Initial Environmental Examination

January 2017

IND: Karnataka State Highways Improvement Project III

Bengaluri-Magadi-Kunigal (Annexures)

Prepared by Project Implementation Unit, KSHIP, Government of Karnataka for the Asian Development Bank

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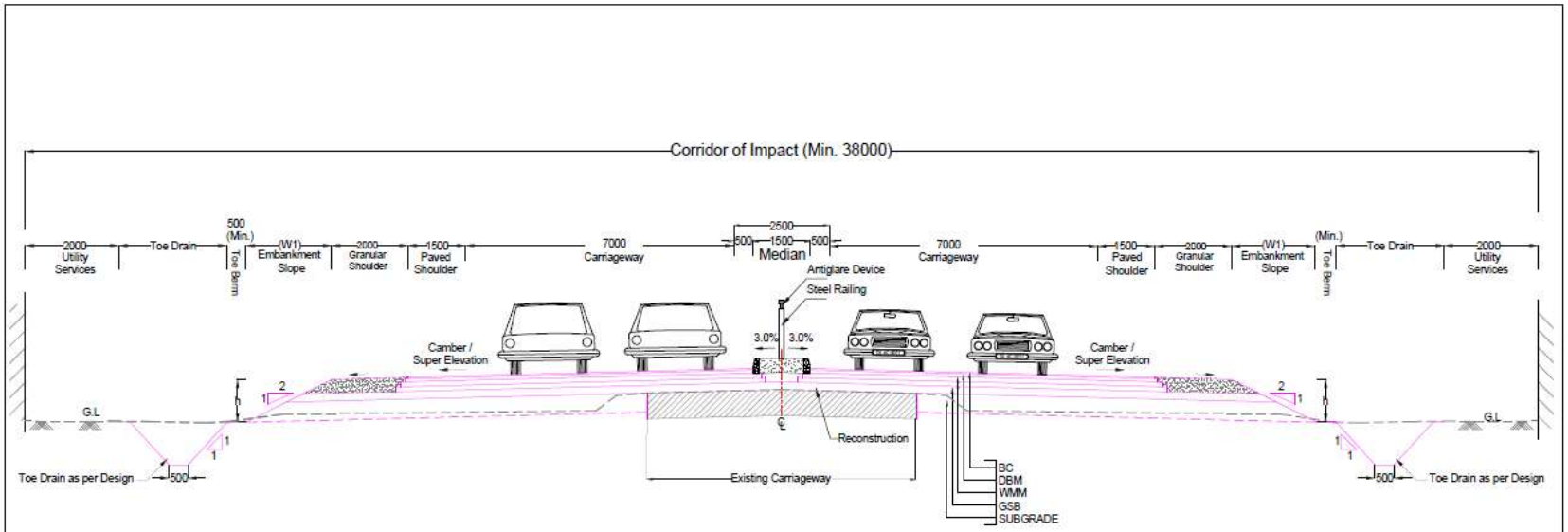
ANNEX 2.1 TYPICAL CROSS SECTIONS



TYPICAL CROSS SECTION FOR 4-LANE DIVIDED HIGHWAY WITHOUT SERVICE ROAD (OPEN COUNTRY)
TCS - 1 - CONCENTRIC WIDENING

APPLICABLE CHAINAGES

Sl. No.	Design Chainage (Km) From	To	Length (Km)	Sl. No.	Design Chainage (Km) From	To	Length (Km)
1	24+500	24+700	0.200	9	36+200	37+629	1.429
2	25+600	26+100	0.500	10	38+100	38+600	0.500
3	26+600	27+200	0.600	11	39+200	40+050	0.850
4	27+769	28+500	0.731	12	40+600	40+700	0.100
5	29+383	29+700	0.317	13	41+000	41+200	0.200
6	30+200	30+400	0.200	14	41+900	44+000	2.100
7	31+200	32+200	1.000	15	44+400	46+438	2.038
8	34+500	34+862	0.362	16	46+800	46+900	0.100

Sl. No.	Embankment Height 'h' (m)	Embankment Slope 'W1' (m)	COI Width (m)
1	1	2	38
2	2	4	42
3	3	6	46
4	4	8	48
5	5	10	52

Note:-
1. All Dimensions are in mm. unless otherwise specified.

CLIENT:- Government of Karnataka, Public Works, Ports & IWT Department, Karnataka State Highways Improvement Project

SCALE: NOT TO SCALE

PROJECT TITLE: Consultancy Services for Detailed Project Report cum Transaction Advisory Services for Karnataka State Highway Improvement Project-III (KSHIP-III) - (Group-II)

Draft Detailed Project Report (Bengaluru to Magadi) Typical Cross Section

CONSULTANT: Intercontinental Consultants & Technocrats Pvt.Ltd, A-8, Green Park, New Delhi - 110016 in joint venture with PricewaterhouseCoopers Pvt.Ltd 4th Floor, Tower - D, The Millenia, 1-2 Murphy Road, Ulsoor, Bangalore - 560 008 in association with Dhir & Dhir Associates (as Sub-Consultant) D-55, Defence Colony, New Delhi -110024

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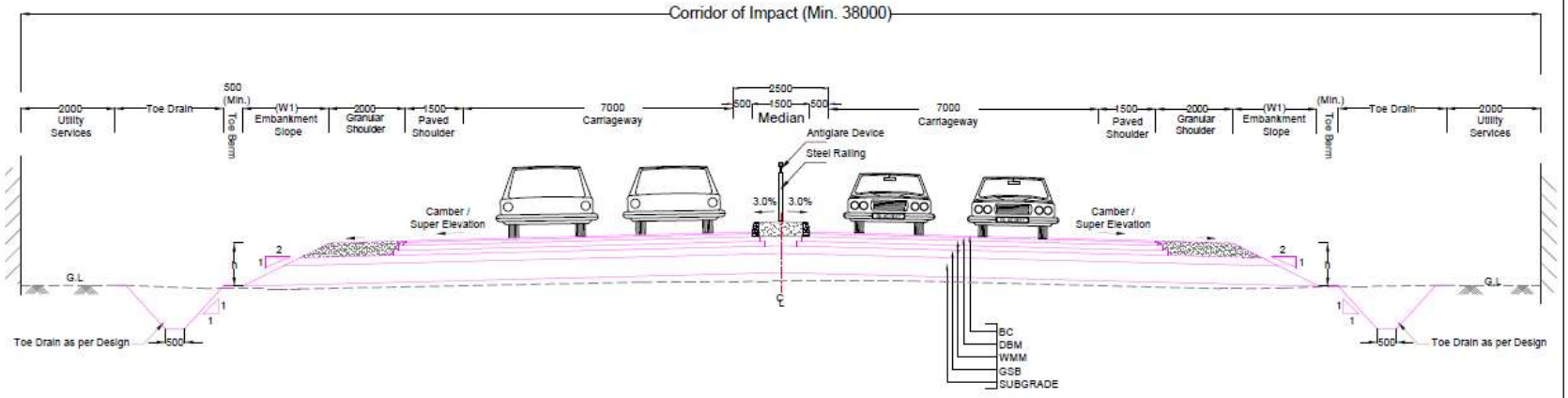

TYPICAL CROSS SECTION FOR 4-LANE DIVIDED HIGHWAY WITHOUT SERVICE ROAD (OPEN COUNTRY)
TCS - 2 - NEW CONSTRUCTION / REALIGNMENT

APPLICABLE CHAINAGES

Sl. No.	Design Chainage (Km) From	To	Length (Km.
1	24+700	25+600	0.900
2	27+200	27+769	0.569
3	28+500	29+383	0.883
4	29+700	29+900	0.200
5	30+400	31+200	0.800
6	33+383	34+100	0.717
7	34+862	35+100	0.238
8	37+629	38+100	0.471
9	40+050	40+600	0.550
10	40+700	41+000	0.300
11	41+400	41+900	0.500
12	44+000	44+400	0.400
13	46+438	46+800	0.362

Sl. No.	Embankment Height 'h' (m)	Embankment Slope 'W1' (m)	COI Width (m)
1	1	2	38
2	2	4	42
3	3	6	46
4	4	8	48
5	5	10	52

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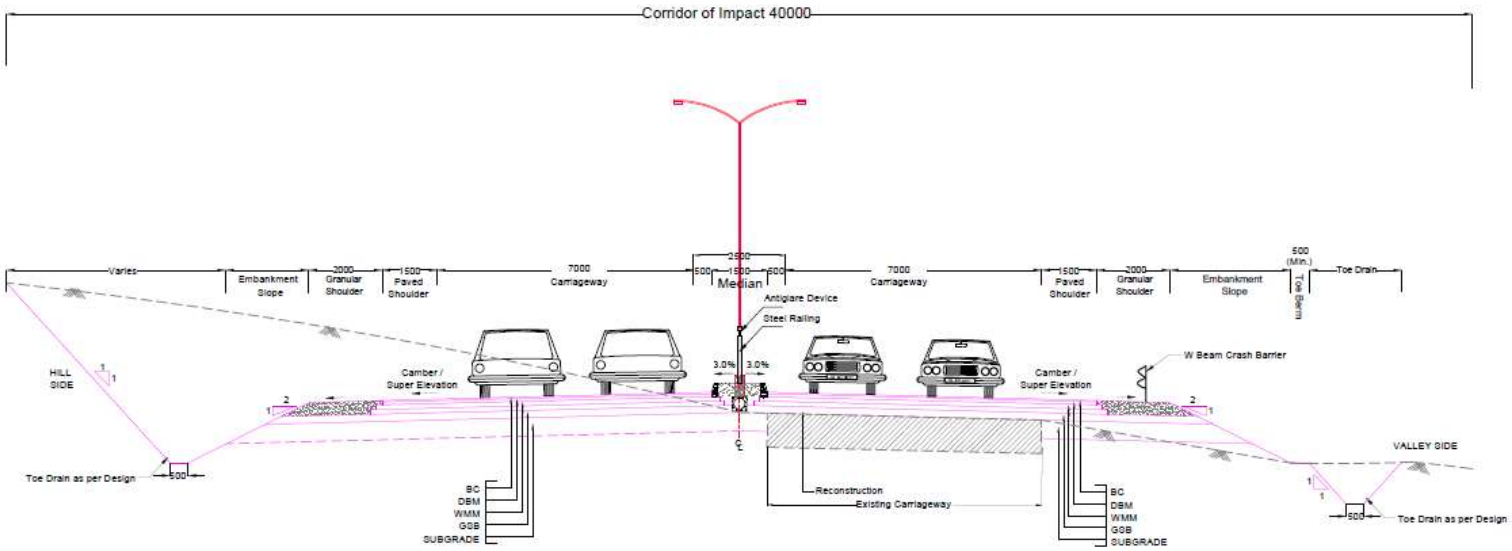

TYPICAL CROSS SECTION FOR 4-LANE DIVIDED HIGHWAY WITHOUT SERVICE ROAD (RURAL SECTION IN HILLY AREA)
TCS - 3 - ECCENTRIC WIDENING

APPLICABLE CHAINAGES

Sl. No.	Design Chainage (Km)		Length (Km)
	From	To	
1	32+560	33+383	0.823
2	35+460	35+850	0.390

Note:-
1. All Dimensions are in mm. unless otherwise specified.

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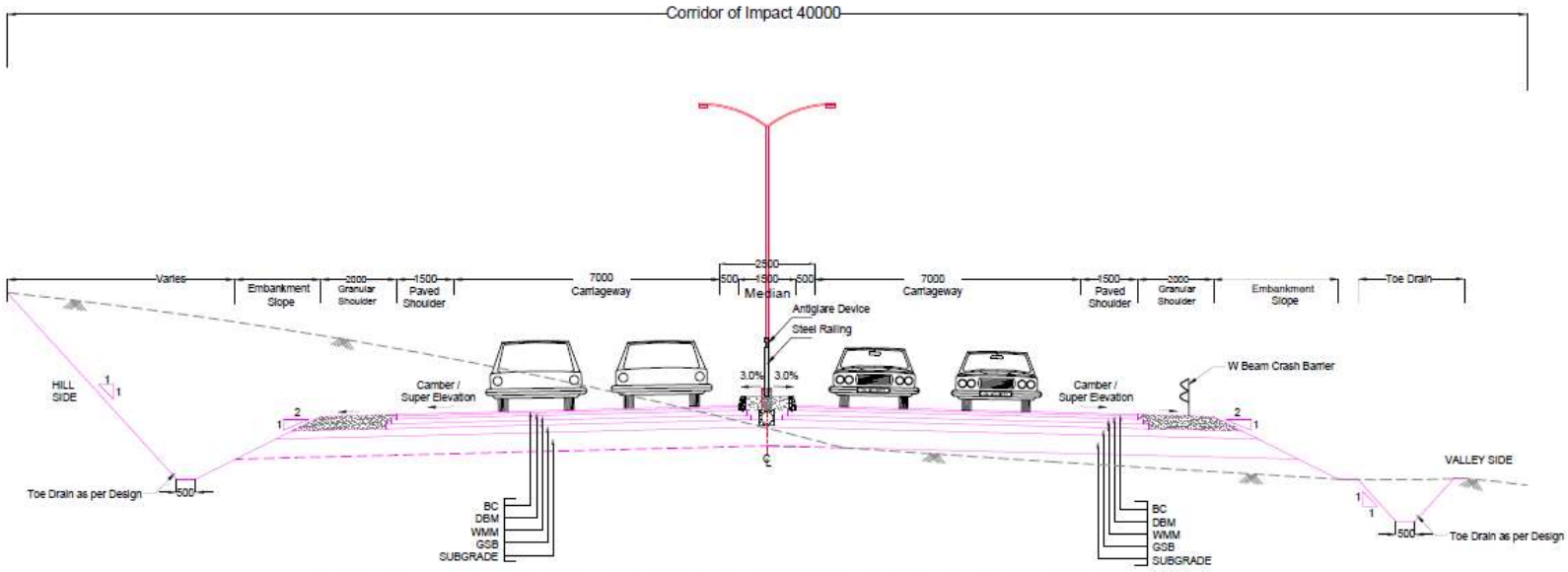

TYPICAL CROSS SECTION FOR 4-LANE DIVIDED HIGHWAY WITHOUT SERVICE ROAD (OPEN COUNTRY IN HILLY AREA)
TCS - 4 - NEW CONSTRUCTION / REALIGNMENT

APPLICABLE CHAINAGES

Sl. No.	Design Chainage (Km) From	To	Length (Km)
1	32+200	32+560	0.360
2	34+100	34+500	0.400
3	35+100	35+460	0.360

Note:-
1. All Dimensions are in mm. unless otherwise specified.

CLIENT:- Government of Karnataka, Public Works, Ports & IWT Department, Karnataka State Highways Improvement Project

SCALE: NOT TO SCALE

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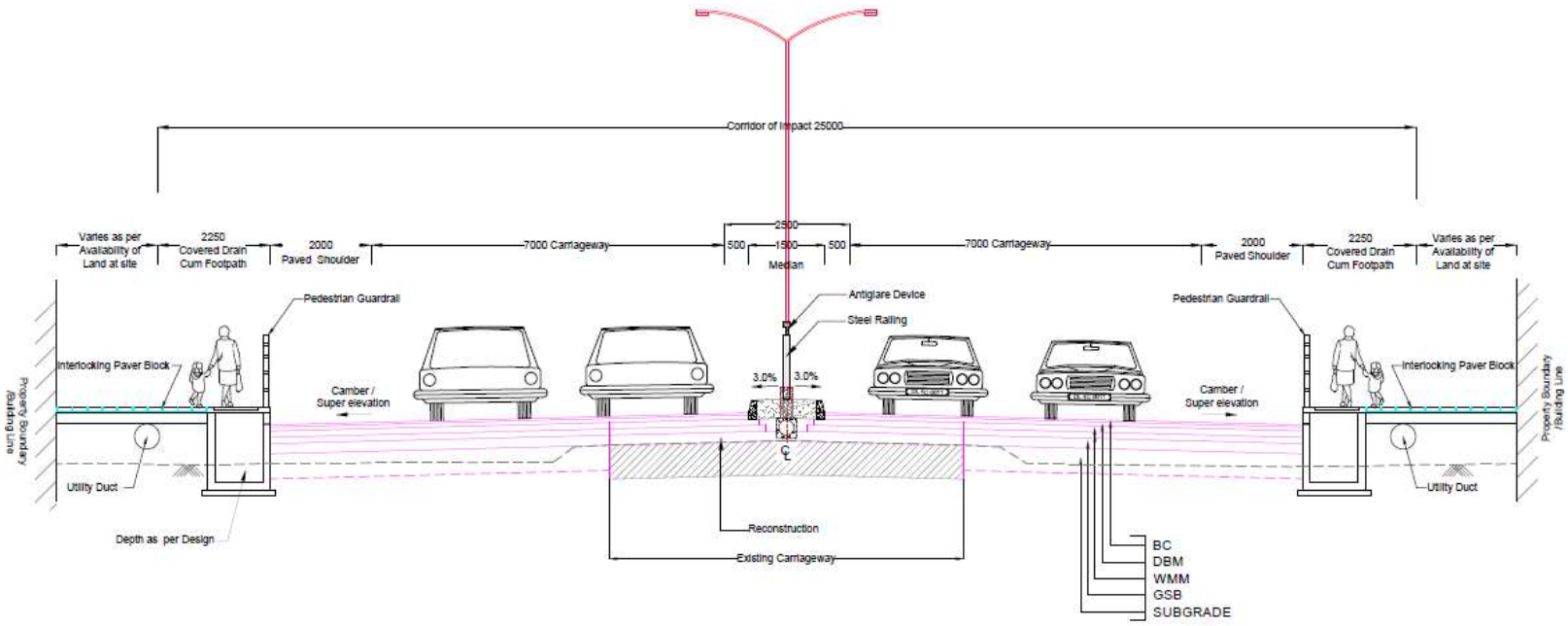

TYPICAL CROSS SECTION FOR 4-LANE DIVIDED HIGHWAY WITH PAVED SHOULDER WITHOUT SERVICE ROAD (BUILT-UP SECTION)
TCS - 5 - CONCENTRIC WIDENING

APPLICABLE CHAINAGES

Sl. No.	Design Chainage (Km) From	To	Length (Km)
1	15+325	23+200	7.875
2	26+100	26+600	0.500
3	30+031	30+200	0.169
4	35+850	36+200	0.350
5	38+600	39+200	0.600
6	41+200	41+400	0.200
7	46+900	51+000	4.100

Note:-
1. All Dimensions are in mm.

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SCALE: NOT TO SCALE

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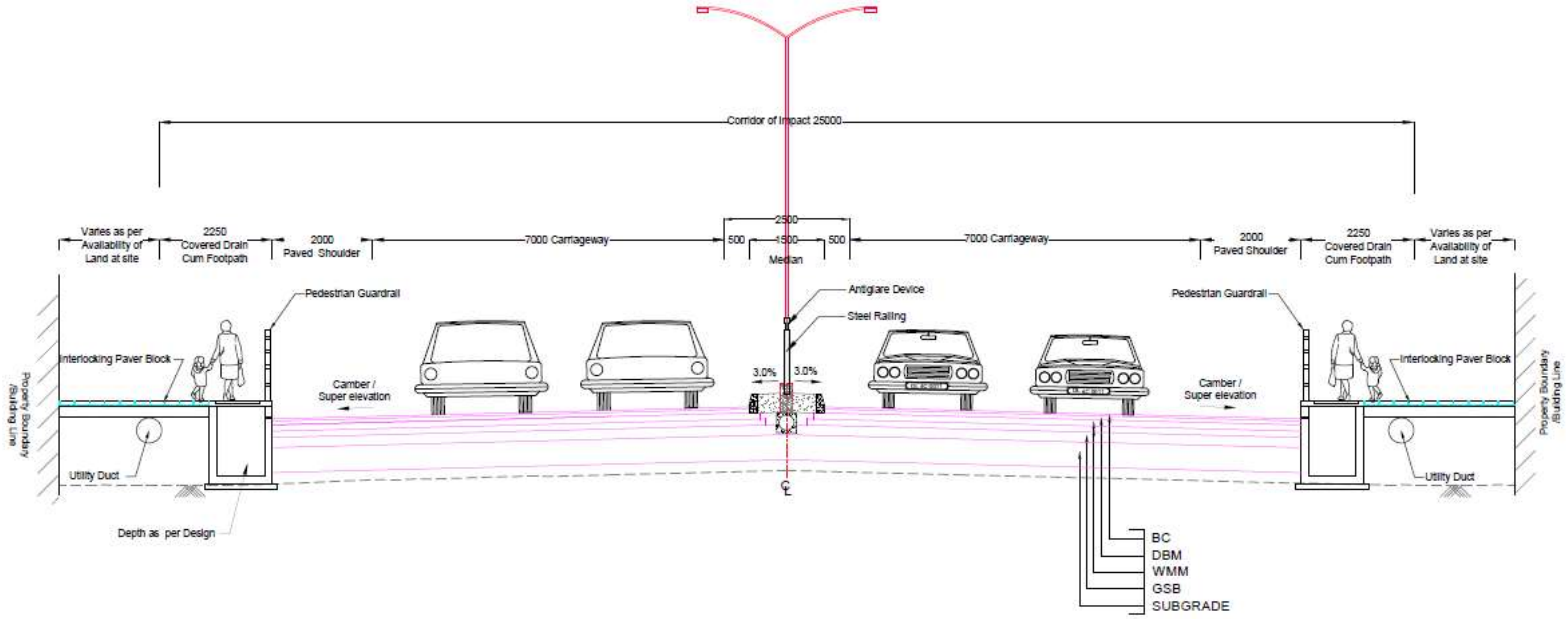

TYPICAL CROSS SECTION FOR 4-LANE DIVIDED HIGHWAY WITH PAVED SHOULDER WITHOUT SERVICE ROAD (BUILT-UP SECTION)
TCS - 6 - NEW CONSTRUCTION / REALIGNMENT

APPLICABLE CHAINAGES

Sl. No.	Design Chainage (Km)		Length (Km)
	From	To	
1	29+900	30+031	131

Note:-
1. All Dimensions are in mm.

CLIENT:- Government of Karnataka, Public Works, Ports & IWT Department, Kamataka State Highways Improvement Project

SCALE: NOT TO SCALE

PROJECT TITLE: Consultancy Services for Detailed Project Report cum Transaction Advisory Services for Karnataka State Highway Improvement Project-III (KSHIP-III) - (Group-II)

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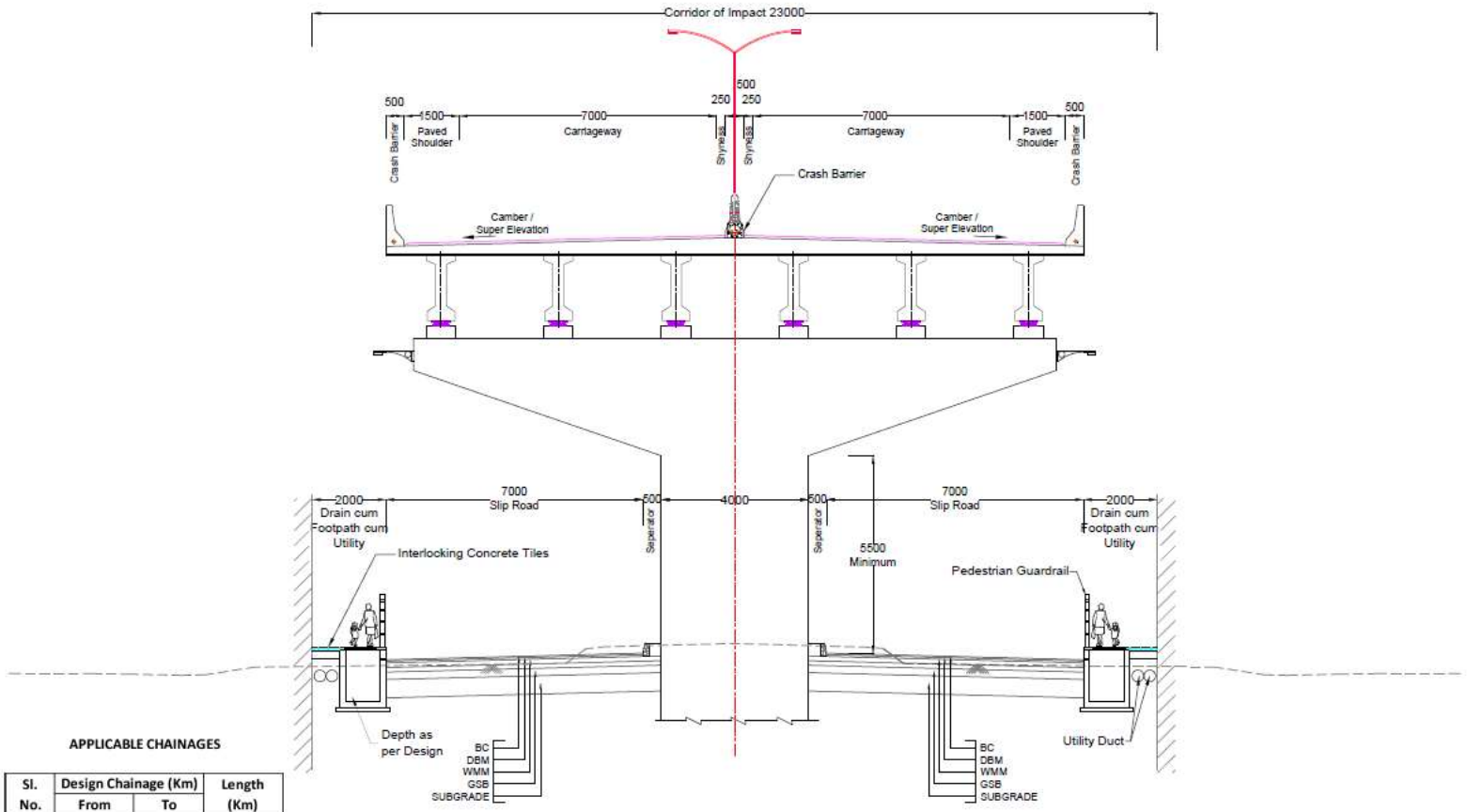

APPLICABLE CHAINAGES

Sl. No.	Design Chainage (Km)		Length (Km)
	From	To	
1	23+675	23+954	0.279

FOUR LANE DIVIDED ELEVATED ROAD WITH WIDE SLIP ROAD - BUILT-UP SECTION
TCS 7 - ELEVATED SECTION

Note:-
1. All Dimensions are in mm. unless otherwise specified.

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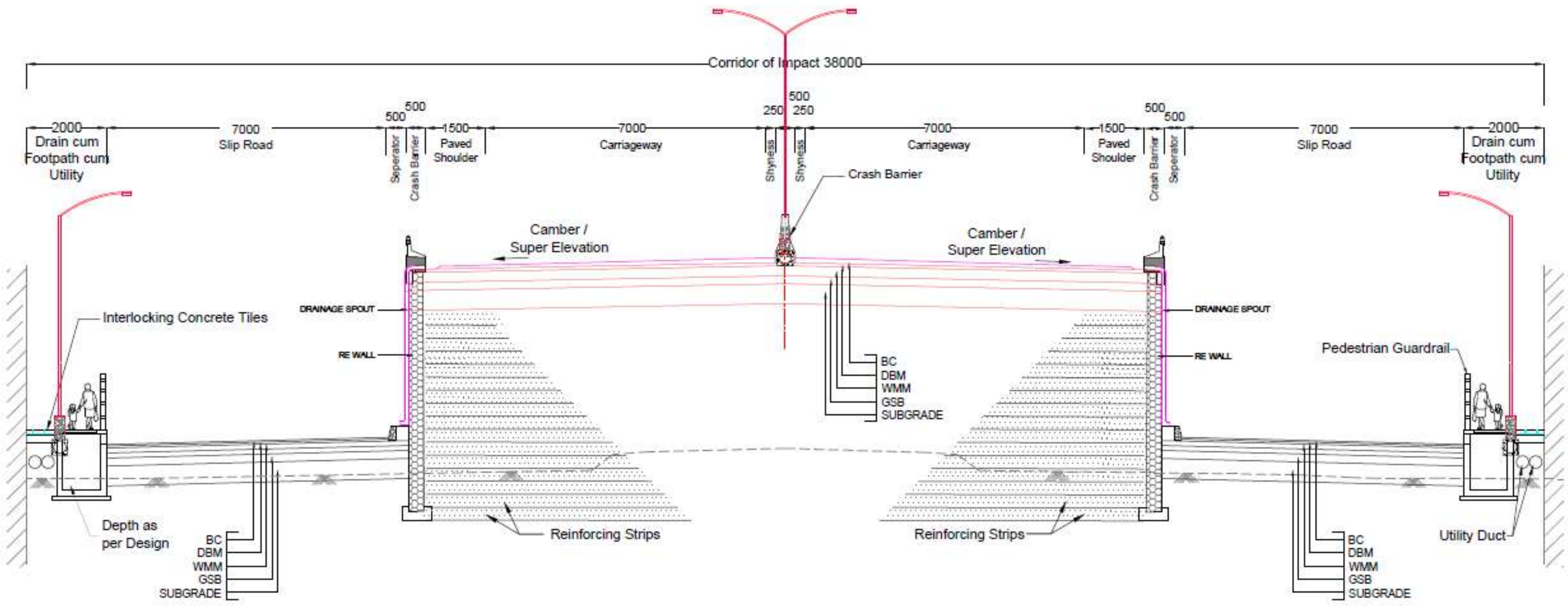

TYPICAL CROSS SECTION FOR 4-LANE DIVIDED FLYOVER APPROACHES WITH SLIP ROAD - BUILT-UP SECTION
TCS-8 - FLYOVER APPROACHES

APPLICABLE CHAINAGES

Sl. No.	Design Chainage (Km) From	Design Chainage (Km) To	Length (Km)
1	23+200	23+675	0.475
2	23+954	24+500	0.546

Note:-
1. All Dimensions are in mm. unless otherwise specified.

CLIENT:-	SCALE:	PROJECT TITLE:		CONSULTANT:
Government of Karnataka Public Works, Ports & IWT Department Karnataka State Highways Improvement Project	NOT TO SCALE	Consultancy Services for Detailed Project Report cum Transaction Advisory Services for Karnataka State Highway Improvement Project-III (KSHIP-III) - (Group-II)	Draft Detailed Project Report (Bengaluru to Magadi) Typical Cross Section	Intercontinental Consultants & Technocrats Pvt.Ltd, A-8, Green Park, New Delhi - 110016 in joint venture with PricewaterhouseCoopers Pvt.Ltd 4th Floor, Tower - D, The Millenia, 1-2 Murphy Road, Ulsoor, Bengalore - 560 008 in association with Dhir & Dhir Associates (as Sub-Consultant) D-55, Defence Colony, New Delhi -110024

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ANNEX 3.1 RELEVANT INDIAN STANDARDS

Table-A.3.1.1 National Ambient Air Quality Standards

[as per Environment (Protection) Rules, 1986]

Sl. No.	Pollutant	Time Weighted Average	Concentration in Ambient Air		
			Industrial, Residential, Rural and Other area	Ecologically Sensitive Area (notified by Central Govt.)	Methods of Measurements
1.	Sulphur Dioxide (SO_2) µg/m^3	Annual *	50	20	- Improved West & Gaeke
		24 hours**	80	80	- Ultraviolet fluorescence
2.	Nitrogen Dioxide (NO_2) µg/m^3	Annual *	40	30	- Modified Jacob & Hochheiser (Na-Arsenite)
		24 hours **	80	80	- Chemiluminescence
3.	Particulate Matter (size less than 10µm) or PM_{10} µg/m^3	Annual *	60	60	- Gravimetric - TOEM
		24 hours **	100	100	- Beta attenuation
4.	Particulate Matter (size less than 2.5µm) or $PM_{2.5}$ µg/m^3	Annual *	40	40	- Gravimetric - TOEM
		24 hours **	60	60	- Beta attenuation
5.	Carbon Monoxide(CO) mg/m^3	8 hours**	02	02	- Non Dispersive Infra Red (NDIR) Spectroscopy
		1 hour**	04	04	

* Annual arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24-hourly at uniform interval.

** 24-hourly or 8-hourly or 01 hourly monitored values as applicable, shall be complied with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days of monitoring.

Note: Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category, it shall be considered adequate reason to institute regular or continuous monitoring and further investigation.

Table-A.3.1.2 World Bank Guideline Values for Ambient Air Quality

Ambient Air Quality Parameter	Averaging Period	WB Guideline Value	
Sulfur dioxide (ug/m3)	24-hr	125	(Interim target)
		50	(Interim target)
		20	(guideline)
	10 min	500	(guideline)
	Annual	None	
Nitrogen dioxide	1 Year	40	(guideline)
	24 Hour	None	
	1 Hour	200	(guideline)
PM10	1 Year	70	(Interim target)
		50	(Interim target)
		30	(Interim target)
		20	(guideline)
	24-hr	150	(Interim target)

Ambient Air Quality Parameter	Averaging Period	WB Guideline Value	
		100	(Interim target)
		75	(Interim target)
		50	(guideline)
PM2.5 (ug/m3)	1 year	35	(Interim target)
		25	(Interim target)
		15	(Interim target)
		10	(guideline)
	24-Hour	75	(Interim target)
		50	(Interim target)
		37.5	(Interim target)
		25	(guideline)
Ozone (ug/m3)	8-hr daily max	160	(Interim target)
		100	(guideline)
Lead (Pb) (ug/m3)	Annual		
	24 hours		
Carbon Monoxide (CP) mg/m3	8 hours		
	1 Hour		
Ammonia (NH3) (ug/m3)	Annual		
	24 hours		

Table-A.3.1.3 Ambient Air Quality Standards in respect of Noise

[as per Noise Pollution (Regulation and Control) Rules, 2000]

Area Code	Category of Area	Limits in dB(A) L_{eq}*	
		Day Time	Night Time
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone	50	40

Notes:

1. Day time shall mean from 6.00 a.m. to 10.00 p.m.
2. Night time shall mean from 10.00 p.m. to 6.00 a.m.
3. Silence zone is defined as an area comprising not less than 100 metres around hospitals, educational institutions and courts. The silence zones are zones which are declared as such by the competent authority.
4. Mixed categories of areas may be declared as one of the four above mentioned categories by the competent authority.

* dB(A) L_{eq} denotes the time weighted average of the level of sound in decibels on scale A which is relatable to human hearing.

