

Initial Environmental Examination

January 2017

IND: Karnataka State Highways Improvement Project III

Chintamani to Andhra Pradesh Border (Annexures)

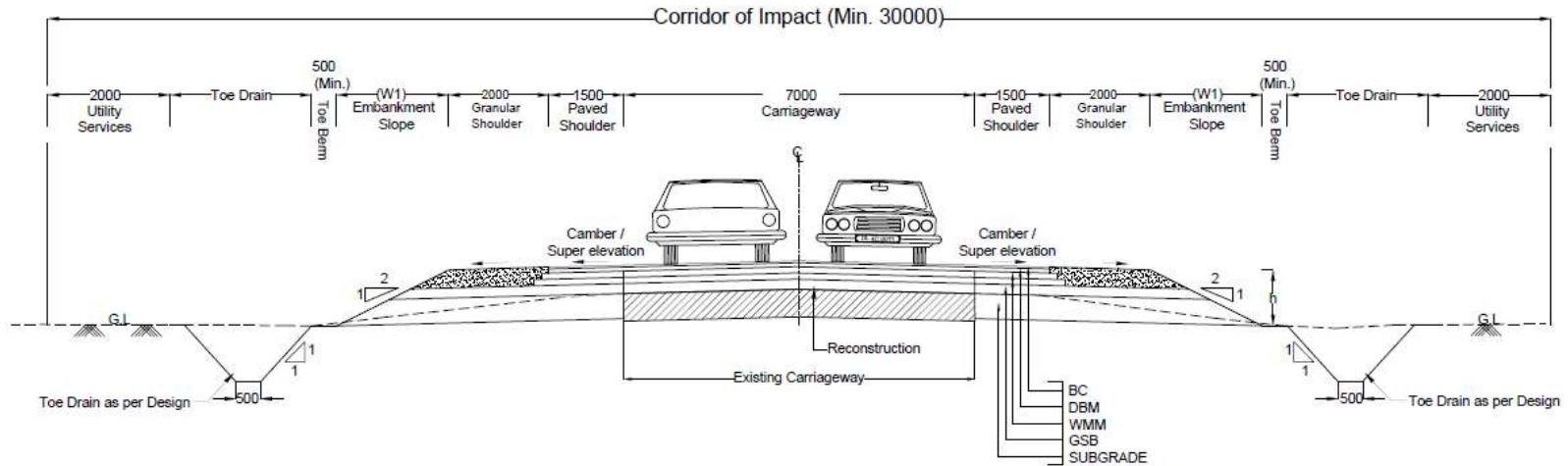
Prepared by Project Implementation Unit, KSHIP, Government of Karnataka for the Asian Development Bank

Table of Contents

ANNEX 2.1 TYPICAL CROSS SECTIONS	1
ANNEX 3.1 RELEVANT INDIAN STANDARDS	9
ANNEX 4.1 LAND USE MAP	18
ANNEX 4.2 TOPOGRAPHICAL SHEET SHOWING PROJECT ROAD ALIGNMENT AND STUDY AREA.....	19
ANNEX 4.3 ON-SITE METEOROLOGICAL MONITORING RESULTS.....	20
ANNEX 4.4 ON-SITE AIR QUALITY MONITORING RESULTS.....	37
ANNEX 4.5 DETAILS OF EXISTING TREES.....	38
ANNEX 4.6 GREEN TUNNEL LOCATIONS ALONG PROJECT ROAD.....	41
ANNEX 4.7 RESULTS OF BIODIVERSITY STUDY.....	42
ANNEX 4.8 SECONDARY DATA FROM STATE FOREST DEPARTMENT	46
ANNEX 6.1 ADB RAPID ENVIRONMENTAL ASSESSMENT CHECKLIST	50
ANNEX 7.1 PCM QUESTIONNAIRE	53
ANNEX 7.2 REGISTRATION OF PARTICIPANTS IN PCM	55
ANNEX 8.1 GUIDELINES FOR TOP SOIL CONVERSATION AND REUSE.....	69
ANNEX 8.2 GUIDELINES FOR SITING AND LAYOUT OF CONSTRUCTION CAMP	70
ANNEX 8.3 GUIDELINES ON SLOPE STABILIZATION	74
ANNEX 8.4 GUIDELINES FOR SITING, OPERATION AND RE-DEVELOPMENT OF BORROW AREAS	82
ANNEX 8.5 GUIDELINES FOR SITING, OPERATION AND RE-DEVELOPMENT OF QUARRYING AND STONE CRUSHING OPERATIONS.....	86
ANNEX 8.6 GUIDELINES FOR SEDIMENT CONTROL	93
ANNEX 8.7 GUIDELINES FOR SITING AND MANAGEMENT OF DEBRIS DISPOSAL SITE ..	94
ANNEX 8.8 GUIDELINES FOR PREPARING COMPREHENSIVE WASTE MANAGEMENT PLAN	97
ANNEX 8.9 GUIDELINES FOR PREPARATION OF TRAFFIC MANAGEMENT PLAN	100
ANNEX 8.10 GUIDELINES TO ENSURE WORKER'S SAFETY DURING CONSTRUCTION.	102
ANNEX 8.11 GUIDELINES FOR STORAGE, HANDLING, USE AND EMERGENCY RESPONSE FOR HAZARDOUS SUBSTANCES	113
ANNEX 8.12 TREE PLANTATION STRATEGY	116
ANNEX 8.13 REPORTING FORMAT FOR IDENTIFICATION OF CONSTRUCTION CAMP SITE.....	118
ANNEX 8.14 REPORTING FORMAT FOR SETTING-UP OF CONSTRUCTION CAMP	120
ANNEX 8.15 REPORTING FORMAT FOR ESTABLISHMENT OF HOT MIX PLANT / BATCH MIX PLANT.....	122
ANNEX 8.16 REPORTING FORMAT FOR IDENTIFICATION OF BORROW AREAS	123

ANNEX 8.17 REPORTING FORMAT FOR ESTABLISHMENT OF BORROW AREA	124
ANNEX 8.18 REPORTING FORMAT FOR IDENTIFICATION OF QUARRY AND STONE CRUSHER SITE	125
ANNEX 8.19 REPORTING FORMAT FOR IDENTIFICATION OF DEBRIS DISPOSAL SITE .	126
ANNEX 8.20 REPORTING FORMAT FOR SAFETY CHECKLIST	127
ANNEX 8.21 REPORTING FORMAT FOR ROAD SAFETY MEASUREMENTS DURING CONSTRUCTION	129
ANNEX 8.22 DRAWING OF TYPICAL SILT TRAP	131
ANNEX 8.23 DRAWING OF TYPICAL OIL INTERCEPTOR	132
ANNEX 8.24 DRAWING OF GROUND WATER RECHARGE PIT	133
ANNEX 8.25 DRAWING OF TYPICAL SOLID NOISE BARRIER.....	134
ANNEX 8.26 PHYCO-REMEDICATION OF POLLUTED WATER USING NULAGI.....	135
ANNEX 8.27 POND ENHANCEMENT PLAN.....	145

