered as a main worker. If a person had worked for some time but not for the major part of the last year, he or she was treated as a marginal worker. All others were classified as non-workers. The work participation rate is calculated to be the proportion of main workers plus marginal workers against the total population.

### **(2) Employment in the Study Area**

One of the features of labor market in India is the low worker participation rate of female in urban area. In Delhi, the work participation rate of male is about 52 percent, while the female participation rate is only 7 percent. However, the participation rate in primary sector shows that female is higher than that of male in both Haryana and Uttar Pradesh, and it reaches 72 percent and 85 percent respectively. Other sectors, secondary and tertiary, are similar participation rates in both states. This low female participation rate in urban area may be one of traditional values of Indian society, which is less active role of female in work place. The work

participation rates in three states are shown in Table 2.2.1.

**Table 2.2.1 Work Participation Rate**

State	(as a % of total population)		
	1991		
	Total	Male	Female
Delhi	31.6	51.7	7.4
Haryana	31.0	48.5	10.8
Uttar Pradesh	32.2	49.7	12.3
India	37.5	51.6	22.3

Source: Census of India 1991

The employment data in the study area are shown in Table 2.2.2.

**Table 2.2.2 Worker Distribution in the Study Area**

District	Work Participation Rate (Main+Marginal)	Percentage of main worker in		
		Primary sector	Secondary sector	Tertiary sector
Delhi	31.6	2.8	32.4	64.7
Haryana				
Panipat	30.3	54.6	19.5	25.9
Sonapat	30.7	50.1	15.8	34.0
Rohtak	31.4	59.3	9.9	30.8
Faridabad	30.3	39.2	30.9	29.8
Gurgaon	32.1	55.2	12.6	32.3
Rewari	27.8	55.9	14.8	29.3
Mahendragarh	31.0	60.6	8.1	31.3
Uttar Pradesh				
Meerut	30.5	55.2	17.4	27.4
Ghaziabad	30.2	40.1	24.1	35.8
Bulandshah	29.0	68.3	10.2	21.5

Source: Census of India 1991

The work participation rate for the area is about 30 percent in the most of districts. More than 50 percent of workforce is categorized into the primary sector, except Delhi of 2.8 percent. Delhi and Faridabad share more than 30 percent of workforce in the secondary sector, while the tertiary sector accounts for around 30 percent of the main worker in the most of NCR districts, except for Delhi of 64.7 percent.

The distribution of the worker shows that the primary sector is the dominant sector in Uttar Pradesh and Haryana, while Delhi is domination of the tertiary sector. The tertiary sector in Delhi includes residential support employment such as street vendors, rickshaw drivers, servants etc.

## 2.3 Economic Activities

### 2.3.1 Macro Economic Profile in India

The share of Gross Domestic Product (GDP) in India shows that the agricultural sector has fallen from 41 percent in 1980-81 to 29 percent in 1995-96, while the secondary sector has increased its share from 23 percent in 1980-81 to 28 percent in 1995-96. The tertiary sector increased its share from 36 percent to 43 percent at the same period.

**Table 2.3.1 Macro Economic Development in India**

Items	1981-91	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97
GDP at Factor Cost		2,122.53	2,139.83	2,252.40	2,391.45	2,577.00	2,761.32	2,968.45
Growth Rate (%)	5.7	5.40	0.80	5.30	6.20	7.80	7.20	7.50
Agricultural and allied		632.63	656.53	641.18	680.09	705.13	741.33	719.07
Growth Rate (%)	3.6	3.80	-2	6	4	5	-3	7.90
Industry		637.00	629	655	698	771	867	922.40
Growth Rate (%)	7.2	7.20	-1	4	7	10	13	6.40
Services		829.00	869.98	917.28	988.30	1,064.80	1,175.38	1,270.41
Growth Rate (%)	6.5	5.20	4.80	5.40	7.70	7.70	10.40	8.10

Source: India 1998 Macro Economic Update, June 30/1998, World Bank

Note: GDP figures are constant price at 1980-81

In 1996-97, GDP grew at 7.5 percent after averaging 7 percent in the previous two years. Agricultural growth fell sharply 4.2 percent during 1985-90 to 1.6 percent during 1990-95. Agricultural is dominated by the production of foodgrain about 124 millions hectare out of 170 millions hectare of planted area. The major crops include rice, wheat and oilseeds. Non-agricultural growth fell by nearly 1.5 percent during 1985-90 to during 1990-95. In manufacturing sector, India developed a wide range of industry to attempt self-sufficiency in every sector. Around 50 percent of Industrial production in the organized sector come from basic and capital sectors. Service sector accounts for 40 percent of the GDP and it has been developed at a rapid rate of growth, yet it contained wide variety of economic activities.

### 2.3.2 Major Economic Activities in the Study Area

Although economic activities are widely distributed throughout India, the study area is one of the major economic centers in India. NCR generates 4.6 % of the India's GDP in 1996, although it shares 1.0% of the total area in India. There is a statistical limitation of the economic activities in the NCR and the only available data are the state level economic activities. The major economic activity is agricultural sector in the NCR, especially Uttar Pradesh and Haryana and it accounts for more than 40 percent of the Gross State Domestic Product (GSDP) in both states, and which is

higher than that of India's weighted agricultural average of 30 percent. The GSDP by kind of economic activities at state level is shown in Table 2.3.2.

**Table 2.3.2 GSDP at Factor Cost by Kind of Economic Activities at Constant Cost**

State	Economic Sector	(Rs. millions)							
		1980-81	%	1990-91	%	1995-96	%	Growth Rate(%)	
								1980-1990	1990-1995
Delhi	Primary	1,147	4%	1,758	3%	646	1%	4.36	-18.15
	Secondary	6,714	25%	16,267	27%	21,692	30%	9.25	5.92
	Tertiary	18,990	71%	42,649	70%	50,915	70%	8.43	3.61
	Total	26,851	100%	60,674	100%	73,253	100%	8.49	3.84
Uttar Pradesh	Primary	73,283	52%	100,232	44%	105,761	43%	3.18	1.08
	Secondary	21,438	15%	43,282	19%	46,348	19%	7.28	1.38
	Tertiary	45,399	32%	84,286	37%	94,421	38%	6.38	2.30
	Total	140,120	100%	227,800	100%	246,530	100%	4.98	1.59
Haryana	Primary	18,207	54%	28,390	45%	30,549	41%	4.54	1.48
	Secondary	6,593	19%	15,257	24%	18,997	25%	8.75	4.48
	Tertiary	9,064	27%	19,341	31%	25,007	34%	7.87	5.27
	Total	33,864	100%	62,988	100%	74,553	100%	6.40	3.43
India	Primary	455,650	41%	648,240	34%	702,950	29%	3.59	1.63
	Secondary	253,810	23%	506,940	27%	694,970	28%	7.16	6.51
	Tertiary	393,940	36%	747,000	39%	1,062,120	43%	6.61	7.29
	Total	1,103,400	100%	1,902,180	100%	2,460,040	100%	5.60	5.28

Source: Statistical Abstract of Respective States, Economic and Statistical Department

The tertiary sector in Delhi accounts for 70 per cent of GSDP. The change in economic activities from the primary sector to the secondary or tertiary sectors can be observed in Uttar Pradesh and Haryana. Delhi has little changed its economic structure since 1980.

Therefore, it is safe to say that the structure change of economic activities in the NCR as a whole has been in progressed from primary sector to the secondary or tertiary sectors, yet speed is below the national average.

#### (1) Agricultural

Agricultural Sector of Uttar Pradesh and Haryana accounts for more than 40 per cent of respective GSDP. In Delhi, agricultural sector accounts for only 1 percent of its GSDP in 1995-96 and it has declined at a rate of 18.2 percent annually. Agricultural production increased at a rate of 1.5 percent in Haryana and 1.1 percent in Uttar Pradesh during 1990-1995. The agricultural production in 1995-96 of states is shown in Table 2.3.3.

**Table 2.3.3 Agricultural Production in the State Level in 1995-96**

State	Unit	Foodgrains	Oilseeds	Cotton	Jute
Haryana	000 tonne	10,339	816	1,283	-
	000 hectare	4,403	636	646	-
Uttar Pradesh	000 tonne	38,971	1,469	15	-
	000 hectare	20,650	1,718	15	-
Delhi	000 tonne	157	1	-	-
	000 hectare	47	8	-	-

Source: Statistical Abstract India 1997

Uttar Pradesh accounts for 17 percent of the total foodgrain production in India and Haryana produces 6 per. More than 96 percent of the agricultural production comes from foodgrain in Uttar Pradesh. In Haryana, foodgrain production accounts for more than 83 percent and cotton product shares more than 10 percent. More than 80 percent of land is used for production of foodgrain in both states.

The land productivity of foodgrain is 60 percent higher than that of the national average. Approximately 95 percent of the irrigated land use tubewells in Haryana and Uttar Pradesh.

## **(2) Industry**

The industrial sector is important to generate non-agricultural employment in the study area, except Delhi where service sector has played important roles. The industrial sector has concentrated in urban centers near Delhi or Delhi Metropolitan Area (DMA). Within Delhi, there are 6.6 thousand factories, and which employ 322 thousand people. One third of the factories are textile and textile products followed by the metal and engineering products of 14 percent. The industrial establishment and employment data in the study area are shown in Table 2.3.4.