Table-A.3.1.4 World Bank Noise Guide Values

Receptor	World Bank	
	Day Time	Night Time
	7:00-22:00	22:00-7:00
Residential	55	45
Institutional; educational		
Industrial	70	70
Commercial		
Silence Zone	None	None

Table-A.3.1.5 Tolerance Limits for Inland Surface Waters (as per IS:2296)

SN	Parameter and Unit	Class-A	Class-B	Class-C	Class-D	Class-E
1.	Colour (Hazen Units)	10	300	300	-	-
2.	Odour	Unobject	-	-	-	-
3.	Taste	Tasteless	-	-	-	-
4.	pH (max) (min:6.5)	8.5	8.5	8.5	8.5	8.5
5.	Conductivity (25^{o}C) (μmhos/cm)	-	-	-	1000	2250
6.	DO (mg/L)(min)	6	5	4	4	-
7.	BOD (3 days at 27^{o}C) (mg/L)	2	3	3	-	-
8.	Total Coliforms (MPN/100 mL)	50	500	5000	-	-
9.	TDS (mg/L)	500	-	1500	-	2100
10.	Oil and Grease (mg/L)	-	-	0.1	0.1	-
11.	Mineral Oil (mg/L)	0.01	-	-	-	-
12.	Free Carbon Dioxide (mg/L CO_2)	-	-	-	6	-
13.	Free Ammonia (mg/L as N)	-	-	-	1.2	-
14.	Cyanide (mg/L as CN)	0.05	0.05	0.05	-	-
15.	Phenol (mg/L C_6H_5OH)	0.002	0.005	0.005	-	-
16.	Total Hardness (mg/L as $CaCO_3$)	300	-	-	-	-
17.	Chloride (mg/L as Cl)	250	-	600	-	600
18.	Sulphate (mg/L as SO_4)	400	-	400	-	1000
19.	Nitrate (mg/L as NO_3)	20	-	50	-	-
20.	Fluoride (mg/L as F)	1.5	1.5	1.5	-	-
21.	Calcium (mg/L as Ca)	80	-	-	-	-
22.	Magnesium (mg/L as Mg)	24.4	-	-	-	-
23.	Copper (mg/L as Cu)	1.5	-	1.5	-	-
24.	Iron (mg/L as Fe)	0.3	-	50	-	-
25.	Manganese (mg/L as Mn)	0.5	-	-	-	-
26.	Zinc (mg/L as Zn)	15	-	15	-	-
27.	Boron (mg/L as B)	-	-	-	-	2
28.	Barium (mg/L as Ba)	1	-	-	-	-
29.	Silver (mg/L as Ag)	0.05	-	-	-	-
30.	Arsenic (mg/L as As)	0.05	0.2	0.2	-	-
31.	Mercury (mg/L as Hg)	0.001	-	-	-	-
32.	Lead (mg/L as Pb)	0.1	-	0.1	-	-
33.	Cadmium (mg/L as Cd)	0.01	-	0.01	-	-
34.	Chromium (VI) (mg/L as Cr)	0.05	0.05	0.05	-	-
35.	Selenium (mg/L as Se)	0.01	-	0.05	-	-
36.	Anionic Detergents (mg/L MBAS)	0.2	1	1	-	-
37.	PAH (mg/L)	0.2	-	-	-	-
38.	Pesticides (μg/L)	Absent	-	-	-	-
39.	Insecticides (mg/L)	-	-	Absent	-	-
40.	Alpha Emitters (10^{-6}μc/mL)	0.001	0.001	0.001	0.001	0.001
41.	Beta Emitters (10^{-6}μc/mL)	0.01	0.01	0.01	0.01	0.01
42.	Percent Sodium (%)	-	-	-	-	60
43.	Sodium Absorption Ratio	-	-	-	-	26

Class-A: Drinking water source without conventional treatment but after disinfection.
Class-B: Outdoor bathing.
Class-C: Drinking water source with conventional treatment followed by disinfection.
Class-D: Fish culture and wild life propagation.
Class-E: Irrigation, industrial cooling and controlled waste disposal.

Table-A.3.1.6 Drinking Water Quality Standards (as per IS 10500:2012)

Sl. No.	Parameter and Unit	Acceptable Limit	Permissible Limit in Absence of Alternate Source
1.	pH	6.5-8.5	No relaxation
2.	Turbidity (NTU)	1	5
3.	TDS (mg/L)	500	2000
4.	Total Hardness (mg/L as $CaCO_3$)	200	600
5.	Total Alkalinity (mg/L as $CaCO_3$)	200	600
6.	Calcium (mg/L as Ca)	75	200
7.	Chloride (mg/L as Cl)	250	1000
8.	Fluoride (mg/L as F)	1	1.5
9.	Iron (mg/L as Fe)	0.3	No relaxation
10.	Magnesium (mg/L as Mg)	30	100
11.	Manganese (mg/L as Mn)	0.1	0.3
12.	Boron (mg/L as B)	0.5	1.0
13.	Nitrate (mg/L as NO_3)	45	No relaxation
14.	Sulphate (mg/L as SO_4)	200	400
15.	Zinc (mg/L as Zn)	5	15
16.	Cadmium (mg/L as Cd)	0.003	No relaxation
17.	Lead (mg/L as Pb)	0.01	No relaxation
18.	Mercury (mg/L as Hg)	0.001	No relaxation
19.	Copper (mg/L as Cu)	0.05	1.5
20.	Total Arsenic (mg/L as As)	0.01	0.05
21.	Total Chromium (mg/L as Cr)	0.05	No relaxation
22.	Total Coliforms (MPN/100 mL)	Nil	-

Table-A.3.1.7 General Standards for Discharge of Effluents

[as per Environment (Protection) Rules, 1986]

Sl. No.	Parameter and Unit	Inland Surface Water	Public Sewers	Land for Irrigation	Marine Coastal Water
1.	Temperature (^oC)	#	-	-	#
2.	Colour and Odour	$	-	$	$
3.	pH	5.5-9.0	5.5-9.0	5.5-9.0	5.5-9.0
4.	BOD (3 days at 27^oC) (mg/L)	30	350	100	100
5.	COD (mg/L)	250	-	-	250
6.	Bio-assey (% 96-hrs Survival)	@	@	@	@
7.	TSS (mg/L)	100	600	200	100*
8.	SS Particlesize(pass IS Sieve)	850	-	-	&
9.	Oil and Grease (mg/L)	10	20	10	20
10.	Total Residual Chlorine (mg/L)	1	-	-	1
11.	Nitrate Nitrogen (mg/L as N)	10	-	-	20
12.	Ammonia Nitrogen (mg/L N)	50	50	-	50
13.	Kjeldahl Nitrogen (mg/L as N)	100	-	-	100
14.	Free Ammonia (mg/L as N)	5	-	-	5
15.	Cyanide (mg/L as CN)	0.2	2	0.2	0.2
16.	Phenol (mg/L C_6H_5OH)	1	5	-	5
17.	Fluoride (mg/L as F)	2	15	-	15
18.	Sulphide (mg/L as S)	2	-	-	5
19.	Dissolved Phosphate (mg/L P)	5	-	-	-
20.	Copper (mg/L as Cu)	3	3	-	3
21.	Iron (mg/L as Fe)	3	3	-	3

Sl. No.	Parameter and Unit	Inland Surface Water	Public Sewers	Land for Irrigation	Marine Coastal Water
22.	Manganese (mg/L as Mn)	2	2	-	2
23.	Zinc (mg/L as Zn)	5	15	-	15
24.	Nickel (mg/L as Ni)	3	3	-	5
25.	Vanadium (mg/L as V)	0.2	0.2	-	0.2
26.	Arsenic (mg/L as As)	0.2	0.2	0.2	0.2
27.	Mercury (mg/L as Hg)	0.01	0.01	-	0.01
28.	Lead (mg/L as Pb)	0.1	1	-	1
29.	Cadmium (mg/L as Cd)	2	1	-	2
30.	Chromium (VI) (mg/L as Cr)	0.1	2	-	1
31.	Chromium (Total) (mg/L as Cr)	2	2	-	2
32.	Selenium (mg/L as Se)	0.05	0.05	-	0.05
33.	Alpha Emitters (10^{-6} µc/mL)	0.1	0.1	0.01	0.1
34.	Beta Emitters (10^{-6} µc/mL)	1	1	0.1	1

\# Shall not exceed 5°C above the receiving water temperature.
$ All efforts should be made to remove colour and unpleasant odour as far as practicable.
@ 90% survival of fish after 96 hours in 100% effluent.
* For cooling water effluent 10% above TSS of influent.
& (a) Floatable solids 3 mm, (b) Settleable solids 850 micron.

Table-A.3.1.8 Side-by-Side Comparison of GoI and WHO Drinking Water Standards and Guide Values

S. No.	Parameters	GoI Prescribed limits		Probable effects	World Health Organization Guide Values (2011)
		Desirable	Permissible		
1	COLOUR (HAZEN UNIT)	5	25	Aesthetically undesirable.	No Guideline
2	ODOUR	Essentially free		Aesthetically undesirable.	No Guideline
3	TASTE	Agreeable		Aesthetically undesirable.	No Guideline
4	TURBIDITY (NTU)	5	10	Indicates pollution/ contamination.	No Guideline
5	pH	6.5	8.5	Affects taste, corrodes supply system.	No Guideline
6	HARDNESS, as CaCO3, mg/l	300	600	Causes scaling, excessive soap consumption, calcification of arteries.	No Guideline
7	IRON, as Fe , mg/l	0.3	1	Causes staining of laundry and porcelain. In traces it is essential for nutrition.	No Guideline
8	CHLORIDE, as Cl , mg/l	250	1000	May be injurious to heart or kidney patients. Taste, indigestion, corrosion and palatability are affected.	No Guideline
9	RESIDUAL CHLORINE, only when Water is chlorinated	0.2	-	Excessive chlorination causes asthma, colitis and eczema	0.2
10	TOTAL DISSOLVED SOLIDS, mg/l	500	2000	May cause gastro-intestinal irritation, corrosion and laxative effect to new users.	No Guideline

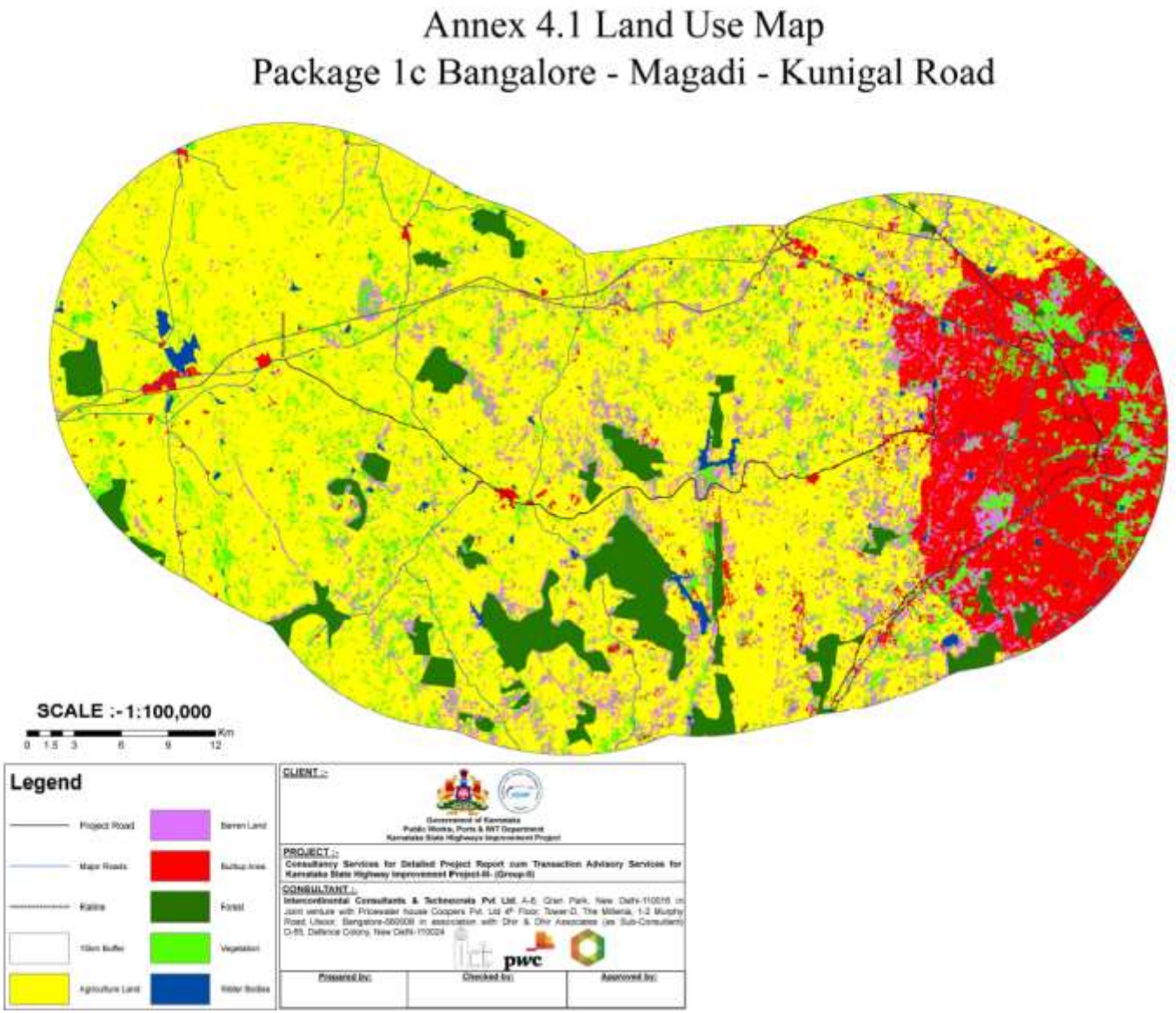
S. No.	Parameters	GoI Prescribed limits		Probable effects	World Health Organization Guide Values (2011)
		Desirable	Permissible		
11	CALCIUM, as Ca, mg/l	75	200	Excessive Cause incrustation, deficiency causes rickets, essential for nervous, muscular, cardiac functions and in coagulation of blood.	No Guideline
12	MAGNESIUM, as Mg, mg/l	30	100	Its salts are cathartics and diuretic. Excessive may cause laxative effect; deficiency causes structural and functional changes. It is activator of many enzyme systems.	No Guideline
13	COPPER, as Cu, mg/l	0.05	1.5	Beneficial in human metabolism, deficiency results in nutritional anaemia in infants. Large amounts may result in liver damage, causes central nervous system irritation and depression. Enhances corrosion of Al in water supply systems.	2
14	SULPHATE, as SO4, mg/l	200	400	Causes gastro-intestinal irritation. Along with Mg or Na can have a cathartic effect. Concentration more than 750 mg/l may have laxative effect.	No Guideline
15	NITRATE, as N, mg/l	45	100	Causes infant methaemoglobinaemia, at very high concentration causes gastric cancer and effects central nervous and cardiovascular system.	As NO3 = 50 mg/l; as NO2=3mg/l
16	FLUORIDE, as F, mg/l	1	1.5	Reduces dental carries, very high concentration may cause crippling skeletal fluorosis.	1.5
17	CADMIUM, as Cd, mg/l	0.01	No relaxation	Acute toxicity may be associated with renal, arterial hypertension, itai-itai (bone disease). Cd salts cause cramps, nausea, vomiting and diarrhoea.	0.003
18	LEAD, as Pb, mg/l	0.05	No relaxation	Burning in mouth, severe inflammation of gastro-intestinal tract with vomiting and diarrhoea. Chronic toxicity produces nausea, severe abdominal	0.01

S. No.	Parameters	GoI Prescribed limits		Probable effects	World Health Organization Guide Values (2011)
		Desirable	Permissible		
				pain, paralysis, mental confusion, visual disturbances, and anaemia etc.	
19	ZINC, as Zn , mg/l	5	15	Essential and beneficial in human metabolism. Imparts astringent taste to water.	No Guideline
20	CHROMIUM, as Cr, mg/l	0.05	No relaxation	Cr6+ produces lung tumours, coetaneous and nasal mucous membrane ulcers and dermatitis.	0.05
21	ARSENIC, as As, mg/l	0.05	No relaxation	Causes skin damage, circulatory problems, and increased risk of skin cancer.	0.01
22	ANTIMONY, as Sb, mg/l	0.006	No relaxation	Raises blood cholesterol, lowers blood sugar.	0.02
23	ALUMINIUM, as Al, mg/l	0.03	0.2	Leads to neurological disorders.	0.9
24	BARIUM, as Ba, mg/l	2	No relaxation	Increases blood pressure.	0.7
25	BERYLLIUM, as Be, mg/l	nil	0.0002	Is carcinogenic	No Guideline
26	CYANIDE, as CN, mg/l	0.05	No relaxation	Causes nerve damage, thyroid problem.	No Guideline
27	MERCURY, as Hg, mg/l	0.001	No relaxation	Neurological and renal disturbances. Excess causes gonadotoxic and mutagenic effects and disturbs the cholesterol metabolism.	0.006
28	MANGANESE, as Mn, mg/l	0.1	0.3	Essential as a cofactor in enzyme systems and metabolism processes. Excessive causes change in appetite and reduction in metabolism of iron to form haemoglobin. Imparts undesirable taste and stains plumbing fixtures and laundry.	No Guideline
29	SELENIUM, as Se, mg/l	0.01	No relaxation	Leads to hair, finger loss, and numbness in fingers or toes, circulatory problems.	0.04
30	BORON, as B, mg/l	1	5	Affects central nervous system, salts may cause nausea, cramps, convulsions, coma, etc.	2.4
31	ALKALINITY, as CaCO3, mg/l	200	600	Imparts unpleasant taste, deleterious to humans in presence of high pH,	No Guideline

S. No.	Parameters	GoI Prescribed limits		Probable effects	World Health Organization Guide Values (2011)
		Desirable	Permissible		
				hardness and TDS.	
32	PESTICIDES, ug/l	nil	0.001	Imparts toxicity, accumulates in different organs of body, and affects immune and nervous systems. Carcinogenic.	Alachlor 0.02; Aldicarb 0.01; Aldrin and dieldrin 0.000 03; Atrazine and its chloro-striazine metabolites 0.1; Carbofuran 0.007; Chlordane 0.000 2; Chlorotoluron 0.03; Chlorpyrifos 0.03; Cyanazine 0.000 6; 2,4-Db 0.03; 2,4-DBc 0.09; 1,2-Dibromo-3-chloropropane 0.001; 1,2-Dibromoethane 0.4a 0.000 4; 1,2-Dichloropropane 0.04; 1,3-Dichloropropene 0.02; Dichlorprop 0.1; Dimethoate 0.006; Endrin 0.000 6; Fenoprop 0.009; Hydroxyatrazine 0.2; Atrazine metabolite Isoproturon 0.009; Lindane 0.002; MCPAd 0.002; Mecoprop 0.01; Methoxychlor 0.02; Metolachlor 0.01
33	PHOSPHATE, as PO4, mg/l	No guideline		High concentration causes vomiting and diarrhoea stimulates secondary hyperthyroidism and bone loss.	No Guideline
34	SODIUM, as Na, mg/l	No guideline		Harmful to persons suffering from cardiac, renal and circulatory diseases.	No Guideline
35	POTASSIUM, as K, mg/l	No guideline		Essential nutrition element but excessive amounts are cathartic.	No Guideline
36	NICKEL, as Ni , mg/l	No guideline		Non-toxic element but may be carcinogenic in animals, can react with DNA resulting in DNA damage in animals.	0.07
37	PATHOGENS a)TOTAL COLIFORM No/dl b)FAECAL	1	10	Causes water borne diseases like coliform jaundice; Typhoid, Cholera etc. produces infections involving skin mucous membrane of eyes, ears	E. coli no detection in any 100 ml sample

S. No.	Parameters	GoI Prescribed limits		Probable effects	World Health Organization Guide Values (2011)
		Desirable	Permissible		
	COLIFORM No/dl			and throat.	
38	RADIOACTIVITY:			Increases risk of cancer.	Gross alpha activity > 0.5 Bq/li and gross beta activitry > 0.1 Bq/li concentrations of individual nucleotides should be determined and compared to below: Uranium-238, 10; Uranium-234 1; Thorium-230, 1; Radium-226, 1; Lead-210, 0.1; Polonium-210, 0.1; Thorium-232, 1; Radium-228, 0.1; Thorium-228, 1; Caesium-134d, 10; Caesium-137d 1.3 × 10−8 10; Strontium-90d, 10; Iodine-131d,e, 10; Tritiume 1.8, 10 000; Carbon-14, 100; Plutonium-239d, 1; Americium-241d, 1;
	-BETA PARTICLES	0-4 milligram/year			
	-ALPHA PARTICLES	0-15 picocuries/year			
	-RADIUM	0-05 picocuries/year			

ANNEX. 4.1 LAND USE MAP



ANNEX 4.2 TOPOGRAPHICAL SHEET SHOWING PROJECT ROAD ALIGNMENT

ANNEX 4.3 ON-SITE AIR QUALITY MONIROTING RESULTS

Table-A.4.3.1 On-Site Ambient Air Quality Monitoring Results

SN	Date	AAQMS Code	Location	PM10	PM2.5	SO_2	NO_2	CO
				($\mu g/m^3$)	($\mu g/m^3$)	($\mu g/m^3$)	($\mu g/m^3$)	(mg/m^3)
1.	08.12.2015	AQ1	Seegahali	68	14	9.2	24	0.54
2.	11.12.2015	AQ1	Seegahali	70	15	11.3	30	0.68
3.	15.12.2015	AQ1	Seegahali	66	13.5	9.4	27	0.70
4.	18.12.2015	AQ1	Seegahali	74	11.6	12.0	25	0.74
5.	22.12.2015	AQ2	Thaverekere	58	11.6	10.9	24	0.44
6.	25.12.2015	AQ2	Thaverekere	66	13.2	12.8	20	0.50
7.	29.12.2015	AQ2	Thaverekere	60	12.0	15.4	22	0.38
8.	01.01.2016	AQ2	Thaverekere	68	13.6	13.2	26	0.27
9.	09.12.2015	AQ3	Magadi	70	16	6.9	14	0.68
10.	12.12.2015	AQ3	Magadi	68	20	5.3	20	0.70
11.	16.12.2015	AQ3	Magadi	66	17	8.6	26	0.65
12.	19.12.2015	AQ3	Magadi	73	22	6.2	22	0.75
13.	23.12.2015	AQ3	Magadi	70	18	6.0	18	0.70
14.	26.12.2015	AQ3	Magadi	68	15	6.5	20	0.65
15.	30.12.2015	AQ3	Magadi	64	21	7.2	24	0.63
16.	02.01.2016	AQ3	Magadi	72	16	8.5	16	0.69

ANNEX 4.4 CHAINAGE WISE DETAILS OF EXISTING TREES

Table - A.4.4.1 Chainage wise Number of Existing Trees on LHS

Chainage		Side	No of Trees in Girth Class (in cm)					Total	Predominant Species Observed
From	To		<30	31-59	60-119	120-180	>180		
Bengaluru to Magadi (SH-85)									
15+325	16+000	LHS	0	10	17	15	3	45	Neem, Arjun
16+000	17+000	LHS	6	2	8	7	9	32	Gulad, Ashok, Banyan, Neem
17+000	18+000	LHS	2	5	1	2	10	20	Pipal, Banyan, Neem
18+000	19+000	LHS	8	2	1	4	4	19	Pipal, Banyan, Silver Oak
19+000	20+000	LHS	2	1	2	1	14	20	Karanj, Neem, Tamarind
20+000	21+000	LHS	4	2	2	3	21	32	Karanj, Cherry, Mango
21+000	22+000	LHS	5	8	0	1	4	18	Karanj, Cherry, Banyan, Tamarind
22+000	23+000	LHS	1	9	1	0	8	19	Mango, Neem, Silver Oak, Cherry
23+000	24+000	LHS	0	2	1	1	5	9	Neem, Banyan, Mango
24+000	25+000	LHS	1	0	0	3	12	16	Janun, Pipal
25+000	26+000	LHS	3	3	0	1	14	21	Pipal, Banyan, Mango. Karanj
26+000	27+000	LHS	4	5	2	4	8	23	Gulad, Jamun, Mango, Neem
27+000	28+000	LHS	1	2	3	2	16	24	Banyan, Jamun, Gulad, Arjun
28+000	29+000	LHS	1	4	4	4	8	21	Karanj, Neem, Gulad
29+000	30+000	LHS	2	0	0	1	1	4	Pipal
30+000	31+000	LHS	1	0	3	6	6	16	Pipal, Gulad, Neem
31+000	32+000	LHS	2	1	6	5	6	20	Gulad, Karanj, Arjun, Neem
32+000	33+000	LHS	2	1	0	0	0	3	Neem
33+000	34+000	LHS	0	1	1	2	0	4	Banyan
34+000	35+000	LHS	11	0	0	0	2	13	Banyan, Eucalyptus
35+000	36+000	LHS	0	4	1	2	4	11	Banyan, Gulad
36+000	37+000	LHS	5	4	1	4	8	22	Karanj, Gulad, Pipal
37+000	38+000	LHS	0	6	4	7	4	21	Banyan, Gulad
38+000	39+000	LHS	4	3	5	6	13	31	Gulad, Neem, Pipal
39+000	40+000	LHS	1	3	7	8	5	24	Neem, Arjun, Gulad
40+000	41+000	LHS	0	3	4	0	2	9	Karanj, Arjun
41+000	42+000	LHS	4	6	6	10	5	31	Gulad, Arjun, Neem, Tamarind
42+000	43+000	LHS	7	13	4	3	12	39	Pipal, Arjun, Karanj,
43+000	44+000	LHS	6	4	4	3	5	22	Arjun, Banyan, Jamun, Gulad
44+000	45+000	LHS	8	10	15	6	17	56	Arjun, Banyan, Gulad, Karanj
45+000	46+000	LHS	2	6	8	5	8	29	Pipal, Karanj, Gulad
46+000	47+000	LHS	9	13	15	4	2	43	Karanj, Arjun, Gulad
47+000	48+000	LHS	5	2	3	2	14	26	Pipal, Gulad
48+000	49+000	LHS	1	1	0	4	13	19	Gulad, Jamun,
49+000	50+000	LHS	12	2	0	1	3	18	Arjun, Neem, Karanj, Cherry
50+000	51+000	LHS	2	0	1	0	17	20	Cherry, Banyan, Pipal, Arjun
51+000	52+000	LHS	2	8	14	4	11	39	Arjun, Tamarind, Silver Oak, Neem
Magadi to Kunigal (MDR)									
00+000	01+000	LHS	13	9	4	1	7	34	Banyan, Tamarind, Honge, Jamun, Sirish
01+000	02+000	LHS	0	1	5	0	8	14	Banyan, Shishum, Mango
02+000	03+000	LHS	1	2	4	2	20	29	Banyan, Shishum, Mango

Chainage		Side	No of Trees in Girth Class (in cm)					Total	Predominant Species Observed
From	To		<30	31-59	60-119	120-180	>180		
03+000	04+000	LHS	0	0	0	0	16	16	Jamun, Sirish, Arjun, Mango, Banyan
04+000	05+000	LHS	0	0	0	0	16	16	Mango, Jamun, Banyan
05+000	06+000	LHS	1	10	0	0	2	13	Sirish, Tamarind, Rain tree
06+000	07+000	LHS	0	1	2	0	9	12	Sirish, Mango, Jamun, Gulmohar
07+000	08+000	LHS	0	4	3	0	8	15	Banyan, Honge
08+000	09+000	LHS	0	2	7	8	1	18	Banyan, Raintree, Sirish, Honge
09+000	10+000	LHS	1	2	12	5	11	31	Sirish, Nilgiri, Honge, Gulhad
10+000	11+000	LHS	0	0	5	0	4	9	Arjun, Honge, Jamun, Jalli
11+000	12+000	LHS	0	0	3	3	5	11	Pipal, Silver Oak, Tamarind
12+000	13+000	LHS	0	0	2	0	3	5	Banyan, Pipal
13+000	14+000	LHS	7	1	1	1	4	14	Gulmohar, Sirish, Pipal, Honge, Arjun
14+000	15+000	LHS	0	0	1	0	3	4	Pipal, Arjun, Banyan
15+000	16+000	LHS	3	3	1	0	1	8	Gulmohar, Sirish, Pipal
			26	**35**	**50**	**20**	**118**	**249**	

Table - A.4.4.2 Chainage wise Chainage wise Number of Existing Trees on RHS

Chainage		Side	No of Trees in Girth Class (in cm)					Total	Predominant Species Observed
From	To		<30	31-59	60-119	120-180	>180		
Bengaluru to Magadi (SH-85)									
15+325	16+000	RHS	1	4	3	2	5	15	Neem, Gulad, Ashok
16+000	17+000	RHS	5	8	1	0	3	17	Neem, Gulad, Ashok, Eucalyptus
17+000	18+000	RHS	2	2	4	0	7	15	Banyan, Eucalyptus
18+000	19+000	RHS	5	3	1	0	0	9	Neem,Eucalyptus
19+000	20+000	RHS	0	1	2	2	8	13	Neem, Gulad, Karanj
20+000	21+000	RHS	1	2	0	3	8	14	Tamarind, Neem, Gulad, Cherry
21+000	22+000	RHS	6	4	0	0	0	10	Banyan, Neem, Karanj
22+000	23+000	RHS	3	10	5	0	2	20	Tamarind, Mango, Cherry
23+000	24+000	RHS	3	2	1	1	2	9	Silver Oak, Neem, Banyan
24+000	25+000	RHS	4	0	1	2	2	9	Pipal, Tamarind
25+000	26+000	RHS	0	2	0	2	7	11	Gulad, Banyan, Tamarind, Karanj
26+000	27+000	RHS	3	5	4	2	8	22	Gulad, Banyan, Tamarind
27+000	28+000	RHS	0	1	4	2	4	11	Banyan, Jamun, Gulad, Arjun
28+000	29+000	RHS	4	6	3	1	0	14	Gulad, Karanj
29+000	30+000	RHS	3	5	3	0	0	11	Pipal
30+000	31+000	RHS	1	6	4	1	2	14	Ashok, Pipal, Neem
31+000	32+000	RHS	3	4	1	0	1	9	Neem, Mango, Gulad, Karanj
32+000	33+000	RHS	2	6	1	1	0	10	Neem, Mango
33+000	34+000	RHS	5	0	0	2	0	7	Ashok, Gulad
34+000	35+000	RHS	0	2	1	0	3	6	Ashok, Gulad
35+000	36+000	RHS	4	0	5	4	9	22	Gulad, Banyan, Tamarind
36+000	37+000	RHS	0	3	2	1	2	8	Karanj, Gulad, Pipal
37+000	38+000	RHS	5	9	2	2	1	19	Neem, Ashok, Gulad
38+000	39+000	RHS	2	17	5	4	0	28	Neem, Ashok, Gulad
39+000	40+000	RHS	1	2	4	2	7	16	Gulad
40+000	41+000	RHS	7	6	6	1	2	22	Gulad, Banyan, Neem
41+000	42+000	RHS	6	4	8	4	6	28	Gulad, Arjun, Neem, Tamarind
42+000	43+000	RHS	4	8	10	4	7	33	Tamarind, Neem, Banyan, Pipal
43+000	44+000	RHS	3	8	6	7	8	32	Banyan, Tamarind, Arjun
44+000	45+000	RHS	6	18	8	1	2	35	Banyan, Gulad
45+000	46+000	RHS	2	4	2	3	7	18	Gulad, Neem
46+000	47+000	RHS	4	11	10	2	1	28	Gulad, Neem
47+000	48+000	RHS	5	12	8	5	0	30	Gulad
48+000	49+000	RHS	2	1	6	8	10	27	Gulad, Neem
49+000	50+000	RHS	6	0	0	0	0	6	Pipal, Neem
50+000	51+000	RHS	0	6	8	8	10	32	Gulad, Pipal
51+000	52+000	RHS	6	15	22	7	5	55	Gulad, Pipal
Magadi to Kunigal (MDR)									
00+000	01+000	RHS	5	7	9	1	5	27	Banyan, Tamarind, Honge, Jamun, Sirish
01+000	02+000	RHS	4	5	2	0	9	20	Banyan, Shishum, Mango
02+000	03+000	RHS	6	7	0	3	8	24	Banyan, Shishum, Mango
03+000	04+000	RHS	4	5	1	1	6	17	Jamun, Sirish, Arjun, Mango, Banyan
04+000	05+000	RHS	0	5	0	8	1	14	Mango, Jamun, Banyan

Chainage		Side	No of Trees in Girth Class (in cm)					Total	Predominant Species Observed
From	To		<30	31-59	60-119	120-180	>180		
05+000	06+000	RHS	9	1	1	0	7	18	Sirish, Tamarind, Rain tree
06+000	07+000	RHS	3	6	2	0	7	18	Sirish, Mango, Jamun, Gulmohar
07+000	08+000	RHS	1	1	0	0	5	7	Banyan, Honge
08+000	09+000	RHS	0	0	0	0	1	1	Banyan, Raintree, Sirish, Honge
09+000	10+000	RHS	0	3	12	0	0	15	Sirish, Nilgiri, Honge, Gulhad
10+000	11+000	RHS	2	1	0	0	0	3	Arjun, Honge, Jamun, Jalli
11+000	12+000	RHS	1	0	0	0	1	2	Pipal, Silver Oak, Tamarind
12+000	13+000	RHS	0	0	0	0	0	0	Banyan, Pipal
13+000	14+000	RHS	5	7	1	0	0	13	Gulmohar, Sirish, Pipal, Honge, Arjun
14+000	15+000	RHS	2	3	3	0	0	8	Pipal, Arjun, Banyan
15+000	16+000	RHS	2	2	0	0	3	7	Gulmohar, Sirish, Pipal
			44	**53**	**31**	**13**	**53**	**194**	

Table - A.4.4.3 Total Number of Existing Trees

Side	No of Trees in Girth Class (in cm)					Total
	<30	31-59	60-119	120-180	>180	
RHS	158	250	182	97	192	**879**
LHS	150	181	194	151	412	**1,088**
	308	**431**	**376**	**248**	**604**	**1,967**

Table-A.4.4.4 List of Giant Tree along Bengaluru to Magadi

Sl. No.	Design Chainage	Side	Distance of Existing Centreline (m)	Species	Girth size (m)
1.	15+350	RHS	8.9	Mango	4.0
2.	15+545	RHS	8.7	Banyan	5.5
3.	15+560	RHS	8.4	Banyan	4.4
4.	15+650	RHS	8.6	Jamun	4
5.	16+040	LHS	8.5	Banyan	3
6.	16+200	LHS	8.6	Banyan	3.8
7.	16+680	RHS	8.7	Banyan	5.1
8.	16+760	LHS	9.5	Banyan	4.8
9.	16+770	LHS	8.5	Banyan	4.1
10.	17+000	RHS	8.6	Banyan	3.7
11.	17+990	LHS	8	Banyan	3.1
12.	17+075	RHS	9.2	Banyan	3.7
13.	17+125	RHS	8	Banyan	3.1
14.	17+178	LHS	9.6	Banyan	3.1
15.	17+340	LHS	10.5	Banyan	4.1
16.	17+560	LHS	9.6	Banyan	3.6
17.	17+630	RHS	9.5	Banyan	6-8.5
18.	17+850	LHS	9.3	Jamun	3.2
19.	17+910	LHS	5.6	peepal	3.5
20.	18+300	LHS	7	Tarmarind	3.1
21.	19+130	LHS	8.5	Jamun	3.5
22.	19+610	RHS	8.5	Jamun	3
23.	19+635	RHS	7.8	Neem	4.5
24.	19+670	RHS	9	Banyan	7.2