ANNEX 2.1 TYPICAL CROSS SECTIONS



TYPICAL CROSS SECTION FOR 2-LANE WITH PAVED SHOULDER (OPEN COUNTRY)
TCS - 1 - CONCENTRIC WIDENING

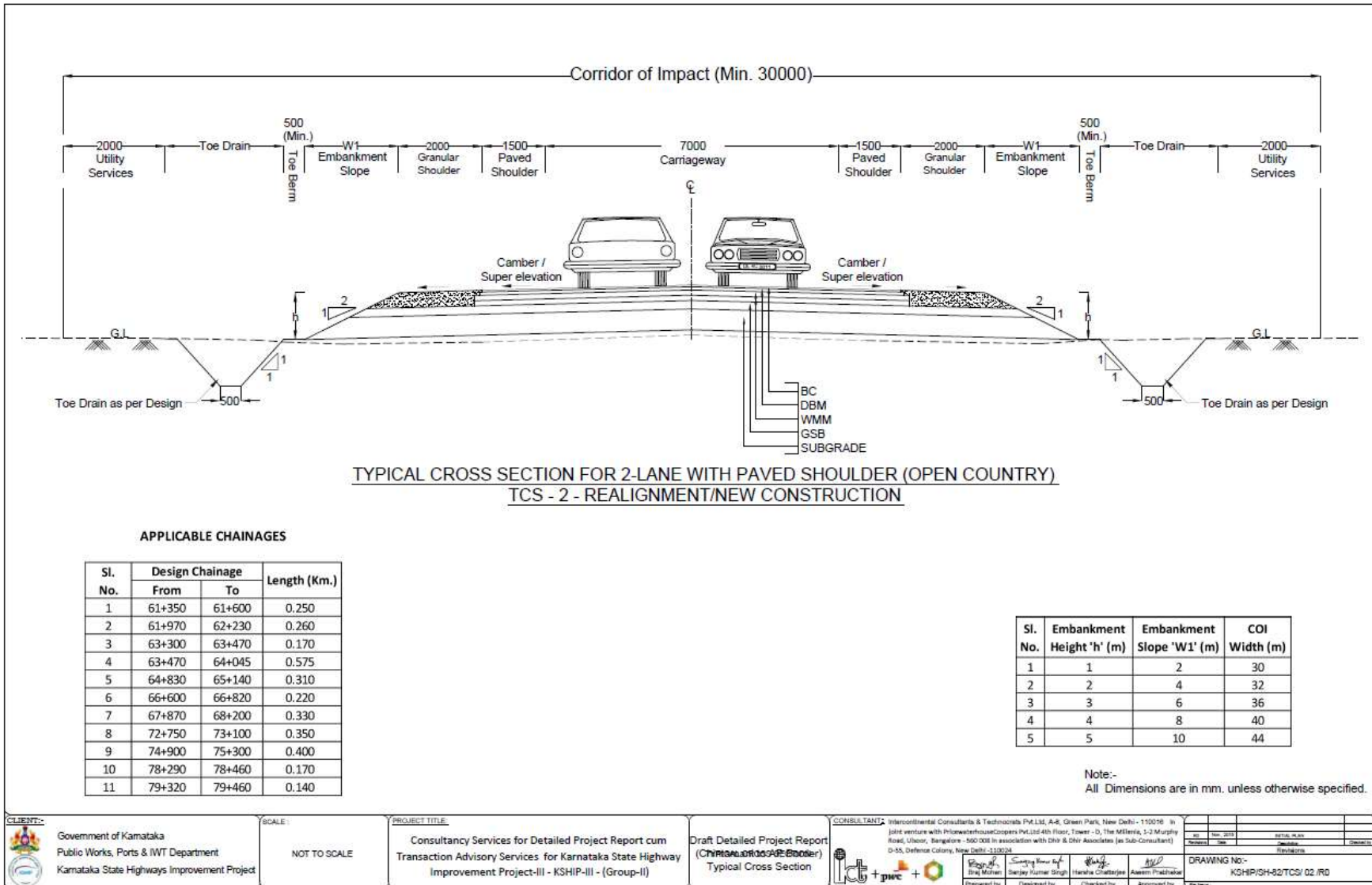
APPLICABLE CHAINAGES

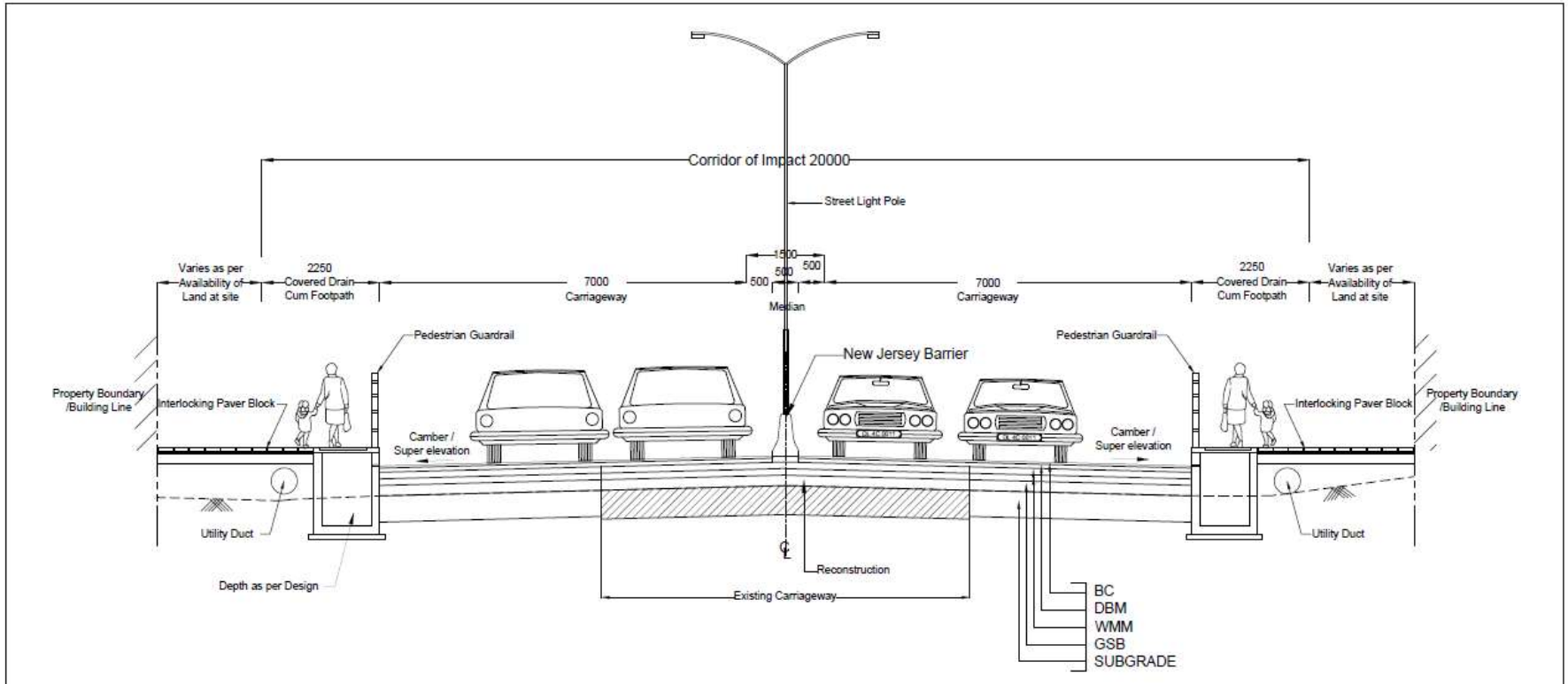
Sl. No.	Design Chainage From	Design Chainage To	Length (Km.)	Sl. No.	Design Chainage From	Design Chainage To	Length (Km.)
1	47+203	48+250	1.047	12	73+100	73+150	0.050
2	49+100	61+350	12.250	13	73+450	74+900	1.450
3	61+600	61+970	0.370	14	75+300	78+290	2.990
4	62+230	63+300	1.070	15	78+460	79+120	0.660
5	64+370	64+500	0.130	16	79+460	80+290	0.830
6	65+140	65+260	0.120	17	80+530	81+990	1.460
7	65+480	66+600	1.120	18	82+130	82+350	0.220
8	66+820	67+870	1.050	19	82+600	85+860	3.260
9	68+200	68+326	0.126	20	86+100	86+510	0.410
10	68+726	70+830	2.104	21	86+760	86+977	0.217
11	71+130	72+750	1.620				

Sl. No.	Embankment Height 'h' (m)	Embankment Slope 'W1' (m)	COI Width (m)
1	1	2	30
2	2	4	32
3	3	6	36
4	4	8	40
5	5	10	44

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

<p>Government of Karnataka Public Works, Ports & IWT Department Karnataka State Highways Improvement Project</p>	<p>SCALE: NOT TO SCALE</p>	<p>PROJECT TITLE: Consultancy Services for Detailed Project Report cum Transaction Advisory Services for Karnataka State Highway Improvement Project-III - KSHIP-III - (Group-I)</p>	<p>Draft Detailed Project Report (Chintamani to AP Border) Typical Cross Section</p>	<p>CONSULTANT: Intercontinental Consultants & Technocrats Pvt.Ltd, A-8, Green Park, New Delhi - 110016. In joint venture with PinarwetehouseCoopers P.L.Ltd 4th Floor, Tower - D, The Millenia, 1-2 Murphy Road, Vijaya Vittala, Bangalore - 560008 in association with DNV & Oler Associates (as sub-consultant) 0-55, Defence Colony, New Delhi - 110024</p>	<p>Prepared by: </p>	<p>Designed by: </p>	<p>Checked by: </p>	<p>Approved by: </p>
					<p>DRAWING No.- KSHIP/SH-52/TCS/ 01 /RD</p>			





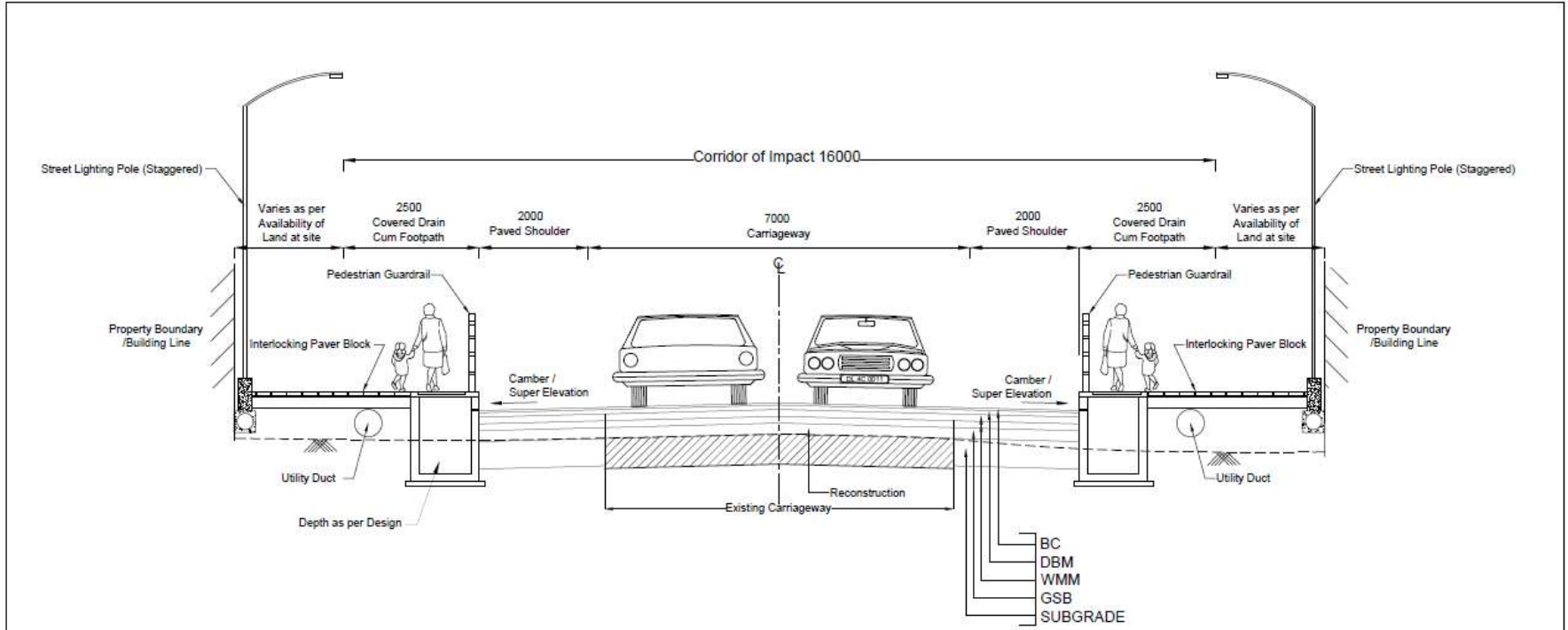
**TYPICAL CROSS SECTION FOR 4-LANE DIVIDED HIGHWAY WITHOUT SERVICE ROAD (URBAN SECTION)
TCS - 3 - CONCENTRIC WIDENING BUILT-UP SECTION (COI 20.0m)**

APPLICABLE CHAINAGES

Sl. No.	Design Chainage		Length (Km.)
	From	To	
1	70+830	71+130	0.300
2	73+150	73+450	0.300

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

<p>Government of Karnataka Public Works, Ports & IWT Department Karnataka State Highways Improvement Project</p>	<p>SCALE</p> <p>NOT TO SCALE</p>	<p>PROJECT TITLE</p> <p>Consultancy Services for Detailed Project Report cum Transaction Advisory Services for Karnataka State Highway Improvement Project-III - KSHIP-III - (Group-II)</p>	<p>Draft Detailed Project Report (Chintamani to AP Border) Typical Cross Section</p>	<p>CONSULTANT</p> <p>Intercontinental Consultants & Technocrats Pvt.Ltd, A-8, Green Park, New Delhi - 110016. In joint venture with PricewaterhouseCoopers Pvt.Ltd 4th Floor, Tower - G, The Millenia, 3-2 Murphy Road, Ufalar, Bangalore - 560 006 In association with DHR & DHR Associates (as Sub-Consultant) D-55, Defence Colony, New Delhi - 110026</p>	<table border="1"> <tr> <td>Prepared by</td> <td>Designed by</td> <td>Checked by</td> <td>Approved by</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> </tr> </table>	Prepared by	Designed by	Checked by	Approved by					<table border="1"> <tr> <td>NO.</td> <td>REV.</td> <td>DATE</td> <td>DESCRIPTION</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> </tr> </table> <p>DRAWING NO- KSHIP/SH-82/TCS/ 03 /R0</p>	NO.	REV.	DATE	DESCRIPTION				
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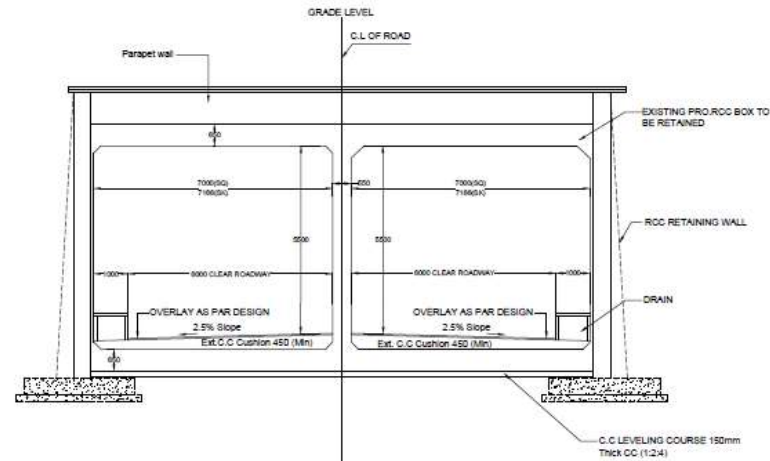
**TYPICAL CROSS SECTION FOR 2-LANE WITH PAVED SHOULDER (URBAN SECTION)
TCS - 4 - CONCENTRIC WIDENING BUILT UP SECTION (COI 16.0m)**

