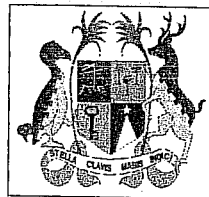


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**ROAD DEVELOPMENT AUTHORITY**

**UPGRADING OF**

**QUARTIER MILITAIRE**

**ROAD (B6)**

**FEASIBILITY STUDY**

**ENVIRONMENTAL IMPACT**

**ASSESSMENT REPORT**

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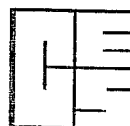
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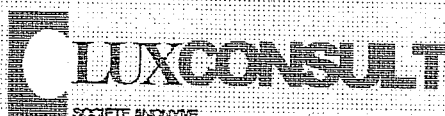
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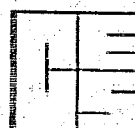
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## CHAPTER - 1

### INTRODUCTION

#### 1.1 BACKGROUND

- 1.1.1 A unique feature of Mauritius is that its road network is the only mode of transport for goods and people within the country. The road network, therefore, plays a key role in the economic growth of Mauritius. To keep pace with the economic progress made by the country, it has become imperative to improve the existing roads and construct new ones.

The Road Development Authority (RDA) of the Government of the Republic of Mauritius have initiated several measures in this direction. Upgrading of the existing B6 road, a 9 km stretch from Wooton Roundabout to Quartier Militaire is one such initiative.

The RDA have appointed Lux Consult, Mauritius to study the feasibility of upgrading/improving this road stretch. As part of this study, Environmental Impact Assessment (EIA) has been carried out with a view to identifying significant impacts and providing mitigation measures to eliminate or reduce the adverse impacts.

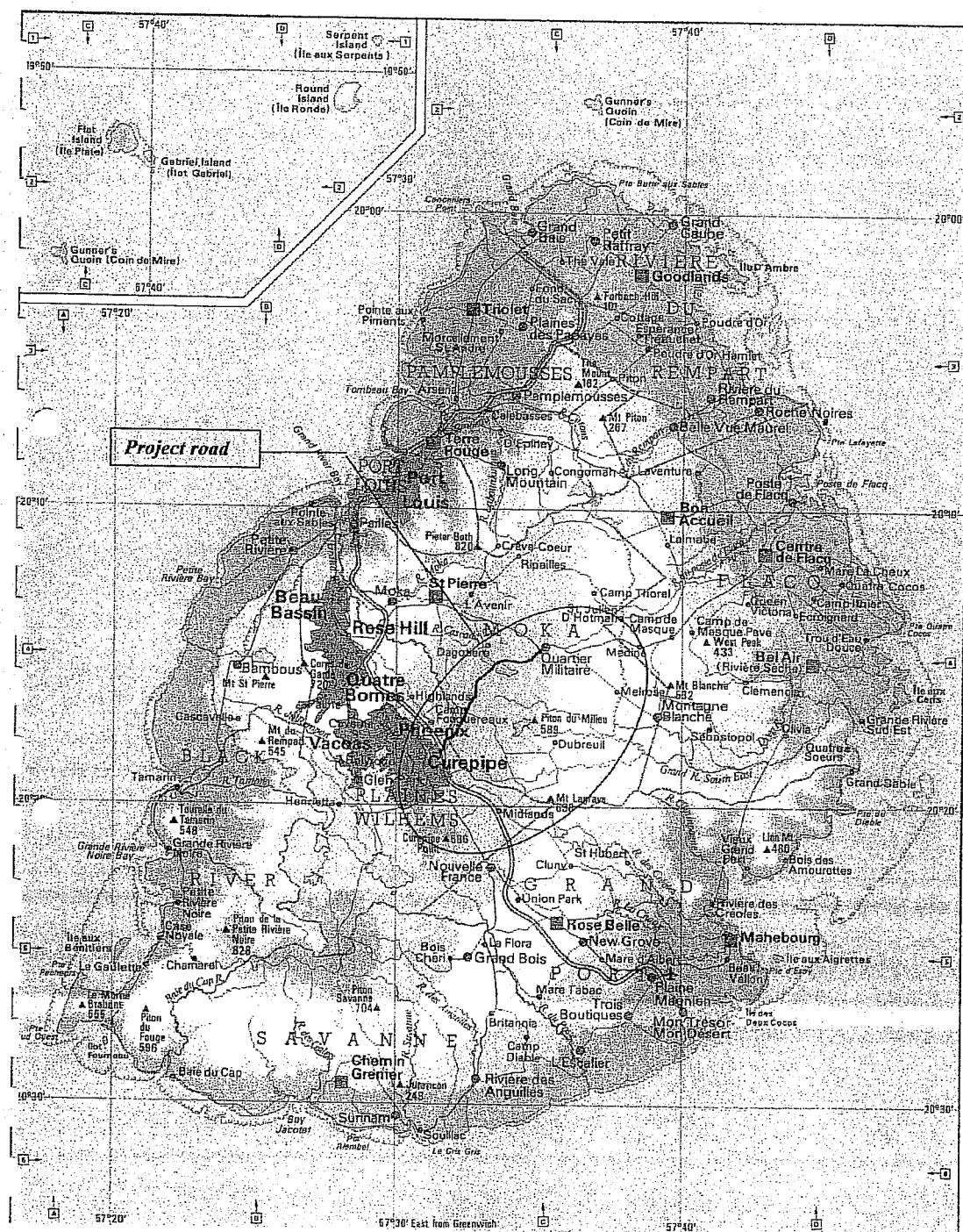
- 1.1.2 The project road is very important for the traffic in Moka District, particularly, Valetta and Quartier Militaire. At present, it is barely two-lane. At a number of places, the road condition is not good, there are several sharp bends and when there is heavy rain, water flows over the road in the low lying sections. With increased traffic, the road is deteriorating further. There is, therefore, urgent need to improve and upgrade the road keeping in view the present and projected traffic. The proposed improvement will have positive impact on the socio-economic scenario of this region.

