Public Works Department, Rajasthan

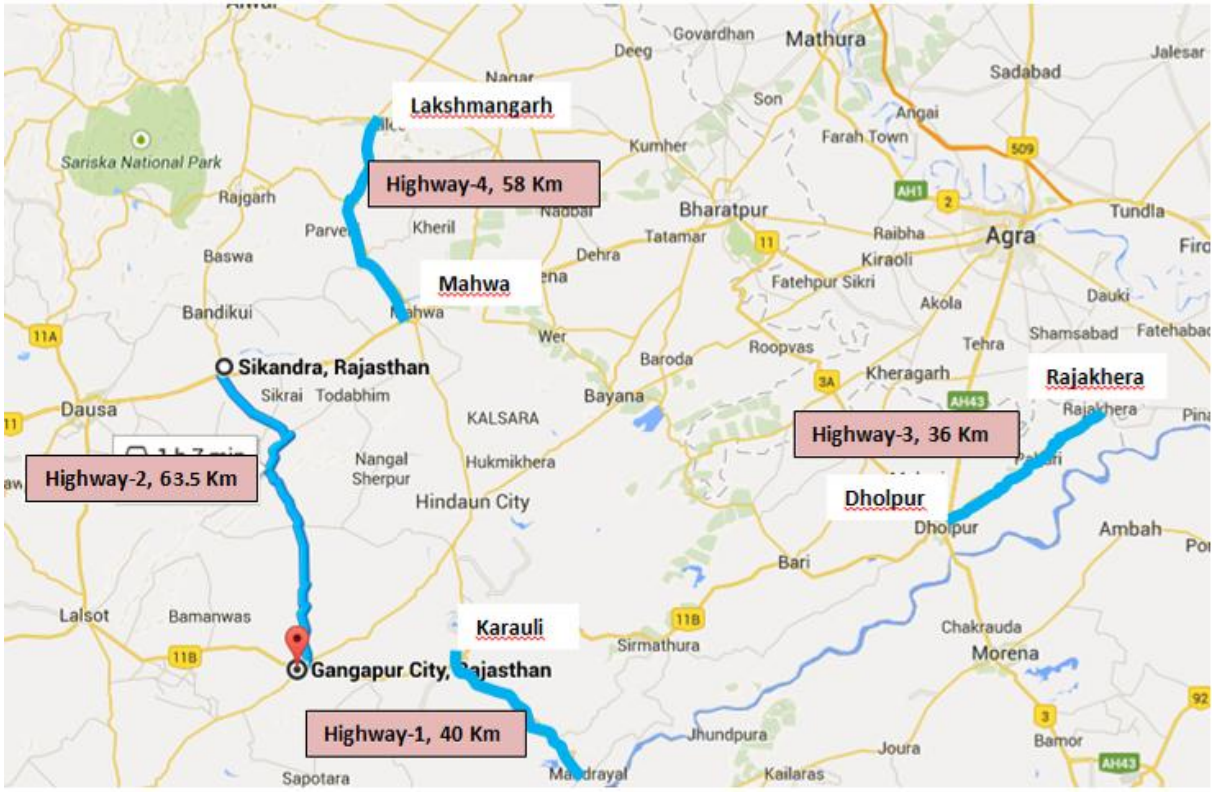
सार्वजनिक निर्माण विभाग,राजस्थान

सत्यमेव जयते

Rajasthan State Highways Development Programme
PPP Division, PWD

Consultancy Services for Preparation of Feasibility Report of Two-Laning of Km 0.0 to Km 63.485 of SH-25 comprising the section from Gangapur to Sikandra

PROJECT REPORT



October-2015

- ***CENTRO DE ESTUDIOS DE RIALS Y CONTROL DE OBRA, S.A.***
- ***AVANZA ENGINEERING PVT.LTD.***
- ***SHP CONSULTING ENGINEERS.***

Office Address: *D – 75, Near BSNL Office, Vaishali Nagar, Jaipur - 302021*

Executive Summary

E1 Project Background

Govt. of Rajasthan has announced development of 20000 kms highways during next 5 years. Projects and schemes are being identified for implementation of the announcement. Planning commission, New Delhi was also approached for selected projects to get 20% VGF from GoI. Several rounds of meetings held at Planning Commission for identification of road stretches, working out packages, finalization of various documents and working out timeline etc.