APPLICABLE CHAINAGES

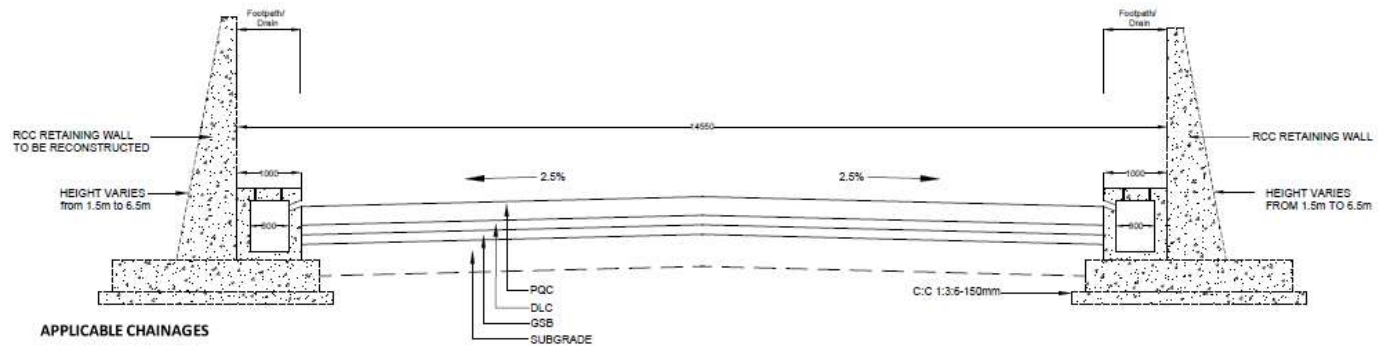
Sl. No.	Design Chainage		Length (Km.)
	From	To	
1	68+326	68+726	0.400

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

<p>Government of Karnataka Public Works, Ports & IWT Department Karnataka State Highways Improvement Project</p>	<p>SCALE: NOT TO SCALE</p>	<p>PROJECT TITLE: Consultancy Services for Detailed Project Report cum Transaction Advisory Services for Karnataka State Highway Improvement Project-III - KSHIP-III - (Group-II)</p>	<p>Draft Detailed Project Report (CONCENTRIC WIDENING BUILT UP SECTION) Typical Cross Section</p>	<p>CONSULTANT: Intercontinental Consultants & Technocrats Pvt.Ltd. A-8, Green Park, New Delhi - 110016 In Joint venture with PriwaterhouseCoopers Pvt.Ltd 4th Floor, Tower - D, The Millenia, 3-2 Murphy Road, Ulsoor, Bangalore - 560 008 In association with DSR & Shri Associates (as Sub-Consultant) D-55, Defence Colony, New Delhi - 110026</p>	<table border="1"> <tr> <td>Prepared by Brij Mohan</td> <td>Designed by Sangeeta Kumar Singh</td> <td>Checked by Hemish Chatterjee</td> <td>Approved by Arun Prakash</td> </tr> </table>	Prepared by Brij Mohan	Designed by Sangeeta Kumar Singh	Checked by Hemish Chatterjee	Approved by Arun Prakash
	Prepared by Brij Mohan	Designed by Sangeeta Kumar Singh	Checked by Hemish Chatterjee	Approved by Arun Prakash					
<p>DRAWING No:- KSHIP/SH-82/TCS/ 04 /RD</p>				<p>DATE: / /</p>					



EXISTING SECTION AT RUB LOCATION (From Ch.48+761 to 48+778)



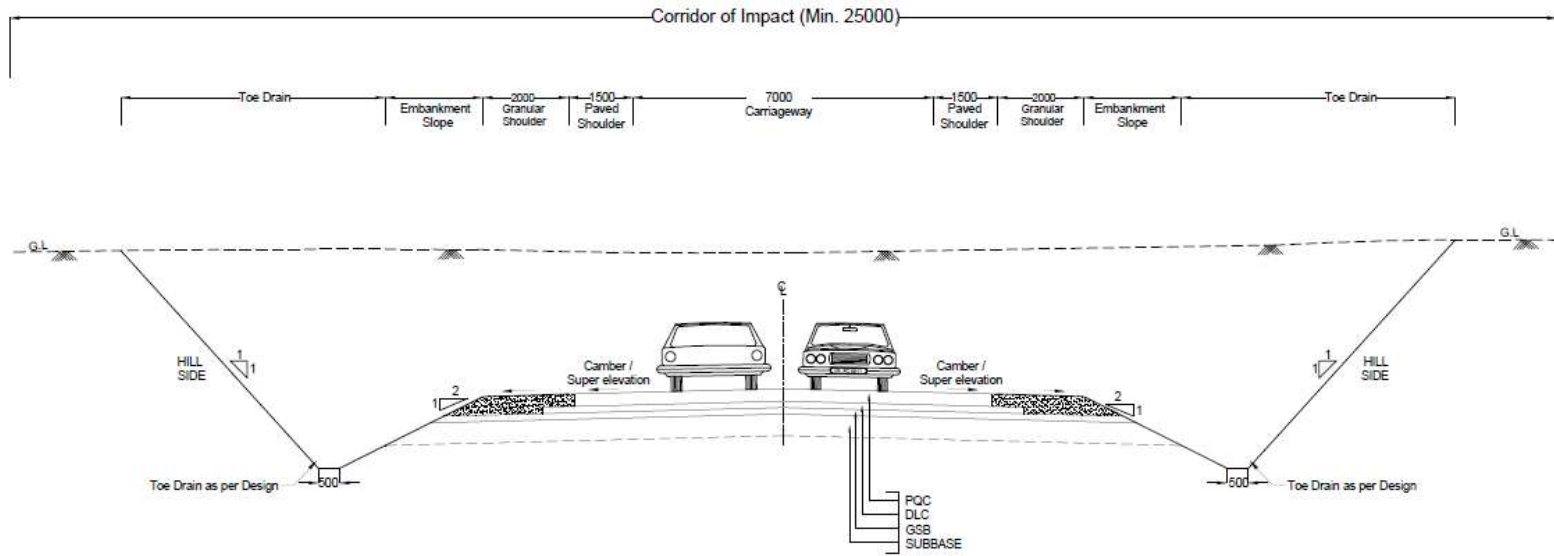
APPLICABLE CHAINAGES

Sl. No.	Design Chainage		Length (Km.)
	From	To	
1	48+475	48+910	435

SECTION AT APPROACHES OF RUB
TYPICAL CROSS SECTION FOR RUB APPROACH (CH. 48+769)
TCS - 5

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

<p>Government of Karnataka Public Works, Ports & IWT Department Karnataka State Highways Improvement Project</p>	<p>SCALE: NOT TO SCALE</p>	<p>PROJECT TITLE: Consultancy Services for Detailed Project Report cum Transaction Advisory Services for Karnataka State Highway Improvement Project-III - KSHIP-III - (Group-II)</p>	<p>Draft Detailed Project Report (Chintamani to AP Border) Typical Cross Section</p>	<p>CONSULTANT: Intercontinental Consultants & Technocrats Pvt.Ltd, A-6, 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 DHR & DHR Associates (as Sub-Consultant) D-35, Defense Colony, New Delhi - 110024.</p>	<p>NO. 05</p>	<p>DATE</p>	<p>SCALE</p>	<p>DATE</p>
					<p>Prepared by Brij Mohan</p>	<p>Designed by Sanjay Kumar Singh</p>	<p>Checked by Hemant Chatterjee</p>	<p>Approved by Assem Prabhakar</p>



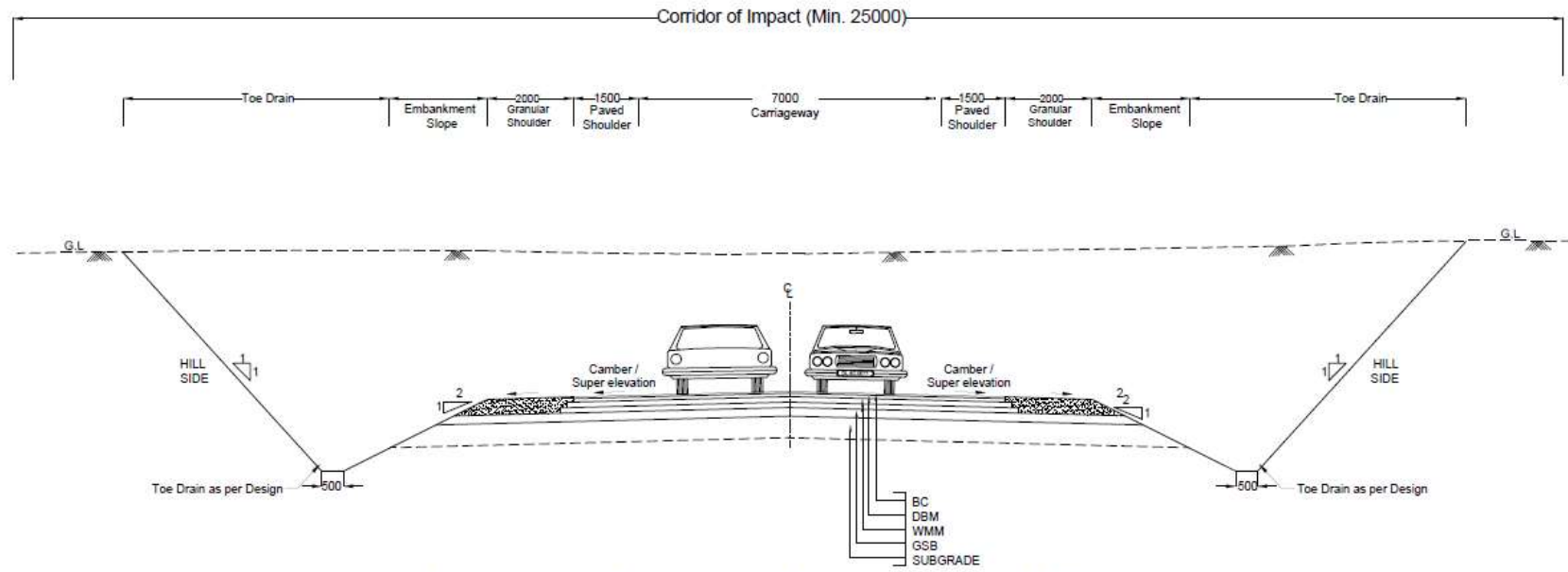
TYPICAL CROSS SECTION FOR 2-LANE WITH PAVED SHOULDER (CUTTING SECTION)
TCS - 6 - RIGID PAVEMENT

APPLICABLE CHAINAGES

Sl. No.	Design Chainage		Length (Km.)
	From	To	
1	48+250	48+475	0.225
2	48+910	49+100	0.190