**Table 2.3.4 Industrial Establishment in the Study Area**

Area	Number of Factories	Number of Workers
Delhi	6,677	322,200
Haryana	4,127	280,685
Panipat	588	23,534
Sonipat	432	23,022
Rohtak	185	10,745
Faridabad	2,127	158,880
Gurgaon	682	54,376
Rewari	113	10,128
Mahendragarh	60	4,250
Uttar Pradesh		
Merrut	N.A	N.A
Ghaziabad	3,452	85,979
Bulandshahu	N.A	N.A

Source: Statistical Abstract of Respective State

There are four thousand factories in Haryana, and which employ 280 thousand workers. In Haryana, the towns like Faridabad, Gurgaon, Panipat and Sonipat where are located near Delhi attract many industrial establishments. For example, Faridabad district, located in DMA, has more than 50 percent of the establishment as well as workers in Haryana followed by Gurgaon of 16.5 percent of the total establishment. Faridabad has 27 percent of metal related factories and 28 percent of machinery factories, while Grgaon is concentrated with textile and light industries.

In Uttar Pradesh, the industrial sector has concentrated in the Mccrut and Gahziabad areas, where the major urban areas are developed.

### **2.3.3 Income**

According to the World Development Report 1998/99<sup>1</sup>, India's GNP per capita in 1997 is US\$ 390 and it has increased at an average growth rate of 3.2 percent during 1996-97. India is ranked 102 for GNP per capita and 92 for purchasing power parity (PPP) among countries in the world.

Available information about income is per capita Net National Product (NNP) that is extract depreciation from GNP at state level and thus comes closer to measuring the net amount of goods produced in the country. The NNP per capita in NCR is higher than that of national average of Rs. 2,573 at 1980-81 constant price or Rs. 12,096.6 at current price except Uttar Pradesh, which is only 65 percent of national average (see

<sup>1</sup> The World Bank, 1999, World Development Report Knowledge for Development, New York, N.Y., Oxford University Press

Table 2.3.5).

**Table 2.3.5 Net National Product Per Capita Income of the Study Area**

Fisical Year	(In Rs. at 1980-81 constant prices)						
	1980-81	1990-91	1995-96	1995-96	Growth Rate		
					1980-90	1990-95	1990-95
Delhi	3,759	4,962	5,683	6,049	2.8%	2.8%	3.2%
Haryana	2,370	3,509	3,674	3,670	4.0%	0.9%	3.0%
Uppter Pradesh	1,278	1,652	1,641	1,666	2.6%	-0.1%	1.8%
India	1,630	2,222	2,449	2,573	3.1%	2.0%	3.1%

Source: Delhi Statistical Hand Book, 1998 Directorate of Economic and Statistics  
Government of National Capital Territory of Dehli

The per capita income of the study area has increased at a rate of below national average of 3.1 percent during 1980-95, except for Delhi where increased at a rate of 3.22 percent. Income level of Delhi is approximately 2.5 times above the national average.

According to the World Bank study<sup>2</sup>, a poverty rate in Haryana East is 28 percent and Uttar Pradesh West is 30 percent, while Indian average is 36 percent. It is concluded that the poverty rate in the NCR is lower than that of the national average. It is partly because of fertility of soil for agricultural to produce more agricultural output in the rural area.

## 2.4 Social Characteristics

In India, a schedule cast (SC) and a schedule tribe (ST) could be categorized into disadvantage population. The scheduled cast and scheduled tribe population in India is 24.6% of the total population. Except Rajasthan, all other constituent States of the NCR have a lower rate of the schedule cast and schedule tribe population than the national average, yet the schedule cast population alone is higher in the constituent States than the national average of 16.5 percent. The distribution of the schedule cast and schedule tribe population in the constituent States is given in Table 2.4.1.

<sup>2</sup> The World Bank, 1998. Reducing Poverty in India Options for More Effective public Services, Washington D.C, USA



**Table 2.4.1 Scheduled Cast (SC) and Scheduled Tribe (ST) Population**

Constituent States of NCR	S.C. and S.T. Population (%)	S.C. Population
Uttar Pradesh	21.25	21.04
Haryana	19.75	19.75
Rajasthan	29.73	17.29
Delhi	21.25	19.05

Source: Statistical Abstract of India, 1997

A literacy rate, which is defined as the number of literate to 1,000 persons, is 522 in India. The literacy rate in the constituent states of NCR is given in Table 2.4.2. The rate in Uttar Pradesh and Rajasthan is below the national average.

**Table 2.4.2 Literacy Rate**

Constituent States of NCR	Literacy Rate
Uttar Pradesh	416
Haryana	558
Rajasthan	386
Delhi	820
India	522

Source: Statistical Abstract of India, 1997

The overall sex ratio, which is defined as the number of female to 1,000 males, is 929 in India. The ratio in the constituent States of NCR is very low compared to the national average of 929. The sex ratio in the constituent states is given in Table 2.4.3.

**Table 2.4.3 Sex Ratio**

Constituent States of NCR	Sex Ratio
Uttar Pradesh	881
Haryana	874
Rajasthan	913
Delhi	830

Source: Statistical Abstract of India, 1997

The sex ratio in rural areas in India is very high in comparison to the urban areas. That is 941 in rural areas and 893 in urban areas. The same trend is observed in all constituent States of NCR except in Delhi where the urban sex ratio is higher than the rural one. The Urban and rural sex ratios in NCR are given in Table 2.4.4.

**Table 2.4.4 Urban and Rural Sex Ratio**

Constituent States of NCR	Urban Sex Ratio	Rural Sex Ratio
Uttar Pradesh	862	886
Haryana	868	877
Rajasthan	881	923
Delhi	831	821

Source: Statistical Abstract of India, 1997

The birth and death rates in India are 29.5 and 9.8 respectively. The constituent States of NCR have on average the same rates as those in India. The States of Delhi and Haryana have lower rates whereas the States of Rajasthan and U.P have higher rates. The birth and death rates are shown in Table 2.4.5.

**Table 2.4.5 Birth and Death Rate**

Constituent States of NCR	Birth Rate	Death Rate
Uttar Pradesh	34	10.2
Haryana	28.8	8.1
Rajasthan	32.3	9.1
Delhi	21.2	5.4

Source: Statistical Abstract in India, 1997

## **2.5 Motorization**

A feature of vehicle registration in India is a domination of two-wheel vehicle and it accounts for more than 75 percent of total registered vehicles in Delhi. Other characteristics of the registered vehicles are 13.6 percent for passenger car, 1.4 percent for buses and 6.5 percent for trucks. Registered vehicles in India have increased rapidly from 5.2 millions or 7.6 vehicles per 1,000 people in 1980-81 to 21.4 millions or 25.3 vehicles per 1,000 people in

1990-91 at an annual growth rate of 15.2 percent. The current growth rate, however, has decreased to 9.4 percent during 1990-91 to 1995-96.

In 1997, a total number of registered vehicles in Delhi is about 2.8 millions or 224 vehicles per 1,000 people, of which 66 percent of the total vehicles are motor cycles and 25 percent are cars and jeeps. The number of the vehicle per 1,000 people in Delhi is approximately 9 times of the national average. In fact, the registered vehicles in Delhi are very high compared to other metropolitan cities in India, for example, 42 vehicles per 1,000 people in Bombay, and 22 vehicles per 1,000 people in Calcutta. The registered vehicles in Delhi share 10.4 per cent of the national total of registered vehicles, although the population of Delhi is about 1 percent of the national total population.

The vehicle registration data shows that the growth in vehicle registration has increased at an annual average of 5.8 percent in Delhi during 1990-1997, yet the growth rate is lower than that of the national average vehicle growth rate of 9.4 percent.

**Table 2.5.1 Registered Vehicle in Delhi**

Type of the Vehicle	1981		1986		1990		1995		1997	
<b>Delhi</b>										
Car and Jeeps	126,000	22%	201,947	11%	428,000	22%	617,585	24%	705,923	25%
Motor Cycles and Scootoc	372,000	66%	747,672	42%	1,294,000	68%	1,707,528	66%	1,876,053	66%
Auto Rickshaws	-		-		-		77,884	3%	80,210	3%
Taxis	-		-		-		13,384	1%	15,015	1%
Buses	9,000	2%	14,751	1%	20,000	1%	27,473	1%	29,572	1%
Goods Vehicles etc.	60,000	11%	825,575	46%	172,000	9%	131,877	5%	140,922	5%
<b>Total</b>	<b>567,000</b>	<b>100%</b>	<b>1,789,945</b>	<b>100%</b>	<b>1,914,000</b>	<b>100%</b>	<b>2,575,731</b>	<b>100%</b>	<b>2,847,695</b>	<b>100%</b>

Source: Delhi statistical Hand Book, 1998



## **CHAPTER 3:**

### **URBAN AND REGIONAL DEVELOPMENT CONTEXT**

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#### **3.1 Administrative Structure and Jurisdiction**

##### **3.1.1 Definition of Urban Areas**

According to the census classification, urban area is defined as follows:

- (1) All statutory towns i.e. all places with a Municipal Corporation, Municipal Board, Cantonment Board or Notified Town Area.
- (2) All other places which satisfy the following criteria
  - A minimum population of 5,000;
  - Seventy five percent of the male working population engaged in non agricultural (and allied) activity and;
  - A density of population of at least 400 per sq.km.

A town with a population of 100,000 and above is treated as a City.

Based on the urban definition mentioned above, total urban population of India is 212.9 million in 1991, compared to 156.4 million in 1981 and 107.0 million in 1971. Now, more than 25 per cent of total population lives in urban area. There are 3,697 towns in India in 1991 and out of which 300 are Class I towns (Population above 100,000) so that they are treated as cities and 345 are Class II towns (Population between 50,000 and 99,999).