An index map of the project road is given at *Fig. 1.1*.

#### 1.2 LEGAL FRAMEWORK

The First Schedule (Section 2) of EPA, 1991 lists undertakings requiring an Environmental Impact Assessment. The list includes transportation sector.

The RDA may, if necessary, submit the EIA Report and/or seek exemption under the relevant provisions of the Act.



**Fig. 1.1: Location of Project Road**

### 1.3 EIA METHODOLOGY

The environmental impact assessment has been carried out on the following lines:

- Field study of the proposed alignment and its surrounding areas.
- Study of the alignment on the topographical map of that area.
- Collection of secondary and primary data of relevant environmental parameters related to the area in particular and Mauritius in general.
- Identification of significant impacts, both positive and adverse.
- Mitigative measures for adverse impacts
- Management Plan for monitoring mitigative measures

### 1.4 REPORT STRUCTURE

The EIA Report is presented under the following chapters :

Chapter - 1	:	Introduction
Chapter - 2	:	Project Description
Chapter - 3	:	Existing Environment
Chapter - 4	:	Potential Impacts and Mitigative Measures
Chapter - 5	:	Environmental Management Plan

## CHAPTER - 2

### PROJECT DESCRIPTION

- 2.1 Quartier Militaire Road (B6) is a 9 km stretch linking Wooton Roundabout and Quartier Militaire. Like most other local road network, B6 has developed from existing sugar tracks, which have been widened and provided with a riding surface to cope with changing traffic volume and loads over the past decades. It is a major link between the Upper Plaines Wilhems, including the airport area, and the districts of Moka and Flacq, which are important manufacturing and touristic areas. The risks of accidents along B6 have increased on account of the low geometrical standard and inadequate road furniture.
- 2.2 In view of its strategic location, the rehabilitation of road B6 is expected to improve access to the eastern part and promote growth of economic activities in the region.
- 2.3 The rehabilitation and improvement of the existing road would entail localized improvements in the horizontal and longitudinal profile. It would be difficult to go for major modifications owing to constraints such as Rivulet Cascade, the reservoir near Valetta and inhabited areas in Quartier Militaire and Valetta. Possibilities have, however, been explored to bypass the inhabited areas.
- 2.4 Three alignment options have been considered for upgrading the existing road. In the Alternative 1, improvement of existing layout and longitudinal profile have been considered in the rural stretches to improve the geometric standards for a design speed of 100 Km per hour. It also provides two bypasses at Valetta and Quartier Militaire for through traffic. The existing road sections in these two places, with minor improvements, will be used by local traffic.