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

<p>Government of Karnataka Public Works, Ports & IWT Department Karnataka State Highways Improvement Project</p>	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 (Chintamani to AP Border) Typical Cross Section	<p>CONSULTANT: Intercontinental Consultants & Technocrats Pvt.Ltd, A-4, Green Park, New Delhi - 110016 in joint venture with PricewaterhouseCoopers Pvt.Ltd 4th Floor, Tower - D, The MBlock, 1-2 Murphy Road, Uboor, Bangalore - 560 008 In association with DHR & DHR Associates (as Sub-Consultant) D-93, Defence Colony, New Delhi - 110028</p>	<table border="1"> <tr> <td>Prepared by: Brij Mishra</td> <td>Designed by: Sandeep Kumar Singh</td> <td>Checked by: Harsha Chatterjee</td> <td>Approved by: Amitesh Prasad</td> </tr> </table>	Prepared by: Brij Mishra	Designed by: Sandeep Kumar Singh	Checked by: Harsha Chatterjee	Approved by: Amitesh Prasad
	Prepared by: Brij Mishra	Designed by: Sandeep Kumar Singh	Checked by: Harsha Chatterjee	Approved by: Amitesh Prasad					
DRAWING No- KSHIP/SH-82/TCQ/ 06/R0									



TYPICAL CROSS SECTION FOR 2-LANE WITH PAVED SHOULDER (CUTTING SECTION)
TCS - 7

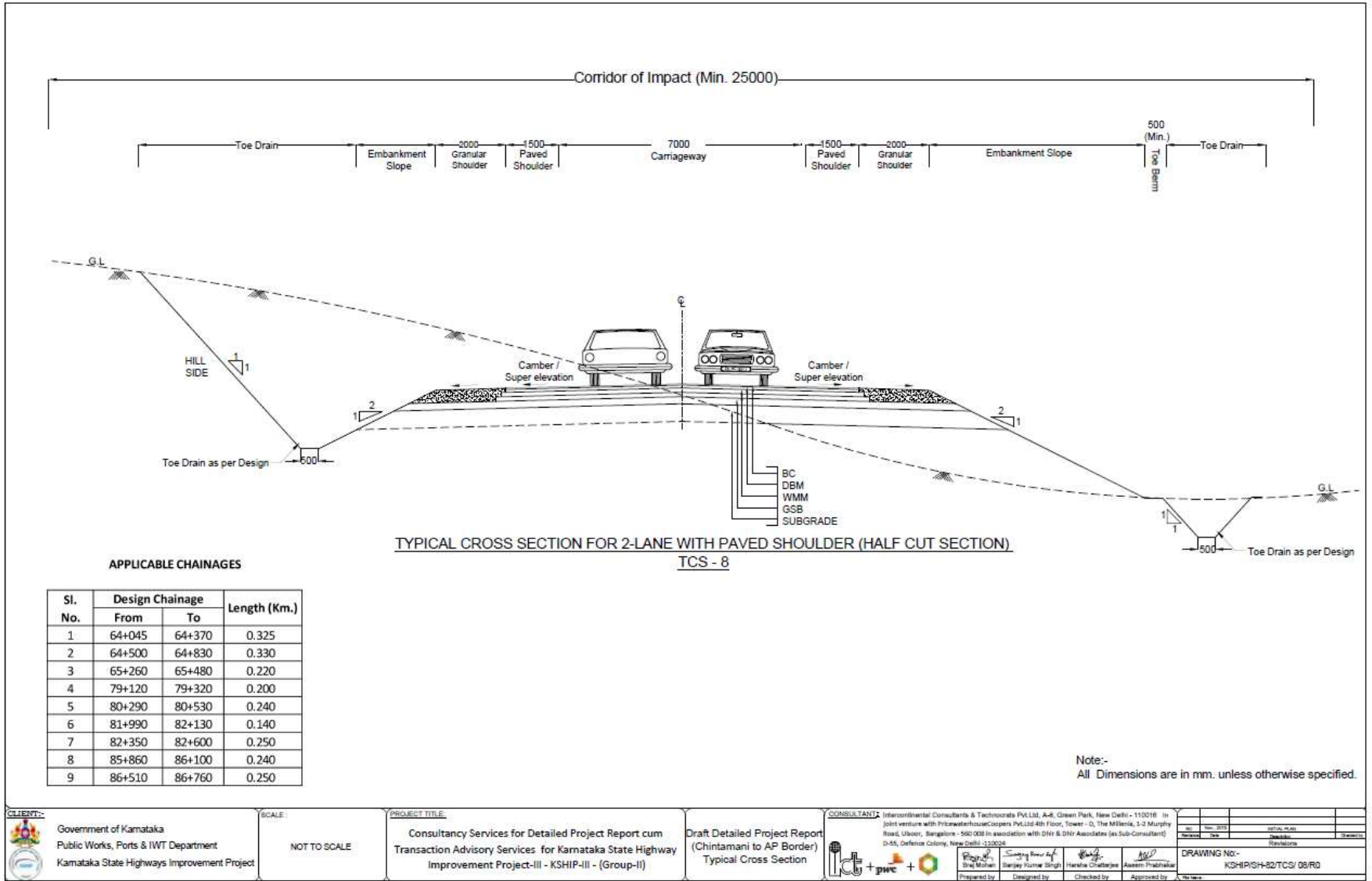
APPLICABLE CHAINAGES

Sl. No.	Design Chainage		Length (Km.)
	From	To	
1	64+045	64+370	0.325
2	64+500	64+830	0.330
3	65+260	65+480	0.220
4	79+120	79+320	0.200
5	80+290	80+530	0.240
6	81+990	82+130	0.140
7	82+350	82+600	0.250
8	85+860	86+100	0.240
9	86+510	86+760	0.250

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

<p>Government of Karnataka Public Works, Ports & IWT Department Karnataka State Highways Improvement Project</p>	SCALE	PROJECT TITLE	CONSULTANT	<table border="1"> <tr> <td>No.</td> <td>Date</td> <td>Revised</td> <td>Drawn</td> <td>Checked</td> <td>Reviewed</td> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </table>	No.	Date	Revised	Drawn	Checked	Reviewed						
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Pragathi Bhat Mishra	Sangeeta Kulkarni Sanjay Kumar Singh	Hemika Chatterjee	Asmita Prabhakar													

DRAWING NO-
KSHIP/SH-82/TCS/ 07/R0



APPLICABLE CHAINAGES

Sl. No.	Design Chainage		Length (Km.)
	From	To	
1	64+045	64+370	0.325
2	64+500	64+830	0.330
3	65+260	65+480	0.220
4	79+120	79+320	0.200
5	80+290	80+530	0.240
6	81+990	82+130	0.140
7	82+350	82+600	0.250
8	85+860	86+100	0.240
9	86+510	86+760	0.250

Note:-
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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, 19686]

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
		24 hours**	100	100	- TOEM - Beta attenuation
4.	Particulate Matter (size less than 2.5µm) or PM _{2.5} µg/m ³	Annual *	40	40	- Gravimetric
		24 hours**	60	60	- TOEM - 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)

Ambient Air Quality Parameter	Averaging Period	WB Guideline Value	
PM10	1 Year	70	(Interim target)
		50	(Interim target)
		30	(Interim target)
		20	(guideline)
	24-hr	150	(Interim target)
		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°C) (µmhos/cm)	-	-	-	1000	2250
6.	DO (mg/L)(min)	6	5	4	4	-
7.	BOD (3 days at 27°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 ₆ H ₅ OH)	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

SN	Parameter and Unit	Class-A	Class-B	Class-C	Class-D	Class-E
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 (°C)	#	-	-	#
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°C) (mg/L)	30	350	100	100
5.	COD (mg/L)	250	-	-	250
6.	Bio-assay (% 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

Sl. No.	Parameter and Unit	Inland Surface Water	Public Sewers	Land for Irrigation	Marine Coastal Water
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 ₆ H ₅ OH)	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
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 Gol and WHO Drinking Water Standards and Guide Values

S. No.	Parameters	Gol 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 CaCO ₃ , 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	No Guideline

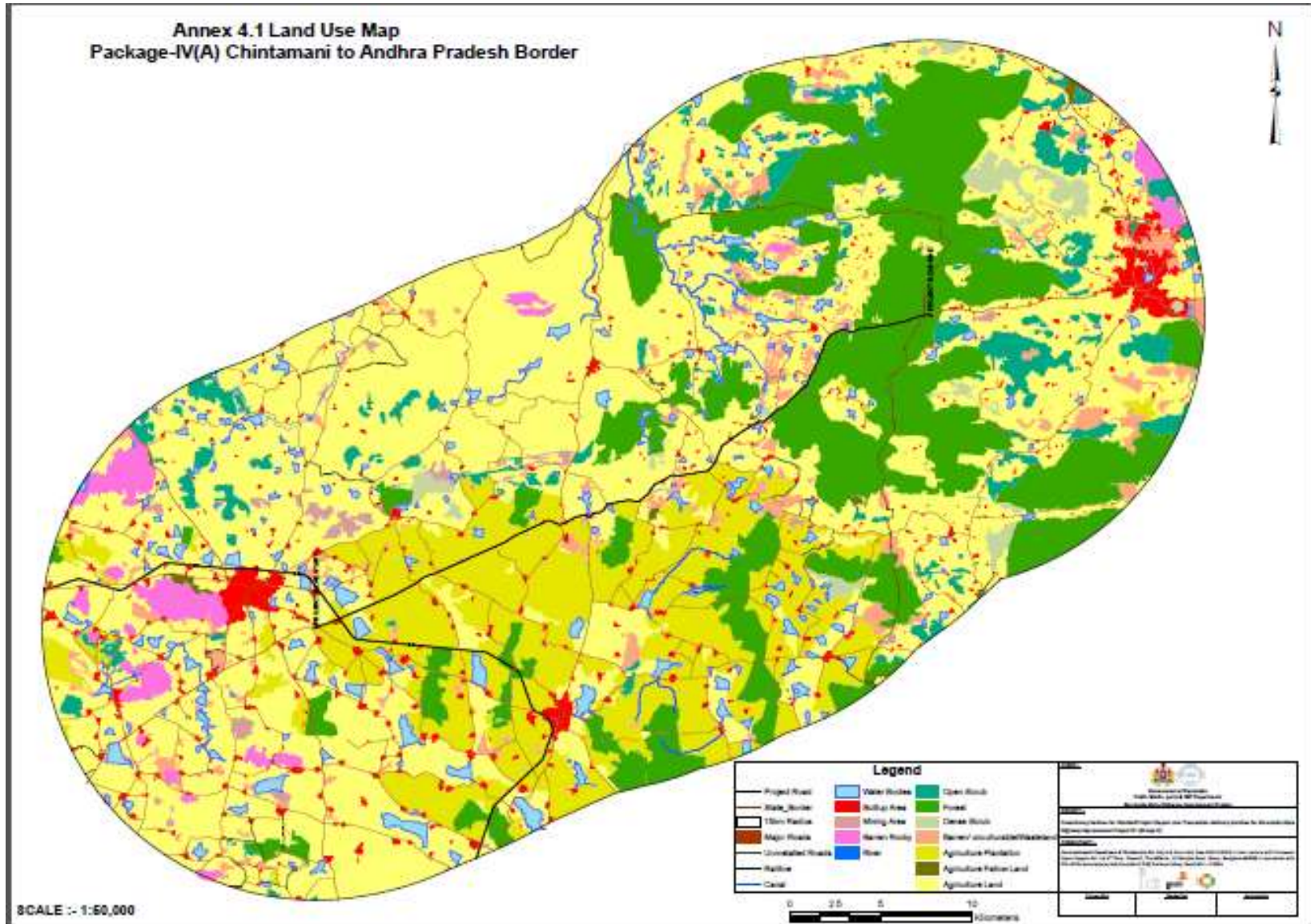
S. No.	Parameters	GoI Prescribed limits		Probable effects	World Health Organization Guide Values (2011)
		Desirable	Permissible		
				is essential for nutrition.	
8	CHLORIDE, as Cl, mg/l	250	1000	May be injurious to heart or kidney patients. Taste, indigestion, corrosion and palatability are affected.	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
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 SO ₄ , 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 NO ₃ = 50 mg/l; as NO ₂ =3mg/l
16	FLUORIDE, as F, mg/l	1	1.5	Reduces dental carries, very high concentration may cause crippling	1.5