##### **3.1.2 Administrative Structure**

###### **(1) National and State Level**

Planning and management of the cities and towns in general, and more specially mega and metropolitan cities are assumed to be of the greatest significance in the context of

development. The urban administrative structure in India is defined at three levels of government:

National Level where responsible agencies are Planning Commission, sectoral ministries such as the Ministries of Finance and the Ministry of Urban Affairs and special function related corporations and agencies such as the National Housing Bank. Planning in the national level is generally economic and social aspects and physical setting of the major infrastructure of major industrial estates, ports and national highways. At the central level schemes such as the Integrated Urban Development Programs (IUDP) and Integrated Development of Small and Medium Towns (IDSMT) have been undertaken for cities with over 0.3 million and 0.1 million population respectively.

Regional or state levels where responsible agencies are state planning and development boards, sectoral ministries or departments and special functional corporation agencies. The state planning board is the apex body for the formulation, review and evaluation of plans, programmes and schemes. The organisation of the planning board has the following functions:

- To make assessment of the State resources and formulate plans for effective and balanced utilisation of resources,
- To determine plan priorities of the State within the priorities of the National Plan,
- To assist district authorities in formulating their development plans,
- To identify factors which related to the economic and social development of the State
- To determine condition for successful execution of the plans, and
- To review the progress of implementation of the plans and recommend adjustments

The state government is responsible for planning, agriculture, irrigation power, education, health, social services, small industries, roads, road transport and minor ports. Since land is a state subject and therefore in context of spatial planning and development, the states play a major role.

Local level is the district administration and urban settlement administration that includes various types of municipal administration, urban development trusts and authorities and special function agencies.

The development works at all three levels of the government structures are managed

through an integrated frame of Perspective plan, Five-Year Plan, Annual Plans and Projects.

## (2) National Capital Region (NCR)

Delhi, the national capital had been under serious consideration by the central government due to its unprecedented growth. It has emerged as a gigantic magnet, attracting people not only from the proximate states of Haryana, Rajasthan and Uttar Pradesh but also from the far-flung regions of the country. This continuous influx of population and the need to adopt a regional approach was raised in 1959. The Delhi Master Plan was formulated to direct development within Delhi in 1962 and recommended the formation of a statutory body for the NCR. The National capital Region Planning Board (NCRPB) was constituted under an act of Parliament of National Capital Region Planning Board Act, 1985.

In order to prepare a Regional Plan for the balanced, harmonised and coordinated development of the NCR and to enforce, oversee and monitor the implementation of the Plan, the National Capital Region Planning Board (NCRPB), an apex body has been constituted in 1989. For successful implementation of the Plan in the region, suitable institutional arrangements were necessary at all levels of the related governments. The Regional Plan is required to be implemented by the participating constituent three states and National Capital Territory of Delhi (NCTD), while schemes falling in the central sector will be implemented by the concerned central government. Table 3.1.1 shows the state level urban development authorities.

**Table 3.1.1 Development Authority in NCR**

State	Development Agency (For urban areas)
DUT	Delhi Development Authority
Haryana	Haryana Urban Development Authority
Uttar Pradesh	State Town and Country Planning Department
Rajasthan	Urban Improvement Trusts

According to the National Capital Region Planning Board Act, 1985, the functions of the board are determined as follows:

- To prepare the Regional Plan and the Functional Plans;

- To arrange for the preparation of Sub-Regional Plans and Project Plans by each of the participating States and the Union Territory;
- To co-ordinate the enforcement and implementation of the Regional Plan, Functional Plans, Sub-Regional Plans and Project Plans through the participating States and the Union Territory;
- To ensure proper and systematic programming by the participating States and the Union Territory in regard to project formulation, determination of priorities in the National Capital Region or sub-regions and phasing of development of the National Capital Region in accordance with stages indicated in the Regional Plan; and
- To arrange for, and oversee, the financing of selected development projects in the National Capital Region through Central and State plan funds and other sources of revenue.

The board is chaired by the Union Minister of Urban Development and has members not exceeding 21, which consist of:

- The Union Minister for Works and Housing who shall be the Chairman,
- The Chief Minister of the State of Haryana,
- The Chief Minister of the State of Rajasthan,
- The Chief Minister of the State of Uttar Pradesh,
- The Administrator of the Union Territory,
- Eight members to be nominated by the Central Government on the recommendation of the participating States,
- Three members with knowledge and experience in town planning,
- Member Secretary of the Board to be nominated by the Central Government.

A statutory committee is headed by the Member Secretary of NCRPB. The function of the committee are given by the Act as follows:

- Preparation and co-ordination of the implementation of the Regional Plan and the Functional Plans; and



- Scrutinizing the Sub-Regional Plans and all Projects and Plans to ensure the same are in conformity with the Regional Plan.

The Committee may also make recommendations to the Board amendment and modification of any Sub-Regional Plans or any Project Plans.

The NCRPB Act provides for constitution of NCR fund, which shall have:

- All grants and loans from the Central Government,
- All sums paid to the Board by the participating States and Delhi UT, and
- All sums received by the Board are consultation with the Central Government, State Governments and Delhi UT.

The other sources of NCRPB funds include:

- Life Insurance Corporation of India,
- Debentures/ Bonds,
- Nationalized Commercial Banks,
- Proposed Urban Development and Urban Water Supply Finance Corporation,
- National Housing Bank,
- National Bank for Agriculture and Rural Development, and
- Private Investments.

### **3.2 Current Urban and Regional Development Trends**

The urbanization has progressed in the NCR since 1961. The urban population of the NCR reached 13.7 million in the year 1991 and more than 50 percent of the population in the NCR lived in the urban area. There are around 107 towns in the NCR, and out of which 13 are Class I towns and 8 are Class II towns. Although the population of the NCR is approximately 3 percent of the total population of India, the number of Class I towns occupies one-third of the total Class I towns in India.

In the NCR, the Delhi Metropolitan Area (DMA), comprised of the National Capital Territory of Delhi (NCTD) and the six DMA towns of Ghaziabad, Noida, Faridabad, Gurgaon, Bahadurgarh and Kundli, has become major urban center of the Nation.

Growth of metropolitan cities has required facilitating other urban services such as transport, power, water supply and sewage and management of solid wastes. The level of the provision of such services is unsatisfactory in the NCR.

### 3.2.1 Level of Urbanization

The urbanization of the NCR has been prominent in the last 20 years. In the NCR the urbanization level has reached 52 per cent in 1991 and expected to reach 58 percent in 2001. The population density of the NCR is 871 persons/km<sup>2</sup> in 1991 and it is above the national average of 274 person/km<sup>2</sup>. Table 3.2.1 shows the urbanization level of the NCR.

**Table 3.2.1 Urbanization of the NCR**

Year	Rural	Urban	Total	Urban Population	Growth Rate	
					Rural	Urban
NCTD						
1961	299,204	2,359,408	2,658,612	88.75%		
1971	418,675	3,647,023	4,065,698	89.70%	3.36	4.36
1981	452,206	5,768,200	6,220,406	92.73%	0.77	4.58
1991	949,019	8,471,625	9,420,644	89.93%	7.41	3.84
Uttar Pradesh						
1961	3,671,496	778,676	4,450,172	17.50%		
1971	4,351,826	1,088,470	5,440,296	20.01%	1.7	3.35
1981	5,019,579	1,949,067	6,968,646	27.97%	1.43	5.83
1991	5,884,092	3,117,612	9,001,704	34.63%	1.59	6.78
Haryana						
1961	2,432,155	461,210	2,893,365	15.94%		
1971	3,120,856	677,372	3,798,228	17.83%	2.49	3.84
1981	3,668,902	1,198,944	4,867,846	24.63%	1.62	5.71
1991	4,808,344	1,835,260	6,643,604	27.62%	2.7	4.26
Rajasthan						
1961	511,497	72,707	584,204	12.45%		
1971	646,334	111,065	757,399	14.66%	2.34	4.24
1981	788,055	173,956	962,011	18.08%	1.98	4.19
1991	1,115,704	264,524	1,380,228	19.17%	3.48	4.19

Source: NCRPB

A speed of urbanisation in the NCR has reached at more than 4 percent per year since 1960s. During 1981-1991, the growth rate of the urban population in Uttar Pradesh is relatively high 6.8 percent per annual, compared to other constituent states. In 1991, almost 35 percent of Uttar Pradesh population in the NCR inhabit in urban area. In Haryana and Rajasthan states, an urbanization rates are lower that of Utter Pradesh, i.e. 28 percent and 19 percent respectively.

The rapid urbanization has progressed within the Delhi and DMA towns. The urban populations of the DMA towns are 1.66 millions in 1991, while DUT has 9.0 millions. Faridabad and Ghaziabad increased at rate of more than 8 percent in the last ten years,

while Delhi recorded at 5 percent increase of the urban population. The urbanization of Delhi and DMA towns will be continued without a proper policy intervention by the Governments.

### 3.2.2 Lack of Urban Services

The level of urban services in the NCR, especially Delhi, is unsatisfactory such as transport, power, water supply and sewage and management of solid waste. The additional requirements of the urban services in Delhi are summarized as Table 3.2.2.