Sl. No.	Design Chainage	Side	Distance of Existing Centreline (m)	Species	Girth size (m)
25.	19+720	RHS	8	Neem	3.2
26.	19+750	RHS	8.4	Mango	3.2
27.	19+810	RHS	8.7	Banyan	8
28.	19+870	LHS	8.9	Jamun	3.2
29.	19+920	LHS	8.2	Banyan	5
30.	19+960	LHS	8.4	Jamun	3.7
31.	19+975	LHS	8.6	Banyan	10
32.	20+010	RHS	8.5	Jamun	4.3
33.	20+040	RHS	9.7	Jamun	3.6
34.	20+060	LHS	8.5	Jamun	3.2
35.	20+110	LHS	8.7	Jamun	3.2
36.	20+150	RHS	8.7	Banyan	3.9.5
37.	20+160	LHS	8.4	Jamun	3
38.	20+220	RHS	9.1	Jamun	3.4
39.	20+260	LHS	8.7	Mango	3.3
40.	20+500	LHS	8.5	Jamun	3.5
41.	20+540	LHS	8.7	Jamun	3.7
42.	20+700	RHS	8.9	Banyan	4.7
43.	20+770	RHS	12.5	Banyan	3.4
44.	20+850	LHS	8.5	Mango	5.4
45.	20+950	LHS	9.9	Banyan	6
46.	21+080	LHS	9.3	Banyan	5.9
47.	21+090	LHS	9.1	Banyan	8.1
48.	21+150	LHS	8.8	Banyan	5.3
49.	21+320	LHS	7.8	Tarmarind	3.9
50.	22+100	LHS	8.7	Mango	3.2
51.	22+360	LHS	8.6	Mango	4.5
52.	22+610	RHS	8	Tarmarind	3.5
53.	22+800	LHS	9.5	Jamun	4.2
54.	23+080	RHS	8.2	Tarmarind	3.6
55.	23+300	LHS	9.9	Banyan	5.4
56.	23+350	LHS	9.5	Mango	4.39
57.	24+320	LHS	7.1	Pipal	6.3
58.	24+360	LHS	9	Pipal	9.5
59.	24+480	LHS	9.2	Jamun	6.1
60.	24+490	LHS	7.4	Jamun	9.6
61.	24+550	LHS	9	Tarmarind	4.8
62.	24+860	LHS	11.5	Banyan	3.7
63.	24+900	RHS	8.2	Banyan	5.8
64.	24+950	RHS	7.9	Banyan	5.3
65.	25+000	RHS	11	Banyan	5.5
66.	25+050	RHS	9.3	Banyan	6
67.	25+100	RHS	7.8	Banyan	6.3
68.	25+200	LHS	8.4	Banyan	4.78
69.	25+200	RHS	9.9	Banyan	3.8
70.	25+205	LHS	8.3	Banyan	5.65
71.	25+250	RHS	6.3	Banyan	4.15
72.	25+260	LHS	5.6	Banyan	4.1
73.	25+265	LHS	10.1	Banyan	3.5
74.	25+280	LHS	9.5	Banyan	3.55
75.	25+300	LHS	11.5	Banyan	4.2
76.	25+750	LHS	12	Banyan	3.7

Sl. No.	Design Chainage	Side	Distance of Existing Centreline (m)	Species	Girth size (m)
77.	26+040	RHS	8.2	Banyan	5.5
78.	26+260	RHS	10.3	peepal	4.3
79.	26+270	LHS	80.5	Mango	3.55
80.	26+450	RHS	80.5	Pipal	5.1
81.	26+460	RHS	8.5	Mango	4.74
82.	26+560	LHS	9	Tarmarind	3.7
83.	26+850	RHS	10.2	Banyan	4.3
84.	26+900	LHS	9.8	Banyan	6.5
85.	26+975	LHS	9.9	Banyan	3.1
86.	27+100	RHS	8.1	Banyan	3.8
87.	27+165	LHS	11.8	Banyan	3.45
88.	27+180	LHS	11.9	Tarmarind	3.9
89.	27+210	LHS	9.8	Banyan	3.65
90.	27+630	RHS	18.5	Banyan	4.2
91.	27+780	LHS	8.7	Banyan	8
92.	27+850	RHS	8.4	Banyan	6.8
93.	28+600	LHS	7.4	Banyan	3.5
94.	30+000	RHS	8.5	Pipal	4.05
95.	30+180	LHS	11.5	Shirish	3.8
96.	31+150	LHS	6.2	Pipal	3.4
97.	31+210	LHS	8.3	Jackfruit	6.1
98.	35+060	RHS	7.4	Banyan	4.2
99.	35+500	RHS	7.7	Banyan	7
100.	35+580	RHS	7.1	Banyan	3.4
101.	35+630	RHS	8.5	Banyan	5.8
102.	35+650	RHS	7.8	Banyan	4.6
103.	35+680	LHS	8	Banyan	4.8
104.	35+690	RHS	7.7	Banyan	6
105.	35+760	LHS	9.5	Peepal	7.6
106.	36+020	RHS	8	Banyan	4
107.	36+025	LHS	8.4	Banyan	5.8
108.	36+920	LHS	7.1	Copper pod	3.2
109.	37+360	LHS	9.3	Banyan	10.15
110.	37+380	LHS	9.5	Banyan	15.2
111.	38+530	LHS	7.1	Arjun	3.4
112.	38+960	LHS	7.5	Shirish	4
113.	40+660	RHS	8	Banyan	4.2
114.	41+260	RHS	11	Peepal	7
115.	41+280	RHS	10.45	Peepal	6.1
116.	41+680	RHS	9.5	Banyan	3.8
117.	41+860	RHS	9.7	Banyan	3.5
118.	42+130	RHS	8.2	Banyan	4.45
119.	42+240	RHS	7.2	Banyan	4.1
120.	42+430	LHS	6.5	Neem	5.77
121.	42+530	LHS	6.3	Banyan	5.5
122.	42+790	LHS	7	Tarmarind	5
123.	42+840	RHS	6.8	Tarmarind	6.5
124.	42+870	LHS	7.2	Peepal	4
125.	42+940	LHS	8.9	Gulmohar	3.7
126.	42+960	RHS	5.6	Shirish	4.4
127.	42+980	RHS	9.4	Banyan	9.4
128.	43+030	RHS	9.7	Banyan	3.2

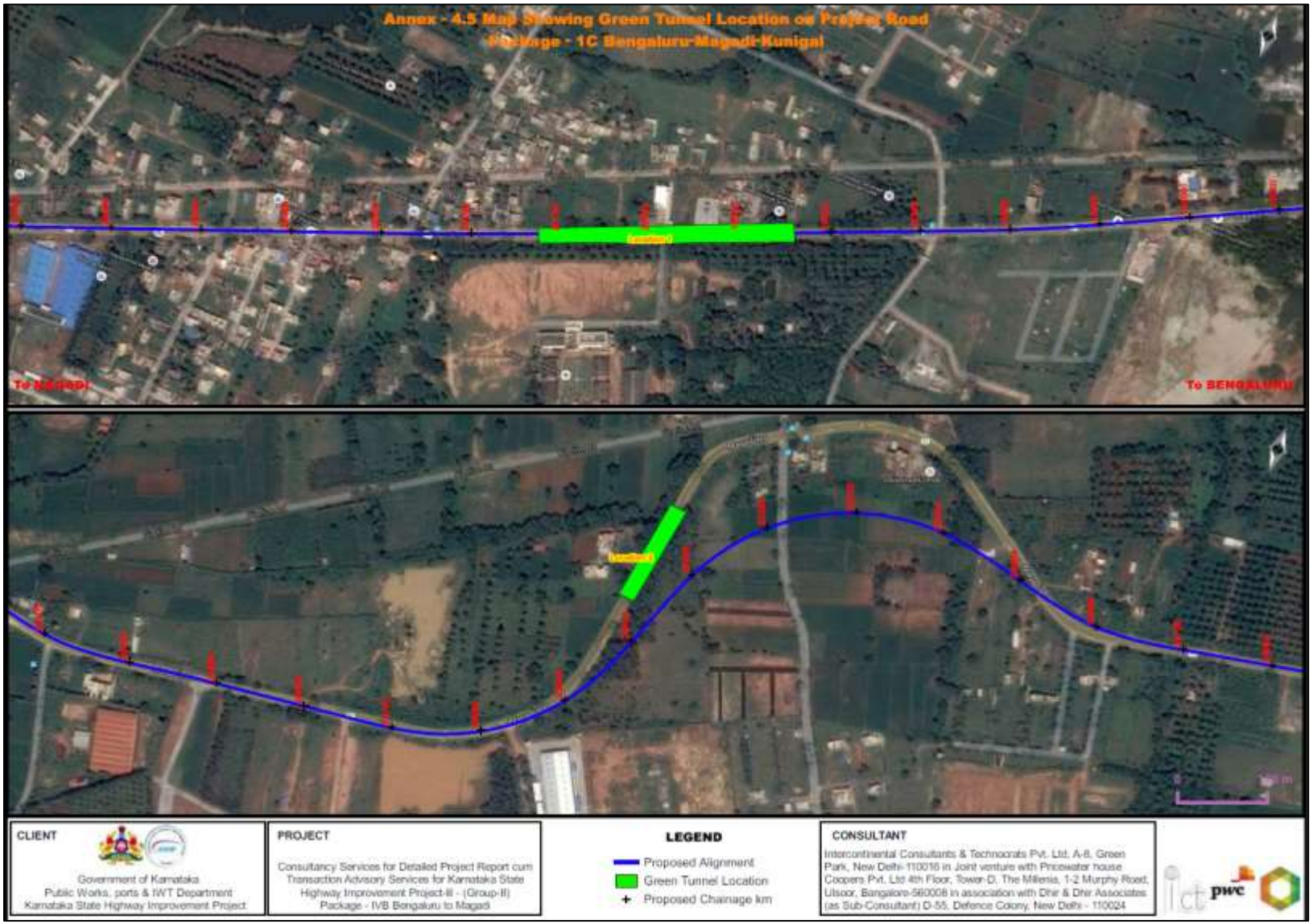
Sl. No.	Design Chainage	Side	Distance of Existing Centreline (m)	Species	Girth size (m)
129.	43+050	RHS	9.8	Banyan	3.6
130.	43+120	LHS	6.7	Banyan	7.4
131.	43+170	RHS	6.1	Peepal	4
132.	43+860	RHS	6.4	Banyan	6.8
133.	43+870	RHS	7	Banyan	6.3
134.	43+990	RHS	10	Banyan	3.6
135.	44+300	LHS	7.4	Banyan	5.8
136.	44+325	LHS	7.2	Banyan	4
137.	44+340	LHS	7.1	Banyan	4.3
138.	44+400	RHS	6.9	Banyan	5.8
139.	44+480	LHS	7	Banyan	8.35
140.	44+540	LHS	6.7	Pipal	6.8
141.	44+725	LHS	5.6	Pipal	6.3
142.	44+740	LHS	8.1	Pipal	4.3
143.	44+795	LHS	7.2	Pipal	7.5
144.	44+820	LHS	6.9	Pipal	15.2
145.	44+875	LHS	8.7	Pipal	6.3
146.	45+060	RHS	6.9	Pipal	3.8
147.	45+180	LHS	7.2	Pipal	3.3
148.	45+190	RHS	6.5	Pipal	3.1
149.	45+210	LHS	6.4	Pipal	3.7
150.	45+920	LHS	10	Pipal	3.3
151.	46+265	RHS	8.4	Pipal	4.7
152.	47+450	LHS	6.8	Pipal	6
153.	47+780	LHS	8.9	Pipal	4.8
154.	48+180	RHS	5	Shirish	3.1
155.	48+210	RHS	4.7	Gulmohar	4
156.	48+290	LHS	6.8	Shirish	3.2
157.	48+300	LHS	6.7	Shirish	9.2
158.	50+410	RHS	6.2	Banyan	3.4
159.	50+440	LHS	8.1	Banyan	5.4
160.	50+450	LHS	7.5	Banyan	3
161.	50+500	LHS	8.7	Banyan	5.7
162.	50+560	RHS	6.1	Banyan	5.5
163.	50+570	RHS	6.2	Banyan	5.1
164.	50+580	LHS	7.2	Banyan	5.5
165.	50+620	LHS	7.5	Banyan	6
166.	50+675	RHS	7.5	Banyan	3.2
167.	50+680	RHS	6.7	Banyan	4.2
168.	50+720	RHS	8.5	Banyan	11.1
169.	50+820	LHS	9.3	Pipal	4.3
170.	50+860	RHS	8.7	Pipal	3.9
171.	50+875	LHS	7.1	Banyan	5.4
172.	50+880	RHS	2.2	Banyan	4.2
173.	50+910	LHS	8.3	Banyan	5
174.	50+920	LHS	8.3	Banyan	3.7
175.	50+960	RHS	6.9	Banyan	6.1
176.	51+000	RHS	6.5	Banyan	3.3
177.	51+050	RHS	9	Banyan	4.2

Table-A.4.4.5 List of Giant Tree along Magadi to Kunigal

S. N.	Chainage		Side	Distance of Existing Centreline (m)	Coordinates		Species	Girth Size (m)
	From	To						
1	0+400	0+500	LHS	8.3	739206.6	1434590.67	Banyan	5.3
2	0+400	0+500	RHS	6.7	739204.74	1434609.09	Banyan	6.8
3	0+400	0+500	LHS	8.3	739188.65	1434604.48	Banyan	5.1
4	0+400	0+500	RHS	6.5	739184.82	1434618.50	Banyan	6.4
5	1+000	1+100	LHS	8	738681.3	1434883.86	Banyan	4.3
6	1+100	1+200	LHS	8.7	738651.62	1434902.80	Banyan	5.7
7	1+100	1+200	LHS	9	738620.03	1434926.21	Banyan	7
8	1+100	1+200	LHS	9	738612.36	1434925.91	Banyan	7.4
9	1+300	1+400	LHS	9.3	738508.6	1434998.38	Shireesh	3.6
10	1+300	1+400	RHS	6.5	738495.63	1435027.14	Banyan	6.2
11	1+300	1+400	RHS	6	738463.07	1435049.41	Banyan	3.8
12	1+500	1+600	RHS	6.5	738394.08	1435102.81	Arjun	3.2
13	1+600	1+700	RHS	4.5	73304.13	1435159.63	Banyan	8.2
14	1+700	1+800	RHS	6.9	738151.31	1435239.43	Mango	3.4
15	1+700	1+800	RHS	7.2	738155.22	1435248.22	Shireesh	3.1
16	1+800	1+900	RHS	8.6	738110.29	1435279.42	Shireesh	3.2
17	1+800	1+900	RHS	8.8	738091.51	1435283.12	Mango	3.4
18	2+000	2+100	LHS	7	737953.11	1435337.12	Banyan	3.5
19	2+100	2+200	LHS	4	737887.75	1435392.26	Banyan	8
20	2+100	2+200	LHS	8.5	737867.38	1435397.01	Mango	3.1
21	2+100	2+200	LHS	7	737835.42	1435421.32	Jamun	4.5
22	2+100	2+200	LHS	7.5	737821.25	1435433.54	Arjun	4.3
23	2+100	2+200	RHS	6	737763.96	1435480.04	Mango	4.8
24	2+200	2+300	LHS	5.2	737724.89	1435509.15	Mango	4.1
25	2+200	2+300	RHS	6.7	737726.2	1435531.04	Banyan	6.8
26	2+200	2+300	LHS	8.5	737706.12	1435529.98	Mango	3.8
27	2+300	2+400	LHS	8.4	737682.91	1435551.23	Mango	3.2
28	2+400	2+500	RHS	6.4	737612.83	1435654.70	Mango	4.2
29	2+400	2+500	LHS	4.1	737551.63	1435709.74	Mango	4.8
30	2+600	2+700	LHS	4.1	737539.17	1435723.64	Mango	4.8
31	2+600	2+700	RHS	4.6	737548.36	1435731.50	Mango	4.2
32	2+600	2+700	LHS	5.8	737519.21	1435741.01	Banyan	6
33	2+600	2+700	LHS	4.1	737509.08	1435754.23	Banyan	4.8
34	2+700	2+800	LHS	4.8	737429.18	1435845.37	Banyan	4.2
35	2+700	2+800	RHS	3.8	737413.01	1435880.13	Mango	3.8
36	2+800	2+900	RHS	4	737275.15	1436031.56	Banyan	5.8
37	3+200	3+300	LHS	5.8	737086.62	1436230.60	Mango	6.4
38	3+200	3+300	LHS	5.5	737039.74	1436291.41	Shireesh	4.3
39	3+200	3+300	LHS	5.5	737028.03	1436304.12	Shireesh	3.8
40	3+400	3+500	RHS	4	737037.13	1436317.82	Arjun	3.4
41	3+400	3+500	LHS	4.8	737019.91	1436320.79	Shireesh	3.2
42	3+400	3+500	LHS	4.6	737015.48	1436331.38	Mango	3.6
43	3+500	3+600	LHS	4.5	737008.74	1436346.85	Mango	3.5
44	3+500	3+600	RHS	3.2	736998.84	1436374.27	Mango	3.2
45	3+500	3+600	LHS	3.9	736987.60	1436372.83	Mango	3.4
46	3+500	3+600	RHS	3.2	736988.37	1436382.26	Mango	3.1
47	3+500	3+600	LHS	3.3	736979.60	1436382.75	Mango	3.3
48	3+500	3+600	RHS	3.2	736993.88	1436393.65	Mango	3.4
49	3+500	3+600	LHS	3.6	736976.45	1436393.43	Mango	3.8

S. N.	Chainage		Side	Distance of	Coordinates		Species	Girth
50	3+600	3+700	RHS	3.8	736920.06	1436468.24	Shireesh	3.8
51	4+000	4+100	LHS	4	736672.91	1436781.57	Jamun	3.7
52	4+000	4+100	LHS	4.8	736503.31	1436942.32	Mango	3.3
53	4+000	4+100	LHS	4.6	736489.81	1436964.17	Banyan	4.8
54	4+400	4+500	LHS	5	736421.39	1437030.34	Tamarind	3.9
55	4+500	4+600	RHS	3.3	736349.47	1437110.52	Mango	3.2
56	4+500	4+600	RHS	3.9	736322.34	1437190.12	Tamarind	3.3
57	5+200	5+300	RHS	4.2	735833.65	1437560.45	Mango	3.2
58	5+900	6+000	RHS	6.5	735182.95	1437720.86	Banyan	5.2
59	6+200	6+300	RHS	5.2	734922.97	1437841.75	Mango	3.3
60	6+200	6+300	LHS	4.3	734887.89	1437842.11	Mango	3.5
61	6+400	6+500	LHS	4	734770.23	1437883.88	Jamun	3.8
62	6+400	6+500	LHS	4	734752.64	1437892.90	Banyan	4.6
63	6+400	6+500	RHS	5	734736.76	1437904.50	Mango	4.2
64	6+500	6+600	LHS	4.3	734673.04	1437917.86	Shireesh	3.6
65	6+500	6+600	RHS	4	734644.20	1437934.80	Mango	3.8
66	6+500	6+600	RHS	4.1	734625.50	1437940.55	Mango	3.5
67	6+800	6+900	RHS	4.3	734325.36	1438038.67	Mango	3.8
68	6+800	6+900	LHS	4.1	734244.61	1438055.36	Banyan	3.7
69	6+800	6+900	RHS	4.8	734248.01	1438064.96	Banyan	6.3
70	7+100	7+200	LHS	4.5	734146.14	1438087.12	Banyan	6.5
71	7+100	7+200	LHS	3.6	734105.73	1438098.14	Banyan	3.6
72	7+200	7+300	RHS	5.3	734085.78	1438111.22	Banyan	5.2
73	7+400	7+500	LHS	4.9	733899.25	1438264.48	Banyan	3.8
74	7+700	7+800	LHS	6.2	733635.93	1438377.54	Banyan	3.6
75	7+700	7+800	RHS	4.5	733614.40	1438391.39	Banyan	4.4
76	8+500	8+600	RHS	4.2	732948.19	1438581.13	Mango	4.9
77	9+000	9+100	LHS	7.3	732503.32	1438703.57	Shireesh	3.6
78	9+100	9+200	LHS	5.9	732363.56	1438744.48	Banyan	3.3
79	10+100	10+200	LHS	4.8	731516.44	1439159.44	Jamun	3.8
80	10+200	10+300	LHS	5	731472.94	143914.96	Mango	4.1
81	10+300	10+400	LHS	5.2	731370.87	1439250.70	Jackfruit	3.9
82	10+300	10+400	LHS	5.8	731366.41	1439257.67	Mango	4.2
83	10+300	10+400	LHS	6.8	731218.93	1439359.01	Shireesh	4.3
84	11+400	11+500	LHS	6.9	730365.12	1439706.57	Pipal	3.4
85	11+400	11+500	LHS	6.7	730343.83	1439720.80	Mango	3.2
86	11+500	11+600	LHS	5.9	730324.21	1439736.91	Mango	3.6
87	11+700	11+800	LHS	5.7	730191.35	1439862.44	Pipal	3
88	11+700	11+800	RHS	6.1	730179.53	1439886.28	Mango	3.6
89	12+400	12+500	LHS	7.2	729730.76	1440321.08	Banyan	4.5
90	12+600	12+700	LHS	7.6	729578.51	1440423.08	Pipal	5.2
91	13+000	13+100	LHS	7	729260.85	1440624.05	Arjun	3.2
92	14+100	14+200	LHS	6.6	728332.36	1441090.81	Pipal	4.1
93	14+100	14+200	LHS	5.8	728294.40	1441107.66	Banyan	3.8
94	14+400	14+500	LHS	4.7	728079.50	1441213.40	Arjun	3.9
95	15+600	15+700	RHS	5.5	727028.74	1441852.41	Tamarind	4.2
96	15+700	15+800	RHS	5.5	727011.35	1441873.54	Pipal	4
97	15+700	15+800	RHS	5.7	726984.16	1441924.80	Banyan	4.2
98	15+700	15+800	LHS	4.9	726953.77	1441944.36	Shireesh	4.1

ANNEX 4.5 GREEN TUNNEL LOCATIONS ALONG PROJECT ROAD



ANNEX 4.6 RESULTS OF BIODIVERSITY STUDY

Table-A.4.6.1 Relative Frequency (RF), Relative Density (Rd), Important Value Index (IVI) and Species Abundance for Trees

Sl. No.	Species Name	RF	Rd	IVI	Abundance
1	*Pongamia pinnata*	9.68	9.65	19.33	3.67
2	*Tamarindus indica*	6.45	7.02	13.47	4.00
3	*Albizia lebbeck*	6.45	5.26	11.71	3.00
4	*Ficus benghalensis*	6.45	5.26	11.71	3.00
5	*Leucaena leucocephala*	6.45	5.26	11.71	3.00
6	*Acacia catechu*	6.45	4.39	10.84	2.50
7	*Azadirachta indica*	3.23	7.02	10.24	8.00
8	*Diospyros melanoxylon*	3.23	7.02	10.24	8.00
9	*Peltophorum pterocarpum*	6.45	3.51	9.96	2.00
10	*Cassia siamea*	3.23	6.14	9.37	7.00
11	*Vitex altissima*	3.23	5.26	8.49	6.00
12	*Eucalyptus tereticornis*	3.23	4.39	7.61	5.00
13	*Syzigium cumini*	3.23	4.39	7.61	5.00
14	*Acacia auriculiformis*	3.23	3.51	6.73	4.00
15	*Grevillea robusta*	3.23	3.51	6.73	4.00
16	*Acacia nilotica*	3.23	2.63	5.86	3.00
17	*Annona squamosal*	3.23	2.63	5.86	3.00
18	*Delonix regia*	3.23	2.63	5.86	3.00
19	*Ficus religiosa*	3.23	2.63	5.86	3.00
20	*Psidium guajava*	3.23	2.63	5.86	3.00
21	*Butea monosperma*	3.23	1.75	4.98	2.00
22	*Morinda tinctoria*	3.23	1.75	4.98	2.00
23	*Samanea saman*	3.23	1.75	4.98	2.00

Table-A.4.6.2 Relative Frequency (RF), Relative density (Rd), Important Value Index (IVI) and Species Abundance for Shrub Species

Sl. No.	Species Name	RF	Rd	IVI	Abundance
1	*Stachytarpheta indica*	5.71	11.23	16.94	16.00
2	*Lantana camara*	5.71	10.88	16.59	15.50
3	*Securinega virosa*	5.71	9.12	14.84	13.00
4	*Pterolobium hexapetalum*	5.71	8.42	14.14	12.00
5	*Sida acuta*	5.71	6.67	12.38	9.50
6	*Argyreia cuneata*	5.71	5.26	10.98	7.50
7	*Canthium parviflorum*	5.71	4.91	10.63	7.00
8	*Ziziphus oenoploea*	5.71	4.21	9.92	6.00
9	*Acacia concinna*	5.71	3.16	8.87	4.50
10	*Agave americana*	5.71	2.46	8.17	3.50
11	*Chromolaena odorata*	2.86	5.26	8.12	15.00
12	*Tarenna asiatica*	2.86	4.91	7.77	14.00
13	*Jasminum ritchiei*	2.86	4.21	7.07	12.00
14	*Jatropha curcas*	5.71	1.05	6.77	1.50
15	*Cassia tora*	2.86	2.81	5.66	8.00
16	*Vicoa indica*	2.86	2.81	5.66	8.00
17	*Rhus mysorensis*	2.86	2.46	5.31	7.00
18	*Sida cordifolia*	2.86	2.46	5.31	7.00
19	*Dodonaea viscosa*	2.86	2.11	4.96	6.00
20	*Sida rhombifolia*	2.86	1.40	4.26	4.00
21	*Calotropis procera*	2.86	1.05	3.91	3.00
22	*Opuntia dillenii*	2.86	1.05	3.91	3.00
23	*Solanum indicum*	2.86	1.05	3.91	3.00
24	*Stylosanthes fruticosa*	2.86	1.05	3.91	3.00

Table-A.4.6.3 Relative Frequency (RF), Relative density (Rd), Important Value Index (IVI) and Species Abundance for Herb Species

Sl. No.	Species Name	RF	Rd	IVI	Abundance
1	*Hybanthus enneaspermus*	6.98	12.11	19.09	15.67
2	*Cynodon dactylon*	6.98	11.08	18.06	14.33
3	*Dolichos falcatus*	6.98	9.02	16.00	11.67
4	*Parthenium hysterophorus*	4.65	9.02	13.67	17.50
5	*Achyranthes aspera*	6.98	6.44	13.42	8.33
6	*Asparagus racemosus*	6.98	3.61	10.58	4.67
7	*Phyllanthus urinaria*	4.65	5.67	10.32	11.00
8	*Desmodium triflorum*	4.65	4.64	9.29	9.00
9	*Evolvulus alsinoides*	4.65	4.64	9.29	9.00
10	*Tridax procumbens*	4.65	4.38	9.03	8.50
11	*Hemidesmus indicus*	4.65	3.87	8.52	7.50
12	*Orthosiphon diffuse*	4.65	3.87	8.52	7.50
13	*Commelina benghalensis*	4.65	3.09	7.74	6.00
14	*Vernonia cinerea*	4.65	2.06	6.71	4.00
15	*Leucas aspera*	4.65	1.55	6.20	3.00
16	*Tylophora indica*	4.65	1.55	6.20	3.00
17	*Phyllanthus amara*	2.33	3.61	5.93	14.00
18	*Mimosa pudica*	2.33	2.32	4.65	9.00
19	*Mitracarpous vertisilata*	2.33	2.32	4.65	9.00
20	*Spilanthes acmella*	2.33	2.32	4.65	9.00
21	*Tinospora cordifolia*	2.33	1.80	4.13	7.00
22	*Ocimum americanum*	2.33	1.03	3.36	4.00

Table-A.4.6.4 Relative Frequency (RF), Relative Density (Rd), Important Value Index (IVI) for overall Faunal Species

Sl. No.	Scientific Name	Kind	RF	Rd	IVI	Abundance
1	*Apis dorsata*	Insect	3.70	16.72	20.43	25.00
2	*Sympetrum flavolum*	Insect	3.70	16.72	20.43	25.00
3	*Apis cerana*	Insect	1.85	8.36	10.21	25.00
4	*Coptotermes formosanus*	Insect	1.85	8.36	10.21	25.00
5	*Ischnura hecterostica*	Insect	1.85	8.36	10.21	25.00
6	*Papillio polytes*	Insect	3.70	3.68	7.38	5.50
7	*Eurema brigitta*	Insect	3.70	3.01	6.71	4.50
8	*Euploea core*	Insect	3.70	1.34	5.04	2.00
9	*Hypolimnas misippus*	Insect	3.70	1.34	5.04	2.00
10	*Eurema hecabe*	Insect	1.85	2.68	4.53	8.00
11	*Freyeria trochylus*	Insect	1.85	2.68	4.53	8.00
12	*Catopsilia pomona*	Insect	1.85	2.01	3.86	6.00
13	*Ixias marianne*	Insect	1.85	2.01	3.86	6.00
14	*Colotis etrida*	Insect	1.85	1.34	3.19	4.00
15	*Dicaeum agile*	Bird	1.85	1.34	3.19	4.00
16	*Vanessa cardui*	Insect	1.85	1.34	3.19	4.00
17	*Zizeeria karsandra*	Insect	1.85	1.34	3.19	4.00
18	*Atrophaneura aristolochiae*	Insect	1.85	1.00	2.86	3.00
19	*Chorthippus brunneus*	Insect	1.85	1.00	2.86	3.00
20	*Corvus splendens*	Bird	1.85	1.00	2.86	3.00
21	*Herpestes edwardsii*	Mammal	1.85	1.00	2.86	3.00
22	*Psuedocoladenia dan*	Insect	1.85	1.00	2.86	3.00
23	*Saxicola caprata*	Bird	1.85	1.00	2.86	3.00
24	*Xylocopa violacea*	Insect	1.85	1.00	2.86	3.00

Sl. No.	Scientific Name	Kind	RF	Rd	IVI	Abundance
25	*Acridotheres tristis*	Bird	1.85	0.67	2.52	2.00
26	*Bubulcus ibis*	Bird	1.85	0.67	2.52	2.00
27	*Castalius rosimon*	Insect	1.85	0.67	2.52	2.00
28	*Corvus macrorhynchos*	Bird	1.85	0.67	2.52	2.00
29	*Fumambilus palmarum*	Mammal	1.85	0.67	2.52	2.00
30	*Megalaima viridis*	Bird	1.85	0.67	2.52	2.00
31	*Phalanta phalanta*	Insect	1.85	0.67	2.52	2.00
32	*Atrophaneura hector*	Insect	1.85	0.33	2.19	1.00
33	*Calotes versicolour*	Reptile	1.85	0.33	2.19	1.00
34	*Cuculus micropterus*	Bird	1.85	0.33	2.19	1.00
35	*Danaus chrysippus*	Insect	1.85	0.33	2.19	1.00
36	*Delias eucharis*	Insect	1.85	0.33	2.19	1.00
37	*Dicrurus paradiseus*	Bird	1.85	0.33	2.19	1.00
38	*Dinopium javanense*	Bird	1.85	0.33	2.19	1.00
39	*Halcyon smyrnensis*	Bird	1.85	0.33	2.19	1.00
40	*Haliastur indus*	Bird	1.85	0.33	2.19	1.00
41	*Ictinaetus malayensis*	Bird	1.85	0.33	2.19	1.00
42	*Junonia iphita*	Insect	1.85	0.33	2.19	1.00
43	*Muscicapa dauurica*	Bird	1.85	0.33	2.19	1.00
44	*Nectarinia zeylonica*	Bird	1.85	0.33	2.19	1.00
45	*Neptis hylas*	Insect	1.85	0.33	2.19	1.00
46	*Psilopogon haemacephalus*	Bird	1.85	0.33	2.19	1.00
47	*Psittacula krameri*	Bird	1.85	0.33	2.19	1.00
48	*Tirumala septentrionis*	Insect	1.85	0.33	2.19	1.00

ANNEX 4.7 SECONDARY DATA FROM STATE FOREST DEPARTMENT

Table-A.4.7.1 List of Flora of the Project Area

S. No	Name of Flora Species	S. No	Name of Flora Species
1	*Aagyrei cuneata*	42	*Azadirachta indica*
2	*Abrus precatorius*	43	*Azima tetracantha*
3	*Abutilon indicum*	44	*Bambusa arundinacea*
4	*Acacia auriculiformis*	45	*Bauhinia purpurea*
5	*Acacia catechu*	46	*Bauhinia racemosa*
6	*Acacia chundra*	47	*Bauhinia vahlii*
7	*Acacia concinna*	48	*Bombax malabaricum*
8	*Acacia ferruginea*	49	*Boswellia serrata*
9	*Acacia intsia*	50	*Bridelia retusa*
10	*Acacia leucophloea*	51	*Buchanania angustifolia*
11	*Acacia nilotica*	52	*Buchanania lanzan*
12	*Acacia polycantha*	53	*Butea frondosa*
13	*Acacia suma*	54	*Butea monosperma*
14	*Achras zapota*	55	*Caesalpinia bonduc*
15	*Achyranthus aspera*	56	*Caesalpinia mimosoides*
16	*Adathoda vasica*	57	*Caesearia tomentosa*
17	*Adenanthera pavonina*	58	*Calotropis gigantean*
18	*Adina cordifolia*	59	*Calotropis procera*
19	*Aegle marmelos*	60	*Canthium parviflorum*
20	*Aeschynomene indica*	61	*Canthium sps*
21	*Agave sisalana*	62	*Capparis horrida*
22	*Ailanthus excelsa*	63	*Capparis stylosa*
23	*Alangium lamarckii*	64	*Cardiospermum halicacabum*
24	*Albizia amara*	65	*Careya arborea*
25	*Albizia lebbeck*	66	*Carissa carandas*
26	*Albizia odoratissima*	67	*Caryota urens*
27	*Albizia procera*	68	*Cassia auriculata*
28	*Albuitilon indicum*	69	*Cassia fistula*
29	*Alloteropsis cimicina*	70	*Cassia hirsuta*
30	*Anacardium occidentale*	71	*Cassia javanica*
31	*Andropogon serratus*	72	*Cassia mimosoides*
32	*Annona squamosa*	73	*Cassia siamea*
33	*Anogeissus latifolia*	74	*Cassia tora*
34	*Araucaria cookii*	75	*Casuarina equisetifolia*
35	*Araucaria cunninghamii*	76	*Celastrus montana.*
36	*Araucaria excelsa*	77	*Celastrus paniculata*
37	*Araucaria robusta*	78	*Ceropegia tuberosa*
38	*Ardisia humilis*	79	*Chloroxylon swietenia*
39	*Aristolochia indica*	80	*Cipadessa baccifera*
40	*Artocarpus integrifolia*	81	*Cissus quadrangularis*
41	*Asparagus racemosus*	82	*Clematis gouriana*
83	*Cochlospermum gossypium*	127	*Eucalyptus teriticormis*
84	*Cordia macleodii*	128	*Eugenia jamulana*
85	*Cordia myxa*	129	*Euphorbia antiquorum*