In the second alternative, the improvements in rural areas will be same as in Alternative 1. But, instead of bypasses at Valetta and Quartier Militaire, full rehabilitation of the existing road will be carried out in these sections. This will, however, entail demolition of existing commercial and residential structures in Valetta.

The third alternative provides for the construction of two bypasses at Valetta and Quartier Militaire as in Alternative 1. The rest of the alignment follows the existing road, which is assumed to be widened and strengthened, except for a section of 850 m which is scheduled to be realigned at Couacaud (CH 0 + 700).

Cost-wise, the difference between the three options is marginal – Alternative 1 being marginally costlier. But, considering social factor and future traffic demand, the first alternative is preferred.



## CHAPTER - 3

### EXISTING ENVIRONMENT

#### 3.1 GEOLOGY

The project area mainly consists of doleritic basalts " Intermediate Lavas " and " Late Lavas ". They are light greyish in colour and have small phenocrysts of olivine scattered in the doleritic network of feldspars and pyroxenes. They are generally porous and vesicular with many cracks and fissures and have high permeability.

The lavas filled the old depressions and now cover almost 70 percent of the surface of the island. The central plateau and the plains are formed of this material. The flat topography contrasts greatly with the prominent hills of the old series.

#### 3.2 TOPOGRAPHY AND DRAINAGE

The project road passes through a flat terrain. There are a few low lying sections and there is a big reservoir close to the road in Valetta. Natural drainage is poor ; water-logging in the low lying areas is common during the rain.

#### 3.3 SOIL

The soils of Mauritius have developed from basic volcanic rocks, mostly olivine basaltic lavas or highly recirculated basaltic lavas, and are generally shallow, rocky and non-eroded. The agriculturally important soils fall into two main groups:

- a) The typical mature soil or latosols, where the basaltic lava rock has decomposed to such an extent that, leaving aside large boulders and stones, there are no undecomposed minerals in the soil complex.
- b) The typical immature soils, where minerals are still in the process of weathering. They are characterized by the presence of more or less high proportion of angular stones and gravel of vesicular lava.

Since rainfall is the dominant soil forming factor, the boundaries between the latosolic soils are diffuse. Natural fertility of the soils are low, as all of them need nitrogen, phosphate and potash before crops can be grown economically. The soils in the project area consist of upland humic soil, upland brown prairie soil and waterlogged soil.

The soils in Valetta particularly are hydromorphic soils under permanent waterlogging due to rainfall. They are strongly acidic with low exchangeable bases, and are of little agricultural importance because of their poor physical and chemical properties.

### **3.4 CLIMATE**

- 3.4.1 A highly persistent regime of easterlies flow over Mauritius. Average monthly mean wind speed varies from about 15 kmph in summer months to about 32 kmph in August. The wind near the surface is gusty in character. Local accelerations are there due to contours of the land. At mountain tops, the wind may be upto twice the speed in the plains.

Sea breeze flows along the surface in the day time and a return current from land to sea is established above 600 metres. After mid-night land breeze prevails and continues till mid-morning. The local wind is thus affected by the sea and land breeze effects and shows changes of direction with time in the day.

- 3.4.2 Seasonal variation in temperature ranges from 22° C to 28° C at Port Louis, and from 17° to 22° at Curepipe. Seasonal temperature variations are shown in Fig. 3.1.
- 3.4.3 The annual average rainfall in the east coast is around 1600 mm, rises to 4000 mm near the centre and falls gradually to about 900 mm at Medine. Fig. 3.2 shows average rainfall over Mauritius in the form of isohyets at 400 mm intervals.
- 3.4.4 Cyclones in the summer months of November to March are typically experienced in Mauritius and nearby regions. The strongest recorded gusts have been 280 kmph in February 1975.
- 3.4.5 Humidity is always fairly high. Mean relative humidity is about 80% in most places.