This Feasibility Report details the approach, methodology and work plan for carrying out feasibility study of the following road grouped under package-13

Project Road Considered for Study

The project road starts at Km 0.0 near Gangapur at NH-11B and ends at Km 63.485 at NH-11 junction in Sikandra. The design length is 63.485 Km

S No	Description of Road	Length (Km)
1	Gangapur to Sikandra	63.485

E2 Present Study

The Study consists of the following:

- feasibility study including survey and investigation
- preliminary project designs and cost estimates
- preparation of technical schedules

E3 Traffic Studies and Analysis

The traffic data were collected on the study corridor and relevant information obtained on traffic flow characteristics including classified traffic volume, hourly and daily traffic variation and travel pattern and vehicle load characteristics. The following primary surveys were conducted to assess the present traffic scenario:

- Classified Traffic Volume Counts
- Axle Load Survey
- Pedestrian Crossing Surveys
- Turning Movement Count

E3.1 Present Traffic Scenario

Project road sections witness annual average daily traffic (AADT) in the range of 2,571-4,442 vehicles (2,864 – 4,283 PCUs). Composition of cars is in the range of 10-16percent, mini buses and buses is in the range of 2-3.5percent. Among commercial vehicles, mini LCVs and LCVs is in the range of 2-3percent and all categories of trucks together constitute about 3-4percent in total traffic.

The AADT so obtained at all the traffic survey locations are projected at a uniform growth rate of 5% for all categories of vehicles as mentioned in the TOR. The year in which the project road reaches its design service volume at LOS-B is worked out for intermediate lane and 2-lane configuration. The results are tabulated ***Table E-1***.

Table E-1: Year of Achieving DSV (PCUs/day)

Loc No.	Location	Traffic (PCUs/Day) Y-2015	I-Lane	2-Lane
			LOS-B	LOS-B
			DSV-6000	DSV-15000
1	Km-12	2864	2031	Beyond 2045
2	Km-39	4283	2022	2041
3	Km-58	3610	2026	2045
Average		3586	2026	2045

LOS-B: Level of Service-B, DSV-Design Service Volume

To estimate the Equivalent Standard Axle Load of traffic, axle load surveys were carried out at one location at Km 58.0. Based on the Spectrum of Axle loads and analysis of axle load data, the resulting VDFs are as given in ***Table E-2***.

Table E-2: Vehicle Damage Factors

Location	Direction	LCV	Buses	2-AT	3-AT	MAV
Km 58	Gangapur to Sikandra	0.01	0.05	1.13	7.06	10.51
	Sikandra to Gangapur	0.03	0.05	4.80	7.91	-
	Both Directions	0.017	0.05	3.07	7.45	10.51
Adopted value for the project road		**1.00**	**1.00**	**5.0**	**8.0**	**10.5**

The major commodity types being carried along the Project Road comprise machinery, agricultural products chemical and pharmaceuticals, iron, steel and manufacturing goods.

E4 Engineering Surveys and Investigations

The Consultants have carried out engineering surveys and investigations along the Project Road. These include: topographic surveys, road inventory and condition survey, alignment study, pavement investigations, Benkelman beam deflection, pavement surface roughness, hydrological study, environmental study, axle load survey, condition surveys for bridges and structures and exploration and selection of construction materials.

E5 Road Alignment

The alignment has been studied, based on physical features and other constraints at site viz. Land acquisition, Utilities, Construction activities, presence of religious structures etc. It has been observed that Optical Fibre Cable (O.F.C.) is running along the road alignment. Symmetrical widening has been proposed and through built-up area except at locations of sharp horizontal curves.

E6 Existing Road: Inventory

E6.1 Land use and Terrain

Project road traverses through plain, rolling and hilly terrain. Land use being predominantly barren and interspersed with built-up sections.

E6.2 Horizontal Alignment

The majority of the existing curves have radii not in conformity to SH standards for the chosen design speed. These locations need geometric improvement. Existing curves having radii for design speed lower than 50 Kmph were improved.

E6.3 Vertical Profile

Topographic survey data reveals that majority of longitudinal gradients except in hilly (ghat) sections is less than 2 percent and maximum gradient at some over bridge approaches is around 2.5 per cent.

E6.4 Carriageway, Shoulder and Roadway width

Existing road has 7.0m dual carriageway with 0.6-0.7m wide median for a length of 0.15Km (0.2%) at end of the project road, 2lane wide carriageway for 32Km (48%) length, intermediate lane for 25 Km (38.3%) and balance 9.0Km (13.5%) length has carriageway width of 3.75-5.0m. 0.5m to 2.0m granular shoulder exists in the rest of the length. 58km length of road has bituminous surface and about 8Km length has rigid pavement. The roadway width varies from 6 to 10 m.