**Table 3.2.2 Infrastructure Requirement in Delhi**

	Water in mgd	Sewage in mgd	Power in mw	Solid Waste in tons per day
Present Requirement	496	397	650	2,568
Present availability	253	118	-	2,058
Projection 2001	1,127	902	4,000	6,735
<u>Additional Requirement</u>	<u>874</u>	<u>784</u>	<u>3,300</u>	<u>4,677</u>

Source: Master Plan for Delhi, Delhi Development Authority

The other urban social services such as schools and hospitals are similar situations. It is clear that the urban services can not be provided at the same speed of urbanization. Without proper urban infrastructure and services, the living standard of the national capital can not be improved.

### 3.3 Existing Land Use in NCR

The existing NCR land use in 1986-87 shows that about 80 percent of land is classified as cultivated land. In Haryana and Uttar Pradesh, cultivated land is more than 80 percent of the respective total areas. More than 60 percent of land is classified as cultivated land in Delhi and non-agricultural land occupies only 24 percent of total area. The land classified as forest accounts for less than 2 percent of the total NCR area.

**Table 3.3.1 Existing Landuse of NCR 1986-1987**

Landuse Patter of the NCR 1986-87		Based on Stallite Imageries								(unit: hectare)	
Category	Delhi		Haryana		Sub-Region Utt Pradesh		Rajasthan		NCR		
1 Forest	2,678	1.8%	2,075	0.2%	11,601	1.1%	19,203	4.3%	35,557	1.2%	
2 Land put to Non-agricultural use	35,820	24.2%	128,431	9.6%	114,860	10.6%	17,398	3.9%	296,509	9.8%	
3 Barren Land	11,438	7.7%	88,044	6.6%	38,217	3.5%	58,539	13.0%	196,238	6.5%	
4 Water Bodies	329	0.2%	3,569	0.3%	2,017	0.2%	2,407	0.5%	8,323	0.3%	
5 Permanent pasture and other grazing Land	793	0.5%	12,000	0.9%	2,593	0.2%	11,262	2.5%	26,648	0.9%	
6 Land under Misc Tree crops and groves	1,137	0.8%		0.0%	3,512	0.3%	91	0.0%	4,740	0.2%	
7 Culturable	856	0.6%	24,000	1.8%	25,555	2.4%	7,073	1.6%	57,484	1.9%	
8 Cultivated land	95,249	64.2%	1,083,182	80.8%	883,994	81.7%	333,256	74.2%	2,395,631	79.3%	
Total	148,300	100.0%	1,341,301	100.0%	1,082,349	100.0%	449,229	100.0%	3,021,130	100.0%	

Source: National Capital Region growth and Development, 1996

### 3.4 Delhi Union Territory

The development of Delhi has constrained by two physical features, the hills of the Aravalli (the Ridge) and Yamuna river. Some parts of the Ridge are maintained the green area and no development is permitted in this area. The expansion of the Delhi has constrained by the Yamuna river because of difficulty of bridge construction. There are six bridges on Yamuna river within Delhi. Delhi also provides historical areas where designed as controlled conservation, especially the walled city area.

The need for preparing Regional Plan-2001 raises from the unprecedented population growth in Delhi since 1960. In fact, the population concentration to the Delhi UT has been accelerated to reach more than 4 percent during the last three decades. The planned development for the NCR was prepared only to cope with the problems that are facing in Delhi today.

National Capital Territory of Delhi has an area of 1,483 sq. km of which 40 % had been urbanized area and the remaining 60 percent of the areas were spread over 231 rural settlements. According to the 1981 census, the urban areas in Delhi are divided into 6 settlements, while the number of the settlement have increased to 8 settlements in 1991 census. Table 3.4.1 shows the urban population distribution within Delhi.

**Table 3.4.1 Population Distribution within Delhi**

Towns	1981		1991		Population Density (persons/km <sup>2</sup> )	
	Area (sq km)	Population (thousand)	Area (sq km)	Population (thousand)	1981	1991
Delhi U.A.	540.74	5,729.00	624.28	8,419.00	10,595	13,486
Bawana	16.97	12.63	16.97	19.00	744	1,120
Alipur	8.55	6.70	8.55	9.26	784	1,083
Pooth Khurd	9.98	7.15	9.98	8.29	716	831
Pehlادour Banga	4.67	5.01	4.67	4.83	1,073	1,034
Bijwasan	10.90	9.44	10.90	9.44	866	866
Kanjihawala	-	-	8.94	6.10	-	682
Asola	-	-	11.95	5.06	-	423
<b>Total</b>	<b>591.81</b>	<b>5,769.93</b>	<b>696.24</b>	<b>8,480.98</b>	<b>9,750</b>	<b>12,181</b>

Source: Census 1981 and 1991

The population density in Delhi Urban Agglomeration (UA) reaches to 13,500 persons/km<sup>2</sup> in 1991, yet the other urban areas are somewhat around 1,000 persons/km<sup>2</sup>. The gross population density in the urban area of Delhi has increased from 9,750 persons/km<sup>2</sup> to 12,181 person/km<sup>2</sup> during 1981-1991, while the urban area has increased about 100 km<sup>2</sup> during the same period. The most populated area in Delhi is Babar Pur Census Town, and which population density has reached 600 persons/hector in 1991.

The Delhi Metropolitan Area (DMA) is comprised of National Capital Territory of Delhi; Ghaziabad-Loni Complex and NOIDA controlled area in Uttar Pradesh; Faridabad-Ballabhgarh Complex, Gurgaon, Bahadurgarh, the proposed township of Kundli and the extensions of the Delhi Ridge in Haryana. The total DMA area is 3,182 km<sup>2</sup> and the area exclusion of National Capital Territory of Delhi would be 1,696 km<sup>2</sup>.

In Delhi, the existing land use is characterized as mixed use of residential areas, commercial activities and small-scale industrial activities taking place in close proximity to dense residential areas. The recent expansion of the urban limit absorbed many rural villages, which are the mix land use. The newly development area tend to be more segregated to use residential, commercial and industrial areas.



## **CHAPTER 4:**

### **PROFILE OF EXISTING TRANSPORT MODES AND TRAFFIC**

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#### **4.1 The Transport Sector in India**

Between the census years of 1981 and 1991 the population of India increased from 680 million to nearly 850 million, a national growth rate of 2% per annum. However in the mega cities of Delhi, Mumbai, Chennai and Calcutta this growth rates climbs in some of these cities to 6% per annum as a result of the combined effect of natural growth rate and net rural to urban immigration.

In this context the large and increasing population of India, in particular urban India results in a large and increasing demand for both intra-urban and inter urban passenger travel as well a significant increase in the movement of goods to support these communities.

The motor vehicle population has grown from 0.3 million in 1951 to 27.5 million in 1995 ( a growth of 10.8% per annum), the road network has expanded from 0.4 million km to 2.9 million km in the same period and has thus failed to maintain the same growth rate as the vehicle . The Indian road system administered by the Central Government, State Government, Local Bodies and Project Authorities is split into three categories namely:

- Primary Road System covering National Highway 34,298km;
- Secondary Road System covering State Highway 128,622 km; and
- Other roads including local district roads 2,700,000 km.

Within India the vehicle fleet consists of around 70 % two wheelers, whilst within the NCR this level of two wheel vehicles is slightly lower at 65%. In 1995/1996 the annual growth rate in two wheel vehicles was 16 % in comparison to a national growth rate of 7 and 8 per cent for cars and jeeps respectively. The increase in the vehicle fleet is reflected in traffic in Delhi. For example traffic growth across the Yamuna

River inbound to the city in the morning peak hour on the ITO Bridge grew by 8 % per annum between 1989 and 1993.

Traffic growth in two corridors of interest to the proposed Faridabad-Noida-Ghaziabad Expressway is presented in Tables 4.1.1 and Table 4.1.2. There are major variations in the growth rates, which range from -17% to a level in excess of 50% per annum. In the text from which these tables are taken, it is stated that there are problems in the analysis of historical traffic count data in Delhi due to different locations of data collection. These two tables illustrate the problems with using historical data. There is apparently no long-term traffic counting program within the NCR.

**Table 4.1.1 Traffic Growth in the Delhi-Ghaziabad Corridor**

<i>Year</i>	<i>Cars</i>	<i>2&amp;3 Wheelers</i>	<i>Trucks</i>
1987	1,424	4,766	5,814
1991	9,572	8,178	4,045
1993	31,697	77,435	6,796
<b>Growth Rate per Annum</b>	<b>&gt;50%</b>	<b>&gt;50%</b>	<b>2.6%</b>

Source: Proposed Faridabad- Noida- Ghaziabad Expressway ~ Final Report, 1995

**Table 4.1.2 Traffic Growth in the Delhi-Faridabad Corridor**

<i>Year</i>	<i>Cars</i>	<i>2&amp;3 Wheelers</i>	<i>Trucks</i>
1987	7,071	8,171	6,501
1991	6,775	15,318	1,303
1993	14,966	20,933	2,191
<b>Growth Rate per Annum</b>	<b>13%</b>	<b>17%</b>	<b>-17%</b>

Source: Proposed Faridabad- Noida- Ghaziabad Expressway ~ Final Report, 1995

## **4.2 Existing Road Network and Functions within the National Capital Region**

Within the National Capital Region (NCR) the road network is characterised by nine major radials inter urban road corridors in the regional network namely:

- Delhi – Ghaziabad – Meerut ;
- Delhi – Ghaziabad – Hapur – GarhMukteshwar;
- Delhi – Ghaziabad – Bulandshahar – Khurja ;
- Delhi – Faridabad – Palwal –Behror;
- Delhi – Gurgaon – Bawal –Behror;
- Delhi – Gurgaon – Sohna – Nuh – Alwar;
- Delhi – Sonipat – Panipat;
- Delhi – Rohtak – Meham; and
- Delhi – Loni – Baghpat – Baraut.