### 3.5 AIR QUALITY

3.5.1 Under the Environment Protection (Standards for Air) Regulations, 1998 (Government Notice No. 105 OF 1998), the national environmental standards for ambient air has been set out in its Second Schedule and is as follows :

**Table 3.1: Ambient Air Quality Standards**

Ambient Pollutant	Standard ( $\mu\text{g}/\text{m}^3$ ) Maximum	Averaging Time	Measurement Method
Total Suspended Particles	150	24 hours	Hi-Volume Sampler
	50	Annual Average	Hi-Volume Sampler
PM 10	100	24-hours	Hi-Volume Sampler
SO <sub>2</sub>	230	1-hour	Fluorescence SO <sub>2</sub> Analyzer
	200	24-hours	Fluorescence SO <sub>2</sub> Analyzer
	50	Annual Average	Colorimetry
NO <sub>2</sub>	200	24-hour	Sodium Arsenite Chemiluminescence
CO	25000	1-hour	Non-dispersive Infra red
	10000	8-hours	Photometry
Pb	1.5	3-month average	HVS with Atomic Absorption
O <sub>3</sub>	100	1-hour	Ozone Analyzer, Chemiluminescence

3.5.2 With effect from 1st January 2000 emission standards for vehicles have also been introduced in terms of carbon monoxide and hydrocarbon for petrol driven vehicles and in terms of smoke opacity for diesel vehicles. Mauritius is following EC and Japanese standards in this regard.

### 3.6 NOISE LEVEL

- 3.6.1 Standards of Noise Level given in the Environment Protection (Environmental Standards for Noise) Regulations 1997 (Government Notice No. 17 of 1997) are applicable to "industrial noise" i.e. noise generated by a factory and "neighbourhood noise" which is defined as noise other than (a) industrial noise, or (b) noise made by an aircraft, an animal or traffic. The Regulation does not mention about Ambient Noise Level for different areas such as residential, commercial, sensitive areas, etc.
- 3.6.2 Noise emission standards by vehicle types have, however, been specified. The maximum permissible limits range from 79 dB(A) for auto cycles to 92 dB(A) for Goods Vehicles and Buses exceeding 10,000 cc.
- 3.6.3 Ambient noise level was monitored at different locations along the alignment. The results are as under :

On Week-ends	Near the Wooton Roundabout	58 dB(A)
	Near Valetta	58 dB(A)
	Near Quartier Militaire	62 dB(A)
On Week Days	Near Wooton Roundabout	62 dB(A)
	Near Valetta	64 dB(A)
	Near Quartier Militaire	68 dB(A)

Noise levels have been recorded at a distance of about 10 metres from the edge of the road. All the readings are at about 1.50 metres above ground level.

### 3.7 FLORA & FAUNA

The road (B6) passes mostly through sugarcane fields. In the first three kilometres from Wooton Roundabout, there are matured trees on both sides. Similarly, at the Quartier Militaire end, one can see avenue trees. In the rest of the section, there is hardly any tree. No indigenous plant has been observed in the area. Since the area is dominated by sugarcane fields and human settlements, wild fauna are not seen here.

### 3.8 SURFACE WATER QUALITY

Surface water samples were collected from Valetta reservoir and Cascade rivulet. Results of analysis are summarized in the following table.

**Table 3.2: Surface Water Quality Analysis Results**

Parameters	Unit	Results	
		Valetta Reservoir	Cascade Rivulet
Colour	Pt	30.0	20.0
pH	-	7.46	7.27
Total Dissolved Solids	mg/l	69.0	78.0
Total Suspended Solids	mg/l	8.6	4.4
Total Alkalinity	mg/l	14.2	23.0
Ammonia	mg/l	0.4	0.3
Chloride	mg/l	13.8	15.5
Fluoride	mg/l	< 0.10	< 0.10
Nitrate	mg/l	0.50	0.97
Nitrite	mg/l	< 0.01	0.02
Reactive Phosphorus	mg/l	< 0.15	< 0.15
Silica	mg/l	5.84	11.15
Sulphate	mg/l	3.58	2.89
Copper	mg/l	< DL <sup>1</sup>	< DL <sup>1</sup>
Nickel	mg/l	< DL <sup>2</sup>	< DL <sup>2</sup>
Zinc	mg/l	< DL <sup>3</sup>	< DL <sup>3</sup>