E6.5 Roadside Drains

There are no channelized regular longitudinal drains in most part of the project section.

E6.6 Utilities

Low-tension overhead electrical lines are running along the highway and cross the highway at certain locations. While widening the road, the utility lines located on the new carriageway or widening portion would need shifting. At intersections of the cross-roads and locations of traffic facilities, there may be a need for relocation of a few electric and telephone poles during execution stage.

E7 Pavement Condition

Detailed pavement condition surveys bring out the following salient aspects:

Pavement condition survey by visual method was carried out on the Project Road to assess the condition of existing pavement. The % distress is compared with criteria for classification of pavement sections as per IRC: 81-1997.

17% of project road length is in good condition, 39% in fair condition and 44% in poor condition.

Pavement Composition: The existing pavement consists of bituminous layers, WBM and granular sub base. The minimum existing thickness excluding subgrade is about 430 mm. The composition of various layers of the pavement in above reaches is summarised here under:

Pavement layer	Thickness
Bituminous courses	20 to 70 mm
WBM	270 to 520 mm
Sub Base	130 to 300 mm

Pavement Deflection and sub grade strength: The BBD values vary between 0.43 mm to 0.77mm along the project road.

The CBR value at sub grade level is 5-8% at various locations along the project road.

E8 Improvement Proposals

The standards have been formulated for design speed of 100 kmph, in general, but not less than 60 kmph in plain terrain. In built-up sections the existing geometric will be improved without any social impacts. The granular shoulder of 2.5 m has been proposed. Camber of 2.5 percent has been adopted for the carriageway and paved shoulder and 3.0% for earth shoulders. Super-elevation adopted is restricted to 7 per cent.

The last 0.20 Km section of project road shall have 4 lane divided carriageway (CC pavement reconstruction) with 1.2m median and rest of the length shall have 7m wide carriageway.

E9 Pavement Design

E9.1 Main Carriageway

The design inputs i.e. CBR value (effective CBR of 7% is considered for design) for the proposed subgrade material, Traffic loading in terms of cumulative standard axles in million (MSA) considered for pavement design have been summarized in ***Table E-3***. Base and sub base layers have been designed for 15 years and surface layers have been designed for 8 years.

Table E-3: Design Inputs for Flexible pavement

Design Parameter	Entire Project Road length
	2-Lane with Granular Shoulder
Design Period, Years (Base & Sub-base)	15
Design Period, Years (Wearing Course)	8
CBR (Effective)	7%
Traffic Loading (MSA) for 15 years	10 (actual 5.65)
Traffic Loading (MSA) for 8 years	5 (actual 2.51)

The pavement composition and layer thicknesses as per IRC: 37 –2012 considering the above design parameters are presented in ***Table E-4***.

Table E-4: Pavement Layer Thicknesses (mm)

Pavement Composition	New Construction
Bituminous Concrete (BC)	40
Dense Bituminous Macadam (DBM)	50
Wet Mix Macadam (WMM)	250
Granular Sub base (GSB)	230
Subgrade (Effective CBR=7%)	500

The thickness of DBM & BC overlay have been designed considering the subgrade strength, total required thickness and available thickness of existing pavement.

Project road sections with poor condition shall have GSB (total=230mm) layer for the entire width of formation and two layers of WMM (total=250mm) for the entire carriageway width and surface layers were recommended over WMM layer.

The proposed pavement composition and layer thicknesses considering the above design parameters are presented in ***Table E-5*** for various category of pavement surface conditions (good/fair, poor) recorded and for new construction.

Table E-5: Proposed Pavement Layer Thicknesses (mm)

Pavement Composition	Widening & Strengthening Sections		Reconstruction Sections		New Construction
	Widening Portion	Central portion	Widening Portion	Central portion	
Bituminous Concrete (BC)	40	40	40	40	40
Dense Bituminous Macadam (DBM)	50	-	50	50	50
Wet Mix Macadam (WMM)	250	-	250	250	250
Granular Sub base (GSB)	230	-	230	230	230
Subgrade (Effective CBR=7%)	500	-	500	-	500

E9.2 Shoulders

Shoulder has been designed as a single unit with main carriageway with 2.5m as granular shoulder.

E10 Bridges and Culverts

The engineering studies included inventory and condition survey of the existing bridges and cross drainage structures, development of scheme for widening of bridges and cross drainage structures and design of new bridges, if any.