These radial routes that converge on the capital consist of the national highways NH1, NH24, NH2, NH8, NH10 and NH58 (see Figure 4.2.1) and the state highways 22, and 57 in Uttar Pradesh and state highway 13 in Haryana. The national highways NH1, NH24, NH2, NH8, NH10 and NH58 link Delhi to the cities of Karnal, Muradabad, Agra, Jaipur, Hissar and Roorkee respectively.

The principal road transport sector in India is controlled by two groups namely the state and central governments. The Public Works Departments of the State Governments are responsible for the state highways whilst the control of the national highways is vested in the Ministry of Surface Transport and the National Highway Authority of India.

In general the standard of the national highway approach roads to Delhi is a four lane divided road. Outbound from Delhi this standard is maintained on NH1 until Panipat, on NH2 until Ballabgarh, on NH8 until Gurgaon, on NH10 until Bahadurgarh and on NH24 until Ghaziabad.

These radial routes then provide the major road network for Delhi. These routes are crossed by a series of ring roads the most important being the Outer Ring Road which links the national highway radial routes. The Yamuna River which cuts the National Capital Territory of Delhi (NCTD) is spanned by 6 permanent bridges. A new toll bridge is also under construction, planned to link Delhi with the rapidly developing city, Noida and Greater Noida. There are also several seasonal bridges that operate only in the dry season (September – June).

#### **4.3 Existing Railway Network and Functions**

The rail access into the NCR is provided along similar corridors to the radial road corridors. The only difference being is that there is no parallel rail link associated with state highway 13 in Haryana (see Figure 4.3.1).

In administrative terms, the rail network covers five divisions of three zonal railway systems (Northern, Western and Central). The rail network within the NCR includes both Broad and Metre Gauges. Five railway lines converge in central Delhi. The network has two specially identified lines known as the Goods Avoiding Line (GAL) and the Delhi Avoiding Line (DAL). The GAL provides a direct entry into New Delhi from Ghaziabad bypassing the congested Delhi Railway Station complex. The DAL provides a direct passage from the major yards (Tughlakabad and Ghaziabad) directly into the Delhi - Ambala - Kalka section.

#### 4.4 Review of Transport System within the NCR

In Delhi there is currently no mass transit system, although a mass transit system is under construction. Delhi has a high urban population in comparison with other cities in India. It also has one of the highest per capita incomes in India and as a result has the largest number of motorised vehicles (Table 4.4.1).

Early in the last decade Delhi was known for having the highest number of cycles of any city in India. This tendency towards personalised transport has continued and now has resulted in the replacement of the bicycle by private motorised transport in the form of cars and two wheelers. Between 1980 and 1995 the car fleet in Delhi increased at a rate of nearly 10% per annum.

**Table 4.4.1 Motor Vehicles on Delhi Roads**

<i>Year</i>	<i>Car/ Jeep</i>	<i>Two Wheelers</i>	<i>Three Wheelers</i>	<i>Taxi</i>	<i>Goods Vehicle</i>	<i>Tonga</i>	<i>Hand Cart</i>
1980	117,213	334,389	19,947	6,258	35,741	1,822	6,231
1985	174,890	637,267	31,354	6,654	58,925	1,354	6,517
1990	383,610	1,191,186	62,007	10,026	99,078	974	4,886
1995	617,585	1,707,528	77,884	13,384	131,877	796	5,518
2001 (Estimate)	784,000	2,772,000	184,000	24,000	-	-	-

Source: Transport Department, Government of National Capital Territory of Delhi

In the absence of an effective rail based transit mode, bus is the principal mode of public transport. Approximately 70% of daily commuters use bus in Delhi. Even those persons travelling between Delhi and the neighbouring towns, about 1.6 million trips per day 63% of these trips are by bus. The number of buses associated with each operator in 1997 is given in Table 4.4.2.

**Table 4.4.2 Public Buses in Delhi in 1997**

<i>Type</i>	<i>Number of Buses</i>
Red Line Buses (Now Blue Line)	2,425
Blue Line	550
Yellow Line + Mini Buses	620
White Line –Luxury Private Buses	100
Green Line – Luxury Bus operated by DTC	230
Delhi Transport Corporation(DTC)	4,000

Source: Transport Department, Government of National Capital Territory of Delhi

Public Transport as stated in Delhi is essentially road based. The only alternative to the road-based transport is the ring railway services run by Northern Railways. This accounts for less than 1% of total intra city trips in Delhi. Until 1993, Delhi Transport

Corporation (DTC) was the sole agency responsible for public transport in Delhi. It had a fleet of around 3000 buses. A fleet of between 500 and 600 buses under private ownership supported DTC operations.

Non Motorised Transport still plays an important role in Delhi with over 1 million cycles in the city and a large number of rickshaws. These however are principally used for short distance trips.

## **4.5 Traffic Survey and Analysis Results**

For this study several traffic surveys were undertaken namely:

- Classified Traffic counts at 16 locations;
- Roadside Interview Surveys at 10 locations;
- Vehicle Axle Load Surveys at 5 Locations;
- Travel Time Surveys; and
- User Opinion Surveys

### **4.5.1 Classified Traffic Counts**

The traffic location (16 sites) are shown in Figure 4.5.1 and 4.5.2. The results by vehicle composition are presented in Table 4.5.1 and diagrammatically in Appendix 4.1.1 to Appendix 4.1.8.

The traffic distribution by time of day for car and truck is presented in Appendix 4.2.1 to Appendix 4.2.8 for four key sides namely:

- NH1;
- NH2;
- NH 58; and
- ITO Bridge

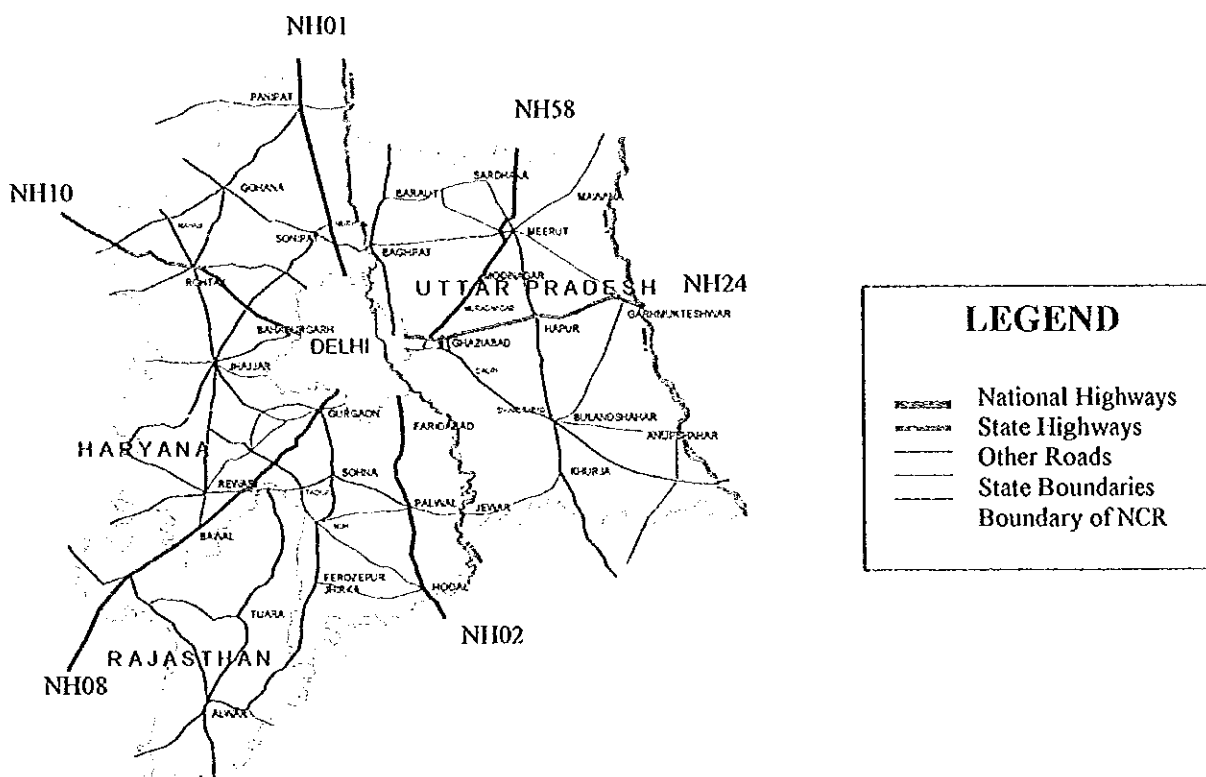


Figure 4.2.1 State Boundaries & Major Roads Outside National Capital Territory Of Delhi