<b>MICROBIOLOGICAL TEST</b>			
Total Coliform	MPM/100 ml	> 180	> 180
E-Coli	MPM/100 ml	Absent	Absent

Note: DL - Detection Limit  
DL<sup>1</sup> - 0.03 mg/l  
DL<sup>2</sup> - 0.10 mg/l  
DL<sup>3</sup> - 0.01 mg/l

With respect to drinking water standards of Mauritius, the parameters Colour, pH, Total Dissolved Solids, Chloride, Fluoride, Nitrate, Nitrite, Sulphate, Copper, Nickel and Zinc are within permissible limits. Coliform organisms, however, show results which are beyond permissible limit. Therefore, the water quality of Valetta Reservoir and Cascade Rivulet are not suitable for drinking purpose.

### **3.9 LAND USE AND HUMAN SETTLEMENTS**

As stated earlier, land on both sides of B6 is mostly used for sugarcane cultivation. Human settlements are mostly concentrated at Quartier Militaire and Valetta.

In terms of economic activities, a little over 50% of the workforce in Moka District are employed in manufacturing activities. Next in importance are trading, agriculture and community, social and personal services. A tabular presentation of employment figures in Moka district is given below:

**Table 3.3: Employment Figures of Moka District, March 1999**

Sector	Male	Female	Total
Agriculture	1,081	588	1,669
Manufacturing	4,672	4,746	9,418
Construction	288	7	295
Wholesale, Retail Trade, Hotels & Restaurants	1,345	547	1,892
Transport, Storage & Communication	268	53	321
Finance, Insurance, Real Estate & Business Services	203	67	270
Community, Social and Personal Services	2,329	1,561	3,890
Grand Total	10,186	7,567	17,755

*Source : Central Statistical Office, Port Louis, Mauritius*

## CHAPTER - 4

### POTENTIAL IMPACTS AND MITIGATION MEASURES

#### 4.1 OBJECTIVE

- 4.1.1 Upgrading the project road may have varying degrees of environmental impact. Impacts which would be more or less pronounced, have been identified and discussed here. These are broadly grouped in two categories -impacts in the construction phase and impacts in the operation phase. We may further state that only impacts specific to the project area have been identified. -

#### 4.2 CONSTRUCTION PHASE

- 4.2.1 Major impacts having adverse effect on the environment are:

- a) Air pollution due to smoke and dust particles from construction activities using equipment.
- b) Noise pollution from the equipment mainly.
- c) Problems in normal traffic movement due to temporary diversion.
- d) Dumping of excavated materials and wastes causing temporary blocking of land.
- e) Spoiling vegetation and land profiles in borrow areas.
- f) Causing water pollution while using water for construction and related activities.

All impacts are of temporary nature restricted to the construction period. Once it is over, these impacts will not be there.

#### 4.2.2 Soil and Surface Water Contamination

Any major contamination of soil and surface water by sewage is not envisaged, since the workers are expected to commute to the work place and hence need for workers' camp is obviated. However, temporary toilets are required to be provided for use during working hours. These are to be located at suitable places away from the water courses and cleaned and disinfected daily.

To avoid contamination due to dripping coolants and lubricants, these containers should be kept on hard surface, and the area should be cleaned regularly. The equipment are to be maintained properly to avoid leaking of oil and lubricant.



#### 4.2.3 Soil Entrainment in Water Courses

During stripping, cutting and filling of soil in the construction stage, it may be possible that chunks of soil may get inadvertently entrapped in the water courses nearby. Precautions may be taken to avoid dumping of soil and debris close to the water courses. Suitable site-specific precautionary measures may be taken while operating the earthmoving equipment near the waterbodies to prevent entrainment of soil in them.