No major bridges were observed along the project road

There are 49 nos culverts and 6 nos minor bridges. Majority of the culverts have also been inspected and found to be structurally functional. Some additional culverts are proposed for efficient cross drainage.

The slab and pipe culverts details are presented in the following ***Table E-6*** with their improvement proposal.

Table E-6: Details of Culverts

Type of Structure	Total Numbers	Structure Condition		
		Retained	Proposed for Widening	Proposed for Reconstruction
Hume pipe	23	13	3	7
RC Slab	20	7	7	6
Causeway	6	-	-	6

The details of structures provided across the irrigation canals are provided in the following ***Table E-7*** along with the suggested improvement.

Table E-7: Details of Minor Bridges

Type of Structure	Total Numbers	Structure Condition		
		Retained	Proposed for Widening	Proposed for Reconstruction
RC Slab	6	4	2	-

E11 Road bridges over Railway lines

No RUB, ROB and at-grade railway level crossing were observed along the project road.

E12 Toll Plaza

Project road is proposed with two toll plazas, for its entire length. The tentative locations and section length for tolling purpose are presented in ***Table E-8***

Table E-8: Tentative Tolling Sections

Section	Tentative Toll Plaza Location	Toll Plaza	Toll Road Section Length km	TVC location
Gangapur to Nadauti	Km 12.6 (PWD Km 13)	TP-1	28.0	Km 12
Nadauti to Sikandra (NH-11)	Km 56.450 (PWD Km 58)	TP-2	35.5	Km 58

E13 Wayside Amenities & Truck Lay bye

Wayside amenity and truck lay byes are not envisaged as part of the project proposal.

E14 Cost Estimate

The unit rates for various items of works have been worked out on the basis of BSR PWD Rajasthan.

The estimated total construction cost of the Project is Rs**. 110.74 Cr.**

Total Project Cost (at 15% additional over 2015 cost) is Rs. **127.35 Cr**.

E15 Financial Analysis

Project is not found financially viable for VGF less than 40% on BOT (Toll) basis.

E16 Social Impact Assessment

Provided in a separate attachment

E17 Environmental Impact Assessment

Provided in a separate attachment

1. Project Description

1.1. Background

Govt. of Rajasthan has announced development of 20,000 kms highways during next 5 years. Projects and schemes are being identified for implementation of the announcement. Planning commission, New Delhi was also approached for selected projects to get 20% VGF from GoI. Several rounds of meetings held at Planning Commission for identification of road stretches, working out packages, finalization of various documents and working out timeline etc.

For time bound implementation of PPP projects GoR has shown commitment by introducing a first ever comprehensive 'Raj. State Highways Bill-2014'. The bill has been passed by Rajasthan State Legislative Assembly on 09-04-2015.

The Governor of Rajasthan acting through the Chief Engineer (Roads), Public Works Department, Government of Rajasthan (the "Authority") is engaged in the development of state highways and as part of this endeavour, the Authority has decided to undertake package wise shortlisted road sections (the "Project") through Public Private Partnership (the "PPP") on Design, Build, Finance, Operate and Transfer (the "DBFOT") basis.

Authority has decided to conduct feasibility studies for determining the technical feasibility and financial viability of all Highways comprising the Project. If found technically feasible and financially viable, the Highways under the Project may be awarded on DBFOT basis to a private entity (the "Concessionaire") selected through a competitive bidding process. The Project would be implemented in accordance with the terms and conditions stated in the concession agreement to be entered into between the Authority and the Concessionaire (the "Concession Agreement").

In pursuance of the above, the Authority has decided to carry out the process for selection of a Technical Consultant, a Financial Consultant and a Legal Adviser for preparing the Feasibility Report and bid documents. The Financial Consultant will develop the revenue model and assist the Authority in the bidding process. The Legal Adviser will review the draft concession agreement based on the Model Concession Agreement for State Highways through Public Private Partnership (the "MCA") read with the Manual of Standards and Specifications. The Technical Consultant shall prepare the Feasibility Report in accordance with the Terms of Reference specified ("TOR").

1.2. Project Road Details

The shortlisted roads were grouped under various packages for carrying out feasibility studies. Further to the bidding process, package-13 consisting of four roads as mentioned below were assigned to technical consultant M/s CEMOSA, AVANZA and SHP for carrying out feasibility study on individual road basis, vide LOI dated 12/05/2015 and subsequently agreement for carrying out consultancy was signed on 22/05/2015.