S. No.	Parameters	GoI Prescribed limits		Probable effects	World Health Organization Guide Values (2011)
		Desirable	Permissible		
				skeletal fluorosis.	
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 pain, paralysis, mental confusion, visual disturbances, and anaemia etc.	0.01
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	No Guideline

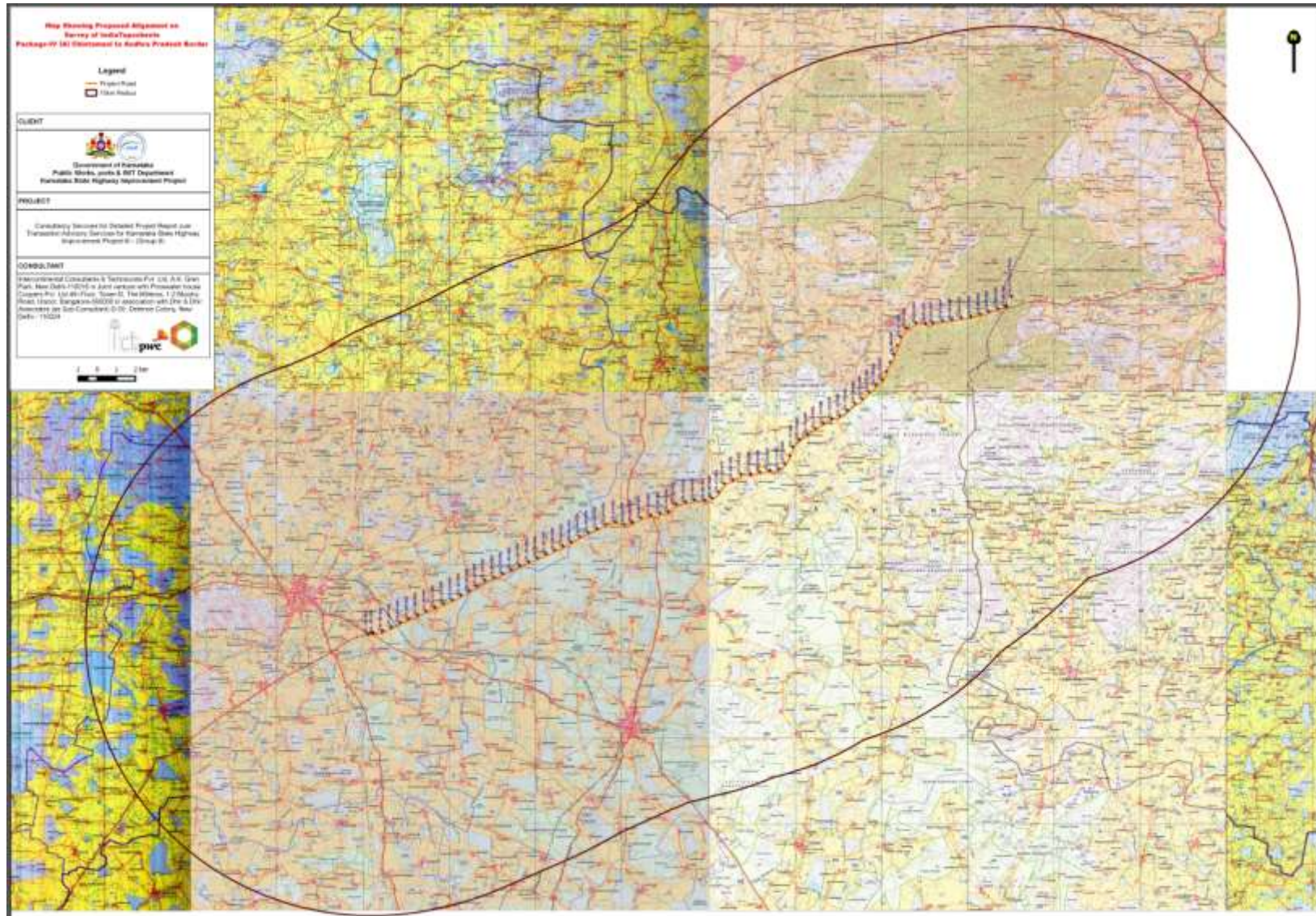
S. No.	Parameters	GoI Prescribed limits		Probable effects	World Health Organization Guide Values (2011)
		Desirable	Permissible		
				metabolism of iron to form haemoglobin. Imparts undesirable taste and stains plumbing fixtures and laundry.	
29	SELENIUM, as Se, mg/l	0.01	No relaxation	Leads to hair, 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 CaCO ₃ , mg/l	200	600	Imparts unpleasant taste, deleterious to humans in presence of high pH, hardness and TDS.	No Guideline
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 PO ₄ , 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	No Guideline

S. No.	Parameters	GoI Prescribed limits		Probable effects	World Health Organization Guide Values (2011)
		Desirable	Permissible		
				diseases.	
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	1	10	Causes water borne diseases like coliform jaundice; Typhoid, Cholera etc. produces infections involving skin mucous membrane of eyes, ears and throat.	E. coli no detection in any 100 ml sample
	a)TOTAL COLIFORM No/dl				
	b)FAECAL COLIFORM No/dl				
38	RADIOACTIVITY:			Increases risk of cancer.	Gross alpha activity > 0.5 Bq/li and gross beta activity > 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; Tritium 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 AND STUDY AREA



ANNEX 4.3 ON-SITE METEOROLOGICAL MONITORING RESULTS

Date & Time	Air Temperature (°C)	RH (%)	Wind Speed (m/sec)	Wind Direction (°)	Rainfall (mm)
DD/MM/YYYY HH:MM					
08/12/ 2015 - 14:00	20.34	62.09	1.7	351	0
08/12/ 2015 - 15:00	20.44	61.33	2.7	351	2
08/12/ 2015 - 16:00	20.46	61.1	1.8	353	0
08/12/ 2015 - 17:00	20.47	60.6	2.7	354	0
08/12/ 2015 - 18:00	20.49	61.49	2.4	353	0
08/12/ 2015 - 19:00	20.52	60.72	2.7	353	0
08/12/ 2015 - 20:00	20.54	60.37	3.1	353	0
08/12/ 2015 - 21:00	20.56	60.28	2.0	344	0
08/12/ 2015 - 22:00	20.56	60.1	1.3	315	0
08/12/ 2015 - 23:00	20.55	60.1	0.8	185	0
08/12/ 2015 - 00:00	20.56	60.28	0.9	196	0
09/12/2015 - 01:00	20.58	59.69	1.6	121	0
09/12/2015 - 02:00	20.58	59.84	1.4	104	0
09/12/2015 - 03:00	20.58	59.87	1.3	108	0
09/12/2015 - 04:00	20.59	58.91	1.6	136	0
09/12/2015 - 05:00	20.6	58.94	2.0	242	0
09/12/2015 - 06:00	20.58	59.15	2.5	173	0
09/12/2015 - 07:00	20.6	59.18	3.1	140	0
09/12/2015 - 08:00	20.6	59.36	2.5	193	0
09/12/2015 - 09:00	20.61	59.3	3.0	188	0
09/12/2015 - 10:00	20.6	59.3	1.8	189	0
09/12/2015 - 11:00	20.61	59.36	1.4	188	0
09/12/2015 - 12:00	20.61	59.36	1.8	170	0
09/12/2015 - 13:00	20.62	59.51	2.7	337	0
09/12/2015 - 14:00	20.62	59.57	1.6	225	0
09/12/2015 - 15:00	20.62	59.45	3.0	296	0
09/12/2015 - 16:00	20.62	59.69	3.0	325	0
09/12/2015 - 17:00	20.63	59.46	3.0	265	0
09/12/2015 - 18:00	20.63	59.52	3.0	144	0
09/12/2015 - 19:00	20.64	59.64	3.9	350	0
09/12/2015 - 20:00	20.62	59.66	4.2	255	0
09/12/2015 - 21:00	20.63	59.73	3.9	216	0
09/12/2015 - 22:00	20.64	60.00	3.4	146	0
09/12/2015 - 23:00	20.64	60.09	1.3	250	0
10/12/2015 - 00:00	20.63	60.02	1.7	303	0
10/12/2015 - 01:00	20.64	60.09	3.4	346	0
10/12/2015 - 02:00	20.64	60.21	1.7	358	0
10/12/2015 - 03:00	20.64	60.3	3.3	242	0
10/12/2015 - 04:00	20.64	60.3	3.5	173	0
10/12/2015 - 05:00	20.64	60.41	4.2	140	0
10/12/2015 - 06:00	20.64	60.47	1.4	193	0
10/12/2015 - 07:00	20.65	60.42	4.2	188	0
10/12/2015 - 08:00	20.65	60.45	3.9	351	0