S. No	Name of Flora Species	S. No	Name of Flora Species
86	*Crotalaria filipes*	130	*Euphorbia hirta*
87	*Crotalaria hirta*	131	*Euphorbia tirukalli*
88	*Crotalaria retusa*	132	*Evolvulus alsinoides*
89	*Croton bonplandianus*	133	*Ficus bengalensis*
90	*Cryptolepias buchanani*	134	*Ficus benjamina*
91	*Curculigo orchioides*	135	*Ficus glomerata*
92	*Curcuma longa*	136	*Ficus hispida*
93	*Cymbopogon citrates*	137	*Ficus infectoria*
94	*Cynodon dactylon*	138	*Ficus lacor*
95	*Cynoglossum denticulatum*	139	*Ficus macrophylla*
96	*Daemia extensa*	140	*Ficus mysorensis*
97	*Dalbergia latifolia*	141	*Ficus racemosa*
98	*Dalbergia paniculata*	142	*Ficus religosa*
99	*Dalbergia sissoo*	143	*Ficus tomentosa*
100	*Datura metel*	144	*Ficus tsjahela*
101	*Delonix regia*	145	*Fimbristylis dichotoma*
102	*Dendrocalamus strictus*	146	*Flacourtia indica*
103	*Desmodium heterocarpon*	147	*Flacourtia ramontchi*
104	*Desmodium velutinum*	148	*Flacourtia sepiaria*
105	*Desmodum pulchellum*	149	*Flemingia strobilifera*
106	*Desnidium motorium*	150	*Fluggea leucopyrus*
107	*Digitaria longiflora*	151	*Fluggea microcarpa*
108	*Dioscorea pentaphylla*	152	*Garcinia cambogia*
109	*Diospyros melanoxylon*	153	*Garcinia xanthochymus*
110	*Diospyros montana*	154	*Gardenia gummifera*
111	*Dodonea viscosa*	155	*Gardenia latifolia*
112	*Dregea volubilis*	156	*Garuga pinnata*
113	*Elaeodendron glaucum*	157	*Gauzuma tomentosa*
114	*Eleocharis retroflexa*	158	*Girardinia zeylanica*
115	*Elephant grass*	159	*Givotia rottleriformis*
116	*Embelia ribes*	160	*Gloriosa superba*
117	*Embelia tsjeriam-cottom*	161	*Glossocardia bosvallea*
118	*Emblica officinalis*	162	*Glycosmis pentaphylla*
119	*Emblica sonchifolia*	163	*Glyricidia maculata*
120	*Entada scandens*	164	*Gmelina asiatica*
121	*Eranthemum pulchellum*	165	*Grevillea robusta*
122	*Erythrina stricta*	166	*Grewia arborea*
123	*Erythrina suberosa*	167	*Grewia hirsuta*
124	*Erythroxylon monogynum*	168	*Grewia retusa*
125	*Eucalyptus citriodora*	169	*Grewia tiliaefolia*
126	*Eucalyptus hybrid*	170	*Gymnema sylvestre*
171	*Gymnosporia montana*	215	*Limonia crenulata*
172	*Habenaria roxburghii*	216	*Limonia acidissima*
173	*Hardwickia binata*	217	*Limnophila indica*
174	*Helicteres isora*	218	*Loranthus falcatus*
175	*Hemidesmus indicus*	219	*Loranthus indica*

S. No	Name of Flora Species	S. No	Name of Flora Species
176	*Hibiscus furcatus*	220	*Ludwigia parviflora*
177	*Hibiscus rosa sinensis*	221	*Madhuca indica*
178	*Hibiscus vitifolius*	222	*Magnolia fuscata*
179	*Holarrhena antidysenterica*	223	*Magnolia pterocarpa*
180	*Holoptelea intergrifolia*	224	*Mallotus philippensis*
181	*Hymenodictyon excelsum*	225	*Mangifera indica*
182	*Ichnocarpus wightiana*	226	*Martynia diandra*
183	*Imperata arundinacea*	227	*Melia composita*
184	*Inchnocarpus frutescens*	228	*Millettia ovalifolia*
185	*Indigofera pulchella*	229	*Millingtonia hortensis*
186	*Indigofera tinctoria*	230	*Mimosa pudica*
187	*Indigofera wightii*	231	*Mitragyna parviflora*
188	*Ipomoea horsfalliae*	232	*Morinda sanctum*
189	*Isachne lisboae*	233	*Morinda tomentosa*
190	*Ischaemum indicum*	234	*Moringa oleifera*
191	*Ixora nigricans*	235	*Mucuna pruriens*
192	*Ixora parviflora*	236	*Mundulea sericea*
193	*Jacarada mimosifolia*	237	*Murdannia nudiflora*
194	*Jasminum arborescens*	238	*Nauclea macrophylla*
195	*Jasminum auriculatum*	239	*Nerium oleander*
196	*Jasminum dichotomum*	240	*Ochna obtusata*
197	*Jasminum pubescens*	241	*Ocimum canum*
198	*Jasminum sambac*	242	*Ocimum sanctum*
199	*Jatropha curcas*	243	*Odina wodier*
200	*Jatropha gossypifolia*	244	*Oldenlandia corymbosa*
201	*Justicia betonica*	245	*Olea dioica*
202	*Justicia simplex*	246	*Oplismenus compositus*
203	*Lagasca mollis*	247	*Opuntia dillenii*
204	*Lagerstroemia flosreginae*	248	*Oxalis corniculata*
205	*Lagerstroemia lanceolata*	249	*Parkia biglandulosa*
206	*Lagerstroemia microcarpa*	250	*Parthenium hysterophorus*
207	*Lagerstroemia parviflora*	251	*Passiflora foetida*
208	*Lagerstroemia reginae*	252	*Pavetta indica*
209	*Lantana camara*	253	*Pavonia zeylanica*
210	*Lawsonia alba*	254	*Peltophenium hysterophorus*
211	*Lemon grass*	255	*Peltophorum ferrugineum*
212	*Leucas aspera*	256	*Peltophorum pterocarpum*
213	*Leucas linifolia*	257	*Pennisetum pedicellatum*
214	*Leucas montana*	258	*Peristeria elata*
259	*Peristrophe bicalyculata*	303	*Sida veronicifolia*
260	*Perotis indicus*	304	*Smilax zeylanica*
261	*Phoenix humilis*	305	*Smithia bigemina*
262	*Phoenix sylvestris*	306	*Smithia conferta*
263	*Phyllanthus amarus*	307	*Solanum erianthum*
264	*Phyllanthus maderaspatensis*	308	*Solanum ferox*
265	*Phyllanthus simplex*	309	*Solanum indicum*

S. No	Name of Flora Species	S. No	Name of Flora Species
266	*Phyllanthus virgatus*	310	*Solanum torvum*
267	*Plumbago zeylanica*	311	*Solanum xanthocarpum*
268	*Plumeria acuminata*	312	*Sophubia delphinifolia*
269	*Plumeria alba*	313	*Soymida febrifuga*
270	*Plumeria rubra*	314	*Spathodia companulata*
271	*Polyalthia longifolia*	315	*Spondias mangifera*
272	*Polygala elongata*	316	*Stachytarpheta indica*
273	*Polygala longifolia*	317	*Sterculia urens*
274	*Pongamia pinnata*	318	*Stereospermum chelonoides*
275	*Porana paniculata*	319	*Stereospermum suaveolens*
276	*Premna tomentosa*	320	*Streblus asper*
277	*Prosopis juliflora*	321	*Striga asiatica*
278	*Prosopis spicigera*	322	*Strychnos potatorum*
279	*Protium caudatum*	323	*Sweitenia mahagony*
280	*Psidium guajava*	324	*Swietenia macrophylla*
281	*Pterocarpus acerifolium*	325	*Syzygium jambos*
282	*Pterocarpus marsupium*	326	*Syzygium cumini*
283	*Pterolobium hexapetalum*	327	*Tabebuia argentia*
284	*Randia dumetorum*	328	*Tabebuia avellanedae*
285	*Rhinacanthus communis*	329	*Tabebuia pallida*
286	*Ricinus communis*	330	*Tabebuia rosea*
287	*Ruellia prostrata*	331	*Tagetas erecta*
288	*Rungia repens*	332	*Tamarindus indica*
289	*Samanea saman*	333	*Tecoma stans*
290	*Santalum album*	334	*Tectona grandis*
291	*Sapindus laurifolius*	335	*Tephrosia pulcherrima*
292	*Saraca cauliflora*	336	*Tephrosia purpurea*
293	*Schleichera trijuga*	337	*Tephrosia villosa*
294	*Schreberas swietenoidies*	338	*Terminalia arjuna*
295	*Scilla hyacinthina*	339	*Terminalia belerica*
296	*Scutia indica*	340	*Terminalia catappa*
297	*Semecarpus anacardium*	341	*Terminalia chebula*
298	*Sesabania bispinosa*	342	*Terminalia coriacea*
299	*Shorea roxburghii*	343	*Terminalia paniculata*
300	*Sida acuta*	344	*Terminalia tomentosa*
301	*Sida cordifolia*	345	*Terminalia tremula*
302	*Sida glutinosa*	346	*Thespesia populnea*
347	*Thevetia nerifolia*	360	*Viscum monoicum*
348	*Tinospora cordifolia*	361	*Vitex altissima*
349	*Toddalia aculeata*	362	*Vitex negundo*
350	*Tragia involucrata*	363	*Wendlandia exserta*
351	*Tragus roxburghii*	364	*Withania somnifera*
352	*Trebulus terestris*	365	*Wrightia tinctoria*
353	*Trema orientalis*	366	*Wrightia tomentosa*
354	*Triumfetta rhomboidea*	367	*Xanthium strumarium*
355	*Triumfetta pilosa*	368	*Zizyphus jujuba*

S. No	Name of Flora Species	S. No	Name of Flora Species
356	*Tylophora asthmatica*	369	*Zizyphus oenoplia*
357	*Ventilago madraspatana*	370	*Zizyphus rugosa*
358	*Vernonia anthelmintica*	371	*Zizyphus xylopyrus*
359	*Vernonia cinerea*	372	*Ziziphus glabrata*
		373	*Zornia diphylla*

Source: Forest working plan -Bangalore Urban and Bangalore Rural Division

Table-A.4.7.2 List of Fauna of the Project Area

S.No	Name of Fauna species
Mammals	
1.	Bonnet Macaque
2.	Common Mongoose
3.	Tiger
4.	Leopard
5.	Jungle cat
6.	Wild dog
7.	Elephant
8.	Gaur
9.	Sambar
10.	Spotted deer
11.	Barking deer
12.	Mouse deer
13.	Indian wild boar
14.	Pangolin
15.	Common langur
16.	Small Indian coivet
17.	Sloth bear
18.	Indian porcupine
19.	Indian hare
20.	Jackal
21.	Flying fox
Birds	
1	The Tree Pie
2	The Grey Tit
3	The Jungle Babbler
4	The Redwhiskered Bulbul
5	The Paradise Flycatcher
6	Red Munia
7	Black Headed Munia
8	The Rufousbacked Shrike
9	The Scarlet Minivet
10	The Indian Cuckoo Shrike
11	The Racket Tailed Drongo
12	The Ashy Wren Warbler
13	The Steaked Weaver Bird
14	The Spotted Munia
15	The Yellowthroated Sparrow
16	The Rose Finch
17	The Wiretalled Swallow
18	The Large Pied Wagtail
19	The Indian Pipit

S.No	Name of Fauna species
20	The Crested Lark
21	The White Eye
22	The Purplerumped Sunbird
23	The Purple Sunbird
24	The Indian Pitta
25	The Mahratta Wood Peaker
26	The Blue Tailed Bee Eater
27	The Koel
28	The Crow Pheasnt
29	The Rose Ringed Parakeet
30	The Indian Lorikeet
31	The White Breasted King Fisher
32	The Common Grey Hornbill
33	The Barn Owl
34	The White Scavenger Vulture
35	The Brahminy Kite
36	The Shikra
37	The Green Pigeon
38	The Common Peafowl
39	The Grey Partridge
40	The Common or Grey Quail
41	The White Breasted Waterhen
42	The Purple Moorhen
43	The Coot
44	The Bronze Winged Jacana
45	The Yellow Wattled Lapwing
46	The Golden & Blackheaded Oriole
47	The Darter
48	The Spoon Bill
49	The Openbill Stork
50	The Little Egret
51	The Night Heron
52	The Cotton Teal
53	The Painted Stork
54	The Short-tied Eagle
55	The White-eyed Buzzard
56	The Tawny Eagle
57	The Blackwinged kite
58	The Greyheaded Fishing Eagle
59	The Pale Harrier
60	The Black or King Vulture
61	The Small Greenbilled Malkoha
62	The Grey Pelican
63	Or Bengal Vulture
64	The Indian White Backed
65	The Pied King Fisher
66	The Common Grey Horn bill
67	The Indian Hoopoe
68	The River Tem
Reptiles	
1.	Binocellate Cobra
2.	Russels Viper

S.No	Name of Fauna species
3.	Common Krait
4.	Saw Scaled Viper
5.	Checkerded Keelback
6.	Common Verm or Blind Snake
7.	Russell's Earth Boa
8.	Trinket Snake
9.	Rat Snake
10.	Common Wolf Snake
11.	Common Kukri Snake
12.	Mock Viper
13.	Tree Snake/Common Indian Bronzeback
14.	Buffstriped Keelback
15.	Cat Snake or Indian Gamma
16.	Moonocellate/Binocellate Cobra
17.	Banded or Fasciolated Racer
18.	Indian Python
19.	Garden or Blood Sucker Lizard
20.	Common or Brahminy Skink Monitor Lizard
21.	Peninsular Rock Agama
22.	Indian Chameleon

Source: Forest working plan -Bangalore Urban and Bangalore Rural Division

ANNEX-6.1 ADB RAPID ENVIRONMENTAL ASSESSMENT CHECKLIST

Rapid Environmental Assessment (REA) Checklist - Roads and Highways

Rapid Environmental Assessment (REA) Checklist - Roads and Highways

Rapid Environmental Assessment (REA) Checklist - Roads and Highways

Screening questions	Yes	No	Remarks
A. Project Sitting - Is the Project area adjacent to or within any of the following environmentally sensitive areas?			
▪ Cultural heritage site		No	
▪ Protected Area		No	
▪ Wetland		No	
▪ Mangrove		No	
▪ Estuarine		No	
▪ Buffer zone of protected area		No	
▪ Special area for protecting biodiversity		No	
B. Potential Environmental Impacts - Will the Project cause…			
Encroachment on historical / cultural areas; disfiguration of landscape by road embankments, cuts, fills and quarries?		No	
Encroachment on precious ecology		No	
Alteration of surface water hydrology of waterways crossed by roads, resulting in increased sediment in streams affected by increased soil erosion at construction site?	Yes		No major changes in surface water hydrology of Waterways crossed by the road is envisaged as construction of cross drainage structures will be taken up during lean stream flow periods (summer) to avoid diversion of stream flow, soil erosion and flooding in the adjacent areas. All existing cross drainages will be reviewed for impact on surface water hydrology; reconstruction and replacement of distressed cross drainage structures along with new structures will minimize the impact on the surface water hydrology.
Deterioration of surface water quality due to silt runoff and sanitary wastes from worker-based camps and chemicals used in construction?	Yes		▪ Adequate mitigation measures will be suggested to minimize the silt runoff from construction sites, ▪ Construction camps will be away from the surface water bodies; ▪ Silt trap trenches across the natural drains will be provided, ▪ Toilets will be provided with Septic tanks and sullage water will be connected to soak pits, ▪ Paved platform will be provided for vehicle service area, ▪ Chemicals and oil spills will be collected in oil interceptors and stored separately for recycling
Increased local air pollution due to rock crushing, cutting and filling works, and chemicals from asphalt processing?		No	Impacts on air quality during construction stage are transitory in nature and can be limited by mitigating measures. Crushing units, hot mix plant and wet mix plants will be located away from the human settlements and sensitive ecosystems. SPCB consents will be obtained and conditions laid there will be complied by the Contractor for establishing and operating these plants.
Noise and vibration due to blasting and other civil works?		No	Not envisaged

Screening questions	Yes	No	Remarks
Dislocation or involuntary resettlement of people	Yes		
Other social concerns relating to inconveniences in living conditions in the project areas that may trigger cases of upper respiratory problems and stress?		No	
Hazardous driving conditions where construction interferes with pre-existing roads?		No	Site specific Traffic Management Plan will be prepared. Assistance from local police will be taken. Temporary diversions will be provided by maintaining adequate carriage way for diversion traffic. Barricades, Traffic Safety Signs, Caution Boards, Markings, Flags, Lights and Flagmen as may be required will be provided to avoid interference to the flow of traffic at preexisting roads.
Poor sanitation and solid waste disposal in construction camps and work sites, and possible transmission of communicable diseases from workers to local populations?		No	Construction camps will be provided with sanitary latrines and urinals. The sewage system will be operated properly to avoid health hazards, ground water and soil contamination. Compost pits will be constructed for the disposal of the garbage and other Bio-degradable wastes generated from the camps. Proper collection, transportation and disposal of the wastes will be ensured. Construction and labour camps will be sited away from human settlements to avoid possible transmission of communicable diseases from workers to local populations
Creation of temporary breeding habitats for mosquito vectors of disease?		No	Better sanitation will be provided in construction and labour camps. Open pits near settlements will be filled with construction debris and covered with soil.
Dislocation and compulsory resettlement of people living in right-of-way?	Yes		
Accident risks associated with increased vehicular traffic, leading to accidental spills of toxic materials and loss of life?		No	Not envisaged However, if any accidental spill occurs, emergency spill procedure such as stopping the flow; removing ignition source; initiating emergency response; cleanup and safe disposal will be followed.
Increased noise and air pollution resulting from traffic volume?	Yes		Short-term impact; Mitigation measures will be suggested After the completion of project, there will be reduction in noise and air pollution due to smooth and uniform flow of traffic. Further, proposed avenue and median plantation along the road sides and in medians shall help to control dust, fugitive emissions and noise from reaching the receptors.
Increased risk of water pollution from oil, grease and fuel spills, and other materials from vehicles using the road?	Yes		▪ There may be negligible risk of water pollution from small quantities of oil, grease and fuel spills and other materials from vehicles using the road. ▪ Oil interceptors will be proposed for all the construction camps. ▪ Emergency Services will be engaged for the containment, cleanup and disposal of contamination release into the environment.

ANNEX 7.1 PCM QUESTIONNAIRE

Karnataka Public Works Department

KSHIP

ಕರ್ನಾಟಕ ರಾಜ್ಯ ಹೆದ್ದಾರಿ ಸುಧಾರಣೆ ಯೋಜನೆ – ಹಂತ II

ಪರಿಸರದ ಬಗ್ಗೆ ಹೂಡಿಕೆದಾರರ ಪ್ರತಿಕ್ರಿಯೆ

ಸ್ಥಳ	ಸ್ಪರ್ಧೆಯ ವಿವರಗಳು
1 ಸ್ಥಳ	4 ಹೆಸರು
2 ದಿನಾಂಕ	5 ಹಳ್ಳಿ
3 ರಸ್ತೆ	6 ದೂರವಾಣಿ ಸಂಖ್ಯೆ :

ಸೂಕ್ತವಾದುದನ್ನು ಆಯ್ಕೆ ಮಾಡಿ (✓)

ಶಬ್ದ ಮಾಲಿನ್ಯ

1 ನಿಮಗೆ ಸಂಚಾರದ ಶಬ್ದದಿಂದ ತೊಂದರೆಯಾಗುತ್ತದೆ ಎಂದು ಅನಿಸುತ್ತದೆಯೆ	ಹೌದು ☐				ಇಲ್ಲ ☐
ಹೌದು ಎನ್ನುವುದಾದರೆ, ನಂತರ ಪರಿಣಾಮದ ಪ್ರಮಾಣ ➢	ಉತ್ತಮ	ಮಧ್ಯಮ	ಕಡಿಮ	ಅತ್ಯಲ್ಪ	ಹೇಳಲು ಸಾಧ್ಯವಿಲ್ಲ
ಪ್ರಸ್ತುತ ಸಂಚಾರದ ಕಬ್ಬಿಣಿಂದ ತೊಂದರೆಯೇ					
ಪ್ರಸ್ತುತ ಸಂಚಾರದ ಹಾರ್ನ್ ಕಬ್ಬಿಣಿಂದ ತೊಂದರೆಯೇ					
2 ಯೋಜನೆಯ ಅನುಷ್ಠಾನದ ನಂತರ ಸಂಚಾರದ ಪರಿಮಾಣವನ್ನು ಹೆಚ್ಚಿಸುವುದು					

3 ನೀವು ಯೋಜನೆಯ ಕಾರಣ ಶಬ್ದ ಮಟ್ಟದಲ್ಲಿ ಯಾವುದೇ ಬದಲಾವಣೆ ನಿರೀಕ್ಷಿಸುತ್ತೀರ	ಹೆಚ್ಚುವುದು ☐		ಇಳಿಸುವುದು ☐		ಬದಲಾವಣೆ ಇಲ್ಲ ☐
ನಿರೀಕ್ಷಣೆಯ ಹೆಚ್ಚಾದರೆ, ನಂತರ ಪರಿಣಾಮದ ಪ್ರಮಾಣ ➢	ಉತ್ತಮ	ಮಧ್ಯಮ	ಕಡಿಮೆ	ಅತ್ಯಲ್ಪ	ಹೇಳಲು ಸಾಧ್ಯವಿಲ್ಲ
ಯೋಜನೆಯ ಅನುಷ್ಠಾನದ ನಂತರ ಕಬ್ಬವನ್ನು ಹೆಚ್ಚಿಸುವುದು					
ಯೋಜನೆಯ ಅನುಷ್ಠಾನದ ನಂತರ ಹಾರ್ನ್ ಹೆಚ್ಚಿಸುವುದು					
ಯಂತ್ರಗಳು ಮತ್ತು ನಿರ್ಮಾಣ ವಾಹನಗಳಿಂದ ತೊಂದರೆಯೇ					
4 ಯಾವುದಾದರು ಸಲಹೆಗಳು ಶಬ್ದ ಮಾಲಿನ್ಯವನ್ನು ತಗ್ಗಿಸಲು :					

ಸೂಕ್ತವಾದುದನ್ನು ಆಯ್ಕೆ ಮಾಡಿ (✓)

ವಾಯು ಮಾಲಿನ್ಯ

5 ನಿಮಗೆ ವಾಯು ಮಾಲಿನ್ಯದಿಂದ ತೊಂದರೆಯಾಗುತ್ತದೆ ಅನಿಸುತ್ತದೆಯೆ	ಹೌದು ☐				ಇಲ್ಲ ☐
ಹೌದು ಎನ್ನುವುದಾದರೆ, ನಂತರ ಪರಿಣಾಮದ ಪ್ರಮಾಣ ➢	ಉತ್ತಮ	ಮಧ್ಯಮ	ಕಡಿಮ	ಅತ್ಯಲ್ಪ	ಹೇಳಲು ಸಾಧ್ಯವಿಲ್ಲ
ಪ್ರಸ್ತುತ ಸಂಚಾರದ ಗಾಳಿ ಹೊರಸೂಸುವಿಕೆಯಿಂದ ತೊಂದರೆಯೇ					
ಪ್ರಸ್ತುತ ಸಂಚಾರದ ಧೂಳಿನಿಂದ ತೊಂದರೆಯೇ					
6 ಸಂಚಾರ ಹೊರಹೊಮ್ಮಿಸಿ ದೇಗೆ ಯಾವುದಾದರೂ ವಾಯು ಮಾಲಿನ್ಯದ ಮೂಲಗಳಿವೆಯೇ? ಇದ್ದರೆ, ಆ ಮೂಲಗಳನ್ನು ಹೆಸರಿಸಿ:					

7 ನೀವು ಯೋಜನೆಯ ಕಾರಣದಿಂದ ವಾತಾವರಣದ ಗುಣಮಟ್ಟದಲ್ಲಿ ಯಾವ ನಿರೀಕ್ಷಿಸುವೆ	ಹೆಚ್ಚುವುದು ☐		ಇಳಿಸುವುದು ☐		ಬದಲಾವಣೆ ಇಲ್ಲ ☐
ನಿರೀಕ್ಷಣೆಯು ಹೆಚ್ಚಾದರೆ, ನಂತರ ಪರಿಣಾಮದ ಪ್ರಮಾಣ ➢	ಉತ್ತಮ	ಮಧ್ಯಮ	ಕಡಿಮ	ಅತ್ಯಲ್ಪ	ಯಾವುದೇ ಟೀಕೆಗಳಿಲ್ಲ
ಸಂಚಾರದ ಹೊಗೆಯಿಂದ ವಾಯು ಮಾಲಿನ್ಯ ಹೆಚ್ಚಾಗಿದೆಯೇ					
ಸಂಚಾರದ ಹೊಗೆಯಿಂದ ಧೂಳು ಹೆಚ್ಚಾಗಿದೆಯೇ					
8 ನಿರ್ಮಾಣದ ಕಾರ್ಯಗಳಿಂದ ಧೂಳು ಹೆಚ್ಚಾಗಿದೆಯೇ					
ಯಾವುದಾದರು ಸಲಹೆಗಳು ವಾಯು ಮಾಲಿನ್ಯವನ್ನು ತಗ್ಗಿಸಲು :					

ಇಂಟರ್ ಕಾಂಟಿನೆಂಟಲ್ ಕನ್ಸಲ್ಟೆಂಟ್ಸ್ ಮತ್ತು ಟೆಕ್ನೋಕ್ರಾಟ್ಸ್ ಪ್ರೈವೇಟ್ ಲಿಮಿಟೆಡ್, ಸ್ಯೂ ಚೆಲ್ಲಿ ವಿರುದ್ಧಿಸಿದಂತೆ
ಪರಿಸರ ವಿಷಯದ ಬಗ್ಗೆ ಸಂಪರ್ಕಿಸಿ ಸಲಹೆ

ಪರಿಸರದ ಬಗ್ಗೆ ಹೂಡಿಕೆದಾರರ ಪ್ರತಿಕ್ರಿಯೆ

ಸೂಕ್ತವಾದುದನ್ನು ಆಯ್ಕೆ ಮಾಡಿ (✓)

ರಸ್ತೆ ಸುರಕ್ಷತೆ

9 ರಸ್ತೆ ಅಪಘಾತವು ಪೀಡಿತವೇ ?	ಹೌದು ☐				ಇಲ್ಲ ☐
ಹೌದು ಎನ್ನುವುದಾದರೆ, ನಂತರ ಪರಿಣಾಮದ ಪ್ರಮಾಣ ➤	ಉತ್ತಮ	ಮಧ್ಯಮ	ಕಡಿಮ	ಅತ್ಯಲ್ಪ	ಯಾವುದೇ ಟೀಕೆಗಳಿಲ್ಲ
ಸಣ್ಣ ಅಪಘಾತದ ಅಪವರ್ತನ					
ಮಾರಣಾಂತಿಕ ಅಪಘಾತದ ಅಪವರ್ತನ					

10 ನೀವು ಅಪಘಾತದ ಅಪವರ್ತನದಲ್ಲಿ ಯೋಜನೆಯಿಂದ ಯಾವುದಾದರೂ ಬದಲಾವಣೆಯನ್ನು ನಿರೀಕ್ಷಿಸುತ್ತೀರ?	ಹೆಚ್ಚಿಸುವುದು ☐		ಇಳಿಸುವುದು ☐		ಬದಲಾವಣೆ ಇಲ್ಲ ☐
ನಿರೀಕ್ಷಣೆಯ ಹೆಚ್ಚಾದರೆ, ನಂತರ ಪರಿಣಾಮದ ಪ್ರಮಾಣ ➤	ಉತ್ತಮ	ಮಧ್ಯಮ	ಕಡಿಮೆ	ಅತ್ಯಲ್ಪ	ಯಾವುದೇ ಟೀಕೆಗಳಿಲ್ಲ
ನಿರ್ಮಾಣದ ಹಂತದಲ್ಲಿ ಅಪಘಾತ ಹೆಚ್ಚಾಗಿದೆಯೇ					
ಕಾರ್ಯಾಚರಣೆ ಹಂತದಲ್ಲಿ ಅಪಘಾತ ಹೆಚ್ಚಾಗಿದೆಯೇ					
11 ರಸ್ತೆ ಅಪಘಾತ ಕಡಿಮೆ ಮಾಡಲು ರಸ್ತೆ ಸುರಕ್ಷತಾ ಕ್ರಮಗಳನ್ನು ಆಯ್ಕೆ ಮಾಡಿ					
ವೇಗದ ಬ್ರೇಕ್/ ರೋಡ್ ಹಂಪ್					
ಪಾದಚಾರಿಗಳು ದಾಟುವ ಸ್ಥಳ					
ರಸ್ತೆ ರುಜುಗಳು					
ಸುಧಾರಿತ ತುರ್ತು ಸೇವೆಗಳು					
ಪೋಲೀಸ್ ಪೆಟ್ರೋಲ್					
ವೇಗದ ಕ್ಯಾಮೆರ					
ರಸ್ತೆ ಸುರಕ್ಷತಾ ಶಿಕ್ಷಣ ಕ್ಯಾಂಪ್					
ಚಾಲಕ ಜಾಗೃತಿ ಕಾರ್ಯಕ್ರಮಗಳು					
ಇತರೆ ಕ್ರಮಗಳನ್ನು (ಸಲಹೆ ನೀಡಿ)					

12 ಇತರೆ ಯಾವುದೇ ಸಲಹೆಗಳು :

13 ಕಾಡು ಪ್ರಾಣಿಗಳು ಸುತ್ತಮುತ್ತಲಿನ ಪ್ರದೇಶಗಳಲ್ಲಿ ಗುರುತಿಸಲ್ಪಡುತ್ತದೆಯೇ?	ಹೌದು ☐				ಇಲ್ಲ ☐
ಹೌದು ಎನ್ನುವುದಾದರೆ, ನಂತರ ಪರಿಣಾಮದ ಪ್ರಮಾಣ ➤	ಉತ್ತಮ	ಮಧ್ಯಮ	ಕಡಿಮ	ಅತ್ಯಲ್ಪ	ಯಾವುದೇ ಟೀಕೆಗಳಿಲ್ಲ
ಕಾಡು ಪ್ರಾಣಿಗಳ ದೃಶ್ಯದ ಅಪವರ್ತನ					
ಕಾಡು ಪ್ರಾಣಿಗಳು, ಬೆಳೆ / ಆಸ್ತಿಗಳಿಗೆ ಹಾನಿ ಮಾಡಿದ ಘಟನೆ					
ವನ್ಯಜೀವಿ ಒಳಗೊಂಡ ಅಪಘಾತ					
ಮನುಷ್ಯ ವನ್ಯಜೀವಿ ಭಿನ್ನಾಭಿಪ್ರಾಯದ ಘಟನೆ					
ಹತ್ತಿರದ ಪ್ರದೇಶದಲ್ಲಿ ಆಕ್ರಮಣಕಾರರಿಂದ ವನ್ಯಜೀವಿ ಕಳ್ಳಸಾಗಣೆ ಘಟನೆ					

14 ದಯವಿಟ್ಟು ನೀವು ಆಗಾಗ್ಗೆ ನೋಡುವ ವನ್ಯಜೀವಿಗಳ ಹೆಸರು ತಿಳಿಸಿ

15 ನೀವು ಯವುದೇ ಕಿರು ಅರಣ್ಯ ಉತ್ಪನ್ನವನ್ನು ಬಳಸುತ್ತೀರಾ? ಬಳಸುವಿರಾದರೆ ಅವುಗಳ ಹೆಸರು :

16 ದಯವಿಟ್ಟು ಯಾವುದಾದರೂ ಆಗಾಗ್ಗೆ ಆಗುವ ವನ್ಯಜೀವಿ ಅಪಘಾತ ತಾಣಗಳ ಹೆಸರು ತಿಳಿಸಿ

17 ಸಾಮಾನ್ಯವಾಗಿ ನಿಮ್ಮ ಪ್ರದೇಶದಲ್ಲಿರುವ ಔಷಧೀಯ ಸಸ್ಯಗಳು ಯಾವುವು ?

18 ನಿಮ್ಮ ಇಷ್ಟದ ಯವ ಜಾತಿಯ ಮರಗಳನ್ನು ಕೃಷಿ ಭೂಮಿಯಲ್ಲಿ ಅಥವಾ ಗಡಿಗಳಲ್ಲಿ ಹಾಕಬಹುದು

19 ರಸ್ತೆ ಬದಿಯಲ್ಲಿ ನೆಡಲು ನಿಮ್ಮ ಇಷ್ಟವಾದ ತಳಿಯ ಹೆಸರುಗಳು?

20 ಬೇರೆಯಾವುದಾದರೂ ಸಲಹೆಗಳು ಜೀವವೈವಿಧ್ಯ ಮತ್ತು ಪರಿಸರದ ಬಗ್ಗೆ

ANNEX 7.2 REGISTRATION OF PARTICIPANTS IN PCM

BM-[redacted] I

Karnataka State Highways Improvement Project (KSHIP-III)
Public Consultation for EIA Studies

Name of the Project Road	Bangalore to Magadi SH 85
Place of Public Consultation	Magadi Govt. Higher Primary School
Date of Public Consultation	11/01/2016 1.00 PM

S. N.	Name of the Participant	Village	Mobile No.	Signature
1.	H. S. Rudreswamy	Hosapet	9036549788	
2.	Prabhu.	Harave	9880023781	
3.	[illegible]	— " —	7022217187	
4.	Nagaraju	— " —	9972103913	
5.	HH Lakshminarasimhaiya	— " —	9686795130	
6.	Narasimhayya	— " —	9591594341	
7.	revanna	— " —	9710044396	
8	Shanu	— " —		Shanu
9	[illegible]	— " —		
10	Ganga ramma	— " —		
11	Shivarudhramma	— " —	8711989206	Shivarudhramma
12	manjula	— " —		
13	Lakshmamma	— " —	9900390841	
14	yashoda	— " —		
15	Rangamma	— " —		
16	Kempamma	— " —		
17	jayalakshamma	— " —		
18	Sharadamma	— " —		

BM - I

Karnataka State Highways Improvement Project (KSHIP-III)
Public Consultation for EIA Studies

Name of the Project Road	Banglore to Magadi SH85
Place of Public Consultation	Magadi, Govt. Higher Primary School
Date of Public Consultation	11/01/2016 1.00Pm

S. N.	Name of the Participant	Village	Mobile No.	Signature
19	Lakshmamma	Hospet		
20	Sivlingamma.	Hospet	8147799[illegible]	
21	Kempamma.			
22	Gangamma.			
23	Murthy			
24	Manjula.		9980788470	
25	Rangamani			
26	Padma.			
27	Kempamma			
28	Shabintaz.			
29	Lakshmamma			
30	Geetha.			
31	Geetha.		9980412915	Geetha
32	Rangamma			
33	Manglamma			
34	Bhagyamma			
35	Lakshmamma			
36	Ratnamma.			