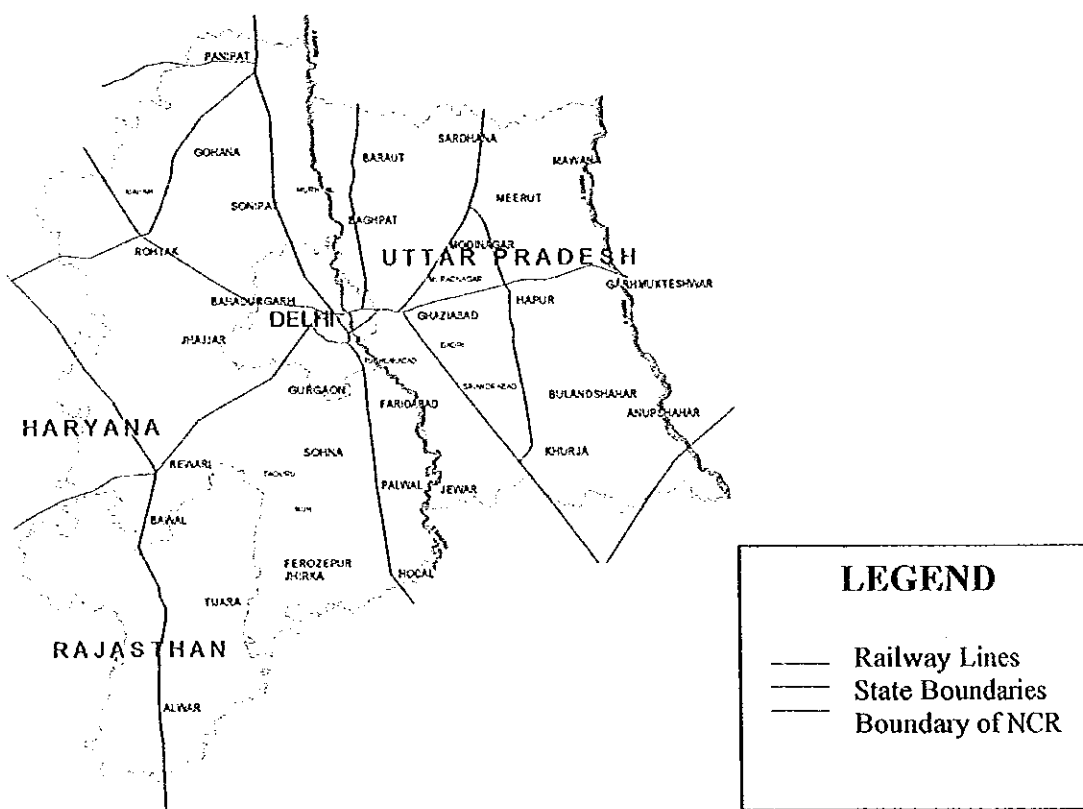


Figure 4.3.1 State Boundaries & Railway Lines Outside National Capital Territory Of Delhi

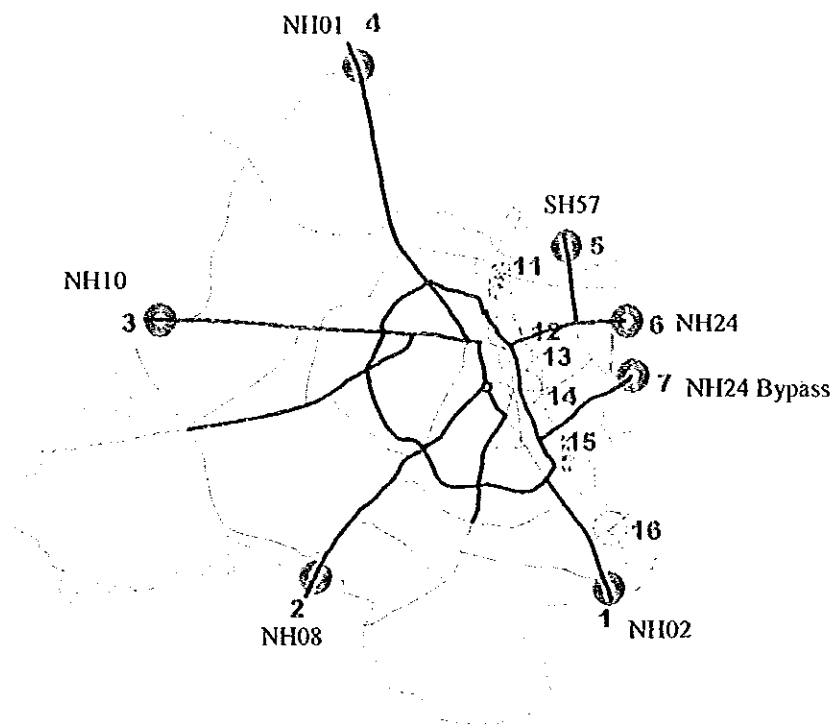


FIGURE 4.5.1 SURVEY SITES WITHIN NATIONAL CAPITAL TERRITORY OF DELHI

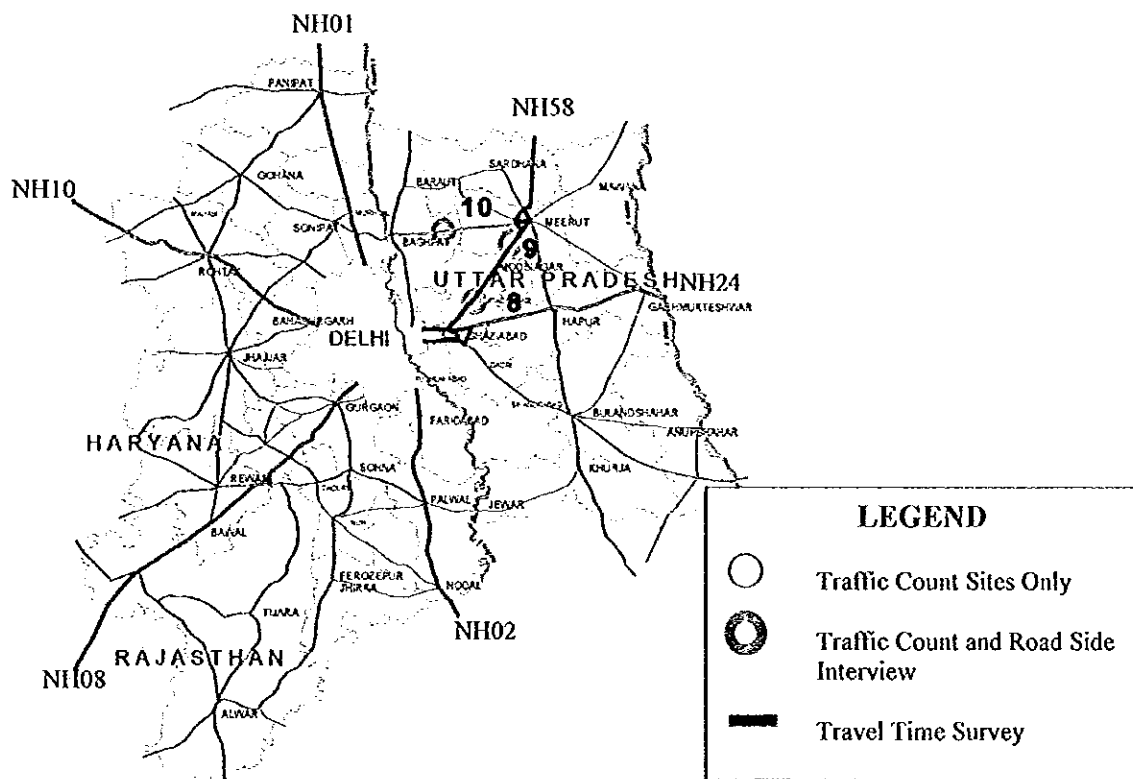


FIGURE 4.5.2 SURVEY SITES OUTSIDE NATIONAL CAPITAL TERRITORY OF DELHI

Table 4.5.1 Traffic Counts-24 Hours

No	Description	Non-Motorized Vehicles			Motor-cycles	Auto-rikshaw	Passenger Car.	Bus	Trucks		Sub-Total	Motorized Vehicles
		1	2	3					4	5		
1	Boundary of Delhi -- NH 2	5,636	10,504	392			20,077	1,408	8,211		29,696	40,592
2	Boundary of Delhi -- NH 8	1,733	8,901	175			24,650	2,533	9,441		36,624	45,700
3	Boundary of Delhi -- NH 10	2,965	4,541	746			6,667	863	5,084		12,614	17,901
4	Boundary of Delhi -- NH 1	1,938	3,863	312			12,714	2,305	11,338		26,357	30,532
5	Boundary of Delhi -- SH 57	2,277	1,752	112			1,833	526	3,857		6,216	8,080
6	Bridge over Hindan -- NH24	8,085	15,122	8,317			22,578	7,924	15,514		46,016	69,455
7	Bridge over Hindan -- NH24 Bypass	6,670	5,003	1,732			5,807	1,221	2,803		9,831	16,566
8	Ghaziabad - Modinagar--NH 58	2,711	4,966	457			8,225	1,920	5,591		15,736	21,159
9	Modinagar - Meerut --NH 58	2,135	3,073	578			6,560	2,150	5,057		13,767	17,418
10	Meerut - Baghpat	866	514	14			492	193	1,029		1,714	2,242
11	Yamuna River -- Wazirabad Bridge	14,657	14,014	2,941			8,274	4,619	9,332		22,225	39,180
12	Yamuna River -- ISBT Bridge	14,989	19,637	13,460			21,342	6,853	13,957		42,152	75,249
13	Yamuna River -- Yamuna Bridge	30,465	19,054	12,275			8,290	335	1,279		9,904	41,233
14	Yamuna River -- ITO Bridge	16,097	58,837	16,795			48,361	9,340	2,831		60,532	136,164
15	Yamuna River -- Nizamuddin Bridge	7,477	34,889	6,411			53,011	4,397	7,675		65,083	106,383
16	Yamuna River -- Okhla Bridge	4,059	7,448	1,419			11,402	845	5,909		18,156	27,023

Source : JICA Study Team

The results from the traffic count surveys suggest that at NH1 and NH2 that the level of traffic volume is highest between 10:00 and 18:00 whilst the count at the ITO bridge clearly show peaks in the morning and the evening. The impact of the ban on truck traffic entering Delhi is clearly shown in the plot of truck traffic by time of day at the count sites for NH1 and NH2. (see Appendix 4.1.1 and Appendix 4.1.8).