Package-13 Road Details

Highway No	Description of Road	Length (Km)
Highway - 1	Mandrayal to Karauli	37.5

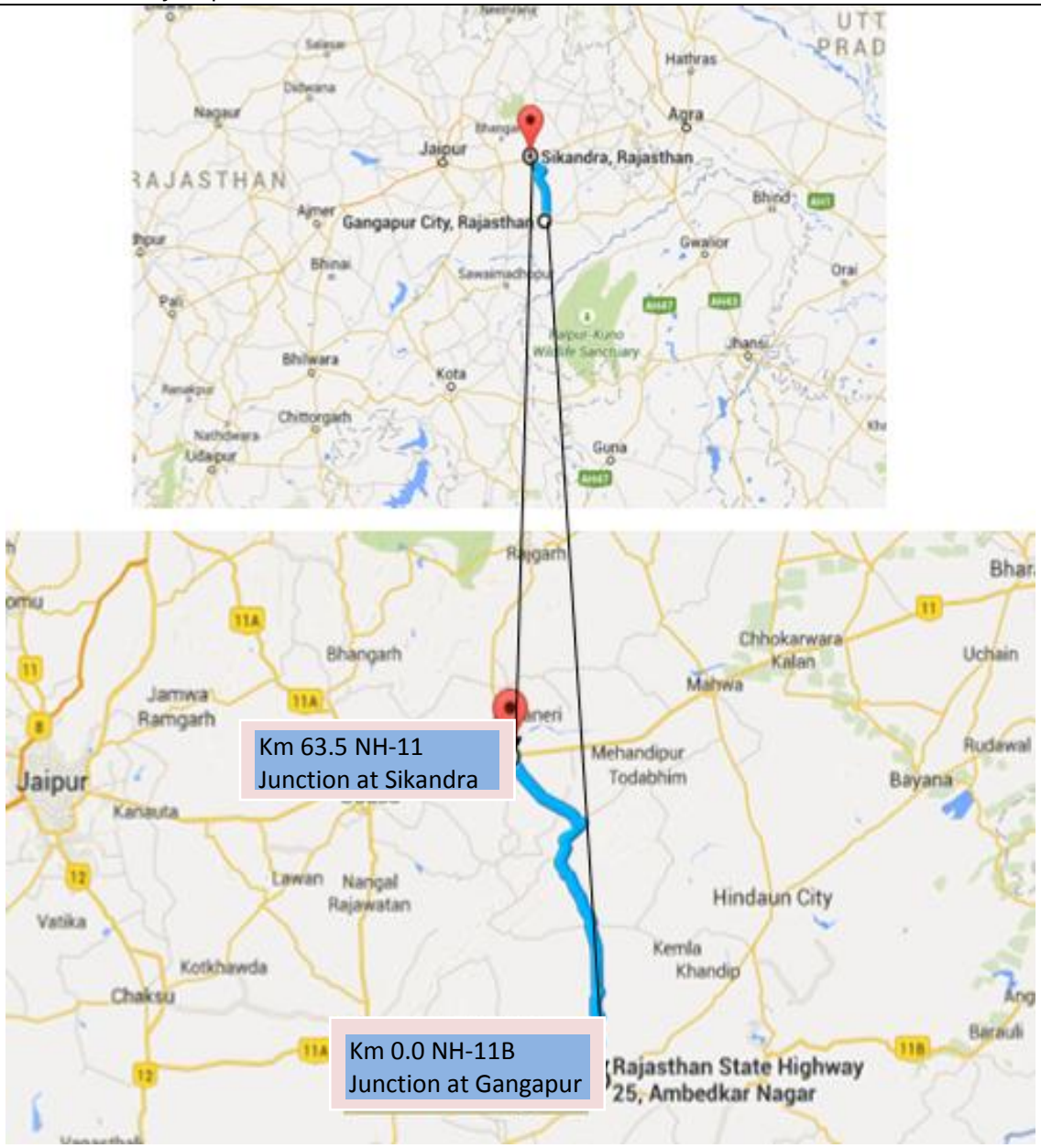
Highway - 2	Sikandra to Gangapur	63.5
Highway - 3	Dholpur to Rajakhera (Border)	45.0
Highway - 4	Mahwa to Govindgarh	65.0
Total =		211.0

This report details the findings of feasibility study of the following road grouped under package-13. Project road lies under Sawai Madhopur, Karauli and Dausa districts

Project Road Considered for Study

Highway No	Description of Road	Length (Km)
Highway - 1	Gangapur to Sikandra	63.5

Figure 1-1: Location Map of Project Road



1.3. Objectives of the Feasibility Study

The main objective of the Consultancy services is to establish the technical and financial viability for the selected project roads.