BM-01

Karnataka State Highways Improvement Project (KSHIP-III)
Public Consultation for EIA Studies

Name of the Project Road	Banglore to Magadi SH85
Place of Public Consultation	Magadi
Date of Public Consultation	11/01/2016 1.00 pm

S. N.	Name of the Participant	Village	Mobile No.	Signature
37	Siddalingamma	Hosapet	8971324977	
38	parvathamma		9900524279	
39	Lakshmi			
40	mangalamma		9740887460	
41	rudramma			
42	murali			
43	Nasru		9632055726	
44	Muju		9844841319	
45	Muniyamma		9731463941	Muniyamma
46	Shivaprasad		9845510349	
47			9964062818	
48			9901077539	
49			9164789611	
50	Shwetha C.N		8277263578	
51	B Ragyalakshamma		77 60621627	
52	Chikka John		9980233178	
53	Manjatha. G		9632558184	
54	Gangahanumakka	Hosapete.	9901651230	

3

BM-II

Karnataka State Highways Improvement Project (KSHIP-III)
Public Consultation for EIA Studies

Name of the Project Road	Banglore Magadi - SH85
Place of Public Consultation	Govt Higher Primary School, Hongonatti
Date of Public Consultation	20/1/2016 10:30 a.m

S. N.	Name of the Participant	Village	Mobile No.	Signature
1	[illegible]	[illegible]	-	[illegible]
2	[illegible]	[illegible]	-	[illegible]
3	[illegible]	-"-	-	[illegible]
4	[illegible]	-"-	-	[illegible]
5	B. [illegible]	-"-	9632767668	B. [illegible]
6	[illegible]	-"-	8970341616	[illegible]
7	[illegible] K.R	-"-	9036153604	[illegible] K.R.
8	[illegible]	-"-	-	[illegible]
9	[illegible]	-"-	-	[illegible]
10	[illegible]	-"-	9739180807	[illegible]
11	[illegible]	-"-	9008656220	[illegible]
12	[illegible]	-"-	9741793197	CHARLES BABU
13	[illegible]	-"-	-	[illegible]
14	[illegible] Teacher	[illegible]	9035163556	[illegible]
15	[illegible]		8710964916	[illegible]
16	[illegible]	GHPS [illegible]	8762768017	[illegible]
17	[illegible]	GHPS [illegible]	9880464712	[illegible]
18.	[illegible]	GHPS [illegible]	8095479109	[illegible]

Karnataka State Highways Improvement Project (KSHIP-III)
Public Consultation for EIA Studies

Name of the Project Road	Banglore Magadi
Place of Public Consultation	Govt Higher Primary School. Hongonatti
Date of Public Consultation	20/1/2016 10.30 AM

S. N.	Name of the Participant	Village	Mobile No.	Signature
19	Syeedabanu	[illegible]	9740521551	[illegible]
20	Anu	[illegible]	7259537515	Anu
21	A. Kalyani HM.	[illegible]	9535199634	A Kalyani
22	[illegible]	— " —	—	[illegible]
23	[illegible]	— " —	—	[illegible]
24.	[illegible]	[illegible]	9900798628	[illegible]
25	[illegible] M	[illegible]	9632339748	[illegible]
26.	C Reddy Sekhar	ICT Pvt LTD Bangalore	8150962831	[illegible]
27	Veeresh. A.H	ICT PVT LTD Delhi	9538590805	[illegible]
28	Manoj Kumar. M	ICT PVT Ltd Bang	9916659919	[illegible]
29	Tirthankar Banerjee	ICT, NewDelhi	9599233384	Tirthankar

ANNEX 8.1 GUIDELINES FOR TOP SOIL CONSERVATION AND REUSE

1. The top soil from all sites including road side widening and working area, cutting areas, quarry sites, borrow areas, construction camps, haul roads in agricultural fields (if any) and areas to be permanently covered shall be stripped to a specified depth of 15 cm and stored in stock piles for reuse.

2. At least 10% of the temporary acquired area for construction purposes shall be earmarked for stockpiling of fertile top soil

3. The locations for stacking will be pre-identified in consultation and with approval of Environmental Specialist of the Independent Engineer.

4. The following precautionary measures will be taken by the contractor to preserve the stock piles till they are re-used:

- Slop of the stockpiles should not exceed 1:2 (vertical to horizontal), and height is restricted to 2m to retain soil and allow percolation of H2O.
- The edges of pile should be protected by silt fencing and allow percolation of water, which will help to retain soil
- Multiple handling kept to a minimum to ensure that no compaction occurs.
- Stockpiles shall be covered with empty gunny bags or will be planted with grasses to prevent the loss during rains.

5. Such stockpiled topsoil will be utilized for

- Covering reclamation sites or other disturbed areas including borrow areas (not those in barren areas).
- Top dressing and raising turfs in embankment slopes
- Filling up of tree pits
- For developing median plantation
- In the agricultural fields of farmers, acquired temporarily that needs to be restored.

6. Residual top soil, if there is any, shall be utilized for the plantations works along the road corridor. The utilization as far as possible shall be in the same area from where top soil was removed. The stripping, preservation and reuse shall be carefully inspected, closely supervised and properly recorded by the Environmental Specialist of the Independent Engineer.

ANNEX 8.2 GUIDELINES FOR SITING AND LAYOUT OF CONSTRUCTION CAMP

A. Siting

1. The following guidelines shall be followed while siting the construction camps:

- The construction camps shall be located at least 500 m away from habitation. The living accommodation and ancillary facilities for labour shall be erected and maintained to approved standards and scales.
- Non-agricultural land should be used, as for as possible
- Not within 1,000 m of either side of locations of Forest areas.
- All sites used for camps must be adequately drained. They must not be subject to periodic flooding, nor located within 300 feet of pools, sink holes or other surface collections of water unless such water surface can be subjected to mosquito control measures.
- The camps must be located such that the drainage from and through the camps shall not endanger any domestic or public water supply.
- All sites must be graded, ditched and rendered free from depressions such that water may get stagnant and become a nuisance.

B. Layout

2. Contractor shall follow all relevant provisions of the Factories Act, 1948 and the Building and the other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 for development and maintenance of construction camp. A conceptual layout of a typical construction site has been presented in **Figure-A.** The contractor during the progress of work shall provide, erect and maintain necessary (temporary) living accommodation and ancillary facilities for labor to standards and scales approved by the Engineer of IE. The site must be graded and rendered free from depressions such that water does not get stagnant anywhere. The entire boundary of the site should be fenced all around with barbed wire so as to prevent the trespassing of humans and animals. All temporary accommodation must be constructed and maintained in such a fashion that uncontaminated water is available for drinking, cooking and washing. Safe drinking water should be provided to the dwellers of the construction camps. Adequate washing and bathing places shall be provided and kept in clean and drained condition. Construction camps are to be sited away from vulnerable people and adequate health care is to be provided for the work force. Vehicle parking area is to be made impervious using 75 mm thick P.C.C. bed over 150 mm thick rammed brick bats. The ground will be uniformly slopped towards to adjacent edges towards the road. A drain will take all the spilled material to the oil interceptor.

C. Drinking Water

3. The contractor should provide potable water within the precincts of every workplace in a cool and shaded area, which is easily accessible. All potable water storage facilities must be on a safely raised platform that is at least 1m above the surrounding ground level. Such facilities shall be regularly maintained from health and hygiene point of view. If necessary, water purifier units shall be installed for providing potable water. As far as possible, shallow wells should not be used as potable source of water. However, if water is drawn from any existing well, irrespective of its location from any polluting sources, regular disinfection of the water source (which may include application of lime, bleaching power and potassium permanganate solution) has to be ensured at weekly/fort nightly interval. All open wells will be entirely covered and will be provided with a trap door to prevent accidental fall and contamination from dust, litter etc. The trap door will be kept locked and opened only for cleaning or inspection, which will be done at least once in a month. A reliable pump will be fitted to each covered well. A drain shall be constructed around the well to prevent flow of contaminated water into the well from road, camp or other sources.

4. Contractor's vehicles shall not be allowed to wash in the river / stream / pond. This is toavoid potential pollution from oil residues.

D. Sanitation Facilities

5. Construction camps shall be provided sanitary latrines and urinals. Adequate number of toilets shall be provided separately for men and women depending on their strength. Sewerage drains should be provided for the flow of used water outside the camp. Drains and ditches should be treated with bleaching powder on a regular basis. The sewage system for the camp must be properly designed, built and operated so that no health hazard occurs and no pollution to the air, ground or adjacent watercourses takes place. Compliance with the relevant legislation must be strictly adhered to. Garbage bins must be provided in the camp and be regularly emptied at designated disposal place in a hygienic manner.

6. Portable toilets may be brought to use and the night soil from such units has to be disposed through designated septic tanks so as to prevent pollution of the surrounding areas. All these facilities shall be inspected on a weekly basis to check the hygiene standards.

E. Shelter at Workplace

7. At every workplace, there shall be provided free of cost, four suitable shelter, two for meals and two others for rest, separately for use of men and women laborers. The height of shelter shall not be less than 3 m from floor level to lowest part of the roof. Sheds shall be kept clean and space provided shall be the basis of at least 0.5 m2 per head.

F. Canteen Facilities

8. A cooked food canteen on a reasonable scale shall be provided for the benefit of workers wherever it is considered necessary and should generally conform to sanitary requirements of local medical, health and municipal authorities including such precautionary measures as necessary to prevent soil pollution of the site.

G. First Aid Facilities

9. At every workplace, a readily available first-aid unit including an adequate supply of sterilized dressing materials and appliances shall be provided as per the Factory Rules. Workplaces in remote location and far away from regular hospital shall have indoor health units with one bed for every 250 workers. Suitable transport shall be provided to facilitate taking injured and ill persons to the nearest hospital. At every work place an ambulance room containing the prescribed equipment and nursing staff shall be provided.

H. Health Care Facilities

10. Health problems of the workers should be taken care of by providing basic health care facilities through health centres temporarily set up for the construction camp. The health centre should have at least a doctor, nurses, duty staffs, medicines and minimum medical facilities to tackle first aid requirements or minor accidental cases, linkage with nearest higher order hospital to refer patients of major illnesses or critical cases.

11. The health centre should have MCW (Mother & Child Welfare) units for treating mothers and children in the camp. Apart from this, the health centre should provide with regular vaccinations required for children.

I. Day Care Facilities

12. At every construction site, provision of a day care shall be worked out so as to enable women to leave behind their children. At construction sites where 20 or more women are ordinarily employed, there shall be provided at least a hut for use of children under the age of 6 years belonging to such women. Huts shall not be constructed to a standard lower than that of thatched roof, mud walls and floor with wooden planks spread over mud floor and covered with matting. Hut shall be provided with suitable and sufficient openings for light and ventilation. There shall be adequate provisions of sweepers to keep the places clean. There shall be two maid servants (or aayas) in the satisfaction of local medical, health, municipal or cantonment authorities. Where the number of women workers is more than 25 but less than 50, at least one hut and one maid servant should be provided to look after the children of women workers. Size of cares shall vary according to the number of women workers employed.

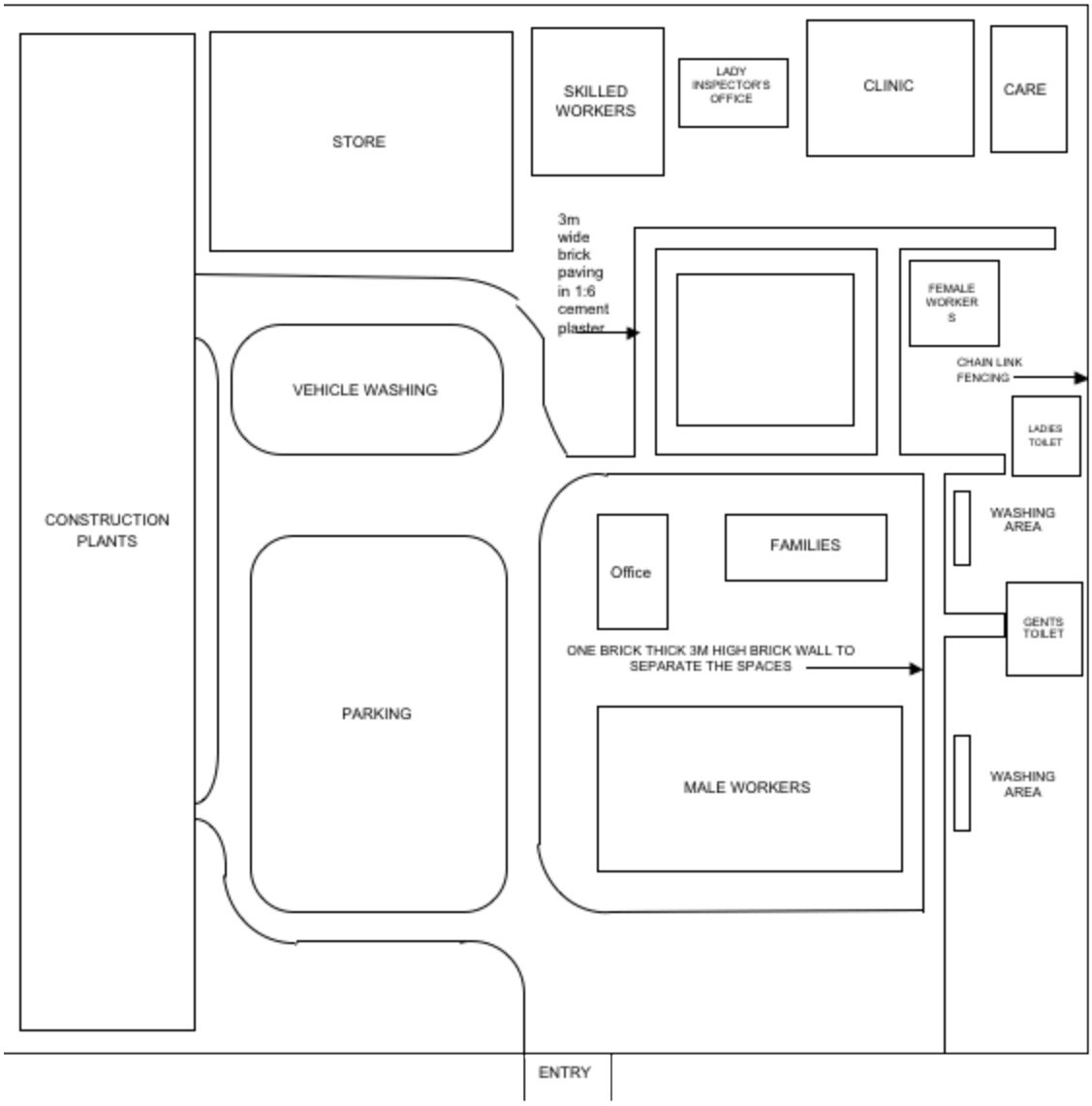


Figure-A Typical Layout of Construction Camp

ANNEX 8.3 GUIDELINES ON SLOPE STABILIZATION

A. Introduction

1. Erosion Control on roads is fundamental for the protection of water quality. Soil stabilization and erosion control practices are needed and should be used in areas where soil is exposed. Bare ground should be covered, typically with grass seed and some form of matting or mulch. This will help prevent erosion and subsequent movement of sediment into river, streams, lakes and ponds. This movement of sediment can occur during and after road construction. Erosion control measures need to be implemented immediately following construction and every time an area is disturbed.

B. Soil Erosion Control

2. Soil erosion is the process of detachment and transportation of soil particles by wind, water principally. Normally non-cohesive soil particles are blown away by wind erosion. The kinetic energy of falling rain drops causes detachment of soil particles and subsequently carried away by surface run-off. Erodibility co-efficient of soil and impact of rain drops are determinant factors in the process. This is guided by the nature of soil (clay content), particle size distribution and soil condition like saturation, density, permeability, plasticity etc. Dislodged soil particles flow down the slope with the overland flow, eroding and destabilizing the soil-body. When the intensity of rainfall increases surface run-off velocity accelerates and facilitates carriage of subsequent particles and ultimately results in disorders in the form of rill to gully and finally to erosion ditches. These disorders will impair slope stability worst if not controlled with proper protective measures.

3. Ground cover is considered as the most suitable solution for erosion protection. Tress, grass and other plant species are natural soil-binders and provide the best natural solution against erosion. In bio-engineering, plants have mainly two functions viz. hydrological and mechanical. Hydrological effects of plants are many such as interception (rain drops strike the leaves first before striking the ground soil), storage (leaves and stems hold water for some time before it eventually reaches the ground), infiltration (stems and shoots roughen and loosen the ground, enabling water to infiltrate more easily) etc. Mechanical function of plant is to reinforce the soil by binding the loose soil particles with its fibrous root system.

4. Bio-engineering is the technique of utilizing vegetation in addressing geotechnical problems. Environmental uncertainties are prompting engineers to favour bioengineering measures. Vegetation as an aid to artificial methods in controlling surficial soil erosion is gaining larger acceptability among engineers all over the world. Growth of appropriate vegetation on exposed soil surface is facilitated by use of natural geotextiles such as **Coir Geotextiles**. Properly designed Coir Geotextiles laid on slopes or any other exposed soil surface provides a cover over exposed soil lessening the probability of soil detachment and at the same time reduces the velocity of surface runoff, the main agent of soil dissociation. Natural geotextiles bios-degrade quicker than man-made counterpart, but facilitate growth of vegetation quicker and better due to its inherent characteristics. Road slope stabilization can range from allowing **native grass (Vetiver grass)** to re-establish on a disturbed slope to building an engineered wall.

C. Role of Coir Geotextile in Slope Stabilization

5. Coir is a biodegradable organic fibre material which is coarse, rigid and strong. The constituents of coir have been found to be mostly cellulose and lignin. Coir fibre is weather resistant and resistant to fungal and bacterial decomposition. The rate of decomposition of coir is much less than any other natural fibre. These characteristics are attributed due to the high lignin content in the fibre. Coir in the form of woven mesh mattings or non-woven stitch bonded blankets are used in engineering applications in the geotechnical field. Due to growing awareness to preserve environment, use of biodegradable natural material has gained popularity. The natural fibre, coir, which has been used in geotextiles for the past 20 years, has already proved its worth.

6. Coir geotextiles are made from coconut fibre extracted from the husk of coconut. Like other polymeric counterparts, coir geotextiles are developed for specific application in civil engineering like erosion control, ground improvement, filtration, drainage, river bank protection, road pavements, slope stability etc. This biodegradable and environment friendly material is virtually irreplaceable by any of the modern synthetic substitutes.

Coir geo-textiles specifications: Grade I- 400g/m^2

Advantages of Coir Geotextile

- The high tensile strength of coir fiber protect steep surface from heavy flows and debris movement
- It can withstand considerable pedestrian movement and vehicular traffic without deterioration
- Easy to install and huge contour of the soil surface due to its heavy weight and ability to absorb water
- Totally Biodegradable, 100% natural
- Water absorbent, thus act as mulch on the surface and as a wick in the soil mantle
- Environmental friendly and aesthetically pleasing and nonpolluting
- Provides excellent microclimate for plant establishment and healthy growth
- The thick and protruding fibers from the yarn render an extra protection against soil erosion and Provide roughness to the surface floor and hold the soil particles in place.
- The coir geo textile gives the grass plenty of room to grow and at the same time provides large number of "CHECK DAMS" per square meter of soil media
- During the manufacturing process of coir yarn, non-chemicals are used
- Holds the seeds and saplings in place
- Allows sunlight to pass through

7. Coir Geotextile is laid on the shoulder and slope surface helped retain the soil particles and prevented detachment of soil particles from the prepared slope. Establishment of vegetation ensured stabilization of the soil on the slope surface. It is a bio-degradable natural geotextile, can conveniently be used for controlling surface soil erosion and help growth of vegetation as a bio-engineering measure. After biodegradation coalesces with the soil and adds nutrient to the soil and fosters growth of vegetation.

D. Role of Vetiver Grass in Slope Stabilization

8. Vetiver grass (Chrysopogon zizanioides) **is native to India.** It has been has been shown to be a simple and economical method to conserve soil by slowing the velocity of water and trapping sediment, filtering out nutrients, and stabilizing steep slopes. In western and northern India, it is popularly known as khus. Several aspects of Vetiver make it an excellent erosion control plant in warmer climates:

- Vetiver grass does not have stolons or rhizomes. It's massive finely structured root system that can grow very fast; in some applications rooting depth can reach 3 to 4m in the first year. This deep root system makes Vetiver plant extremely drought tolerant and difficult to dislodge by strong current.
- Stiff and erect stems, which can stand up to relatively deep water flow
- Highly resistance to pests, diseases and fire
- A dense hedge is formed when planted close together acting as a very effective sediment filter and water spreader
- New roots grow from nodes when buried by trapped sediment. Vetiver will continue to grow up with the deposited silt eventually forming terraces, if trapped sediment is not removed.
- Tolerance to extreme climatic variation such as prolonged drought, flood, submergence and extreme temperature from -14°C to +55°C
- Tolerance to wide range of soil pH from 3.3 to 12.5 without soil amendment
- High level of tolerance to herbicides and pesticides
- Highly efficient in absorbing dissolved nutrients such as N and P and heavy metals in polluted water.
- Highly tolerant to growing medium high in acidity, alkalinity, salinity and magnesium

- Highly tolerant to Al, Mn and heavy metals such as As, Cd, Cr, Ni, Pb, Hg, Se and Zn in the soils
- As typical tropical grass, Vetiver is intolerant to shading. Shading will reduce its growth and in extreme cases, may even eliminate Vetiver in the long term. Therefore Vetiver grows best in the open and weed free environment, weed control may be needed during establishment phase. On erodible or unstable ground Vetiver first reduces erosion, stabilizes the erodible ground (particularly steep slopes), then because of nutrient and moisture conservation, improves its microenvironment so other volunteered or sown plants can establish later. Because of these characteristics Vetiver can be considered as a nurse plant on disturbed lands

- Vetiver is useful to treat pollution due to its capacity to quickly absorb nutrients and heavy metals, and its tolerance to elevated levels of these elements. Although the concentrations of these elements in Vetiver plants is often not as high as those of hyper-accumulators, it's very fast growth and high yield allows Vetiver to remove a much higher volume of nutrients and heavy metals from contaminated lands than most hyper-accumulators.


Planting Vetiver Grass on Coir Mat


Vetiver Grass after 15-20 days of Plantation


Vetiver Grass after 60-90 days of Plantation

- When planted closely together, Vetiver plants form dense hedges that reduce flow velocity, spread and divert runoff water and create a very effective filter that controls erosion. The hedges slow down the flow and spreads it out, allowing

more time for water to soak into the ground.

- Acting as a very effective filter, Vetiver hedges help to reduce the turbidity of surface run-off. Since new roots develop from nodes when buried by trapped sediment, Vetiver continues to rise with the new ground level. Terraces form at the face of the hedges, this sediment should never be removed. The fertile sediment typically contains seeds of local plants, which facilitates their re-establishment.

E. Cost Analysis

9. Cost of slope stabilization using Coir Geo-textile and Vetiver Grass is **Rs. 450/- per square meter**, which includes coir geo-textiles (erosion control blanket) 600 to 700 GSM woven or non-woven type (inclusive of transportation to site), GI hooks of 4 mm diameter U-Shaped point sharp edges of 300 mm length, installation charges, coir mat spreading, cutting, seeds mix broadcasting, over lapping, watering for 7-9 days twice per day and after complete installation of work get the quality certification from the authorized technical agency.

F. Where to Approach

The Karnataka State Coir Co-operative Federation Ltd. (Govt. of Karnataka Enterprise)
#953/A, 2nd Main, 4th Block, Rajajinagar, Bangalore - 560 010
Phone No: 080 – 23154220; Fax No. 080 - 23154231

10. Karnataka State Coir Co-Operative Federation an Enterprise of Government of Karnataka was established in the year 1961 with the main objective of developing coir industry through co-operative movement in Karnataka state.

ANNEX 8.4 GUIDELINES FOR SITING, OPERATION AND RE-DEVELOPMENT OF BORROW AREAS

A. Introduction

1. Potential sources of earth (borrow areas) for the construction of embankment and subgrade were identified on either side of project road. The details of proposed borrow areas investigated with their respective locations; corresponding chainages and lead from nearest point to project road are tabulated below:

Location of Proposed Borrow Areas

S. No.	Chainage of Nearest Point on Project Road (km)	Side	Location / Village Name	Lead From Nearest Point on Project Road (km)	Type of Land	Present Land Use
1.	25+500	LHS	Kanakanagar	4	Govt.	Barren
2.	29+500	RHS	Tippagondanahalli	0.6	Govt.	Barren
3.	33+300	LHS	Tuppagondanahalli	0.1	Govt.	Barren
4.	39+500	LHS	Adakamaranahalli	0.2	Govt.	Barren
5.	45+500	RHS	Tandya	1	Private	Barren
6.	47+700	LHS	Magadi	0.1	Govt.	Barren
7.	54+900	LHS	Vishwanathpura	0.1	Private	Barren
8.	57+350	RHS	Kempasagara	0.3	Govt.	Barren
9.	63+300	RHS	Alesabela	0.2	Govt.	Barren

2. However, borrow areas for the project will be finalized by the Contractor. All provisions stipulated in this guideline shall be strictly adhered to. The finalization of all such locations will depend on the approval given by the Sr. Environmental Specialist of the Independent Engineer (IE) on technical and environmental grounds. This includes on-site verification by the IE to cross-check the correctness of details provided by the Contractor in the prescribed format. Only after receipt of the written approval from the IE, the Contractor shall enter into a formal agreement with landowner.

B. Siting

3. The selection of borrow areas shall be based on environmental considerations apart from civil engineering considerations. Environmental considerations dictate that:

- Borrow areas should be located away from human habitation (1 km away) to avoid breeding of mosquitos and other organisms during monsoon when the borrow areas are flooded.
- Borrow areas should be at a distance of about 1.5 km from ecologically sensitive area i.e. Reserve Forest, Protected Forest, Sanctuary, National Park and any archaeological sites
- Borrow areas should be generally on degraded land unsuitable for any productive purpose. Government or community land should be preferred to private land. Productive agricultural land should not as far as possible, be used

for borrowing earth and where it is used, the productive top soil must be stored and reuse.

- Borrow areas should not, as far as possible, obstruct the natural drainage of the ground and bunds and/or boundary drains should be created on their periphery to restore the flow of natural run off.
- Borrow areas should not be selected near sensitive locations such as banks or beds of rivers or channels, which can adversely affect the river hydrology and hydraulics, or along the road or rail embankment, which, apart from threatening the embankment may enhance the severity of accidents if these happen, or close to public structures such as transmission towers whose foundation can be endangered.
- Borrow area sites must be authorized sites. If located on private land, there should be written consent of the owner in the form of lease agreement permitting the use of the land for borrowing earth. If located on government or community land, the permission should be of the appropriate authority.

4. Avoid locating borrow area close to any road (maintain at least 30m distance from ROW and 10 m from toe of embankment, whichever is higher);

C. Borrow Area Operations

- Excavation in the areas should be planned keeping in view the end use of the borrow area land the shape and dimensions of the area to be excavated from (length, breadth and depth) should be accordingly decided. Generally the depth of excavation should not be deeper than 2 m from the consideration of safely of the humans or animals against accidental fell into the ditch.
- The eventual slope of the excavation should be 2 (H):1(V) from the consideration of safety of the slopes as well as humans.
- There should be safe access to the earth moving equipment and transport vehicles into the borrow areas
- The approach to the borrow areas from the public or private haul roads should have a reasonable design to withstand the movement of transport vehicles.
- Dust palliation measures should be taken to minimise dust pollution on the approach roads (e.g. watering, spraying of lime or cement slurry or bitumen emulsion, etc.)
- Spillage of materials under transit on to the haul roads or main roads through gaps in the transport vehicles should be guarded against buy plugging such gaps. Similarly, Wind blowing of the materials in transit should be checked by suitable covers.
- Where productive agricultural land is used for borrow areas, the top soil in 150 mm thickness should be scrapped, stock piled and re-used for rehabilitation of borrow areas. At least 10% of the temporary land should be earmarked for stockpiling. The top soil should be seeded and mulched to cover the slopes, or any degraded area in thickness between 75 -150 mm.

D. Borrow Area Rehabilitation Plan

5. The borrow area must be rehabilitated after completion of the work and rehabilitation plan should be prepared in advance in consultation with the community. The area shall be restored to a safe and secure area usable to the public enabling safe access and entry to the restored site vy filling the borrow pit floor to approximately the access road level. Some indicative rehabilitation measures could be community water storage facility, pisciculture ponds, recreational spots, landscape enhancement, or rehabilitation by re-vegetation of the borrow area. Where re-vegetation is done, it should be ensured that:

- Vegetative cover is established on all affected land
- Topsoil is placed, seeded and mulched within 30 days of final grading if it is within a current growing season or within 30 days of the start of the next growing season.
- Vegetative materials to be used are grasses, legumes, herbaceous or woody plants or a mixture thereof
- Plant material must be planted during the first growing season following the reclamation phase
- Selection and use of vegetative cover should take into account soil and site characteristics such as drainage, pH, nutrient availability and climate to ensure permanent growth. Choice of plant species for the planting program shall be made in consultation with ecological consultant and local forest department.
- The planning of trees and shrubs results in a permanent stand or regeneration and succession rate, sufficient to assure a 75% survival rate
- The planning results in 90% ground coverage
- The site should be inspected when the planting is completed and again at one year to ensure compliance whit the reclamation plan

E. Borrow Area Documentation

6. Location reference and potential yield: The information as per the table below should be contained in the documentation:

Sample No.	Name of Village	Material Type	Site identification		
			Nearest Chainage (Km)	Left / Right	Offset from nearest Chainage (m)
1	2	3	4	5	6

Approximate Quantity (Cum)				Available land / Terrain	Surrounding Land / Terrain	Remarks
Length (m)	Breadth (m)	Depth (m)	Total (cum)			
7	8	9	10	11	12	13

7. Land use and vegetative cover (exiting)

- Existing land use (agricultural/barren/scrub/grazing/any other type)
- Vegetation /trees to be removed
- Erosion /degradation potential
- Distance and name of the nearest settlement
- Distance from the nearest surface water body
- Drainage pattern of the area
- Distance of the nearest reserve forest / eco-sensitive area (if any)
- Distance of the nearest sacred tree (if any)
- Distance from the nearest school/hospital/primary health center
- Daily / occasional or avenues for generation of income for adjoining community

8. Borrow area and community features

- Area (in Sq. m)
- Type of Access / width / kutcha / pucca etc. from carriageway
- Soil type
- Slope / drainage characteristics
- Water Table of the area or identify from nearest well etc. /ask people
- Land-use type such as barren / agricultural / gazing land
- Social features of settlement / community and its proximity to
- Present use of the borrow area by the community
- Identification of any other community facility in the vicinity of the borrow pit

9. Plans and photographs

- Borrow area site plans showing the land use, habitation, drainage pattern and structures and other physical features such as access roads, haul roads, existing community facilities (roads, schools, play grounds, community facilities, religious places etc.)
- Before and after photographs of the borrow areas.

ANNEX 8.5 GUIDELINES FOR SITING, OPERATION AND RE-DEVELOPMENT OF QUARRYING AND STONE CRUSHING OPERATIONS

A. Introduction

1. Three stone quarries are identified along the project road section and samples are collected and tested. The materials have been tested to ascertain their suitability for road construction and compliance with the specifications requirements. The sampling locations, name of quarry /village and approximate lead distances from project site are tabulated below:

Location of Stone / Coarse Aggregate Material

S. No.	Chainage of Nearest Point on Project Road (km)	Side	Source and Village Name	Lead From Nearest Point on Project Road (km)	Approx. Quantity
1	32+400	LHS	Ganapati Stone Crusher, Mahadevapatna	3.0	Huge
2	44+200	RHS	TJM-AIKYA-JV, Panakanakallu	1.2	Huge
3	80+200	RHS	Balaji Stone Crusher, Tharikare	17.0	Huge

2. Local enquiry suggests that extraction / mining of natural sand is banned in Karnataka state. It is therefore suggested to use manufactured sand which can be obtained by crushing the stone at crusher plant itself, in the pavement construction as well as concreting of the structures. During field investigation **two sources** of manufactured sand were identified and representative samples were collected and tested from these sources. Details of these locations are presented below:

Location of Fine Aggregate Material (Sand)

S. No.	Chainage of Nearest Point on Project Road (km)	Side	Location / Village Name	Lead From Nearest Point on Project Road (km)
1	44+200	RHS	TJM-AIKYA-JV, Panakanakallu	1.2
2	80+200	RHS	Balaji Stone Crusher, Tharikare	17.0

B. Overview

3. A quarry is a type of open-pit mine from which rock or minerals are extracted for building materials, such as dimension stone, construction aggregate, riprap, sand, and gravel. Quarrying causes environmental damages like air and noise pollution, water logging etc. and requires permission from regulatory authorities like mining department, state pollution control board etc. It requires a careful approach in the site selection process, scientific method of quarrying and appropriate measures to redevelop it.

C. Criteria for Locating the Site/s

4. The selection of a quarry is sole responsibility of the contractor and should be undertaken in adherence to the rules & regulations of the authorities. Following criteria should be followed while selecting a quarry site:

- To the extent possible barren land or waste lands shall be preferred during site selection and fertile land and agricultural land shall be avoided.
- There shall be no quarrying of sand in any river bed or adjoining area or any other area which is located within 500 meters radial distance from the location of any bridge, water supply system, infiltration well or pumping installation of any of the local bodies or Central or State Government
- Department or any area identified for locating water supply schemes by any of the Government Department or other bodies.
- Quarry site shall be located at a minimum distance of 1km from any human settlements and 100 meters from any surface water body / natural drainage channel.
- Locate the quarry and crusher at a min. distance of 1.5 km away from forests / wildlife habitats / ecologically sensitive areas
- Access roads to quarry sites must be wide enough for heavy vehicle movement without inconvenience to local traffic.
- After identification of the site the Contractor should fill up the prescribed reporting format and submit the same for approval to the Sr. Environmental Specialist of the Independent Engineer without which any activity shouldn't be started on the site.

D. Finalization of Selected Site/s

5. The selected site/s shall be approved by IE and PIU, after considering the compliance with the EMP clauses. No agreements or payments shall be made to the land owner/s prior to receipt of a written approval from the IE and PIU. Any consequence of rejection prior to the approval shall be the responsibility of the Contractor and shall be made good at his own cost.

E. Setting up of quarrying and Stone Crusher

6. Quarrying involves not only extraction of material (rock) but also crushing and screening that makes the rock suitable for use as construction material. Following are the major parameters to be considered before the start of quarrying and stone crushing operations:

1. Site Preparation

7. The stripping, stacking and preservation of top soil will be mandatory and absolutely no activity should be allowed prior to the satisfactory completion of this conservation measure as per guidelines in EMP. The boundary of the quarry should be demarcated using barbed wire fencing in order to avoid the future dispute over land as well as to avoid accidental trespassing of people. There should be recorded documents of exact no of trees cut. Contour trenches should be dug along the quarry area boundary and at any other appropriate places considering the topography to reduce the surface run off and conserve soil and water. Side slopes shall be

constructed with slope drains at applicable locations to provide drainage and avoid any landslides. All the drainage constructed should be linked to existing drainages in order to avoid flooding and water logging.