The vehicle distribution shows that cars and two/three wheelers combined are more than 40% of all traffic at every location. At NH1 trucks and light commercial vehicles represent 35% of all traffic. Along NH 58 this group of vehicles represent 25 % of all traffic.

The directional flow at major sites from the surveys presented in Table 4.5.2.

**Table 4.5.2 Directional Proportional Flow at Margin**

Location		Peak	% Flow to NCTD	% Flow from NCTD
Ghaziabad-Modinagar-NH 58	Morning Peak	1030-1130	55.4	44.6
	Evening Peak	1730-1830	46.7	53.4
Modinagar-Meerut-NH 58	Morning Peak	1000-1100	50.3	49.7
	Evening Peak	1215-1315	38.0	62.0
Yamuna river – Wazirabad Bridge	Morning Peak	830-930	74.2	25.8
	Evening Peak	1730-1830	46.8	53.1
Yamuna river – ISBT Bridge	Morning Peak	1045-1145	60.3	39.6
	Evening Peak	1530-1630	33.0	67.0
Yamuna river – Yamuna Bridge	Morning Peak	1000-1100	57.8	42.2
	Evening Peak	1615-1715	55.9	43.9
Yamuna river – ITO Bridge	Morning Peak	915-1015	66.4	33.6
	Evening Peak	1845-1945	24.7	75.3
Yamuna river – Nizammudin Bridge	Morning Peak	830-930	79.3	20.7
	Evening Peak	1745-1845	42.4	57.6
Yamuna river – Okhla bridge	Morning Peak	1030-1130	47.4	52.6
	Evening Peak	1700-1800	43.7	56.3

Source : JICA Study Team

#### 4.5.2 Roadside Origin-Destination Survey

These surveys were undertaken at 10 sites, 7 locations on the boundary of NCTD and three in the vicinity of NCTD (see Figure 4.5.1 and Figure 4.5.2) over a 20 hour period. The sample rate is shown in Table 4.5.3. All sample rates are greater than 10% over the 20 hour period. The lowest sample rate is recorded at the site of the heaviest traffic.

**Table 4.5.3 Road Side Interview Sample**

<i>Location</i>	<i>Description</i>	<i>Direction</i>	<i>Sample</i>	<i>Count</i>	<i>Percent</i>
1	Boundary of Delhi -- NH 2	1	1,977	16,693	11.8%
1	Boundary of Delhi -- NH 2	2	3,104	22,543	13.8%
2	Boundary of Delhi -- NH 8	1	3,086	21,488	14.4%
2	Boundary of Delhi -- NH 8	2	3,624	21,926	16.5%
3	Boundary of Delhi -- NH 10	1	1,502	8,363	18.0%
3	Boundary of Delhi -- NH 10	2	1,562	8,595	18.2%
4	Boundary of Delhi -- NH 1	1	1,764	11,754	15.0%
4	Boundary of Delhi -- NH 1	2	1,907	10,704	17.8%
5	Boundary of Delhi -- SH 57	1	1,173	4,790	24.5%
5	Boundary of Delhi -- SH 57	2	1,011	4,382	23.1%
6	Bridge over Hindan -- NH24	1	3,182	31,021	10.3%
6	Bridge over Hindan -- NH24	2	4,024	31,018	13.0%
7	Bridge over Hindan -- NH24	1	1,379	7,961	17.3%
	Bypass				
7	Bridge over Hindan -- NH24	2	1,289	8,305	15.5%
	Bypass				
8	Ghaziabad - Modinagar--NH 58	1	2,582	10,817	23.9%
8	Ghaziabad - Modinagar--NH 58	2	2,213	9,185	24.1%
9	Modinagar - Meerut --NH 58	1	2,547	7,501	34.0%
9	Modinagar - Meerut --NH 58	2	2,515	9,272	27.1%
10	Meerut - Baghpat -- SH 14	1	448	2,021	22.2%
10	Meerut - Baghpat -- SH 14	2	477	1,813	26.3%

Source : JICA Study Team

Note : All Surveys conducted for 20 Hours between 06:00 to 02:00

Direction 1. - In bound to Delhi

2.- Outbound from Delhi

The road users selected for interview were asked to provide the following information regarding the characteristics of their trip namely:

- Origin of the Trip;
- Destination of the Trip;
- Trip Purpose;
- Residence of the Interviewer; and
- Type of commodity in the case of a Truck.

The following characteristics were observed by the interviewer namely:

- Vehicle Type and
- Number of passengers

The road side interview sample was expanded to the observed count. The following expansion factor was appended to each record namely

$$EPF_{in} = EXPF1 * EPF2 * EPF3 * EPF4 * EPF5$$



Where  $EXPF_{inh}$  = Expansion Factor at site  $i$  for time slice  $n$  and vehicle type  $h$

$EXPF_i$  = Count in/sample in

Where count and sample are for each site  $i$  for time slice  $n$ . Vehicle type  $h$ . There were four time slices namely:

1- 06:00 - 11:00

2- 11:00 – 16:00

3- 16:00 – 21:00

4- 21:00 – 02:00

$EXPF_2$  = Expansion factor from 20-24 hour counts

$EXPF_3$  = Seasonal Factor over three day counting period

$EXPF_4$  = Double Counting Factor

The Double counting factor is to account for a vehicle passing through more than one origin – destination interview site. The Double Counting factor was estimated using traffic assignment software, and by assigning a dummy matrix and analysing each survey as a site in a selected link analysis.

From the expanded results the number of trips entering and leaving NCTD is shown in Table 4.5.4 whilst Table 4.5.5 depicts the different trip purposes of private vehicle trips.

**Table 4.5.4 Trip Destination of Survey Vehicles**

Location	Number of Vehicles	Percentage
NCTD	14,962	16
Haryana	65,490	71
Uttar Pradesh	7,227	8
Others	5,000	5

Source: JICA Study Team

**Table 4.5.5 Trip Purpose of Drivers**

Purpose	Percentage
Work Related	55.0
Private	28.0
Other	13.0
Education	4.0

Source: JICA Study Team

The home of the interviewee by state is given in Table 4.5.6

**Table 4.5.6 Home State of Interviewee**

NCTD	16
Haryana	71
Uttar Pradesh	8
Others	5

Source: JICA Study Team

It is interesting to note that a large proportion of drivers live in the state of Haryana.

### **Axle Load Surveys**

Axle Load Surveys were undertaken at 5 sites (see Figure 4.5.1 and 4.5.2). The distribution of goods by tonnage is presented in Table 4.5.7. In the Ghaziabad -- Meerut corridor, NH58 the highest proportion of goods is associated with the construction industry. During the survey construction fill material was being carted for the construction of the Integrated Multi Modal Mass Rapid Transport System for Delhi.

The average vehicle axle load is shown in Table 4.5.8. For multi axle trucks the maximum axle load is 10.6 tonnes. In Table 4.5.9 the origin destination of trucks in units of PCU is presented.

**Table 4.5.7 Distribution of Goods by Tonnage carried**

Freight Description	Axle Load (%)				
	Boundary of Delhi – NH 2	Boundary of Delhi – NH 8	Boundary of Delhi NH 1	Bridge over Hindan NH 24	Ghaziabad-Modinagar NH 58
Perishable Goods	6.63	3.46	31.99	4.91	4.79
Agricultural Products	3.24	3.06	5.34	2.74	4.13
Processed Food	1.56	18.49	8.21	6.87	16.02
Live stock	5.05	0.94	1.94	2.69	0.86
Construction Materials	4.37	9.31	14.57	9.47	22.78
Mining Products	6.40	0.06	0.05	0.40	0.00
Textile, Fibre and Animal Leather	13.71	9.90	4.23	3.64	3.54
Oil & Oil Products	7.40	10.39	0.18	3.07	0.99
Chemical Products	2.58	2.15	5.44	4.65	10.50
Metal and Machine	20.21	21.03	4.01	14.97	8.40
Misc Industrial Products	10.10	2.93	1.43	24.00	0.73
Waste	0.33	1.93	0.10	4.03	0.48
Empty	11.26	7.73	10.34	9.30	7.28
Others	7.17	8.60	12.19	9.26	19.49
<b>Total of Distribution</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>
<b>Total Axle Load (Tonnes)</b>	<b>7,864</b>	<b>13,747</b>	<b>17,449</b>	<b>22,795</b>	<b>7,989</b>

Source: JICA Study Team

**Table 4.5.8 Average Axle Load**

Vehicle Type	Load/Axle (Tonnes/Axle)	Average Maximum Axle Load (Tonnes/Axle)
Public Large Bus	6.06	7.53
LCV	4.09	5.27
2 Axle Truck	7.79	9.85
Multi Axle Truck	8.63	10.61