Date & Time	Air Temperature (°C)	RH (%)	Wind Speed (m/sec)	Wind Direction (°)	Rainfall (mm)
DD/MM/YYYY HH:MM					
10/12/2015 - 09:00	20.67	60.39	1.2	352	0
10/12/2015 - 10:00	20.68	60.9	1.3	350	0
10/12/2015 - 11:00	20.69	60.69	2.6	350	0
10/12/2015 - 12:00	20.7	60.45	4.1	350	0
10/12/2015 - 13:00	20.71	60.49	4.2	350	0
10/12/2015 - 14:00	20.72	60.52	4.3	350	0
10/12/2015 - 15:00	20.72	60.58	3.8	350	0
10/12/2015 - 16:00	20.72	60.49	6.0	351	0
10/12/2015 - 17:00	20.72	60.49	4.6	350	0
10/12/2015 - 18:00	20.73	60.55	4.4	349	0
10/12/2015 - 19:00	20.74	60.55	3.7	349	0
10/12/2015 - 20:00	20.74	60.64	3.1	349	0
10/12/2015 - 21:00	24.16	77.58	1.7	334	0
10/12/2015 - 22:00	23.07	81.18	1.7	265	0
10/12/2015 - 23:00	22.03	85.29	2.1	13	0
11/12/2015 - 00:00	21.54	88.56	2.1	354	0
11/12/ 2015 - 01:00	20.82	91.14	1.0	308	0
11/12/ 2015 - 02:00	20.46	91.75	0.8	355	0
11/12/ 2015 - 03:00	20.34	92.34	0.5	77	0
11/12/ 2015 - 04:00	20.27	92.55	0.5	348	0
11/12/ 2015 - 05:00	19.66	95.97	2.5	300	0
11/12/ 2015 - 06:00	20.04	96.25	2.9	229	0
11/12/ 2015 - 07:00	20.34	93.3	1.6	356	0
11/12/ 2015 - 08:00	19.89	94.3	1.3	346	0
11/12/ 2015 - 09:00	19.94	93.27	0.6	339	0
11/12/ 2015 - 10:00	23.83	80.08	1.1	32	0
11/12/ 2015 - 11:00	24.82	73.44	2.8	303	0
11/12/ 2015 - 12:00	28.03	58.23	2.3	300	0
11/12/ 2015 - 13:00	29.26	49.24	2.1	296	0
11/12/ 2015 - 14:00	30.68	38.69	2.1	325	0
11/12/ 2015 - 15:00	32.97	26.76	1.7	265	0
11/12/ 2015 - 16:00	34.02	23.72	1.9	144	0
11/12/ 2015 - 17:00	33.55	26.65	2.4	350	0
11/12/ 2015 - 18:00	32.3	31.25	1.6	255	0
11/12/ 2015 - 19:00	31.06	36.71	1.4	216	0
11/12/ 2015 - 20:00	26.33	52.32	5.1	146	0
11/12/ 2015 - 21:00	24.54	67.58	1.9	250	0
11/12/ 2015 - 22:00	22.75	76.72	1.7	303	0
11/12/ 2015 - 23:00	22.19	80.23	1.7	346	0
12/12/ 2015 - 00:00	21.47	84.22	1.6	358	0
12/12/ 2015 - 01:00	20.89	87.27	2.1	318	0
12/12/ 2015 - 02:00	20.36	89.56	0.9	92	0
12/12/ 2015 - 03:00	20.12	90.61	0.6	0	0
12/12/ 2015 - 04:00	26.21	52.43	4.6	216	0
12/12/ 2015 - 05:00	26.21	52.56	1.3	218	0

Date & Time	Air Temperature (°C)	RH (%)	Wind Speed (m/sec)	Wind Direction (°)	Rainfall (mm)
DD/MM/YYYY HH:MM					
12/12/ 2015 - 06:00	24.8	59.52	2.1	186	1.2
12/12/ 2015 - 07:00	23.51	64.17	1.4	216	0
12/12/ 2015 - 08:00	21.97	73.39	2.1	295	0
12/12/ 2015 - 09:00	21.02	79.88	1.8	308	0
12/12/ 2015 - 10:00	20.43	84.03	2.1	332	0
12/12/ 2015 - 11:00	20.12	86.35	2.4	305	0
12/12/ 2015 - 12:00	19.92	87.74	1.5	183	0
12/12/ 2015 - 13:00	19.44	90.09	1	220	0
12/12/ 2015 - 14:00	19.22	91.16	0.6	317	0
12/12/ 2015 - 15:00	18.96	92.42	0.7	187	0
12/12/ 2015 - 16:00	18.66	94.2	1.2	198	0
12/12/ 2015 - 17:00	18.93	92.87	1.1	123	0
12/12/ 2015 - 18:00	19.02	91.94	1	106	0
12/12/ 2015 - 19:00	18.9	91.24	1.2	110	0
12/12/ 2015 - 20:00	18.66	91.84	1.5	138	0
12/12/ 2015 - 21:00	19.79	86.89	1.9	244	0
12/12/ 2015 - 22:00	20.7	84.04	2.4	175	0
12/12/ 2015 - 23:00	21.6	82.55	1.9	142	0
13/12/ 2015 - 00:00	23.52	76.26	2.3	195	0
13/12/ 2015 - 01:00	25.22	71.22	1.4	190	0
13/12/ 2015 - 02:00	25.13	72.7	1.1	191	0
13/12/ 2015 - 03:00	26.32	69.48	1.4	190	0
13/12/ 2015 - 04:00	25.18	73.04	2.1	172	0
13/12/ 2015 - 05:00	24.66	76.27	1.2	339	0
13/12/ 2015 - 06:00	25.56	72.8	2.3	257	0
13/12/ 2015 - 07:00	24.15	77.49	2.3	301	0
13/12/ 2015 - 08:00	24.95	72.94	2.3	242	0
13/12/ 2015 - 09:00	25.83	70.8	2.3	268	0
13/12/ 2015 - 10:00	26.01	71.85	3	264	0
13/12/ 2015 - 11:00	24.09	79.27	3.2	301	0
13/12/ 2015 - 12:00	23.62	80.8	3	305	0
13/12/ 2015 - 13:00	22.04	86.83	2.6	311	0
13/12/ 2015 - 14:00	21.05	90.84	1	290	0
13/12/ 2015 - 15:00	20.71	92.41	1.3	336	0
13/12/ 2015 - 16:00	20.28	93.63	2.6	333	0
13/12/ 2015 - 17:00	20.32	94.05	1.3	299	0
13/12/ 2015 - 18:00	20.27	93.26	2.5	288	0
13/12/ 2015 - 19:00	20.06	94.79	2.7	256	0
13/12/ 2015 - 20:00	19.88	94.74	3.2	344	0
13/12/ 2015 - 21:00	19.09	95.11	1.1	21	0
13/12/ 2015 - 22:00	19.16	96.28	3.2	314	0
13/12/ 2015 - 23:00	19.14	95.17	3	337	0
14/12/ 2015 - 00:00	19.43	94.22	0.9	8	0
14/12/ 2015 - 01:00	18.76	95.47	1	72	0
14/12/ 2015 - 02:00	19.53	93.53	2	342	0
14/12/ 2015 - 03:00	21.0	90.05	3.1	32	0

Date & Time	Air Temperature (°C)	RH (%)	Wind Speed (m/sec)	Wind Direction (°)	Rainfall (mm)
DD/MM/YYYY HH:MM					
14/12/2015 - 04:00	23.82	79.74	3.2	312	0
14/12/2015 - 05:00	26.52	70.44	3.3	323	0
14/12/2015 - 06:00	28.74	62.69	2.9	226	0
14/12/2015 - 07:00	30.09	54.97	4.6	345	0
14/12/2015 - 08:00	32.49	48.19	3.5	20	0
14/12/2015 - 09:00	30.46	53.78	3.4	270	0
14/12/2015 - 10:00	31.05	51.11	2.8	333	0
14/12/2015 - 11:00	32.4	46.65	2.4	292	0
14/12/2015 - 12:00	30.43	51.81	1.3	4	0
14/12/2015 - 13:00	25.39	73.47	1.3	264	0
14/12/2015 - 14:00	23.6	81.16	1.6	276	0
14/12/2015 - 15:00	22.71	87.06	1.6	324	0
14/12/2015 - 16:00	22.06	90	0.8	287	0
14/12/2015 - 17:00	21.57	91.44	1.5	308	0
14/12/2015 - 18:00	21.23	92.4	1.4	309	0
14/12/2015 - 19:00	21.3	92.38	2.3	300	0
14/12/2015 - 20:00	20.97	93.58	2.9	305	0
14/12/2015 - 21:00	21.02	94.64	2.5	285	0
14/12/2015 - 22:00	21.03	93.96	2.3	293	0
14/12/2015 - 23:00	20.4	95.28	0.5	35	0
15/12/2015 - 00:00	20.02	96.2	1.4	330	0
15/12/2015 - 01:00	20.18	96.11	1.4	343	0
15/12/2015 - 02:00	20.44	95.56	1.3	345	0
15/12/2015 - 03:00	21.79	91.19	1.4	338	0
15/12/2015 - 04:00	23.37	85.65	1.3	306	0
15/12/2015 - 05:00	26.44	71.93	2.5	288	0
15/12/2015 - 06:00	27.12	68.47	2.8	319	0
15/12/2015 - 07:00	28.49	59.19	2.3	263	0
15/12/2015 - 08:00	29.59	52.53	1.7	234	0
15/12/2015 - 09:00	29.42	52.96	2.2	197	0
15/12/2015 - 10:00	31.21	43.68	2.2	148	0
15/12/2015 - 11:00	29.09	51.11	2.2	233	0
15/12/2015 - 12:00	30.05	52.14	1.4	137	0
15/12/2015 - 13:00	26.19	64.38	3.1	284	0
15/12/2015 - 14:00	24.16	77.58	0.9	334	0
15/12/2015 - 15:00	23.07	81.18	1.1	265	0
15/12/2015 - 16:00	22.03	85.29	0.4	13	0
15/12/2015 - 17:00	21.54	88.56	0.7	354	0
15/12/2015 - 18:00	20.82	91.14	0.3	308	0
15/12/2015 - 19:00	20.46	91.75	0.8	355	0
15/12/2015 - 20:00	20.34	92.34	0.5	77	0
15/12/2015 - 21:00	20.27	92.55	0.5	348	0
15/12/2015 - 22:00	19.66	95.97	2.5	300	0
15/12/2015 - 23:00	20.04	96.25	2.9	229	0
16/12/2015 - 00:00	20.34	93.3	1.6	356	0
16/12/2015 - 01:00	19.89	94.3	1.3	346	0

Date & Time	Air Temperature (°C)	RH (%)	Wind Speed (m/sec)	Wind Direction (°)	Rainfall (mm)
DD/MM/YYYY HH:MM					
16/12/2015 - 02:00	19.94	93.27	0.6	339	0
16/12/2015 - 03:00	23.83	80.08	1.1	32	0
16/12/2015 - 04:00	24.82	73.44	2.8	303	0
16/12/2015 - 05:00	28.03	58.23	2.3	300	0
16/12/2015 - 06:00	29.26	49.24	2.1	296	0
16/12/2015 - 07:00	30.68	38.69	2.1	325	0
16/12/2015 - 08:00	32.97	26.76	1.7	265	0
16/12/2015 - 09:00	34.02	23.72	1.9	144	0
16/12/2015 - 10:00	33.55	26.65	2.4	350	0
16/12/2015 - 11:00	32.3	31.25	1.6	255	0
16/12/2015 - 12:00	31.06	36.71	1.4	216	0
16/12/2015 - 13:00	26.33	52.32	5.1	146	0
16/12/2015 - 14:00	24.54	67.58	1.9	250	0
16/12/2015 - 15:00	22.75	76.72	1.7	303	0
16/12/2015 - 16:00	22.19	80.23	1.7	346	0
16/12/2015 - 17:00	21.47	84.22	1.6	358	0
16/12/2015 - 18:00	20.89	87.27	2.1	318	0
16/12/2015 - 19:00	20.36	89.56	0.9	92	0
16/12/2015 - 20:00	20.12	90.61	0.6	0	0
16/12/2015 - 21:00	19.53	92.43	0.4	354	0
16/12/2015 - 22:00	19.2	93.26	0.4	332	0
16/12/2015 - 23:00	18.98	94.06	0.7	0	0
17/12/2015 - 00:00	18.91	94.02	0.4	353	0
18/12/2015 - 01:00	19.44	94.31	0.3	314	0
18/12/2015 - 02:00	20.0	92.35	0.6	6	0
18/12/2015 - 03:00	23.44	81.28	1.1	315	0
18/12/2015 - 04:00	26.5	68.51	1.9	341	0
18/12/2015 - 05:00	30.06	56.43	2.1	329	0
18/12/2015 - 06:00	29.45	57.09	2.2	214	0
18/12/2015 - 07:00	30.43	46.81	2.3	288	0
18/12/2015 - 08:00	31.23	43.65	2	174	0
18/12/2015 - 09:00	33.06	35.14	1.9	59	0
18/12/2015 - 10:00	32.22	36.05	2.1	271	0
18/12/2015 - 11:00	28.89	52.57	2.7	326	0
18/12/2015 - 12:00	28.7	53.82	4.7	246	0
18/12/2015 - 13:00	24.76	73.82	2.3	305	0
18/12/2015 - 14:00	23.24	81.39	1.4	296	0
18/12/2015 - 15:00	22.08	86.72	1.6	305	0
18/12/2015 - 16:00	21.44	89.49	1.4	291	0
18/12/2015 - 17:00	21.04	92.08	2.5	323	0
18/12/2015 - 18:00	20.62	93.53	1.2	344	0
18/12/2015 - 19:00	20.2	94.08	1.1	317	0
18/12/2015 - 20:00	19.68	94.47	1.1	348	0
18/12/2015 - 21:00	19.56	95.99	2	317	0
18/12/2015 - 22:00	19.46	96.66	3.4	346	0
18/12/2015 - 23:00	19.41	96.95	2.9	309	0