2. Setting up of a Quarry Site

8. The layout of a quarry should provide a gravity flow of material from the face to the crusher, from the crusher to the storage bin and from the bin to the hauling equipment. Adequate arrangements should be made for avoiding fugitive emissions from quarry and crusher premises. This will include:

a) housing the noise and dust producing units of the crusher plant in a building with wall of minimum 23 cm thickness and with suitable roofing
b) control of air pollution through provision of in-built dust extraction systems in the crusher unit and all transfer points
c) a chimney of appropriate height for the DG set (as specified by SPCB)
d) water sprinkling facilities for the camp premises
e) facilities to store water required for 3 days use

9. Consent to Operate the crusher unit should be obtained from SPCB under Air (Prevention and Control of Pollution) Act, 1981 before starting the operation.

3. Safety Aspects

- Blasting timings in quarry should be fixed avoiding the rush hours and these timings should be adhered to in order to avoid the conflict between the surrounding communities or population. Provide warning sirens 10 minutes before each explosion as a warning alarm to people in and outside the quarry. Damaged explosives must be disposed-off in a safe manner away from the operational area. Speed of the vehicles around the quarry should be restricted to a low speed in order to reduce the noise pollution and dust generation. Workers should not be exposed to sound of more than 85 – 90 dB for more than eight hours a day and shall be provided with adequate safety wears and personal protective equipment like ear muffs / plugs etc. Fire extinguishers should be provided in the site office.
- Traffic movements should be restricted along the access road around times that children walk to and from school. Proper first aid facilities should be provided within the site office and in case of an accident, quick access to nearby hospital /clinic should be provided.

3. Facilities for Workers

- Potable drinking water should be provided in the site office in a hygienic environment sufficient for all the people.
- Adequate no. of toilets shall be provided for the workers with adequate water supply, proper drainage and effluent treatment system like septic tank with soak

pit. Soak pit should have a sealed bottom, honey comb wall and 75cm thick, 2mm sand envelope around that.

- The sewage system for the camp must be properly sited, designed, built and operated so that no health hazard occurs and no pollution to the air, ground or adjacent watercourses takes place.

4. Waste Disposal

- The Contractor should provide separate garbage bins for biodegradable, non-biodegradable and hazardous wastes in the camps and ensure that these are regularly emptied and disposed-off in a hygienic manner.
- No incineration or burning of wastes shall be carried out by the Contractor.
- The disposal of any biodegradable matter shall be carried out in pits covered with a layer of earth within the camp site. Discarded plastic bags, paper and paper products, bottles, packaging material, gunny bags, hessian, metal containers, strips and scraps of metal, PVC pipe scrubber and poly urethane foam, auto mobile spares, tubes, tires, belts, filters, waste oil, drums and other such materials shall be either reused or sold /given out for recycling.
- POL (petroleum, oil and lubricants) waste shall be disposed-off by transfer only to recycler/ re-refiners possessing valid authorization from the State Pollution Control Board and valid registration from the Central Pollution Control Board.
- Used lead batteries, if any, should be disposed as per the Batteries (Management and Handling) Rules 2001.
- Quarry areas should be protected from illegal dumping of waste by third parties. The overburden should kept as minimum to maximize the commercial efficiency of the quarry, it can be utilized for creating earth bunds to mitigate the noise and visual impacts and also for the site rehabilitation process.
- No quarry waste shall be dumped within a 100 m either side of the road. The overburden should be reused or disposed properly. Site for overburden disposal should be planned within the quarry site or any other appropriate site.

5. Training to Workers

- Workers shall be trained in smooth and safe operation of plants and equipment, their regular maintenance and various safety measures to be followed as well as about the need and importance for adherence to these measures.
- All the drivers should be trained about safe driving and should be made aware about the need to observe caution while plying through access roads, especially during the time when children walk to and from school.
- Conduct education programs with the locals regarding the potential impacts of blasting, blasting warning systems, schedules etc.

6. Information Dissemination

- There should be a sign board of size 6’ x 4’ mentioning the project details and contractor’s details to disseminate the information to the public.

- There should be a second sign board displaying the latest air and noise monitoring data against the standards specified.
- Warning sign boards should be set up at the entrance gate for the public as well as at other required places for the workers to alert them about the nature of operation being undertaken.

7. Other Mitigation Measures

- The quarry should not damage any building, work, property or rights of other persons.
- The quarry should not alter any right of way, well or tank.
- Roads inside the crusher premises should be tarred or concreted.
- Water course, if any, from a higher slope should be properly drained out.
- Strom water drainage shall be provided to prevent water logging and flooding in and around the area.
- The possibility of collecting the storm water in a pit or a tank should be explored so that it can be reused for dust suppression and the dependence on other water sources could be reduced. If this is not possible, the water should be safely channeled out of the quarry without disturbing any nearby human settlement.
- A register should be provided in the camp site for public to record their grievances if any.
- Environmental monitoring (air, noise, surface & ground water) should be conducted on quarterly basis.
- The concerned authority – IE / PIU should regularly review the environmental, health and safety aspects. If any adverse effect on environment, habitat and concern of safety is noticed, appropriate measures should be taken as suggested by IE or should arrange an alternative for road construction materials.
- In the case of existing quarries and additional quarries, the contractor has to ensure that all actions in these quarries are in compliance with EMP.

F. Operation of Quarry Site and Stone Crushing Unit

- No quarrying operation shall be done without the approval from the concerned authority.
- The equipment used in quarry should be wear faced, which extends the equipment life and reduce the demand for spare parts.
- Adopt controlled blasting techniques and conduct quarrying in a skillful, scientific and systematic manner.
- All units should operate only between 6 am and 10 pm. or as specified by SPCB in the consent letter.
- Accessory facilities to be provided in the quarry includes sprinklers to spray water for dousing the dust generation, noise suppressers and rubberized mounting to reduce noise and vibration and tarpaulins or covers over material transporting vehicles.
- Provide sufficient water storage facility for 2 days' use.
- Measures have to be taken to reduce the dust generation during drilling

operation. Deep wetting of drilling zones also to be done by water sprinkling and drilling machine shall be fitted with dust suppression, collection and disposal arrangements.

- To avoid spillage of fuel and lubricants, the vehicles and equipment should be properly maintained and repaired. Maintenance should be carried out on impervious platforms with spill collection provisions.

10. Following conditions regarding sound generation should be complied with in a quarry / crusher unit:

- The sound level (L_{eq}) measured at a distance of 1 m from the boundary of the site shall not exceed 55 dB(A) during day time (6 a.m. to 6 p.m.) and 45 dB(A) during night time (6 p.m. to 6 a.m.).
- The DG set shall be provided with exhaust muffler /acoustic enclosure/acoustic treatment with an insertion loss of minimum 25 dB(A) and its emission levels should be within relevant SPCB guidelines.
- A proper, routine and preventive maintenance procedure for the DG set shall be set and followed in consultation with the DG set manufacturer.

G. Quarry Management Plan

11. Quarry Management Plan shall be documented as follows for each quarrying sites:

Sl. No.	Item	Unit	Details
1.	Name / identity of the location		
2.	Nearest project road Chainage		
3.	Name of the owner		
4.	Area involved	m^2	
5.	Existing land use (verification from land records with Revenue Dept.)		
6.	Land use of the area surrounding the proposed site including a Map		
7.	Access Roads – existing conditions, proposed development and maintenance		
8.	Tree cutting and vegetation clearance if any, along with compensation measures	Nos.	
9.	Arrangement with the owner (agreement with land owner should be attached as an annexure)		
10.	Quantity of material to be quarried	Cum	
11.	Machinery and equipment to be used		
12.	Copy of the Consents to Establish and Operate should be attached as an annexure		
13.	Copy of the license from Mining and Geology, Police and Fire Department		
14.	Conditions laid down in the clearances / licenses and plans to ensure compliance		
15.	Information on whether or not the quarry shall be closed under this project. If yes, the proposed closure and restoration plan.		
16.	Concern of the local people living in the immediate / near vicinity (through dialogue / consultation)		

17.	Photographs showing before and after conditions as well as during operations at regular intervals		
18.	Quarry Site Plan		
19.	Quarry Operation Plan		
20.	Quality Plan		
21.	Safety Plan		
22.	Waste Management Plan		
23.	Restoration and Rehabilitation Plan		
24.	Monitoring Plan		

H. Redevelopment of Quarry Area

12. The main objective of the redevelopment of quarries is to make the area safe and secure place and adapt it to a suitable land use like leisure place or fishing place etc. which is suitable for the physical environment as well as for the community around. Along with the preparation of quarry and crusher management plan the contractor should also prepare a re-development plan, which will be submitted for approval to IE who in turn will be responsible for approving and monitoring these plans. The restoration plan should indicate following points:

- List of structures to be demolished and list of the cleanup activities that needs to be undertaken.
- Presence of facilities that could be put in use by the land owner if it is a leased out private land or community in case of a public property
- The proposed use of the quarry site with a layout plan showing the proposed facilities / improvement measures, list of local plant species that could be planted etc.
- Photographs of the site before and during the quarrying process

13. Possible re-development options include the following:

- Re-vegetation of the quarry to merge with surrounding landscape with reuse of top soil mixed together with farm yard manure.
- Development of exhausted quarries as water bodies, where the quarry pit is developed into pond or a rainwater harvesting structure
- Pits created as a result of blasting could be filled with over burden which are removed and stockpiled in other areas or with construction debris. Top soil should be spread back and trees should be planted along the boundary.
- Tree plantation where ever possible depending on the proposed use, erosion control measures etc. should be taken up as part of the redevelopment plan.

I. De-mobilization of the Site

- The contractor should clear all temporary structures; dispose all building debris, garbage, night soils and POL waste as per the approved debris management plan.
- All disposal pits or trenches should be filled in, disinfected and effectively sealed off.
- Once the re-development plan is implemented and the site is restored, the same should be intimated to IE by the contractor.

- The IE shall ensure that all clean-up and restoration operations are completed satisfactorily and written approval is given to the contractor before the ‘works completion’ certificate is issued / recommended.
- The PIU shall ensure through site inspection that the Contractor and IE have complied with all these provisions.
- The site can then be handed over to the concerned owner or local bodies or for local communities as the case may be.
- Certification / documentation pertaining to approval for clean-up and restoration operations and thereafter handing-over to the owner shall be properly maintained by the Contractor, Supervision Consultant and PIU.

ANNEX 8.6 GUIDELINES FOR SEDIMENT CONTROL

1. Right at the initial stage of the work, the operations such as clearing and grubbing, roadway and drainage excavation, embankment / sub-grade construction, bridges and other structures across, pavement courses and shoulders are undertaken. These activities generate huge wastes and debris, which should not find their way into drainage channels and water courses nor should remain exposed to wind at the site and allowed to erode and contaminate productive soils or generate windblown dust particles in the atmosphere.

2. Erosion and sediment control measures shall, therefore, be planned to prevent soil erosion and sedimentation. These measures may involve temporary measures at construction stage, such as of temporary berms, dikes, sediment basins, slope drains, use of temporary mulches, fabrics, mats, seeding or other control devices .Permanent erosion control measures aim at preventing erosion during the project life cycle and should be planned as a part of the project design. These may involve turfing or pitching the embankment Slopes, turfing / mulching / vegetating the exposed areas, vegetating or reinforcing the cut slopes by appropriate methods such as shot-creting, rock bolting, soil-nailing, gabions etc.

3. Sediment control, whether temporary or permanent, would be mostly project and site specific. However, some of the generic measures shall be as follows.

- Debris generated at construction site must be removed immediately and dumped at the designated dump sites after useful recyclable materials are sorted out, and properly stocked or stacked.
- The site cleared after removal of debris would usually be prone to erosion. These areas should be treated by mulching and other dust palliation measures.
- There could be many mulching options such as seeding top soil and spreading the mulch (organic) to permit growth of grass, or other methods like mulches of tiles, brick bats, stone chips, or any other non-erodible wastes, which cover the exposed soil, allow moisture to be retained within soil and prevent erosion.
- Dust palliation measures by any suitable commercially available dust palliatives, application of water, cement, lime or bitumen emulsion in thin application to bind the dust particles together.
- All slush at construction sites, which after drying up become erodible must be either dredged and removed or treated appropriately in-situ (say by mulching).
- Temporary drains combined with sedimentation tanks should be created at the periphery or edge of the work sites to arrest the sediments brought by rains or construction activities requiring water and discharge only sediment free water into the water courses.

ANNEX 8.7 GUIDELINES FOR SITING AND MANAGEMENT OF DEBRIS DISPOSAL SITE

A. Overview

1. Construction of highways generates huge quantity of building debris which needs to be disposed off in previously identified sites suitable for such an activity. This process entails close scrutiny of the sites with respect to their location and this section details out the criteria to be followed in doing so. Moreover, it also guides the contractor as to how to prepare the site without causing much impact on the surrounding environment.

B. Criteria for Locating the Site/s

2. The locations of debris disposal have to be selected such that:

- The said site shall be selected preferably from barren, infertile lands. In case agricultural land needs to be selected, top-soil stripping, stacking and preservation should be undertaken prior to initiation of any activities.
- Debris disposal site should be at least 200 m away from surface water bodies.
- No residential areas should be located downwind side of the site.
- The site should be minimum 1000 m. away from ponds / lakes or other water bodies, protected areas, forests, wildlife habitats, ecologically sensitive areas, seasonal streams, rivers, canals, flood plains, educational institutions, medical centers, religious sites, cultural or heritage sites and play grounds.
- The local governing body and the community should be consulted while selecting the site.
- The selected site should meet with the local regulatory requirements (including those of SPCB, Municipalities etc.).
- The site should preferably be owned by government so that there is no need to acquire the land for the same.
- After identification of the site the Contractor should fill up the prescribed reporting format and submit the same for approval to the Sr. Environmental Specialist of the Independent Engineer. Any activity on the site can be initiated only after obtaining permission form the IE.

C. Finalization of Selected Site/s

3. The selected site/s shall be approved by Sr. Environmental Specialist of the Independent Engineer and PIU, after considering compliance with the EMP clauses and this guideline. No agreements or payments shall be made to the land owner/s prior to receipt of a written approval from the IE and PIU. Any consequence of rejection prior to the approval shall be the responsibility of the Contractor and shall be made good at his own cost.

D. Disposal Site Management Plan

4. The Contractor after getting approval from the competitive authority for the selected site should submit a detailed Debris Disposal Site Management Plan comprising the following details:

- Details of site: Copy of approved site identification report along with location plan on a village map showing the site, its survey no., access road, project stretch, distance from the project stretch, surrounding features and land use like residences, agricultural land, water bodies etc., photograph of the site showing the topography and other existing features.
- Arrangements within the Camp: A layout plan showing the existing trees, green belt, locations were contour trenches should be dug etc.
- Mitigation Measures: Measures will be undertaken as per the EMP while preparing the site and dumping the waste should be separately listed out.
- Other details: Any other relevant details like copy of approvals / clearances obtained, species wise no. of trees to be cut and the details of top soil to be removed and conserved like quantity, location of storing etc. shall also be provided. All the drawings should have north direction marked in it along with prevailing wind direction. Necessary dimensions and specifications should be provided where ever necessary. The debris site management plan should be submitted to the IE for a written approval before any physical work is undertaken. The IE will carefully examine the proposals in light of the various EMP and regulatory provisions and provide suggestions, as necessary to the contractor who will implement it within the stipulated time period.

E. Setting up of Debris Disposal Site

5. Following steps has to be undertaken while setting up a debris disposal site:

- Top soil conservation has to be undertaken as per the guidelines given in EMP.
- Considering the topography of the site contour trenches should be made along the site boundary to prevent soil erosion.
- Fencing should be provided for the debris disposal site to prevent trespassing of humans and animals into the area as well as to prevent spread of the waste material through action of wind, water, scavengers or rag pickers.
- No of trees cut should be recorded and three times the same should be planted as green belt development or elsewhere as part of the project.
- Provide proper drainage facility so that the run off from the site doesn't contaminate any nearby surface water sources.

F. Redevelopment of Debris Disposal Site

6. Along with the format seeking permission / approval for the disposal site / location from the Independent Engineer, the contractor shall also submit a rehabilitation plan for the area. Following points have to be kept in view while undertaking the rehabilitation measure:

- The dump sites shall be suitably rehabilitated by planting local species of shrubs and other plants.
- Vegetative materials to be used are grasses, legumes, herbaceous or woody plants or a mixture thereof
- Plant material must be planted during the first growing season following the reclamation phase
- Selection and use of vegetative cover should take into account soil and site characteristics such as drainage, pH, nutrient availability and climate to ensure permanent growth. Choice of plant species for the planting program shall be

made in consultation with ecological consultant and local forest department.

- The vegetative cover is acceptable if within one growing season of seeding
- The planning of trees and shrubs results in a permanent stand or regeneration and succession rate, sufficient to assure a 75% survival rate
- The planning results in 90% ground coverage
- Rehabilitation can also include conversion into farm land, playground, parking area, block plantation area etc.
- Care should always be taken to maintain the hydrological flow in the area.

ANNEX 8.8 GUIDELINES FOR PREPARING COMPREHENSIVE WASTE MANAGEMENT PLAN

A. Overview

1. A comprehensive waste management plan shall be prepared by the contractor prior to initiation of any works. The purpose of the plan is to provide standardized procedures for the clearance, removal and disposal of waste generated during the construction work as well as to establish the most efficient and cost effective methods to resolve waste disposal issues.

B. Preparation of Comprehensive Waste Management Plan

2. The Contractor should prepare a Comprehensive Waste Management Plan to be submitted to Sr. Environmental Specialist of the Independent Engineer for approval prior to setting up of construction and labour camp and it should comprise the following details:

- Categorization of waste into degradable, biodegradable and hazardous categories and list out different types of waste that falls in each of these categories
- Estimates about the quantity of waste generated in each category and type of storage units required.
- Detail the provisions for storage and handling of waste until disposed. A plan of the respective camps / areas like construction camp, labour camp etc. to be attached indicating the space allocated for storage and handling of wastes.
- Detail the precautions to be taken while storing, handling and disposing each type of waste, trainings to be imparted to workers to create awareness about waste management.
- Details of each debris disposal site
- Copy of approved site identification report along with location plan on a village map showing the waste disposal sites, its survey no., access road, project stretch, distance from the project stretch, surrounding features and land use (like residences, agricultural land, water bodies etc.), photograph of the site showing the topography and other existing features.
- All staff and workers involved in the highway construction should be imparted training about comprehensive waste management plan including the need for such a plan, its components and measures adopted by the contractor for implementing it. In addition, all personnel involved should be made aware about various steps and measures each of them has to follow so as to ensure the compliance to the comprehensive waste management plan.
- Precautions to be adopted during disposal of waste material

3. The contractor shall take the following precautions during transportation and disposal of waste material:

- A register should be kept for recording the details of the waste generated and their disposal.
- The pre-designated disposal sites should be a part of Comprehensive Solid Waste Management Plan and should be identified prior to initiation of any work on a particular section of the road.

- The contractor will take full care to ensure that public or private properties are not damaged/ affected during the site clearance for disposal of debris and the traffic is not interrupted.
- In the event of any accidental spill or spread of wastes onto adjacent parcels of land, the contractor will immediately remove all such waste material/s and restore the affected area to its original state to the satisfaction of Sr. Environmental Specialist of the Independent Engineer.
- Contractor should ensure that any spoils / materials unsuitable for embankment fill shall not be disposed off near any water course; water body; agricultural land; flood plains, forests etc. pasture; eroded slopes; and in ditches, which may pollute the surrounding.
- Contractor should ensure effective water sprinkling during the handling and transportation of materials where dust is likely to be created.
- Materials having the potential to produce dust will not be loaded beyond the side and tail board level and will be covered with a tarpaulin in good condition.

C. Waste Disposal in Construction Camp

- Concrete flooring and oil interceptors should be provided for hot mix plant area, workshops, vehicle washing and fuel handling area.
- POL (petroleum, oil and lubricants) waste shall be stored safely in separate containers and should be disposed-off by transfer only to recycler / re-refiners possessing valid authorization from the State Pollution Control Board.
- Used lead batteries, if any, should be disposed as per the Batteries (Management and Handling) Rules 2001.
- Water separated and collected from oil interceptor should be reused for dust suppression.
- There should be a register to record the details of the oil wastes generated at the workshops and oil storage areas.
- The Contractor will provide separate garbage bins in the camps and ensure that these are regularly emptied and disposed-off in safe and scientific manner as per the Comprehensive Solid Waste Management Plans approved by the IE.
- No incineration or burning of wastes shall be carried out.
- Discarded plastic bags, paper and paper products, bottles, packaging material, gunny bags, hessian, metal containers, strips and scraps of metal, PVC pipes, rubber and poly urethane foam, auto mobile spares, tubes, tires, belts, filters, waste oil, drums and other such materials shall be either reused or will be sold / given out for recycling.
- Septic tank must be provided for toilets and the sludge should be cleared by municipal exhausters.

D. Waste Disposal in Labour Camp

- The Contractor should provide separate garbage bins in the camps for bio-degradable, non-biodegradable and domestic hazardous waste and ensure that these are regularly emptied and disposed off in safe and scientific manner.
- The disposal of kitchen waste and other biodegradable matter shall be carried out in pits covered with a layer of earth within the camp site to avoid smell and pests. The contractor may use the compost from such wastes as manure in the plantation sites.

- Noon-biodegradable waste like discarded plastic bags, paper and paper products, bottles, packaging material, gunny bags, metal containers, strips and scraps of metal etc. and other such materials shall be either reused or should be sold /given out for recycling.
- No incineration or burning of wastes should be carried out.
- Effluent treatment system like septic tank with soak pits provided for toilets should be sited, designed, built and operated in such a way that no health hazard occurs and no pollution to the air, ground or adjacent watercourses takes place.
- Soak pits must be provided to collect waste water from bathrooms and kitchen.

E. Disposal of Bituminous Waste

- The bituminous waste should be used for development of roads inside the construction camps, haul roads or for filling pot holes in rural roads.
- Non reusable bituminous waste to be dumped in 30 cm thick clay lined pits with the top 30 cm layer covered with good earth for supporting vegetation growth over a period only after obtaining approval of Sr. Environmental Specialist of the Independent Engineer.
- The Contractor will suitably dispose-off unutilized non-toxic debris either through filling up of borrows areas located in wasteland or at pre-designated disposal sites, subject to the approval of Sr. Environmental Specialist of the Independent Engineer.
- Debris generated from pile driving or other construction activities along the rivers and streams drainage channels shall be carefully disposed in such a manner that it does not flow into the surface water bodies.

ANNEX 8.9 GUIDELINES FOR PREPARATION OF TRAFFIC MANAGEMENT PLAN

1. The Contractor shall at all times carry out work on the road in manner creating least interference to the flow of traffic with the satisfactory execution. For all works involving improvements to the existing state highway, the Contractor shall, in accordance with the directives of the Sr. Environmental Specialist of the Independent Engineer (IE), provide and maintain, during execution of the work, a passage for traffic either along a part of the existing carriageway under improvement, or along a temporary diversion constructed close to the state highway. The Contractor shall take prior approval of the IE regarding traffic arrangements during construction.

A. Traffic Safety and Roads Works

- Delineate advance warning zones, transition zones and construction zones at both ends of a work front. Use devices such as regulatory signs, delineators, barricades, cones, pavement markings, lanterns and traffic control lights, reflectors and signal men in appropriate manner round the clock.
- No work front should be 'touched' without putting appropriate safety measures in place. Sr. Environmental Specialist of the Independent Engineer will be responsible to ensure that the permission for any activity is not given without the required safety plan and practices in place.

- Put signage at appropriate locations as per the road construction activity plan to warn the road users, construction vehicles / equipment operators, pedestrians and local residents about the work in progress, speed controls, hindrances / blockages, diversions, depressions etc. in lines with contract requirements and IRC guidelines.

- Signage has to be: (i) simple, easy-to-understand and should convey only one message at a time; (ii) has florescent and reflective properties of the paints; (iii) broad, prominent and with appropriate size of letters and figures; (iv) placed at the appropriate 'point/s' as specified in the IRC guidelines to allow proper stoppage / reaction time to approaching vehicles.
- Express a regret signage for the inconvenience caused and alert about the dangers ahead on account of construction activity.

- Different sign boards shall have a mix of pictorial signs and messages in local language, Hindi and English.

- While using barricades, ensure that traffic is kept away from work areas and the road user is guided to the safe, alternative movement track.
- Ensure that excavation sites are provided with effective barriers and reflecting signage to prevent any accidental approach by vehicles during the day or night.
- Provide proper uniform (light reflecting garments) to flagmen engaged in traffic control at diversions so that they can be singled out from the moving traffic.
- Prevent entry of cattle and wildlife through proper fencing / barricading around the excavation sites.
- Provide wide red and green flags or red and green lights to flagmen for controlling traffic. In high traffic zones and congested areas, use of wireless communication devices with protective headgear and shoes by flagmen has to be ensured to prevent confusion and minimize the risk of accidents.

B. Ensuring Traffic Control

- Where the execution of the works requires temporary closure of road traffic use, the Contractor should provide and maintain temporary traffic diversions. The diversions should generally consist of 200 mm thickness of gravel laid directly upon natural ground and earthworks.
- Where the execution of the works requires single-lane operation on public road, the Contractor should provide and maintain all necessary barriers, warning signs and traffic control signals.
- At the points where traffic is to deviate from its normal path (whether on temporary diversion or part width of the Carriageway) the lane width path for traffic should be clearly marked with the aid of pavement markings and painted drums or a similar device. At night, the passage should be delineated with lanterns or other suitable light source.
- One-way traffic operation shall be established whenever the traffic is to be passed over part of the carriageway inadequate for two-lane traffic. This should be done with the help of temporary traffic signals or flagmen kept positioned on opposite sides during all hours. For regulation of traffic, the flagmen should be equipped with red and green flags and lanterns / lights.
- On both sides, suitable regulatory / warnings signs as approved by the IE shall be installed for the guidance of road users. On each approach, at least two signs shall be put up, one close to the point where transition of carriageway begins and the other 120 m away. The signs should be of design and of reflector type.
- Upon completion of the works for which the temporary traffic arrangements or diversions have been made, the Contractor should remove all temporary installations and signs and reinstate all affected roads and other structures or installations to the conditions that existed before the work started.

ANNEX 8.10 GUIDELINES TO ENSURE WORKER'S SAFETY DURING CONSTRUCTION

1. In order to ensure worker's safety while undertaking various operations / stages of construction many safety measures needs to be followed, which are listed down below:

A. Tree Felling

- Use hard hats during tree felling
- Ensure safe use and storage of tools such as axes, power chain saw, hand saw of different types, HDPE ropes of approved thickness to drag felled trees and logs.
- Keep the saw blades in proper lubrication and sharpened state for efficient workability.
- Determine proper foot and body position when using the implements for felling, cutting and dragging.
- Wear appropriate foot protection
- Avoid cutting overhead branches
- Keep first aid kits ready at the site.
- Determine possible hazards in the area, e.g. electrical or telephone or other utility lines, buildings, vehicles and domestic cattle that may create unsafe work situations.
- Prior to felling, determine the safest direction of fall and orient fixing of ropes and cutting positions accordingly.
- Determine the proper hinge size before directing the fall.
- Keep machineries and workers ready for speedy removal of the tree from the main traffic movement area.
- Keep flag men and warning signal signage at either end of felling area to control movement of traffic and warn passers-by

B. Plant Sites, Construction Camp and Quarry Areas

- Install perimeter fencing
- Ensure good visibility and safe access at site entrances
- Provide adequate warning signs at the entrance and exit, as necessary
- Provide adequate space / area for loading and unloading, storage of materials, plant and machinery
- Display emergency procedure and statutory notices at conspicuous locations
- Provide areas for collecting garbage and other waste material, and also arrange for their regular / periodic disposal.
- Arrange appropriate storage, transportation and use of fuel, other flammable materials and explosives in line with the license requirements obtained from concerned authorities
- Provide defined access roads and movement areas within the site
- Ensure availability of first aid facilities and display notices at various work places showing the location of first aid facilities and emergency contact numbers
- Provide and enforce use of PPE at plant and quarry sites

C. House Keeping Practices

- Provide proper slope in kitchen, canteens, washrooms, toilets and bathrooms for easy and immediate draining of water
- Keep all walkways and circulation areas clear and unobstructed at all times
- Ensure that spillages of oil and grease are avoided and in case of accidental spills, these should be collected immediately
- Use metal bins for collection of oily and greasy rags
- Stack raw materials and finished products out of walkways
- Do not leave tools on the floor or in any location where they can be easily dislodged
- Keep windows and light fittings clean
- Maintain the workplace floors dry and in a non-slippery condition
- Provide and maintain proper drainage system to prevent water logging and unhygienic conditions
- Ensure that protruding nails in boards or walls are moved or bent over or removed so that they do not constitute a hazard to people
- Store all flammable materials in appropriate bins, racks or cabinets with proper cover and labels as required for various products
- Make sure that hazardous / dangerous chemicals are kept in the goods stores with the appropriate labeling, display of the material-safety-data-sheet (MSDS) and other precautionary measures.
- Display 'no smoking' signs in areas with high risks of fire, (e.g. near fuelling areas, diesel /oils / lubricant /paint storage area, hessians, rubber, wood and plastic etc.) in and around working area

D. Safety during Excavation

- The risk of accidents involving people and vehicles remains high in excavated sites. All pits or excavations shall to be barricaded to warn the road users and residents and to avoid any unauthorized entry of persons, children, domestic cattle or wildlife. For deep excavations and culvert construction sites, painted GI sheets, delineators, lamps (as required) and retro-reflective signage shall be used.
- Excavation more than 1.5 m is to be done in steps of minimum 500 mm offsets with plank and stuttering support, as required under contract clauses.
- For excavation in slippery or water logged area, try to dewater the area and spread minimum 150 mm thick sand layer to avoid slipping.
- For excavation for drain, the area should be properly barricaded with sign boards and illumination / lamps for night time safety. In congested stretches, watchmen / guards can also be placed for vigil.
- Snake bites or Scorpion stings during excavation - in areas with vegetation, tall grasses and forest cover, the contractor shall provide the labour with gum boots and gloves. He shall also make snake antidotes available on site. Emergency vehicles should also be kept ready to rush the patient to the nearest hospital.

E. Safety during Some Typical Construction Work

1. Centering and Scaffolding

- Many a times ballies joined together give away due to weak joints. Use of metal scaffolding and centering plates with metal fasteners are the safest and highly

recommended materials for use in all road construction works for ensuring safety, stability and casting of structures. All such scaffolding should be placed on a firm and a level base on the ground for ensuring stability. No wooden scaffolding or bamboo scaffolding is to be used for any casting of heavy (RCC) structural construction as the risk to safety of workers is higher.

- Railings are to be provided along working platforms and ladders for better safety. Nets shall be hung below the scaffolding or structures where work is on-going to prevent fall of debris, stones, bricks, equipment and other heavy to retain soil objects and even workmen, which could be fatal.

2. Form-work for small/light beams and slabs

- The collapse of bottom of the beam that may bring down the slab as well is a risk in such operations, which may injure the labour or supervision staff. Slender ballies without bracing are not be allowed for such works. No concreting should be allowed without bracing at 300 mm above ground and at midway for normal beams and slabs. The bracings should be for the support of beams as well as the slabs.
- Direct ballies support from the ground and the practice of tying planks with binding wire to the steel reinforcement shall not be allowed. A temporary railing and properly based working platforms along the periphery of slab reduces risk to the life of labour and supervision staff.

3. Dismantling of Scaffoldings

- Dismantled materials may fall on passer-by and workers. Workers could also get injured during the removal of such materials. Prior to dismantling of scaffoldings / working platforms, the area of operation should be closed for all outsiders. No one should be allowed within 50 m. from the place of demolition.
- Helmets, safety belts and other PPE must be worn by all the workers engaged in such a work. This work requires careful handling by an experienced supervisor / work force and should be executed with utmost caution. Gradual dislodging and use of PPE is required.

4. Column Reinforcements

- The tendency of bar-benders is to tie the vertical steel with coir rope or 8 mm steel rods as ties on all four sides of the column reinforcements. Reinforcement to columns shall be by welding MS rods with metal scaffolding to keep it in position till the final casting of RCC is done.

5. Falling of Objects or Debris from a Height

- At bridges construction sites (or in work areas at a height above ground level) thick nylon net or hessian barriers shall be used to prevent any splinter, debris, mortar or concrete from falling onto the passersby or workmen around.

6. Site Cleaning

- Throwing of waste materials, broken concrete pieces, brick bats, sand etc. straight from the top of a structure onto the ground can injure a worker or a passerby. Such materials should be brought to the ground with the help of lift or the use of rope over pully with a bucket.

7. Operation of Excavators

- Ensure that excavators are operated by authorized persons who have been adequately trained.
- Prevent any unauthorized use of the excavators.
- Ensure that only experienced and competent persons are engaged in supervising all excavations and leveling activity.
- Check and maintain as per the manufacturer’s manual.
- Issue relevant information, including that related to instructions, training, supervision and safe system of work in writing and provides expert supervision for guidance.
- Ensure that the operation and maintenance manuals, manufacturer's specifications, inspection and maintenance log books are provided for the use of the mechanics, service engineers or other safety personnel during periodic maintenance, inspection and examination.
- During tipping or running alongside the trenches, excavators must be provided with stop blocks.
- Excavators must be rested on firm ground after field operation away from the road
- Locate and identify underground services including telephone cables, OFC cables, sewerage and drainage lines, water supply, electrical cables etc. by checking with all concerned underground utility providers.
- When reversing or in cases where the operator's view is restricted, adequate supervision and signaling arrangements shall be provided.
- Ensure that the type and capacity of the excavator are properly chosen for the intended purposes and site conditions. Never use a machine for any purposes other than it is designed for.
- Check and report for excessive wear and any breakage of the bucket, blade, edge, tooth and other working tools of the excavator and ensure replacement / repair to avoid mishap and break down.
- Check that all linkages / hinges are properly lubricated and linkage pins are secured. Never use improper linkage pins.

8. Operation of Trucks and Dumpers

- Ensure that only trained, authorized and licensed drivers operate the vehicles.
- Switch-off the engine when not in use to save fuel, prevent accidents and unnecessary noise and air pollution.
- Lower the tipping bodies when the machine is unattended, but if it is necessary to leave them in the raised position they should be blocked to prevent their fall by fixing a sturdy support below.
- Carryout periodic servicing as per the manufacturer’s requirements
- All records of maintenance and repairs should be in writing and available for verification.
- Keep the vehicle tidy and the cabin free from clumsy utilities, which might

obstruct the controls and create hazards.

- Follow safe driving principles including speed limits as per traffic signage.
- Avoid carrying additional passengers in the cabin or on the body of the dumper, while in field operation other than the connected workers.
- Provide stop blocks when the vehicle is tipping into or running alongside excavations or when it is parked.
- Do not overload the vehicle.
- Carry only well secured loads and use proper covers and fasteners.

9. Manual Handling and Lifting

- Avoid manual handling of heavy and hazardous objects and chemicals.
- Pre-assess the actual requirement of manpower in case of emergency situations.
- The hazardous and poisonous materials should not be manually handled without proper equipment /gears and prior declaration of the risks needs to be made to the involved workers.
- All concerned persons shall be trained in proper methods of lifting and carrying.
- In all manual operations where groups of workers are involved, a team leader with necessary training to handle the entire work force in unison has to be provided for.
- Watch and ward to control / supervise / guide movement of equipment and machineries, loading and unloading operations, stability of the stockpiled materials and irregularly shaped objects have to be provided for safety and security of workers.
- Carriageway used by the workers must be free from objects, which are dangerous.
- Loading and unloading from vehicles shall be under strict supervision.