Source: JICA Study Team

**Table 4.5.9 Distribution of Trucks**

Freight Description	To/From NCTD	To/From NCR (excl. NCTD)	To/From Outside NCR	Through Traffic (NCR)	Total
Perishable Goods	207	999	557	25	1,089
Agricultural Products	54	303	186	16	357
Processed Food	99	833	540	51	939
Live stock	0	156	82	10	166
Construction Materials	190	900	367	34	986
Mining Products	11	32	60	34	72
Textile, Fibre and Animal Leather	151	652	420	58	767
Oil & Oil Products	28	284	208	61	356
Chemical Products	106	439	253	41	514
Metal and Machine	283	1,065	708	76	1,258
Misc Industrial Products	190	881	520	67	1,007
Waste	24	172	49	0	178
Empty	180	1,236	466	44	1,307
Others	204	1,119	523	41	1,210
<b>Total</b>	<b>1,724</b>	<b>9,068</b>	<b>4,934</b>	<b>555</b>	<b>10,203</b>

Source: JICA Study Team

**4.5.4 Travel Time Surveys**

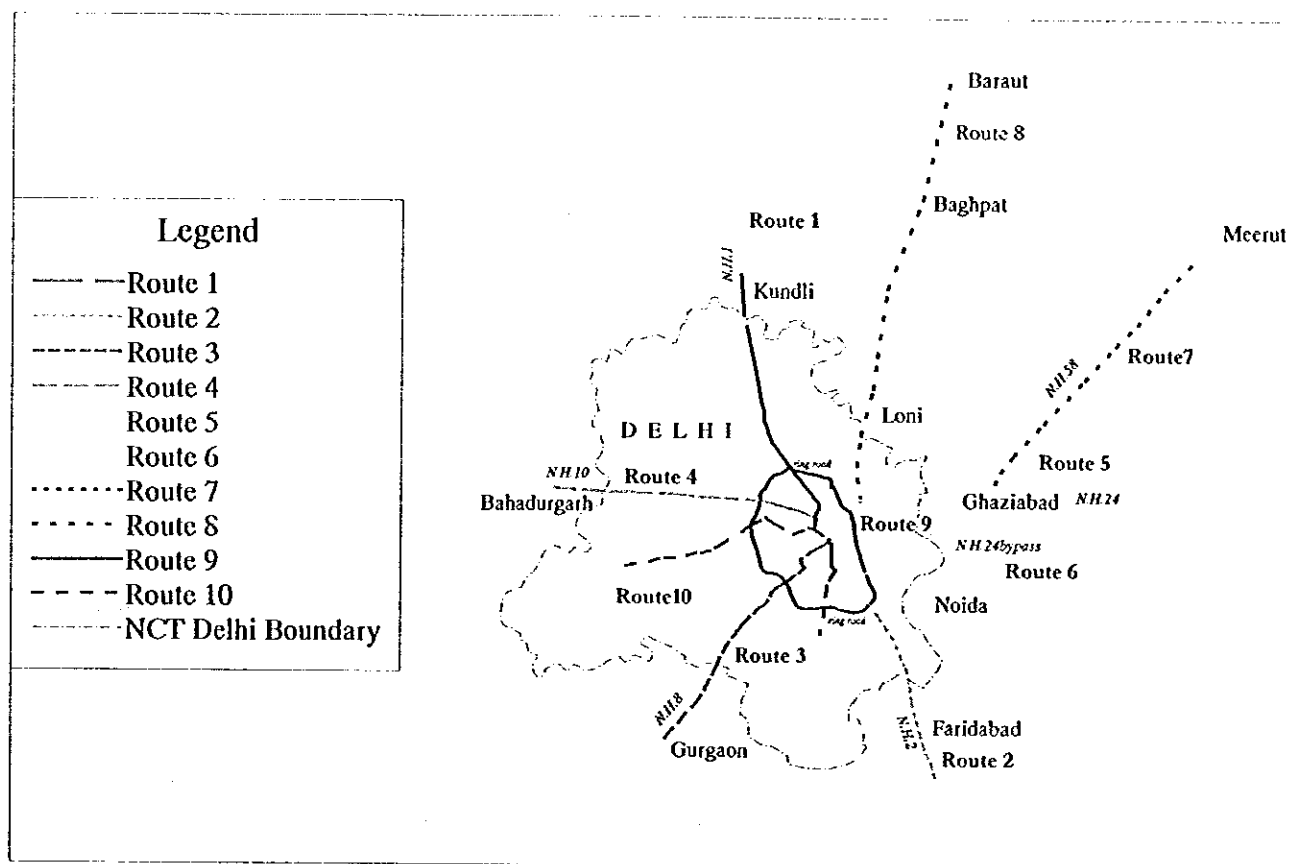
The ten travel time routes are shown in Figure 4.5.3 and the average speed for each route is presented in Table 4.5.10 whilst the morning (inbound and outbound), evening (inbound and outbound) and off peak inbound and outbound are shown in Appendix 4.3.1 through Appendix 4.3.6 respectively.

The lowest morning and evening peak hour averages of around 20kph are recorded on the outer ring road. The highest speeds are recorded on NH8.

**Table 4.5.10 Travel Time Speeds on various corridors**

Corridor Number	Road Name	Start Point	End Point	Travel Time Speeds (kph)		
				Morning Peak	Off Peak	Evening Peak
1	National Highway 1	Kundli	Panchkuian Road	22.2	25.9	19.1
2	National Highway 2	Faridabad Sector	Ring Road	34.2	34.6	29.4
3	National Highway 8	Connaught Place	Gurgaon	34.9	36.4	36.3
4	National Highway 10	Rani Jhansi Road	Bahadurgarh	31.5	33.8	32.5
5	National Highway 24	ISBT	Upper Ganga Canal	24.9	26.1	24.3
6	National Highway 24 bypass	Ring Road	NH-24	33.5	42.1	34.3
7	National Highway 58	Meerut Bypass	NH - 24	29.8	32.0	31.0
8	State Highway 57	Baraut	NH 24	35.5	38.2	36.2
9	Ring Road	ISBT	ISBT	21.8	24.2	19.1
10	Najafgarh to Outer Ring Road via Connaught place	Najafgarh	Outer Ring Road	20.3	20.3	19.5

**Figure 4. 5.3 Map showing the Travel Time Survey Routes**



#### 4.5.5 User Opinion (Willingness to Pay) Survey

This survey was designed to analyze the extent of “Willingness to Pay” a toll against the anticipated saving in travel time. Eventually, the survey result could provide the basis to verify the estimated diversion model to the project expressway.

Potential users of the GM expressway were interviewed in User Opinion Surveys in Meerut, Modinagar and Ghaziabad. There were four types of User Opinion Survey namely:

- Two Wheeler Rider;
- Car Driver;
- Operation Manager of Truck; and
- Operation Manager of Buses

The socio-economic characteristics profile of the interviewees is tabulated in Appendix 4.4.1 through to Appendix 4.4.7 for costs of Vehicle Usage, Monthly Personal Income, Trip Purpose and Residence.

Table 4.5.11 and Table 4.5.12 show the potential number of trips by buses and commercial vehicles on the possible expressway. Table 4.5.13 shows the potential diversion to the proposed expressway for particular vehicle types and relevant time saving. Between Meerut and Ghaziabad, the survey suggests that 53% of potential car users are prepared to pay 20Rs for a 50% time savings. For the same scenario, 68% of the potential truck users are prepared to pay 56Rs for a 50% time savings.

**Table 4.5.11 Breakdown of Bus Vehicle Trips**

Route	Number of Bus Trips Per Day	Number of Bus Trips Per Day Per Operator
Other than Ghaziabad to Meerut	141	2
Ghaziabad to Meerut	100	2
Ghaziabad to Modinagar	27	1
Modinagar to Meerut	4	Very Few

Source: JICA Study Team

**Table 4.5.12 Breakdown of Commercial Vehicle Trips**

Route	Number Of Trips Commercial Vehicle Trips Per Day	Number Of Trips Commercial Vehicle Trips Per Day Per Operator
Other than Ghaziabad to Meerut	262	1
Ghaziabad to Meerut	332	1
Ghaziabad to Modinagar	76	1
Modinagar to Meerut	29	Very Few

Source: JICA Study Team

**Table 4.5.13 Percentage Diversion to Toll Road (as stated in the interview, not weighted for estimating the total population)**

Section: Meerut-Ghaziabad						
Vehicle type	Toll (Rs.)	Change in Travel Time				
		-50%	-25%	0%	25%	50%
<i>M/C</i>	12	79	45	16	5	0
	24	23	11	2	0	0
	36	4	0	0	0	0
<i>Car</i>	20	53	41	5	5	0
	40	5	5	0	0	0
<i>Bus</i>	40	78	61	35	5	0
	80	16	8	5	0	0
<i>Truck</i>	56	68	50	20	10	6
	112	13	7	0	0	0

Section: Ghaziabad-Modinagar						
Vehicle type	Toll (Rs.)	Change in Travel Time				
		-50%	-25%	0%	25%	50%
<i>M/C</i>	7.5	21	18	10	0	0
	15	9	5.5	2	0	0
<i>Car</i>	12.5	0	0	0	0	0
	25	0	0	0	0	0
<i>Bus</i>	25	21	18	8	0	0
	50	0	0	0	0	0
<i>Truck</i>	35	10	8	3	0	0
	70	2	0	0	0	0

Section: Meerut-Modinagar						
Vehicle type	Toll (Rs.)	Change in Travel Time				
		-50%	-25%	0%	25%	50%
<i>M/C</i>	4.5	28	23	12	5.5	0
	9	13.5	9.2	3.1	3	0
<i>Car</i>	7.5	0	0	0	0	0
	15	0	0	0	0	0
<i>Bus</i>	15	27	15	10	5	0
	30	5	0	0	0	0
<i>Truck</i>	21	20	15	5	3	0
	42	2	0	0	0	0

Source: JICA Study Team