#### 4.2.4 Reuse of Debris and Excavated Soil

The soil excavated and debris generated during construction would be utilized for backfilling and resurfacing of borrow areas, as far as possible. Residual materials may be deposited at identified dump sites.

#### 4.2.5 Types and extent of impacts discussed above are presented in Table 4.2 along with suitable mitigation measures.

#### 4.2.6 The proposed improvement in alignment is not expected to disfigure landscape by deep cuts, etc.

#### 4.2.7 The project road passes sugar cane fields, with some matured trees on the first three kilometres from Wooton roundabout. There are also some avenue trees on the approach to Belle Rive.

323 trees will have to be felled along the road to provide for the improvement works envisaged. The list is shown in Table 4.1.

**Table 4.1: Trees to be felled along project road**

Common Name	Scientific Name	Nos.
Bottle Brush	Metrosideros Excelsa	110
Sang Dragon	Pierocarpus Indica	13
Paper Bark	Melaleuca Stypheliodes	16
Pine	Pinus Sylvestris	63
Indian Almod Tree	Terminalia Catapa	16
Cypress	Cypressus Macrocarpa	10
Grande Feuille	Litsea Monopepela	30
Travellers Tree	Ravenalia Madagascariensis	20
Eucalyptus Rouge	Eucalyptus Robusta	20
Bois D'olive	Cassia Orientalis	13
Privet	Ligustrum Robustum	12

It will be necessary to arrange for the planting of at least 1300 trees to compensate for the loss of those listed in **Table 4.1**. This means four trees for every felled should be the norm for compensation. Such a norm is defensible on consideration of the environmental sensitivity of the island.

There should be a budgetary provision to cover the cost of planting the trees. This can be made in the form of a lump sum to be provided in the Bills of Quantities. This lump sum can subsequently be put at the disposal of the Forest Department for the nurturing and planting of trees under the contract. The Contractor for the works would incur all expenditure and be reimbursed at costs plus agreed overheads.

### **4.3 OPERATION PHASE**

#### **4.3.1 Positive Impact**

- a) Traffic movement will improve which will result in :
  - reduced travel time and vehicle operating cost
  - reduced fuel consumption
- b) Access to Moka and Flacq districts will improve which are important manufacturing and touristic areas. This will boost the economic activities in the region.
- c) Risks of accidents and safety hazard will reduce.
- d) Problems of waterlogging would be eliminated or substantially reduced with suitable improvement in road design and improved drainage system.
- e) Suitable avenue plantation and landscaping will improve visual and aesthetic quality.

#### **4.3.2 Adverse Impact: Significant adverse impacts have been identified as under:**

- a) Traffic, at reasonably high speed, will increase when the project becomes operational. This may cause severance to the present users who may need to cross the road. Suitable access may have to be provided for them.
- b) Air pollution is expected to increase. However:
  - Except for the summer months, the prevailing easterlies blow away the pollutants.
  - In the summer months, there is possibility of pollutants hanging in the air in the afternoon, particularly between 14:00 and 16:30 hours. But after sunset and right through the early morning, the cold air comes down and clears the polluting air.

Therefore, the possibility of air pollution and accumulation of pollutants in the ambient air are not there.

- Trees and plants on the roadsides will act as buffers to contain and marginalise the effects of pollutants in the air.
- Emission standards introduced for vehicles with respect to carbon monoxide and hydrocarbon will automatically reduce pollution levels.

Thus, the overall situation is positive so far as air pollution is concerned.

- c) Suitable warning signals and speed limits would be required to be displayed prominently at regular intervals to avoid accidents.

4.3.3 A tabular presentation of the impacts and mitigation measures is given in **Table 4.3**.

#### **4.4 AESTHETIC ENHANCEMENT**

Selective plantation of trees on both sides of the road would, not only mitigate air and noise pollution created by vehicular traffic, but would also, enhance the scenic beauty. A well thought out landscaping plan for the surrounding areas would significantly add to its aesthetic value.

#### **4.5 CONCLUSION**

- 4.5.1 The existing condition of road B6 is not suitable for the present and projected traffic - accident risk is high, there are several avoidable sharp bends, road surface and shoulders need improvement and at several places waterlogging is a problem. Upgrading of the road will lead to better traffic movement, reduced risk of accidents, avoidance of waterlogging, and will help in the economic growth of the region.