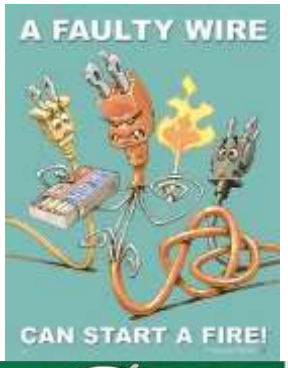
10. Gas Welding

- The welders and welding units should follow all the basic principles of welding for safety and security
- Use face shield to protect the eyes
- Use goggles, particularly when chipping slag and cutting strips.
- Use gloves long enough to protect wrists and forearms against heat, sparks, molten metal and radiation hazards.
- Use high-top boots / gum boots to prevent sparks, splinters, sharp edges of metal and hot welded strips, welding rods, electric cables etc. from injuring the legs.
- Avoid inhaling the noxious fumes and gasses from burning electrodes by using gas masks and screen of the work area to prevent the glare moving outside it.
- Keep the key hung from the regulator control for split seconds operations to stop the valve in

case of any accidental damage or leakage to supply pipeline that may catch fire and cause accidents in case acetylene or LPG cylinder.

- The welding area should have sufficient openings with fixed exhaust ventilators or adequate air flow openings to remove poisonous fumes and gases.
- Take precautions of wearing hard hats or fiber helmets to prevent injury due to fall of any object and accidental injury from projections while welding.
- Welders operating above ground should have adequate safety belt secured to stable platform to prevent accidental fall or injury from the scaffold. All electrical and gas connection lines up to the welder should be sufficiently insulated and protected from sharp edges and sharp objects. These shall not come into contact with hot metal.
- Do not use gas cylinders for supporting work or as rollers. While using LPG or CNG cylinders for welding, follow all safety precautions as has been prescribed by the supplier company.
- Avoid fire hazards and accidents by posting safety supervisors to oversee the activities of workers.
- Do not store explosives, high inflammable materials, loose hanging overhead objects, hot welded strips etc. near gas cylinders.
- Close all valves, switches and circuits while leaving the work place under proper lock and key. In case of mobile units, proper carriage procedure have to be followed for safety and security of men and materials.

F. Electrical Hazards in Construction Areas



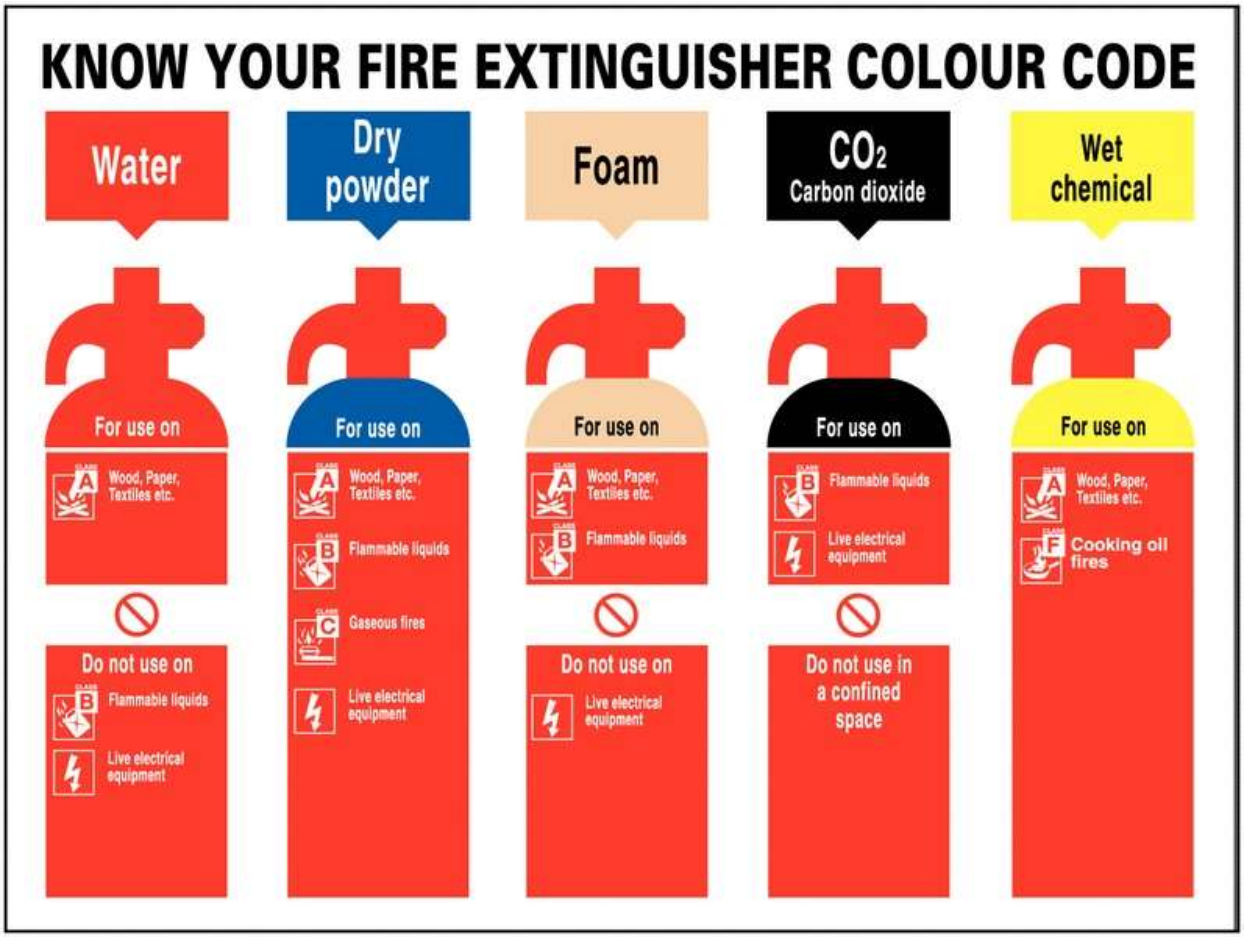
- Statutory warning leaflets / posters are to be distributed / displayed by the Contractor in the vicinity of work sites for the benefit of all workers, officers and supervisors as well as the public, indicating the do's and don'ts and warning related to electrical hazards associated with operations to be executed / in progress.
- All wires shall be treated as live wires
- Report about dangling wires to the site-in-charge and do not touch them.
- Only a qualified electrician should attempt electrical repairs.
- Train all workers about electrical safety.
- Shut down the equipment that is sparking or getting over heated or emitting smoke at the time of operation, if it is not the normal way of working of such machines.
- Inform technical person/s for required maintenance.
- Never used damaged wires for electrical connection
- Demolition, tree felling and removal of overhead transmission lines shall be undertaken with strong, efficient and closely monitored arrangements to avoid accidents.

G. Use and Storage of Gas (LPG)

- Store filled LPG cylinder in a secure area – mark this as a no smoking area.
- Transport, store, use and secure cylinders in upright position
- Ensure proper ventilation at the ground level in locations where LPG is in use.
- Avoid physical damage to the cylinders
- Never weld near the cylinder
- Store empty cylinders secured and upright
- Make sure that the cylinder is closed immediately after use
- Investigate immediately if there is the smell of LPG or gas
- Make sure that there is no other unrelated fire in the vicinity of the cylinder.

H. Fire Safety Practices

- Store flammable material in proper areas having adequate fire protection systems
- Display sufficient warning signs
- Install fire alarm wherever required and test regularly.
- Inspect fire extinguishers regularly and replace as necessary.
- Train selected personal on use of fire extinguishers
- Fire escape route should be kept clear at all times and clearly indicated
- Train workers about the escape route and assembly point/s.
- Carryout fire drill periodically
- When fire breaks out alert all persons through fire alarms or other methods.
- Put off the fire with appropriate fire extinguishers only when you are sure that you are safe to do so.
- Escape if you are in danger through the fire escape route to assembly point.
- Call-up Fire Service
- Fire officers to carryout head count at the assembly point.



I. Noise Hazards and its Control

- Plan camp lay-out in a manner that ensures barriers /buffers between residential / office units and high noise generating zones.
- Use sound meters to measure the level of noise and if it exceeds 75 dB(A), then ensure preventive measures.
- Make personnel aware of noisy areas by using suitable warning signs and insist on use of ear protectors / ear plugs to prevent excess noise affecting the workmen.
- Reduce noise at source by: use of improved equipment; regular and proper maintenance of the machinery as per the manufacturer's manual; by replacing rickety and noisy equipment and machineries.
- Screening locations with noise absorbing material; making changes in the process / equipment; controlling machine speeds; ensuring that two noise-generating machines are not running at the same time close to each other at same location; using cutting oils and hydraulic noise breakers; providing vibration and noise absorbing platform and firm embedding of equipment with fasteners.
- Appoint a competent person to carryout a detailed noise assessment of the site; designate ear protection zone/s; give training / instructions on the necessary precautionary measures to be observed by site personnel including using

suitable type of ear protection equipment.

J. Personal Protective Equipment (General)

- Provision of personal protective equipment has to be made over and above all measures taken for removing or controlling safety hazards on a work site.
- Ensure that sufficient personal protective equipment are provided and that they are readily available for every person who may need to use them.
- The Contractor's Project Manager shall ensure that all persons make full and proper use of the personal protective equipment provided.
- Provide instruction/s and training for the proper use and care of personal protective equipment.
- Ensure that the personal protective equipment is in good condition.
- Train workers to report unintentional damages for replacement and to always keep the personal protective equipment clean. PPE includes, but may not be limited to, hard hats, goggles, ear plugs, gloves, air filters/masks, boots, ropes etc.

1. <u>Eye Protection</u>

- Road construction work sites, quarries and crushers are full of dust particles, sand, splinter, harmful gases, bright light and welding arc lights, which are injurious for the eyes. Therefore, eye protection and adequate lighting in work areas is required. All workers, supervisors and inspection officers and dignitaries coming over for study of works should be compelled to wear eye protecting glasses /goggles properly fitting the eye sockets to prevent damage due to dust, gases and other particles.

2. <u>Head Protection</u>

- Hard hats are compulsory for all workers, supervisors and managers /officials while working and / or inspecting a work sites. Hard hat areas shall be demarcated clearly.

3. Hearing Protection

- Provide ear plugs or ear muffs to the workers and to those who need to get in and out of a high noise area frequently.
- Use re-usable earplugs when the reduction required (15-25 dBA) is not excessive.
- Use earmuffs where a large attenuation of up to 40 dBA is demanded.
- Do not use dry cotton wool for hearing protection because it doesn't provide any such protection.
- Provide disposable ear plugs for infrequent visitors and ensure that these are never re-used.
- Replenish ear plugs from time to time for those who need to work continuously for a long period in a high noise area/s.
- Use ear muffs with replaceable ear cushions because they deteriorate with age or may be damaged in use.
- Avoid wearing spectacles with ear muffs. Use soap and water or the recommended solvent for cleaning ear muffs.

4. Respiratory (Protective) Equipment

- Wear suitable masks for protection when there is a potential for small particles entering the lungs, e.g. emptying of cement bags, working at crusher sites etc.
- Provide training to all persons using the masks / respirators for their correct fitting, use, limitations and symptoms of exposure.
- Clean and inspect all respirators before and after use
- Store respirators properly when not in use

5. Safety Footwear

- Wear suitable footwear for work
- Wear suitable safety shoes or ankle boots when working anywhere where there is high risk of foot injuries from slippery or uneven ground, sharp objects, falling objects etc.
- All safety footwear, including safety shoes, ankle boots and rubber boots, should be fitted with steel toecaps.
- Avoid wearing flip flops, high heeled shoes, slippers, light sport shoes in situations where there is a risk of foot injury and keep shoelace knots tight.

6. Hand Protection

- Wear suitable gloves for selected activities such as welding, cutting and manual handling of materials and equipment.
- Do not wear gloves where there is a risk of them becoming entangled in moving parts of machinery.
- Wash hands properly with disinfectant soap and clean water before drinking or eating.

- Wash hands immediately after each operation on site when the situation warrants.

K. First Aid

- Provide first aid boxes at every work site in a cool and shaded place.
- Ensure that training on the use of the first aid box is provided to at least every supervisor on the site.
- Display the list of persons along with their contact numbers who are trained on providing first aid.
- Ensure that every first aid box is marked "First Aid" in English and in local language.
- Check for expiry dates and replace the contents, as necessary.
- Maintain a register on health records including injuries / accidents.

L. Accident Investigations

- Carryout the investigation/s as quickly as possible
- Investigation should be carried out both internally as well as through third party.
- Conduct interviews with as many witnesses as necessary including the affected persons and supervising officials.
- Do not rely on any one / limited source of evidence.
- Check all the log books, stock registers, issue registers and movement registers on site
- Safety regulations, traffic signals and signal men activities, signage, as well as other field positions and keep a record of all investigations through audio-visual and electronic medium for presenting an evaluation of the incident/s.
- After completion of the investigation / enquiry, a summary of the facts recorded, sequence of happenings, persons-in-charge, persons examined, equipment and machineries tested, follow-up of action as per legal requirements, copy of station diary entry, hospital entry, safety regulations etc. to be prepared with a comparative analysis for proper assessment.

ANNEX 8.11 GUIDELINES FOR STORAGE, HANDLING, USE AND EMERGENCY RESPONSE FOR HAZARDOUS SUBSTANCES

A. Handling Hazardous Substances (including Chemicals)

- As far as practicable the hazardous materials will be stockpiled under proper mechanical loading, unloading and stacking aided by manual labour where necessary.
- Exercise great care in the storage and use of chemicals because they may be explosive, poisonous, corrosive or combustible.
- Separate different chemicals physically and store accordingly after proper labeling.
- Stock taking of all hazardous will be mandatory together with enforcement of manufacturer's or supplier's safety standard/s and drill exercises.
- New and less known chemicals and building materials, for which toxicological studies are wanted, need to be properly evaluated prior to their inclusion in the materials list.
- All containers should be clearly labeled to indicate contents.
- Maintain the Material Safety Data Sheet of all chemicals for reference on safety precautions to be taken and the use of suitable PPE.
- Ensure use of correct personal protective equipment before allowing workers to handle chemicals.
- When opening containers, ensure holding of a rag over the cap / lid or use of safety gloves, as some volatile liquids tend to spurt up when released.
- Eye fountain, emergency shower and breathing apparatus should be available near the workplace.
- Ensure immediate medical attention in case of spill / splash of a chemical.
- Safety instructions for handling emergency situations shall be displayed prominently at both the storage and use locations.

B. Refueling / Maintenance procedure

- Truck or suitable containers will bring in all fuel and fluids. There will be no storage of fuel, oil or fluids within 200m of a water line.
- Prior to re-fueling or maintenance, drip pans and containment pans will be placed under the equipment. Absorbent blankets may also be required to be placed under the equipment and hoses where there is a possibility of spillage to occur.
- All used oils or fluids will be properly contained and transported to appropriately licensed (authorized) disposal facilities;
- Following re-fueling and maintenance, the absorbent blankets (if any) and spill pans will be picked up and the fuel truck or container moved outside of the 200m wide area.

C. Emergency Spill Procedure

1. The applicable emergency spill procedure as outlined below and / or as directed by the manufacturer / supplier shall be followed:

a. Spill Procedure (inside the stream)

2. In the case of a spill, overflow or release of fluid into the stream waterway (whether water is flowing during the spill or not), do what is practical and safely possible to control the situation, then get help.

b. Stop the flow

- Stop the release into the stream waterway
- Shutdown equipment
- Close valves and pumps
- Plug hoses

c. Remove Ignition sources

- Shut off vehicles and other engines
- Do not allow tiger torches, vehicles, smoking or other sources of ignition near the area. Keep a fire extinguisher on hand but keep it a safe distance away from the potential ignition source (if a fire starts, the extinguisher must be easily accessible)

d. Contact the Environmental Officer and initiate emergency response

- Notify the site supervisor and the Contractor's Environmental Officer as soon as possible
- The Environmental Officer will review the situation and decide if emergency services like fire brigade are required
- Appropriate parties to be notified of the spill are:
  - The contractor's Project Manager
  - The Engineer through his designated Environmental Officer
  - The Client
  - Regulatory Agencies like Pollution Control Board, Municipal Authorities, as applicable.
  - Site safety Officer

e. Cleanup and Disposal

- Emergency Services will be engaged for the containment, cleanup and disposal of contamination release into the environment.

f. Reporting

- The Contractor's Environmental Officer will document the event and submit repots to the Engineer, the client and appropriate regulatory agencies like the Pollution Control Board.

g. Procedure Review

- The Engineer will review the report, determine if changes are required to be incorporated in the plan of activity under the revised guidelines and recommendation/s that have been suggested by the technicians / manufacturer / supplier / fire brigade / SPCB / Environment Expert of the PIU, as the case may be.

h. Spill Procedure (on Land)

3. In the case of a spill, overflow or release fluid onto land, do what is practical and safety possible to control the situation and then get help.

a) Stop the flow

- Stop the release into the waterbody
- Shutdown equipment
- Close valves and pumps
- Plug hoses

b) Remove Ignition sources

- Shut off vehicles and other engines
- Do not allow tiger torches, vehicles, smoking or other sources of ignition near the area. Keep a fire extinguisher on hand but keep it a safe distance away from the potential ignition source (if a fire starts, the extinguisher must be easily accessible)

c) Contain the Spill

- Dike around the spill to contain the material
- Spread absorbent or place a spill blanket on the spill
- Enlist the help of personnel on site
- Notify your supervisor as soon as possible

d) Notification

4. Appropriate parties to be notified of the spill are

- The Contractor's Project Manager
- The Engineer through his designated Environmental officer
- The Client
- Regulatory Agencies like Pollution control Board, Municipal Authorities, as applicable
- Site Safety coordinator

5. Cleanup and Disposal

- The Engineer's Environmental officer will ensure that a proper cleanup and disposal method is determined. Absorbent pads will soak up the spilled material. The pads will be contained and removed from site for disposal at a licensed (authorized) facility.

6. Reporting

- The Contractor's Environmental Officer will document the event and submit reports to the Engineer, the Client and appropriate regulatory agencies like the Pollution control Board(s)

7. Procedure Review

- The Engineer will review the report, determine if changes are required to procedures and recommend implementation of all required changes.

ANNEX 8.12 TREE PLANTATION STRATEGY

A. Avenue Plantation

1. The greenbelt development aims for overall improvement in the environmental condition of the project area. Greenbelt development along the road addresses the loss of flora due to the execution of the proposed project. The other objectives are to combat soil erosion, enhance greenery in the area, to control air/noise pollution, mitigate climate change, maintain and improve the ecological and environmental balance.

2. Trees bind soil and control erosion, attract birds/ bees, provide shades, cooling effect and provide aesthetic value to the surroundings. Green belts are also effective mode to control air pollution, where green plants form a surface capable of absorbing air pollutants and forming a sink of pollutants. Leaves with their vast area in a tree crown, absorbs pollutants on their surface, thus effectively reduce pollutant concentration in the ambient air.

Specifications for Plantation

Items	Description
No. of Rows	1 row on each side of road outside drain line
No. of trees per Km	200
Spacing between the plants	10 m
Size of Pits	60 x 60 x 60 cm
Height of Plant	1.5 to 2m
Age of Plant	Not less than 2 Years

***Plantation cost includes maintenance for 5 years.*

3. Tree species attract birds, insects and butterflies and wildlife. Species such as *Tamarindus indica*, *Ficus microcarpa, Zizyphus mauritiana*, *Pongamia Pinnata*, *Aegle marmelos, Syzygium cumini*, *Annona squamosal etc* shall be preferred for plantation near Forests to support the wildlife dwelling the area.

4. Provision for plantation near settlements/urban periphery to improve aesthetic value and pollution sink, species such as *Azadirachta indica*, *Dalbergia sisoo Cassia fistula, Peltophorum pterocarpum, Bauhinia racemosa, Delonix regia etc*. List of tree species suitable for plantation along the road is given below:

.

List of Tree species suggested for Plantation

S.No.	Scientific name	Common Name
1.	*Albizia amara*	Chigare
2.	*Albizia lebbeck*	Sirish
3.	*Annona squamosa*	Custard Apple
4.	*Azadirachta indica*	Neem
5.	*Bauhinia racemosa*	Kachnar
6.	*Butea monosperma*	Palash
7.	*Cassia fistula*	Amaltas
8.	*Cassia siamea*	Kassod

S.No.	Scientific name	Common Name
9.	*Dalbergia sissoo*	Seesham
10.	*Delonix regia*	Gulmohar
11.	*Ficus benghalensis*	Banyan
12.	*Ficus microcarpa*	Indian Laurel
13.	*Ficus mysorensis*	Goni Mara
14.	*Ficus religiosa*	Peepal
15.	*Mangifera indica*	Mango
16.	*Peltophorum pterocarpum*	Radhachura
17.	*Phoenix sylvestris*	Khajur
18.	*Polyalthia longifolia*	Ashok
19.	*Pongamia pinnata*	Karanj
20.	*Syzigium cumini*	Jamun
21.	*Tamarindus indica*	Imli
22.	*Terminalia arjuna*	Arjun
23.	*Ziziphus mauritiana*	Ber

B. Protection & Precautionary Measures

- Plantation activity should be carried out in monsoon season.
- All plants supplied must be planted within three days of removal from the nursery.
- The plants must be watered daily in initial stages; watering 2-3 times a week is a must.
- 2 kg of compost / manure is suggested for each pit before plantation.
- To ensure better growth and survival of plants, surface should have sufficient soil (upto 45cm depth).
- Nurseries can be developed by local habitants with technical guidance from Forest Department so that saplings are available locally.
- Continuous monitoring of plant growth, immediate replacement of causalities, supplementation of nutrients, rescheduling watering regime are important aspects for survival of the plantation.
- Fencing of single row plantation shall be done by using iron/brick/cement guards.
- Progress of planting and status of plantation shall be monitoring on continuous basis for 5 Years.
- The survival rate of sapling should be maintained at 90% after raising the plantation with normal shape and size. Dead sapling shall be replaced.

ANNEX 8.13 REPORTING FORMAT FOR IDENTIFICATION OF CONSTRUCTION CAMP SITE

(Report to be prepared by the Contractor)

Sl. No.	Project Details	Information		
1.	Name and address of the Contractor			
2.	Contact details of the Contractor			
3.	Name of Project Road			
4.	Stage of the Project			
5.	Site Details	Information		
6.	Name of the Village		Panchayat	
7.	Name of the Taluk		District	
8.	Chainage (km)		Side	LHS/RHS
9.	Area of site		Current land use	
10.	Ownership of the land	Owned/Leased	Survey No.	
11.	If leased, name, address and contact details of owner			
12.	Distance from nearest settlement			
13.	Distance from surface water course or body			
14.	Distance from Ecologically Sensitive Areas			
15.	Width of access road			
16.	No trees with girth > 0.3m			
17.	No of trees to be cut			
18.	Is top soil conservation required (Yes/ No)			
List of Enclosure		Location Map		
Remarks				

Submission Details	Submitted by Contractor	Approved by: Sr. Env. Specialist of IE
Signature		
Name		
Designation		

ANNEX 8.14 REPORTING FORMAT FOR SETTING-UP OF CONSTRUCTION CAMP

(Report to be prepared by the Contractor)

Name of Project Road: _____

Construction Stage Report: Date_____

Month: _____

Year: _____

(Site Layout of Construction camp and working drawings of dwelling units with allied facilities to be attached with format)

Format to be submitted before target date of establishing camps

Sl. No	Item	Unit	Details	Remarks by CSC if any
1	Detail of item camp			
	Size of Camp	m x m		
	Area of Camp	Sq.m		
	Distance from nearest settlement			
	Distance from the nearest water source	Type / Size / Capacity / Present Use / Ownership		
	Date of camp being operational dd / mm / yy			
	Present land use			
	No of trees with girth > 0.3m			
	Details of Storage area (Availability of impervious surface)	m x m		
	Availability of separate waste disposal	Cum		
2	Details of topsoil stacking			
	Quantity of top soil removed	Sq.m		
	Detail of storage of topsoil	Describe stacking arrangement		
3	Details of workforce	Nos.		
	Total No of Laborers	Nos.		
	Total no of Male Workers	Nos.		
	No of Male Workers below 18 years of age	Nos.		
	Total No of Female Workers	Nos.		
	No of Female workers below 18 years of age	Nos.		
	No of children	Nos.		
4	Details of dwelling units			
	No of dwellings/huts			
	Minimum Size of Dwelling	m x m		
	No. of openings per dwelling	Nos.		
	Minimum size of opening	m x m		
	Walls	Specifications		
	Roofing	Specifications		
	Flooring	Specifications		
	Drinking Water Tank	Specifications		

Sl. No	Item	Unit	Details	Remarks by CSC if any
	Capacity of Drinking Water Tank	Cum		
	Size of Drinking Water Tank	m x m		
	Total no of WC	Nos.		
	No of WCs for female workers	Nos.		
	Minimum Size of WC	m x m		
	Total No of Bathrooms for female workers	Nos.		
	Size of septic tank for WC / Baths	m x m		
	Capacity of Water Tank for WCs / Bathrooms and general purpose			
	Fencing around camp	Yes / No		
5	Details of facilities			
	Availability of security guard 24 hrs. a day	Yes / No		
	Details of First Aid Facility	Yes / No		
	Availability of Dav Care Centre	Yes / No		
	Availability of dust bins (capacity 60ltr)	Nos.		

Remark

Submitted

Signature

Name

Designation

Contractor

Approved

Signature

Name

Sr. Environmental Specialist

Independent Engineer

ANNEX 8.15 REPORTING FORMAT FOR ESTABLISHMENT OF HOT MIX PLANT / BATCH MIX PLANT

(To be submitted by the Contractor for taking permission from IE)

Name of Project Road: _____

Date_____

Sl. No	Location Details					Area (m^2)
	Name of Village	Chainage (Km)	Side (LHS/RHS)	Latitude and Longitude	Haul Road Length (m)	

Distance from nearest Water Course (m)	Distance from nearest Settlement (m)	Existing Land Use	Prevalent Wind Direction	Whether in Up Wind Direction from Settlement (Y/N)	Approved by EO (Y/N)	Remarks, if any

Submitted

Signature

Name

Designation

Contractor

Approved

Signature

Name

Sr. Environmental Specialist

Independent Engineer

ANNEX 8.16 REPORTING FORMAT FOR IDENTIFICATION OF BORROW AREAS

(Report to be prepared by the Contractor)

Sl. No.	Project Details	Information		
1.	Name and address of the Contractor			
2.	Contact details of the Contractor			
3.	Name of Project Road			
4.	Stage of the project			
5.	Site Details	Information		
6.	Name of the Village		Panchayat	
7.	Name of the Taluk		District	
8.	Chainage (km)		Side	LHS/RHS
9.	Area of site		Current land use	
10.	Ownership of the land	Owned/Leased	Survey No.	
11.	If leased, name, address and contact details of owner			
12.	Distance from settlement			
13.	Distance from surface water course or body			
14.	Distance from Ecologically Sensitive Areas			
15.	Width of access road			
16.	No of trees with girth > 0.3m			
17.	No of trees to be cut			
18.	Is top soil conservation required (Yes/ No)			
List of Enclosure		Location Map		
Remarks				

Submission Details	Submitted by Contractor	Approved by: Sr. Env. Specialist of IE
Signature		
Name		
Designation		

ANNEX 8.17 REPORTING FORMAT FOR ESTABLISHMENT OF BORROW AREA

(To be submitted by the Contractor for taking permission from IE)

Name of Project Road: _____

Date_____

Sl. No	Location Details					Area (m^2)	Land Use	
	Name of Village	Chainage (Km)	Side (LHS/RHS)	Latitude and Longitude	Haul Road Length (m)		Before	After

Distance from nearest Water Course (m)	Distance from nearest Settlement (m)	Quantity of available material (cum)	Type of material	No. of Trees to be felled	Approved by EO (Y/N)	Remarks, if any

Attach Photograph of proposed site, location map, agreement etc.

Re-development Plan:

Remarks

Submitted	Approved
Signature	Signature
Name	Name
Designation	Sr. Environmental Specialist
Contractor	Independent Engineer

ANNEX 8.18 REPORTING FORMAT FOR IDENTIFICATION OF QUARRY AND STONE CRUSHER SITE

(Report to be prepared by the Contractor)

Sl. No.	Project Details	Information		
1.	Name and address of the Contractor			
2.	Contact details of the Contractor			
3.	Name of Project Road			
4.	Stage of the project			
5.	Site Details	Information		
6.	Name of the Village		Panchayat	
7.	Name of the Taluk		District	
8.	Chainage (km)		Side	LHS/RHS
9.	Area of site		Current land use	
10.	Ownership of the land	Owned/Leased	Survey No.	
11.	If leased, name, address and contact details of owner			
12.	Distance from settlement			
13.	Distance from surface water course or body			
14.	Distance from Ecologically Sensitive Areas			
15.	Width of access road			
16.	No of trees with girth > 0.3m			
17.	No of trees to be cut			
18.	Is top soil conservation required (Yes/ No)			
List of Enclosure		Location Map		
Remarks				

Submission Details	Submitted by Contractor	Approved by: Sr. Env. Specialist of IE
Signature		
Name		
Designation		

ANNEX 8.19 REPORTING FORMAT FOR IDENTIFICATION OF DEBRIS DISPOSAL SITE

(Report to be prepared by the Contractor)

Sl. No.	Project Details	Information		
1.	Name and address of the Contractor			
2.	Contact details of the Contractor			
3.	Name of Project Road			
4.	Stage of the project			
5.	Site Details	Information		
6.	Name of the Village		Panchayat	
7.	Name of the Taluk		District	
8.	Chainage (km)		Side	LHS/RHS
9.	Area of site		Current land use	
10.	Ownership of the land	Owned/Leased	Survey No.	
11.	If leased, name, address and contact details of owner			
12.	Distance from settlement			
13.	Distance from surface water course or body			
14.	Distance from Ecologically Sensitive Areas			
15.	Width of access road			
16.	No of trees with girth > 0.3m			
17.	No of trees to be cut			
18.	Is top soil conservation required (Yes/ No)			
List of Enclosure		Location Map		
Remarks				

Submission Details	Submitted by Contractor	Approved by: Sr. Env. Specialist of IE
Signature		
Name		
Designation		

ANNEX 8.20 REPORTING FORMAT FOR SAFETY CHECKLIST

(Report to be prepared by the Contractor)

1. Name of the Project Road
2. Contract No.
3. Name of the Contractor
4. Name of Safety Officer
5. Date of Inspection
6. Location description: Location-1_____; Location-2_____

Particulars	Location-1			Location-2			Remarks
	A	B	C	A	B	C	
General							
House Keeping							
▪ Stacking of Material							
▪ Passageway							
▪ Lighting							
▪ Ventilation							
▪ Others							
Electrical							
▪ Switches							
▪ Wirings							
▪ Fixed Installation							
▪ Portable Lighting							
▪ Portable Tool							
▪ Welding Machine							
▪ Others							
Fire Prevention							
▪ Fire Fighting Appliance							
▪ Dangerous Goods Store							
▪ Gas Welding Cylinders							
Others							
▪ Dust Control							
▪ Noise Control							
▪ First Aid Equipment							
▪ Washing Facility							
▪ Latrine							
▪ Canteen							

Particulars	Location-1			Location-2			Remarks
	A	B	C	A	B	C	
Provision of Personal Protective							
▪ Helmet							
▪ Eye Protector							
▪ Ear Protector							
▪ Respirator							
▪ Safety Shoes							
▪ Safety Belts							
▪ Others							

A = Adequate at the time of Inspection
B = Needs Improvement
C = Needs Immediate Attention

ANNEX 8.21 REPORTING FORMAT FOR ROAD SAFETY MEASURES DURING CONSTRUCTION

(Report to be prepared by the Contractor)
One time reporting before commencement of construction (zone wise)

1. Name of the Project Road
2. Contract No.
3. Name of the Contractor
4. Name of Safety Officer
5. Date of Inspection
6. Location description: Location-1_____; Location-2_____

Sl. No.	Item	Unit	Compliance	Remarks
Details of Construction Zone				
1.	Length of Construction Zone			
2.	Distance between this and next construction zone			
3.	Length of work sub zone in urban stretch (should be <2 km)			
4.	Length of work sub zone in rural stretch (5-10 km)			
5.	Distance between two work sub zones			
Signage's in Construction Zones				
1.	Sign saying 'Men at Work' 1 km ahead of transition sub zone			
2.	Supplementary sign saying diversion 1 km provided			
3.	Sign saying 'Road Closed ahead' provided			
4.	Compulsory Right Turn /Left sign provided			
5.	Detour sign placed			
6.	Sharp deviation sign placed at end of advance warning sub zone			
Signage in Transition Sub Work Zone				
1.	Signage saying 'Keep Right / Left' provided			
2.	Delineators placed along length of transition			
Signage in work sub zone				
1.	Hazard Marker placed where railing for CD structure on diversion starts			
2.	Barricade on either side of work sub zone			
Signage in Termination sub zone				
1.	Sign for indication of end of work zone 120 m from end of termination sub zone			
Road Delineator				
1.	Roadway indicators provided			
2.	Hazard Makers provided			