Date & Time	Air Temperature (°C)	RH (%)	Wind Speed (m/sec)	Wind Direction (°)	Rainfall (mm)
DD/MM/YYYY HH:MM					
19/12/2015 - 00:00	19.29	97.27	1.8	294	0
19/12/2015 - 01:00	19.5	97.24	2.4	341	0
19/12/2015 - 02:00	19.45	97.1	2.1	275	0
19/12/2015 - 03:00	19.96	96.23	2.9	322	0
19/12/2015 - 04:00	20.91	91.35	3.7	294	0
19/12/2015 - 05:00	26.04	67.44	3.6	272	0
19/12/2015 - 06:00	27.81	57.36	2.1	274	0
19/12/2015 - 07:00	29.9	46.35	3.4	136	0
19/12/2015 - 08:00	31.18	39.09	3.1	337	0
19/12/2015 - 09:00	30.73	41.18	3.2	275	0
19/12/2015 - 10:00	32.01	35.96	4.1	319	0
19/12/2015 - 11:00	31.41	39.25	3	277	0
19/12/2015 - 12:00	28.51	48.69	2.3	291	0
19/12/2015 - 13:00	24.88	65.57	1	317	0
19/12/2015 - 14:00	22.95	72.73	1.6	282	0
19/12/2015 - 15:00	22.01	78.17	2	293	0
19/12/2015 - 16:00	21.25	81.84	2.3	312	0
19/12/2015 - 17:00	20.63	86.06	2.5	311	0
19/12/2015 - 18:00	20.13	88.56	2.4	310	0
19/12/2015 - 19:00	19.6	89.47	1.8	296	0
19/12/2015 - 20:00	18.75	91.55	1.6	343	0
19/12/2015 - 21:00	18.39	92.62	1	347	0
19/12/2015 - 22:00	17.93	94.25	1	303	0
19/12/2015 - 23:00	17.49	95.08	1	346	0
20/12/2015 - 00:00	17.33	96.56	1.6	344	0
20/12/2015 - 01:00	17.32	96.67	1.6	346	0
20/12/2015 - 02:00	17.55	96.69	1.5	349	0
20/12/2015 - 03:00	18.05	95.63	2	108	0
20/12/2015 - 04:00	19.17	94.29	2.2	337	0
20/12/2015 - 05:00	21.93	86.36	2.5	14	0
20/12/2015 - 06:00	25.82	69.77	3.1	21	0
20/12/2015 - 07:00	28.76	52.07	2.2	312	0
20/12/2015 - 08:00	30.55	33.7	2.9	288	0
20/12/2015 - 09:00	30.59	26.66	2.4	328	0
20/12/2015 - 10:00	30.63	30.07	2.7	9	0
20/12/2015 - 11:00	29.94	37.99	3.3	301	0
20/12/2015 - 12:00	27.22	45.77	3	293	0
20/12/2015 - 13:00	22.93	63.57	1.7	286	0
20/12/2015 - 14:00	21.23	75.4	1.4	319	0
20/12/2015 - 15:00	20.07	84.12	1.7	1	0
20/12/2015 - 16:00	19.38	86.69	2.3	290	0
20/12/2015 - 17:00	18.64	88.88	1.2	321	0
20/12/2015 - 18:00	17.91	91.52	0.8	346	0
20/12/2015 - 19:00	17.76	92.89	1.3	356	0
20/12/2015 - 20:00	17.36	94.08	1.3	351	0
20/12/2015 - 21:00	17.62	95.99	2.5	349	0

Date & Time	Air Temperature (°C)	RH (%)	Wind Speed (m/sec)	Wind Direction (°)	Rainfall (mm)
DD/MM/YYYY HH:MM					
20/12/2015 - 22:00	17.38	96.71	2.4	299	0
20/12/2015 - 23:00	18.2	91.77	2.2	351	0
21/12/2015 - 00:00	17.89	91.67	2.9	337	0
21/12/2015 - 01:00	16.78	93.84	1.1	344	0
21/12/2015 - 02:00	16.7	93.73	1.6	340	0
21/12/2015 - 03:00	20.24	82.07	3.8	288	0
21/12/2015 - 04:00	22.53	72.34	5.4	305	0
21/12/2015 - 05:00	25.74	57.73	5.1	340	0
21/12/2015 - 06:00	28.03	50.68	4.2	325	0
21/12/2015 - 07:00	28.5	48.23	3.8	344	0
21/12/2015 - 08:00	29.33	44.85	4.5	312	0
21/12/2015 - 09:00	29.62	41.09	4.6	283	0
21/12/2015 - 10:00	29.19	41.83	4.2	259	0
21/12/2015 - 11:00	28.86	44.79	5	323	0
21/12/2015 - 12:00	26.7	51.64	3.7	307	0
21/12/2015 - 13:00	23.36	68.01	2.3	285	0
21/12/2015 - 14:00	21.54	76.13	1.5	316	0
21/12/2015 - 15:00	20.71	80.36	1.6	325	0
21/12/2015 - 16:00	19.73	84.79	0.4	342	0
21/12/2015 - 17:00	19.32	87.69	1.4	346	0
21/12/2015 - 18:00	18.56	89.57	0.7	351	0
21/12/2015 - 19:00	18.16	91.17	1.2	356	0
21/12/2015 - 20:00	18.44	92.15	0	337	0
21/12/2015 - 21:00	18.66	94.31	1.7	312	0
21/12/2015 - 22:00	18.98	93.97	3.8	348	0
21/12/2015 - 23:00	18.57	94.64	3.3	348	0
22/12/2015 - 00:00	19.3	91.85	2.3	301	0
22/12/2015 - 01:00	19.18	91.01	2.9	342	0
22/12/2015 - 02:00	19.07	90.77	1.6	291	0
22/12/2015 - 03:00	19.96	86.83	2.8	275	0
22/12/2015 - 04:00	22.56	76.66	3.6	313	0
22/12/2015 - 05:00	25.89	62.03	4.3	319	0
22/12/2015 - 06:00	24.96	65.24	4	340	0
22/12/2015 - 07:00	26.03	59.65	5.3	341	0
22/12/2015 - 08:00	28.46	50.45	4	351	0
22/12/2015 - 09:00	27.27	52.77	4.3	294	0
22/12/2015 - 10:00	28.59	50.59	4.2	210	0
22/12/2015 - 11:00	27.53	52.23	4.3	278	0
22/12/2015 - 12:00	27.61	49.66	3	346	0
22/12/2015 - 13:00	23.9	65.88	1.9	319	0
22/12/2015 - 14:00	22.69	71.37	0.4	319	0
22/12/2015 - 15:00	21.47	80.31	0.5	320	0
22/12/2015 - 16:00	20.48	85.8	0	320	0
22/12/2015 - 17:00	19.78	89.68	0.6	351	0
22/12/2015 - 18:00	19.53	91.37	0.8	323	0
22/12/2015 - 19:00	19.0	92.98	0.7	350	0

Date & Time	Air Temperature (°C)	RH (%)	Wind Speed (m/sec)	Wind Direction (°)	Rainfall (mm)
DD/MM/YYYY HH:MM					
22/12/ 2015 - 20:00	19.78	94.49	4	300	0
22/12/ 2015 - 21:00	20.06	94.25	4.1	301	0
22/12/ 2015 - 22:00	20.23	93.39	3.8	322	0
22/12/ 2015 - 23:00	19.7	94.78	3.2	293	0
23/12/ 2015 - 00:00	19.32	95.17	1.6	347	0
23/12/ 2015 - 01:00	19.08	95.51	1.3	347	0
23/12/ 2015 - 02:00	19.78	93.68	1.8	311	0
23/12/ 2015 - 03:00	20.88	88.59	3	303	0
23/12/ 2015 - 04:00	22.02	82.67	3.4	258	0
23/12/ 2015 - 05:00	23.63	74.35	3.1	292	0
23/12/ 2015 - 06:00	27.28	61.64	4.4	30	0
23/12/ 2015 - 07:00	27.32	57.81	3.8	317	0
23/12/ 2015 - 08:00	29.36	51.41	3.5	273	0
23/12/ 2015 - 09:00	31.17	43.4	4.2	326	0
23/12/ 2015 - 10:00	28.77	47.14	3.6	306	0
23/12/ 2015 - 11:00	30.39	42.27	3.6	326	0
23/12/ 2015 - 12:00	27.83	46.01	3.7	319	0
23/12/ 2015 - 13:00	24.3	60.99	1.4	309	0
23/12/ 2015 - 14:00	22.29	72.52	0.6	290	0
23/12/ 2015 - 15:00	21.46	78.53	1.3	300	0
23/12/ 2015 - 16:00	21.02	83.66	1.7	312	0
23/12/ 2015 - 17:00	20.3	87.2	1.7	318	0
23/12/ 2015 - 18:00	20.38	92	2.5	313	0
23/12/ 2015 - 19:00	20.2	92.97	2.7	314	0
23/12/ 2015 - 20:00	19.41	94.13	1	11	0
23/12/ 2015 - 21:00	19.57	94.48	1	351	0
23/12/ 2015 - 22:00	19.02	95.07	0.8	10	0
23/12/ 2015 - 23:00	18.74	95.79	0.4	351	0
24/12/ 2015 - 00:00	19.48	94.64	1.9	266	0
24/12/ 2015 - 01:00	19.36	95.12	1.2	290	0
24/12/ 2015 - 02:00	19.74	94.35	1.5	315	0
24/12/ 2015 - 03:00	23.11	80.4	1.9	319	0
24/12/ 2015 - 04:00	23.52	75.91	2.2	217	0
24/12/ 2015 - 05:00	25.81	63.57	3.2	332	0
24/12/ 2015 - 06:00	26.2	58.82	4.6	309	0
24/12/ 2015 - 07:00	28.28	52.33	4.6	268	0
24/12/ 2015 - 08:00	28.6	49.88	4.5	292	0
24/12/ 2015 - 09:00	29.36	47.18	4.7	259	0
24/12/ 2015 - 10:00	29.76	47.4	4.7	310	0
24/12/ 2015 - 11:00	29.78	45.97	5	300	0
24/12/ 2015 - 12:00	28.55	47.55	2.4	257	0
24/12/ 2015 - 13:00	24.26	65.91	1.8	272	0
24/12/ 2015 - 14:00	22.3	74.52	0	307	0
24/12/ 2015 - 15:00	21.25	78.62	0.6	307	0
24/12/ 2015 - 16:00	20.76	81.35	1.2	296	0
24/12/ 2015 - 17:00	20.38	85.41	1.2	278	0