The objective of this consultancy is to undertake feasibility studies and prepare road specific feasibility Reports for all highways comprising the project for the purpose of firming up the Authority's requirements in respect of development and construction of the project and project facilities and enabling the prospective bidders to assess the Authority's requirements in a clear and predictable manner with a view to ensuring:

(i) enhanced safety and level of service for the road users;

(ii) superior operation and maintenance enabling enhanced operational efficiency of the Project;

(iii) minimal adverse impact on the local population and road users due to road construction;

(iv) minimal adverse impact on environment;

(v) minimal additional acquisition of land; and

(vi) phased development of the Project for improving its financial viability consistent with the need to minimise frequent inconvenience to traffic that may be caused if additional works are undertaken within a period of seven years from the commencement of construction of the Project.

1.4. Scope of Work

Scope of Services According to the Terms of Reference of the Study, the consultancy is to cover the following

- Feasibility Study;
- Bidding documents on commercial format

1.4.1. Feasibility Study

Following surveys, investigations and design activities are envisaged during the of the feasibility study

- Traffic surveys
- Axle load survey
- Pavement Invesigations
- Sub-soil investigation along the alignment for the road as well as the bridge.
- Detailed soil and material survey for the purpose of pavement design and for ascertaining the suitability of road construction material.
- Preliminary designs and cost estimates for different alternatives
- Environmental and Social impact assessment of all alternatives.
- Selection of best alternative for the pavement as well as the bridge
- Economic analysis and financial viability of the project on commercial format

1.4.2. Bidding documents on commercial format (PPP)

Following activities are envisaged during the of the Bidding Docs finalisation

- Preparation of indicative BOQ, rate analysis & cost estimates.
- Preparation of Schedules A, B, C, D, R and H of Concession Agreement

1.5. Progress to-Date

This section summarizes the work that has been carried out to-date. Analysis of the data already collected is in hand and it is not considered relevant to this Feasibility Report to provide details of this analysis since this report focuses on the detailed methodology and work program for the study. However where the data collected is relevant to the detailed methodology the information is presented in the following section.

1.6. Staff Mobilization

Following the Agreement dated 22/05/2015, the mobilization of Key Personnel is shown in the Staffing Schedule in Table 1-1.

Table 1-9: Mobilization Dates of Key Personnel

Name	Position	Mobilisation Date
Mr. T R Sharma	Senior Highway Engineer cum Team Leader	28/05/2015
Mr. H L Prakash	Traffic Cum Safety Expert	28/05/2015
Mr. Mahendra Raj Urs S K	Bridge Engineer	28/05/2015
Mr. John George	Surveyor	28/05/2015
Mr. Yogesh Kumar	Financial Analyst	28/05/2015
Mr. Devendra Goyal	Environmental Expert	28/05/2015
	Highway Design Engineer	03/06/2015
	Bridge Engineer	03/06/2015
	Pavement cum Material Engineer	03/06/2015
	Geo-technical Expert	03/06/2015
	Hydrologist	03/06/2015
	Environment analyst	03/06/2015
	Social Analyst	03/06/2015
	Quantity Engineer	03/06/2015
	Surveyor1	03/06/2015
	Surveyor2	03/06/2015
	Surveyor3	03/06/2015
	CAD Draughtman 1	03/06/2015
	CAD Draughtman 2	03/06/2015

1.7. Project Meeting

A meeting was held on 28/05/2015 between the Nodal officer and Consultant team to discuss the proposed methodology that is likely to be adopted for the project roads feasibility study analysis. The issues of suitable pavement treatment options and realistic unit costs to be adopted for analysis were discussed.

S No	Description of Events	Date
1	Mobilisation Meeting	28/05/2015
2	Project Site Visit (Surveys & Investigations) with Project Director	20/06/2015
3	Meeting & presentation to Superintending Engineer on supplementary Inception report	28/07/2015
4	Project Site Visit with Project Director for finalization of project proposal	13/08/2015

1.8. Feasibility Report Structure

Executive Summary

1. Project Background
2. Socio-Economic Profile
3. Design Standards
4. Inventory and Condition Surveys
5. Traffic Surveys
6. Engineering Surveys and Investigations
7. Preliminary Road Design
8. Preliminary Design of Structures
9. Cost Estimates
10. Economic and Financial Analysis
11. Discussions and Conclusions