Sl. No.	Item	Unit	Compliance	Remarks
3.	Object Makers Provided			

Submitted

Signature

Name

Designation

Contractor

Approved

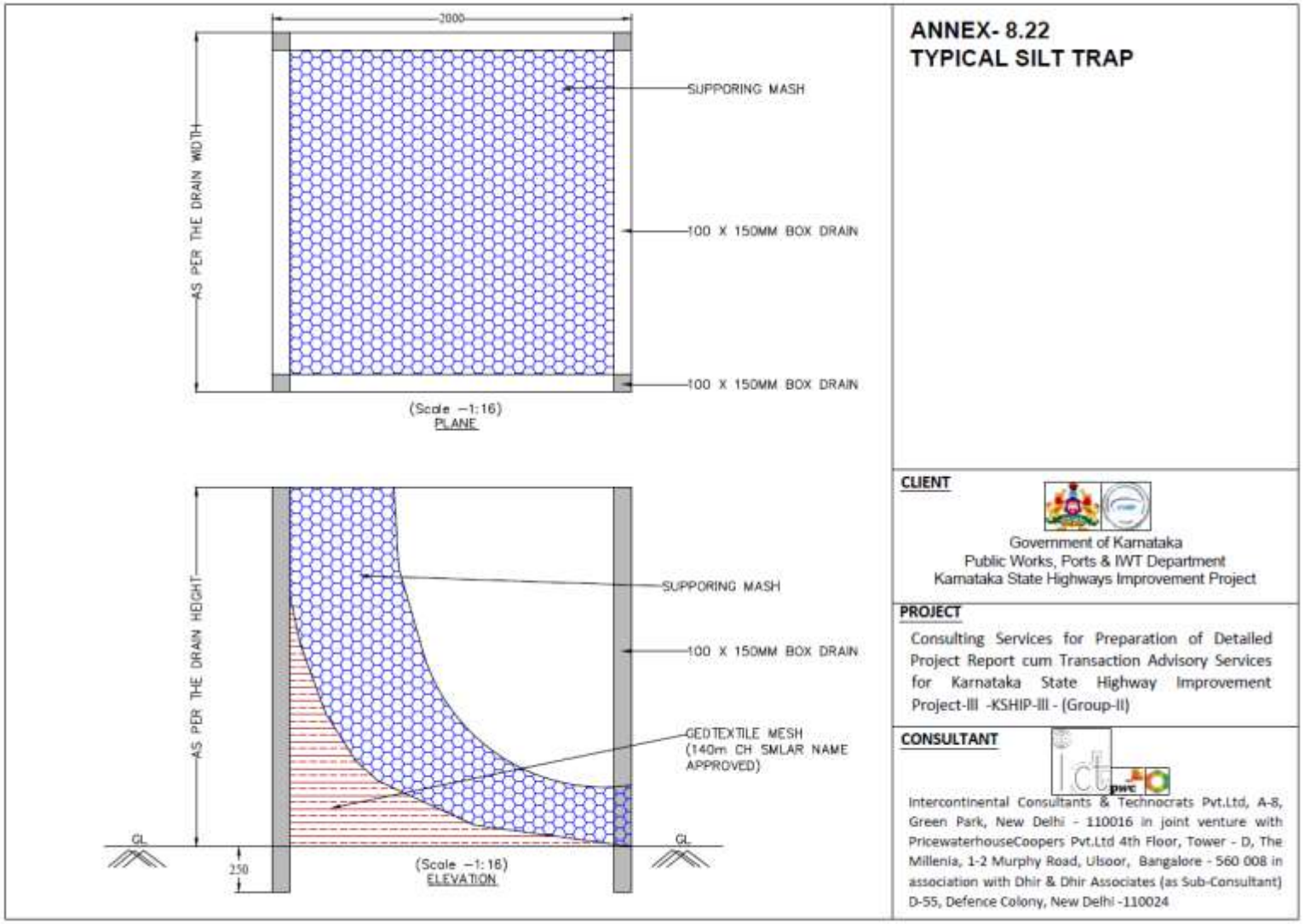
Signature

Name

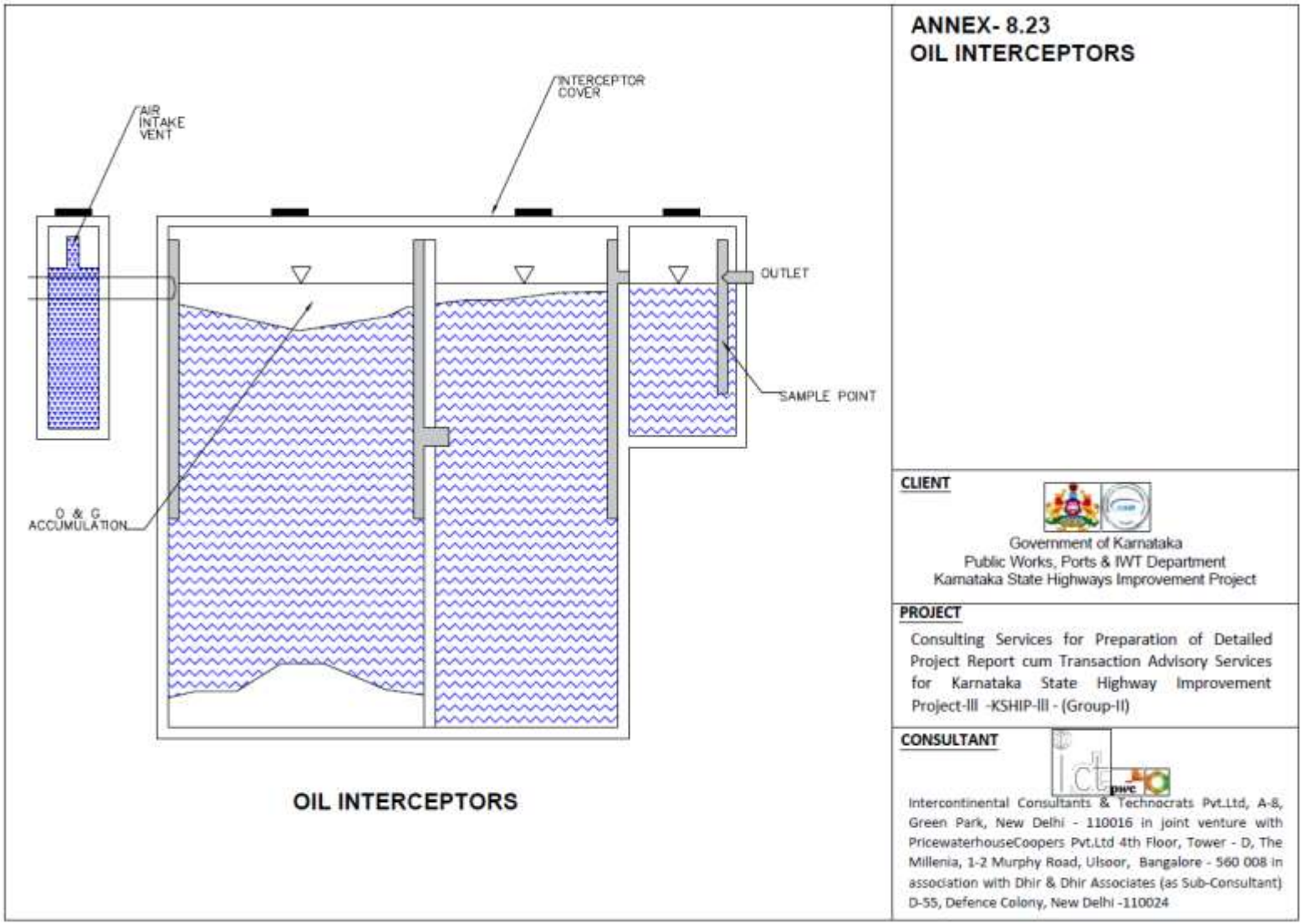
Sr. Environmental Specialist

Independent Engineer

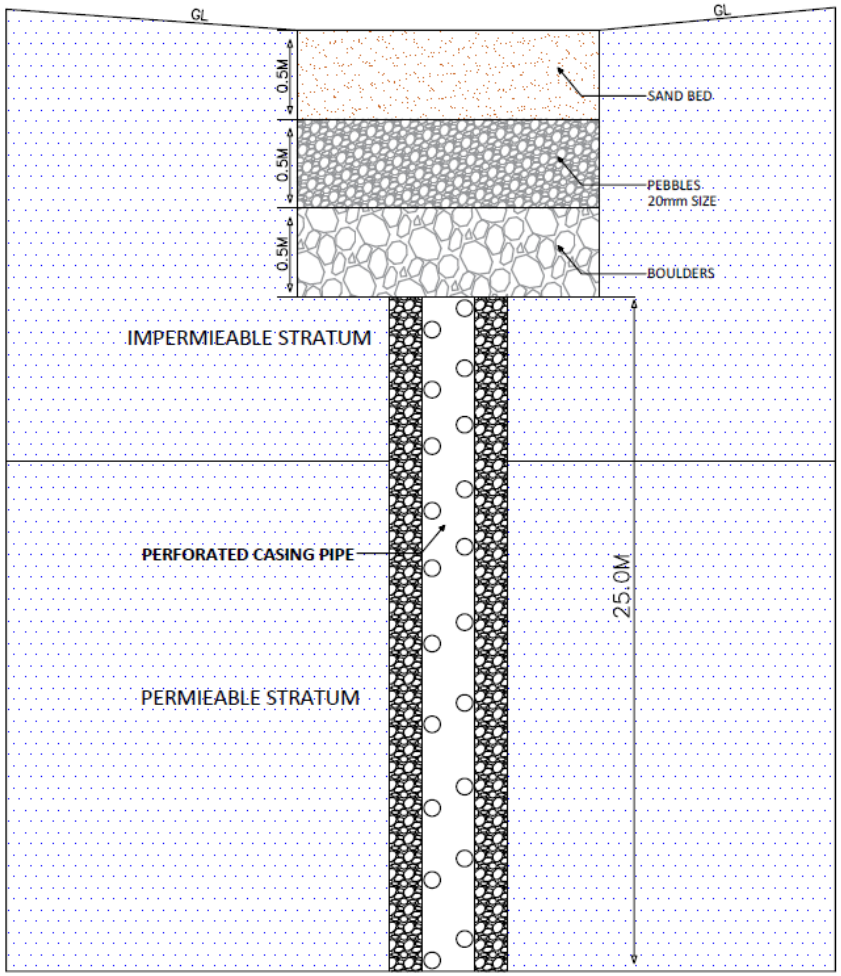
ANNEX 8.22 DRAWING OF TYPICAL SILT TRAP



ANNEX 8.23 DRAWING OF TYPICAL OIL INTERCEPTOR



ANNEX 8.24 DRAWING OF GROUND WATER RECHARGE PIT



TYPICAL DRAWING OF GROUND WATER RECHARGE PIT

ANNEX- 8.24
GROUND WATER RECHARGE PIT

CLIENT

Government of Karnataka
Public Works, Ports & IWT Department
Karnataka State Highways Improvement Project

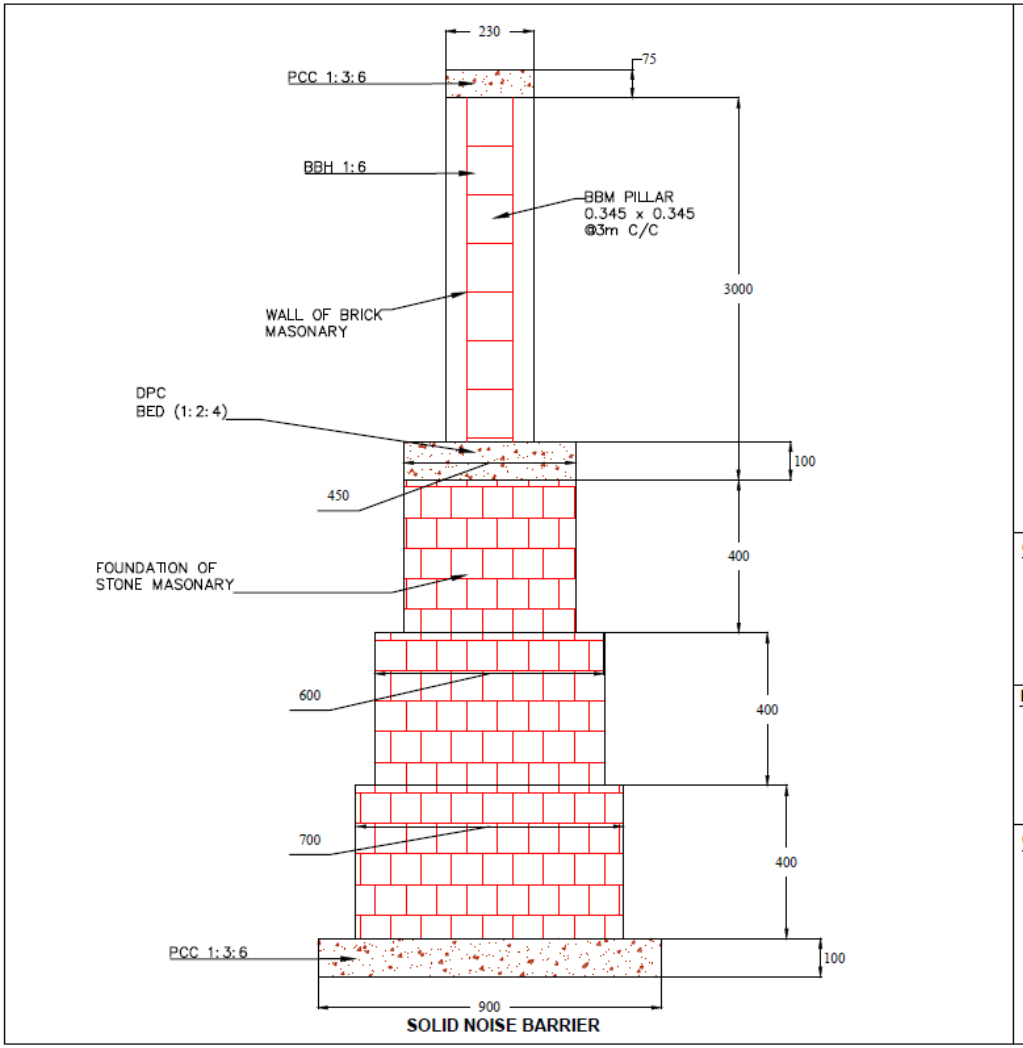
PROJECT

Consulting Services for Preparation of Detailed Project Report cum Transaction Advisory Services for Karnataka State Highway Improvement Project-III -KSHIP-III - (Group-II)

CONSULTANT

Intercontinental Consultants & Technocrats Pvt.Ltd, A-8, Green Park, New Delhi - 110016 in joint venture with PricewaterhouseCoopers Pvt.Ltd 4th Floor, Tower - D, The Millenia, 1-2 Murphy Road, Ulsoor, Bangalore - 560 008 in association with Dhir & Dhir Associates (as Sub-Consultant) D-55, Defence Colony, New Delhi -110024

ANNEX 8.25 DRAWING OF TYPICAL SOLI NOISE BARRIER



ANNEX- 8.25
SOLID NOISE BARRIE

CLIENT

Government of Karnataka
Public Works, Ports & IWT Department
Karnataka State Highways Improvement Project

PROJECT

Consulting Services for Preparation of Detailed Project Report cum Transaction Advisory Services for Karnataka State Highway Improvement Project-III -KSHIP-III - (Group-II)

CONSULTANT

Intercontinental Consultants & Technocrats Pvt.Ltd, A-8, Green Park, New Delhi - 110016 in joint venture with PricewaterhouseCoopers Pvt.Ltd 4th Floor, Tower - D, The Millenia, 1-2 Murphy Road, Ulsoor, Bangalore - 560 008 in association with Dhir & Dhir Associates (as Sub-Consultant) D-55, Defence Colony, New Delhi -110024

ANNEX 8.26 PHYCO-REMEDIATION OF POND WATER USING NUALGI

A. Phyco - Remediation

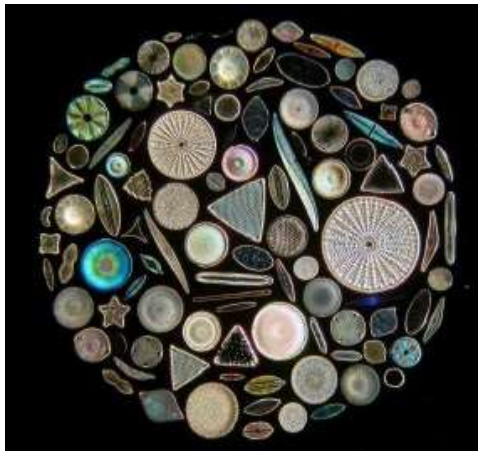
1. Phyco- remediation is the use of algae to remediate polluted waters. Among all the algae, diatoms are the most prolific photosynthesizes because of their silica shells, which are translucent. This helps the diatoms to photosynthesize even in low light conditions. In that sense they outcompete cyanobacteria and other forms of algae. To understand NUALGI based Phyco-remediation, it is important to understand the diatoms.

B. Diatoms and Aquatic Eco Systems

2. Phytoplankton community composition is highly dependent on the quantity and ratio of macro and micronutrients in aquatic ecosystems. There are many examples of taxonomic shifts due to the relative supply of silica (Si) versus other nutrients for example nitrogen (N) and phosphorus (P). Bacillariophytes, or diatoms, are fast-growing phyto-planktons that utilize dissolved silicate (SiO_4) to make their siliceous-armored skeletal frustules *(Horner, 2002)*. In marine systems, diatoms require a particulate cell N/Si ratio of ~1 for balanced growth *(Brzezinski, 1985)*. Other phytoplankton species, such as dinoflagellates, cyanophytes, haptophytes, and raphidophytes, do not utilize silica. If silicate is limiting, other phytoplankton are capable of outcompeting diatoms despite generally slower growth rates *(Walsh et al., 2010)*. Therefore, by 'fertilizing' water that is depleted in silica, relative to other macronutrients, such as with a high Si-content solution, the potential exists to shift the phytoplankton community to diatom dominance.

3. Diatoms are a widespread, diverse group of microalgae found in all aquatic systems. They represent a major component at the base of the marine food web, responsible for up to 50% of total oceanic primary production *(Mann, 1999)* and 25% of all Oxygen produced on the planet. In fact, without their waste oxygen bubbling into the atmosphere for millions of years, we would all be left gasping for air. The secrets of their awesome powers of photosynthesis have been revealed, with enormous implications for the world's climate.

4. Each diatom lives in its own tiny glasshouse, shaped rather like a pill box. Diatoms began to make their mark in the oceans some 40 to 60 million years ago. At the time, the levels of carbon dioxide on Earth were so low that all plant life was gasping for this vital raw ingredient of photosynthesis. Scientists now believe that diatoms solved the carbon dioxide crisis by encasing themselves in glass, a strategy so successful that they came to dominate the world's oceans. Silica in the glass speeds up a vital chemical reaction needed to extract carbon dioxide



from the surrounding seawater. The diatom then turns the carbon into sugary food. In fact, diatoms make a bigger contribution to fighting **global warming** than most plants on land. Because of their dead remains sink to the bottom of the ocean, they effectively lock away their carbon forever. It is the vast reserves of fossilized carbon where much of our oil comes from - over millions of years, tiny globules of oil stored inside diatoms are squeezed out into petroleum deposits. Diatoms can be found from the poles to the tropics *(Horner, 2002)*, vary in size (2-200 µm), shape (centric, pinnate) and can exist as single cells, colonies, or chains *(Hasle and Syvertsen, 1997)*.

5. Diatoms are opportunistic, generally exhibiting high growth rates and blooming rapidly when nutrient and light conditions are favorable *(Furnas, 1990)*. Similarly, blooms can end as quickly when the diatoms have utilized all available nutrients and are either grazed upon (supporting higher trophic levels) or sink rapidly (driving the carbon pump). This combination of the diatom's abilities makes them an ideal organism for water remediation practices. This is called **Phyco- Remediation**.

C. Diatoms and Water Bodies

6. Diatoms work in aquatic and semi aquatic environments. They work from tropics to poles in any kind of water (fresh, brackish, marine, ice capped, sewage base). They also work in running waters like the rivers and drains, and equally in static waters like lakes, ponds, facultative water bodies' etc. They also work in bays, inland waters, wetlands, coastal areas, seas and oceans. Diatoms are also found along the entire cross section of surface, water column and sediment interface. They also attach themselves to plants, rocks or sediment interface in running or static waters. In other words, diatoms work in the entire water body.

D. Nualgi and Diatoms

7. NUALGI-TM is a patented research product specifically designed to provide Silica, Nitrogen, Phosphorous, and other macro and micronutrients at concentrations favorable for the growth of higher order of diatoms in multiple environments. The potential exists for the use of NUALGI to grow diatoms as a solution to a myriad of ecological and economic problems such as remediation of running and static water bodies, sewage treatment, fish farming, energy development, and harmful algal bloom mitigation, to name a few. It has been invented by Mr. T Sampath Kumar of "Viraj Clean Sea Enterprises Ltd." after 12 years of intensive research and development. NUALGI is being exported to more than 15 countries, including USA.

8. The "NUALGI Technology" is based on providing micro nutrients required for diatom

algae growth to speed up the nutrient removal in stagnant water / waste water and converting these nutrients to fish biomass. NUALGI contains micronutrients along with silica which is required for diatom growth, so it is consumed by Diatoms and triggers rapid growth diatom algae in any water body. Diatom algae need less sunlight than any other algae so they grow in total water column.

9. During photosynthesis, diatoms consume Nitrates and Phosphorous, as also uses up CO_2 from the atmosphere. In the process, they release oxygen (pure oxygen in water) to almost saturation levels, which will help the water body regain its original levels of Dissolved Oxygen. The absorption of CO_2 will also mitigate the water acidification and pH levels would move towards more basic levels. The high levels of DO would set up a chain of benefits, primarily it promotes aerobic bacteria which would digest the excess nutrients in water and convert them into the base constituents. Such high levels of DO would also oxidize the heavy metals which would precipitate out of water, where other bacterial strains would consume them.

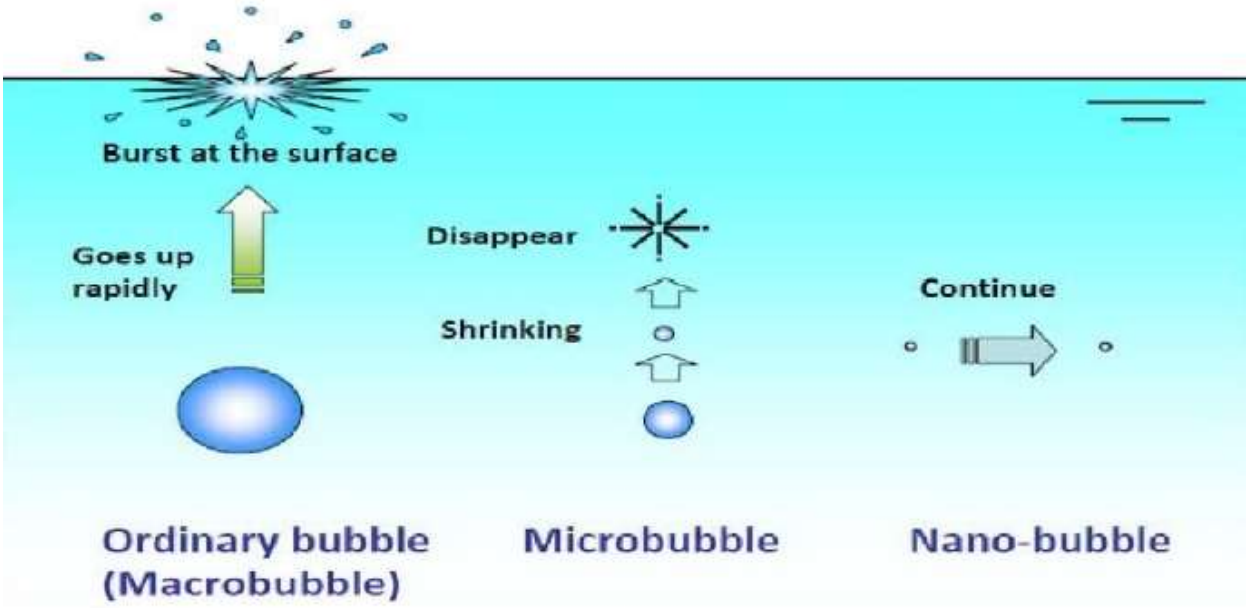
10. Phytoplankton is the elementary producers of the **pond** which carry out photosynthesis, converting the inorganic nutrients in the water into the organic nourishment needed for their growth and reproduction. Fertilization with livestock manure will provide phytoplankton with the materials essential for photosynthesis. As the phytoplankton photosynthesize and reproduce, zooplankton, which feed on phytoplankton start flourishing. NUALGI will also trigger growth of Zooplanktons, which consume diatom algae. The zooplanktons are consumed by fish, thus ensuring that the diatom algae exits the water as fish biomass and does not decay in water like other cellulose algae. Diatoms have silica shells and the zooplankton and fish love to eat this live food as it helps them to build up their body constitution. This will lead to environmentally friendly way of converting the excess nutrients to fish biomass.

E. Nano Scale Technology

11. NUALGI particles are 3 to 50 nanometers in diameter (1 millimeter = 1,000,000 nanometers). Nano particles are known to have different properties than larger sized particles of the same element. These tiny particles have a larger active surface area and can suspend themselves in liquid and are therefore more efficient by being biologically available.

12. For plants and organisms; it is a significant scientific challenge to provide nutrients in bioavailable form. NUALGI is the only product of its kind that effectively addresses this challenge in a water body. Its nutrient particles are small enough to suspend themselves in the water column and are therefore more available for diatom algae to bloom. The free oxygen produced by the Diatoms is in the form of **Nano size bubbles**, which have a very large surface area compared to the volume. This large surface area to volume ratio (‘a’ = Surface Area / Volume) is a key parameter in gas-liquid mass transfer process, between oxygen and water in any fluid medium. Thus, if the surface area to volume ratio (‘a’) is large, the mass transfer process between the oxygen and water will be faster and more efficient and as a result oxygen concentration

in water body will increase significantly. More importantly, the rate of change of the concentration of oxygen in water also increases. Besides, increase in the level of dissolved oxygen and the increased rate of concentration change, the **nano sized bubbles** have higher internal air pressure, higher density and therefore rise slower than the coarse bubbles to the surface of water body.



F. Observed Benefits of Nualgi based Phyco- remediation

1.	Reduction in Fecal Coliform levels to satisfactory standard. Field trials of NUALGI in polluted water bodies have shown remarkable reduction in Fecal Coliform levels to as low as 23 from 3000+.
2.	Reduction in Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD). In field trials it has achieved more than 75 % reduction in BOD and 90% in COD.
3.	Enhancement in levels of Dissolved Oxygen (DO). DO is the major victim of pollution, an increase in DO would set up a chain of benefits. Only 1 litre of NUALGI can produce as much as 100 million mg of oxygen. Increase in DO levels as the treatment brings pure oxygen into water unlike aerators which bring a lot of Nitrogen with air. NUALGI substitutes for aerators, fountains etc.
4.	Elimination of foul smell from polluted waters caused due Hydrogen Sulphide or other foul smelling gases. This happens within hours of dosing.
5.	Cleaner water with low turbidity (NTU scale) and higher clarity (SD Levels increase)
6.	Fish and aquatic life thrives in oxygen rich waters after treatment with NUALGI. Fish get live food in the form of zooplankton and diatoms. Fish prefer silica shelled diatoms as against cellulose algae. Fish weight and numbers increase with each dose.
7.	Benthic diatoms promote bacteria in river beds digesting the sludge and making the river bed clean.
8.	Waste water plants like water hyacinths and weeds lose the nutrients in their roots and disappear over time. Manual cutting and cleaning may be required initially but these would not grow back.
9.	Outcompetes Blue Green Algae which disappears over few dosages. It will thus prevent toxicity

	in water bodies caused by few strains of BGA. BGA is the slimy green algae seen in stagnant waters all over the country.
10.	Prevents mass fish kill due to sudden fall in levels of Dissolved Oxygen. NUALGI is being used by fishermen during summers and monsoons to enhance DO levels thereby precluding mass fish kill due algae crash out.
11.	Diatoms consume carbon dioxide thus reducing the acidic levels in water
12.	Reduce nitrate (all form of Nitrogen including ammonia) and phosphate levels in water substantially.

G. The Process

13. The nano-nutrients in the NUALGI bottle spread rapidly into the water body on its own on the surface as well as at the plankton and benthic level. The coverage is very high as the constituents are at nano scale.

1. Dosing & Dosage:

14. Each litre of NUALGI treats about 4 to 10 million liters in static waters and 10-20 million liters of affected water in a flowing river. Such a large effect is possible because of the nano scale of the nutrients. Such dose would continue till the parameters record within acceptable limits; usually 8 to 16 weeks for static waters and 4 to 6 weeks for running waters. Weekly dosing is required for static waters while daily dosage is required for running waters. As the water quality improves the dosage is brought down to a maintenance dose which is typically 25% of the corrective dose for both static & running waters and the frequency is reduced to about once in a month.

Application process	NUALGI mixes very easily in water, mechanical mixing is not required. It can be poured directly into the pond / lake / sewage or mixed in a small quantity of water – 1 liter in 20 liters and this can be mixed into the water body along the accessible areas of the periphery
Oxygen	1 liter of NUALGI results in release of at least 200 to 1000 kg of Oxygen depending on the condition of the water
Food	1 liter of NUALGI causes bloom of 200 to 1000 kg of Diatoms
Impact on Fish	NUALGI is invented for use in Aquaculture and is safe for all fish, shrimp, etc.
Nitrogen and Phosphorus	1 liter of NUALGI results in consumption of 16 to 80 kg of N and 2 to 11 kg of P
Impact on People	▪ NUALGI has no adverse impact on people ▪ It can be handled with bare hands ▪ There are no side effects and NUALGI does not have any adverse impact on other organisms in the water. ▪ Beneficial bacteria, Zooplankton, Fish, etc., grow in an healthy manner in ponds and lakes dosed with NUALGI

2. Safety:

- NUALGI has been tested (LD50) by “Council for Scientific and Industrial Research – Indian Institute of Toxicology Research (CSIR-IITR), Lucknow”. As per the Organization for Economic Co-operation and Development (OECD) guidelines for acute fish toxicity and has been classifies as Non-Toxic to fish, under test conditions. In practice too, NUALGI is used by many fishermen when fish deaths are being reported. So, it is not just safe for fish, but also supports fish and other aquatic life.

- NUALGI has also been tested for acute dermal toxicity on Wistar rats as per the OECD guidelines and the test have concluded that, NUALGI falls under Category 5 or Unclassified according to the Globally Harmonized System (GHS) for the classification of chemicals.

3. Important Points:

- Since action happens on the top surface layer of water, it is important to keep it free of any rubbish, garbage or floating materials. A clean-up is advised prior to application.
- Preferred time of application is before 8.00 a.m. for first 12 weeks (This is because Diatom Algae comes to the surface of water in early morning)
- For pond area less than or equal to half acre, dosage can be done from the banks of the water body.
- For larger lakes, a paddle boat may be used to access inner lake areas.
- NUALGI is designed to spread quickly and evenly on the surface of water and hence is capable of reaching corners on its own. However for any small or tricky areas such as bends or natural curves, dosage can be applied specifically near the spot.

4. Effects of Treatment:

- Normally pond / lake waters shall show effect within 1-2 applications.
- It is not uncommon for BOD levels to decrease by 90-95% within 12 applications
- Complete start up course is for weekly application for 12 continuous weeks during which time, water shall be cleaned, clear and ready to sustain high biodiversity.
- Monthly once NUALGI application shall be sufficient thereafter to maintain dissolved oxygen levels.
- Increase in biodiversity such as fish growth, insects, reptiles and maybe birds can be observed after 1 year time.
- Any heavy metals in water will be decomposed into their non-toxic valents after 18 months.
- Weeds like Water Hyacinth shall turn yellow and start to disappear forever after 12- 18 months.

H. Cost Analysis

15. Each litre of NUALGI cost Rs. 9,000/- plus VAT

16. So typically, for 1.0 ha surface area of water body the following will be the calculations:

- Start-up course = 1.0 litres of NUALGI per week for 12 weeks = 12 litres for 12 weeks
- Regular maintenance dosage = 0.5 litres of NUALGI per month
- Total number of dosages for One Year = (12 +9) = 21
- Requirement of NUALGI for 1st year = [12 liters + (9 months x 0.5 liters)] = 16.5 liters
- For second year, dosages will be = 0.5 litres of NUALGI per month (6 litres)
- Therefore, total requirement = (16.5 + 6) = 22.5 litres of NUALGI

I. Where to Approach

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17. **Cost Effectiveness:** The company provides a holistic solution, generally for 3-6 months for smaller water bodies such as drains, small ponds, creeks etc. and for 12 months in case of larger water bodies such as rivers, lakes etc. During this period, the product is not sold to the client, but instead the company itself takes control of the dosing and supervision. The client will have to provide for the physical treatment of the water body such as the removal of solid wastes, plastics etc.The treatment of NUALGI

involves neither the use of costly machinery nor there is a requirement for any large manpower to dose it. NUALGI is very cost effective in the value it delivers.

J. Case Study

NUALGI TREATMENT OF MAN SINGH ROAD POND, RAJPATH, INDIA GATE, DELHI

18. **Pond location:** Pond is located on Man Singh Road off Rajpath Road connecting India gate to Raj Bhavan in New Delhi. This pond is one of the ponds located on either side of Rajpath which is a very high profile area with lot of VVIP movement.

19. **Pond Area:** The pond is 500 m x 26 m (3.2 acres) with a depth of 0.7 m (Picture-1) and volume is about 9 million liters

20. **Pond condition:** The pond selected for treatment was one of the dirtiest ponds on the Rajpath with heavy growth of Blue Green Algae (BGA) formed as a mat with a thickness of around 6 inches (**Picture-1A**). This BGA mat has covered around 125 M of the pond. Due to BGA mat water lacked air circulation and light penetration this led to anoxic conditions in the lake bottom leading to foul smell and cessation in biological activities like killing of frogs and fish.

21. **Treatment of Pond using NUALGI:** The pond was dosed with 4 liters of NUALGI initially and then with 1 litre per week for 3 weeks. The dosing was carried out during the month of August and water samples were collected before and after treatment to test the water quality parameters.

22. **Results:** After treating with NUALGI for 3 weeks, the BGA crashed, which lead to disintegration of the thick layer and the dead algae has led to curding effect rather than mat. The dead algae were removed manually. The area of BGA mat reduced to 25 m from 125 m before treatment, about 85% reduction. This remaining mat was also disintegrating and eliminated after further treatment (**Picture-1B**). Foul smell has stopped and there were visible effects of biological activity with recolonization of water insects.

Picture 1A showing the covering of BGA as thick mat before treatment
Picture 1B Showing the remaining curded BGA mat after treatment

Picture 2A and 2B showing the pond after treatment with 85% reduction in BGA

23. **Effect of Treatment on Pond Water Quality Parameters:** Water quality parameters were tested with water collected from the pond before and after treatment. There was a significant reduction of total nitrate **and** total phosphate along with dissolved oxygen (DO) level which has seen a huge increase from 1.9 mg/l before treatment to 7.2 mg/l after treatment. There was improvement in all parameters except for Ammonia, this could be due to the absence of fish. Fish would have consumed the Diatoms and Zooplankton and this would help reduce Ammonia levels.

S. No.	Parameters	Untreated Water 03.08.2013	Treated Water 03.09.2013
1.	pH	7.7	7.98

S. No.	Parameters	Untreated Water 03.08.2013	Treated Water 03.09.2013
2.	Electrical conductivity	1954	523
3.	TSS , mg/l	200	18
4.	Ammonia, mg/l	7.81	8.13
5.	Nitrate, mg/l	13.28	7.43
6.	Phosphorus, mg/l	0.30	0.03
7.	Potassium, mg/l	3.04	2.636
8.	Chloride, mg/l	217.69	53.81
9.	DO, mg/l	1.9	7.2
10.	BOD, mg/l	31	12
11.	COD, mg/l	106	56
12.	Total N, mg/l	22.34	16.86
13.	Total P, mg/l	0.513	0.081

24. **Conclusions:** The treatment using NUALGI has shown very significant effect on reducing BGA contamination and also resulted in resurrecting biological activity. It has also shown a positive effect on improving the water quality by reducing nutrient levels, increased DO and controlling foul odour. If this treatment is continued for longer time the pond quality will further improve and continuous use of this technology can totally eradicate the problem of BGA and poor water quality in future.

Photographs of few other Cases


Bahadurpur, Uttarakhand
Before
After

ANNEX 8.27 POND ENHANCEMENT PLAN