**Table 4.2: Construction Phase Impacts and Mitigative Measures**

SL No.	Impact	Cause of Impact	Nature of Impact	Degree of Impact	Mitigative Measures/Remarks
1	Air Pollution	Construction Activity and Equipment	Temporary Reversible	Medium	Water sprinkling for dust suppression. Proper equipment maintenance.
2	Noise Pollution	Construction Activity and Equipment	Temporary Reversible	Medium	Sound barriers. Earmuffs for workers.
3	Degrading Land Surface	Borrow Areas	Temporary Reversible	Medium	Backfilling, resurfacing, landscaping
4	Traffic Disruption	Temporary Traffic Diversion	Temporary Reversible	Mild	Proper signals
5	Dumps of Waste Material	Dumping During Construction	Temporary Reversible	Mild	Locate proper dumping sites. Use for backfilling borrow areas.
6	Water Pollution	Water Used During Construction	Temporary Reversible	Medium	Proper control & monitoring of water quality.
7.	Soil and water contamination – dropping of coolants, lubricants	Construction equipments and activity	Temporary Reversible	Mild	Storage oil and lubricant containers on hard surfaces. Proper maintenance and management of equipment. Regular cleaning up of oil facility areas.

**Table 4.2: Construction Phase Impacts and Mitigative Measures (contd.)**

Sl. No.	Impact	Cause of Impact	Nature of Impact	Degree of Impact	Mitigative Measures/Remarks
8.	Entrainment of soil into water courses	Stripping cutting filling operation	Temporary Reversible	Medium	Avoid dumping of soil & debris close to the water courses
9.	Cultural Heritage	Alignment location	No Impact	Nil	No heritage site in the vicinity. Hence, no impact envisaged
10.	Excavated soil dumps	Construction Operation	Temporary Reversible	Medium	Backfilling, resurfacing of borrow area

**Table 4.3: Operation Phase Impacts & Mitigative Measures**

Sl. No.	Impact	Cause of Impact	Nature of Impact	Degree of Impact	Mitigative Measures/ Remarks
1	Air Pollution	Vehicular Emission	Intermittent	Mild Impact	Roadside trees. Surface wind will disperse pollutants quickly.
2	Noise Pollution	Vehicular Movement	Intermittent	Mild Impact	Roadside trees
3	Severance	Vehicular Movement	Permanent	Strong	Access roads at suitable locations.
4	Felling of trees	Site Clearance	Permanent	Mild Impact	Planting of new trees

## **CHAPTER - 5**

### **ENVIRONMENTAL MANAGEMENT PLAN**

#### **5.1 OBJECTIVE**

- 5.1.1 An Environmental Management Plan (EMP) is generally required to help the project proponent to put in place a suitable mechanism to control or eliminate adverse impacts during construction and operation phases through effective monitoring and timely action.

#### **5.2 INSTITUTIONAL REQUIREMENTS**

- 5.2.1 Monitoring may be carried out by the RDA themselves or by an agency appointed by them. An indicative list of officials/agencies which may be involved could be:

- RDA designated Supervising Engineer
- Representative of the Department of Environment
- Construction Contractor
- Monitoring Agency
- Representative of the concerned District Council
- Representative of the Forest Department

#### **5.3 MONITORING AND REPORTING**

- 5.3.1 Monitoring and reporting requirements will include:

##### During Construction Phase

- Ambient air quality and noise levels
- Dumping Sites
- Borrow Areas
- Water Quality
- Traffic Diversion Problems

##### During Operation Phase

In this phase, monitoring and review may be carried out by the Department of Environment. Monitoring and review requirements may include :

- Air quality and noise level
- Waterlogging and embankment erosion
- Landscaping and environment enhancement

#### **5.4 BUDGET FOR EMP**

- 5.4.1 Budgetary provision is required to be made in the project cost for implementation of mitigative measures, as well as for monitoring and reporting during construction and operation phases. The amount to be provided may be worked out by the project proponent based on the proposed mitigative measures discussed in this report.



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