Date & Time	Air Temperature (°C)	RH (%)	Wind Speed (m/sec)	Wind Direction (°)	Rainfall (mm)
DD/MM/YYYY HH:MM					
24/12/2015 - 18:00	20.01	87.74	2.4	324	0
24/12/2015 - 19:00	19.41	90.83	1.9	315	0
24/12/2015 - 20:00	19.56	93.08	3.2	315	0
24/12/2015 - 21:00	19.42	93.95	2.1	356	0
24/12/2015 - 22:00	19.48	94.37	3.6	332	0
24/12/2015 - 23:00	19.18	93.8	3.4	282	0
25/12/2015 - 00:00	19.42	91.44	2.8	348	0
25/12/2015 - 01:00	19.48	90.2	3.9	292	0
25/12/2015 - 02:00	19.71	88.88	4.2	291	0
25/12/2015 - 03:00	22.2	78.66	3.9	5	0
25/12/2015 - 04:00	22.98	75.42	4.1	356	0
25/12/2015 - 05:00	25.27	65.41	4.9	275	0
25/12/2015 - 06:00	26.46	57.34	4.6	284	0
25/12/2015 - 07:00	28.84	43.01	5.3	343	0
25/12/2015 - 08:00	30.4	36.75	3.8	353	0
25/12/2015 - 09:00	32.12	31.41	3.1	28	0
25/12/2015 - 10:00	30.62	27.64	2.5	166	0
25/12/2015 - 11:00	32.98	26.24	1.4	12	0
25/12/2015 - 12:00	27.92	40.33	5.3	282	0
25/12/2015 - 13:00	24.94	48.96	2.7	250	0
25/12/2015 - 14:00	22.51	61.73	0.6	0	0
25/12/2015 - 15:00	21.56	63.87	0	356	0
25/12/2015 - 16:00	20.42	71.11	0	2	0
25/12/2015 - 17:00	19.3	76.66	0	345	0
25/12/2015 - 18:00	19.04	78.21	0.6	9	0
25/12/2015 - 19:00	17.86	83.55	0.6	348	0
25/12/2015 - 20:00	18.36	82.11	1.3	347	0
25/12/2015 - 21:00	17.58	85.49	1.2	346	0
25/12/2015 - 22:00	17.46	86.48	1.8	340	0
25/12/2015 - 23:00	16.96	89.15	2.1	342	0
26/12/2015 - 00:00	16.4	91.59	1.6	348	0
26/12/2015 - 01:00	16.28	92.55	2.1	348	0
26/12/2015 - 02:00	16.46	92.03	1.9	353	0
26/12/2015 - 03:00	19.92	83.01	2.9	350	0
26/12/2015 - 04:00	23.72	68.9	2.9	327	0
26/12/2015 - 05:00	27.07	50.46	3.2	309	0
26/12/2015 - 06:00	28.7	41.27	3.5	247	0
26/12/2015 - 07:00	30.78	33.3	3.7	269	0
26/12/2015 - 08:00	30.6	31.36	4.1	277	0
26/12/2015 - 09:00	30.32	32.08	3.2	264	0
26/12/2015 - 10:00	29.91	36.88	3.7	250	0
26/12/2015 - 11:00	30.72	33.79	3.4	348	0
26/12/2015 - 12:00	28.85	39.51	2.4	251	0
26/12/2015 - 13:00	24.5	54.44	1	314	0
26/12/2015 - 14:00	22.62	66.79	1	301	0
26/12/2015 - 15:00	21.47	74.9	1	311	0

Date & Time	Air Temperature (°C)	RH (%)	Wind Speed (m/sec)	Wind Direction (°)	Rainfall (mm)
DD/MM/YYYY HH:MM					
26/12/ 2015 - 16:00	20.53	80.86	0.8	345	0
26/12/ 2015 - 17:00	20.3	83.98	1.8	303	0
26/12/ 2015 - 18:00	19.61	87.76	1.6	305	0
26/12/ 2015 - 19:00	19.5	88.9	1.5	310	0
26/12/ 2015 - 20:00	19.01	92.21	0.8	12	0
26/12/ 2015 - 21:00	19.89	92.18	3.3	259	0
26/12/ 2015 - 22:00	19.0	92.16	1.8	356	0
26/12/ 2015 - 23:00	19.38	92.71	2.3	269	0
27/12/ 2015 - 00:00	19.5	92.15	3.6	334	0
27/12/ 2015 - 01:00	19.07	92.68	3.4	312	0
27/12/ 2015 - 02:00	19.22	90.88	4.6	299	0
27/12/ 2015 - 03:00	19.72	87.09	4.4	310	0
27/12/ 2015 - 04:00	22.98	73.56	5.3	330	0
27/12/ 2015 - 05:00	23.98	70.12	4.4	304	0
27/12/ 2015 - 06:00	26.98	57.61	4	278	0
27/12/ 2015 - 07:00	27.76	51.71	4	301	0
27/12/ 2015 - 08:00	30.09	37.8	3.3	259	0
27/12/ 2015 - 09:00	28.32	41.53	3.2	319	0
27/12/ 2015 - 10:00	27.94	40.61	3.1	261	0
27/12/ 2015 - 11:00	28.9	37.68	2.3	270	0
27/12/ 2015 - 12:00	27.38	41.09	2.7	305	0
27/12/ 2015 - 13:00	24.01	55.68	2.9	302	0
27/12/ 2015 - 14:00	22.12	64.96	0.9	331	0
27/12/ 2015 - 15:00	20.89	72.91	0.8	323	0
27/12/ 2015 - 16:00	20.11	77.28	0.6	316	0
27/12/ 2015 - 17:00	20.36	78.91	3.4	304	0
27/12/ 2015 - 18:00	19.51	88.98	1.9	287	0
27/12/ 2015 - 19:00	19.38	92.44	2	323	0
27/12/ 2015 - 20:00	19.15	93.47	1.8	327	0
27/12/ 2015 - 21:00	18.75	94.51	1.1	0	0
27/12/ 2015 - 22:00	17.62	95.47	0.6	12	0
27/12/ 2015 - 23:00	17.34	96.16	0.7	353	0
28/12/ 2015 - 00:00	17.78	96.6	0.9	354	0
28/12/ 2015 - 01:00	17.62	96.68	0.9	355	0
28/12/ 2015 - 02:00	17.44	96.61	0.9	347	0
28/12/ 2015 - 03:00	18.97	92.06	1	355	0
28/12/ 2015 - 04:00	22.73	77.2	1.4	346	0
28/12/ 2015 - 05:00	28.33	49.39	1.3	347	0
28/12/ 2015 - 06:00	28.67	41.67	2.3	329	0
28/12/ 2015 - 07:00	29.52	32.66	4.2	234	0.2
28/12/ 2015 - 08:00	29.98	31.31	4.6	249	0
28/12/ 2015 - 09:00	30.43	26.83	3.9	294	0
28/12/ 2015 - 10:00	29.0	32.5	4	214	0
28/12/ 2015 - 11:00	29.12	32.94	3.2	135	0
28/12/ 2015 - 12:00	27.46	37.61	3.8	236	0
28/12/ 2015 - 13:00	24.86	46.41	1.5	209	0

Date & Time	Air Temperature (°C)	RH (%)	Wind Speed (m/sec)	Wind Direction (°)	Rainfall (mm)
DD/MM/YYYY HH:MM					
28/12/2015 - 14:00	22.56	61.2	0.9	327	0
28/12/2015 - 15:00	21.11	71.57	0.5	331	0
28/12/2015 - 16:00	20.12	78.7	0.7	352	0
28/12/2015 - 17:00	19.6	83.84	0.6	213	0
28/12/2015 - 18:00	19.2	87.28	0.6	351	0
28/12/2015 - 19:00	18.42	91.19	1.4	351	0
28/12/2015 - 20:00	18.49	95.24	2.4	301	0
28/12/2015 - 21:00	19.32	94.01	3.8	330	0
28/12/2015 - 01:00	18.98	92.98	2.4	342	0
28/12/2015 - 01:00	18.36	94.43	1.6	342	0
28/12/2015 - 01:00	17.75	95.46	1.3	345	0
25/12/2015 - 06:00	16.91	96.13	0	16	0
25/12/2015 - 07:00	16.48	96.65	0.7	354	0
25/12/2015 - 08:00	18.5	94.29	0.8	349	0
25/12/2015 - 09:00	21.96	80.18	1.9	16	0
25/12/2015 - 10:00	26.02	58.79	1.6	229	0
25/12/2015 - 11:00	25.88	45.54	4.9	224	0
25/12/2015 - 12:00	27.07	44.19	5.1	169	0
25/12/2015 - 13:00	26.37	43.21	5.3	217	0
25/12/2015 - 14:00	27.02	43.45	5.3	180	0
25/12/2015 - 15:00	26.52	48.25	4.7	210	0
25/12/2015 - 16:00	25.84	53.56	4.2	202	0
25/12/2015 - 17:00	25.36	55.69	3.2	216	0
25/12/2015 - 18:00	23.64	64.01	2.7	234	0
25/12/2015 - 19:00	22.18	71.02	1.8	128	0
25/12/2015 - 20:00	21.24	74.62	0.3	206	0
25/12/2015 - 21:00	20.34	77.41	0.6	224	0
25/12/2015 - 22:00	20.09	84.18	0.6	267	0
25/12/2015 - 23:00	19.33	88.46	1.1	135	0
26/12/2015 - 00:00	20.26	87.34	0.5	132	0
26/12/2015 - 01:00	20.8	86.59	0.2	207	0
26/12/2015 - 02:00	20.16	86.44	1.6	207	0
26/12/2015 - 03:00	19.06	89.79	1	72	0
26/12/2015 - 04:00	18.8	90.17	1.4	223	0
26/12/2015 - 05:00	18.78	90.81	1.5	197	0
26/12/2015 - 06:00	17.92	93.15	1.2	313	0
26/12/2015 - 07:00	18.12	92.25	0	335	0
26/12/2015 - 08:00	21.06	84.95	0.7	211	0
26/12/2015 - 09:00	21.94	76.48	2.7	293	0
26/12/2015 - 10:00	25.11	60.82	2.9	218	0
26/12/2015 - 11:00	25.5	50.48	3.5	220	0
26/12/2015 - 12:00	27.94	43.18	4.3	289	0
26/12/2015 - 13:00	27.84	37.65	5.4	191	0
26/12/2015 - 14:00	29.82	36.56	5	290	0
26/12/2015 - 15:00	27.8	43.7	4.9	184	0
26/12/2015 - 16:00	29.4	40.35	4.8	326	0

Date & Time	Air Temperature (°C)	RH (%)	Wind Speed (m/sec)	Wind Direction (°)	Rainfall (mm)
DD/MM/YYYY HH:MM					
26/12/2015 - 17:00	25.5	55.02	3.3	191	0
26/12/2015 - 18:00	23.44	64.39	3.1	227	0
26/12/2015 - 19:00	22.18	71.89	2.8	245	0
26/12/2015 - 20:00	21.24	77.25	1.4	318	0
26/12/2015 - 21:00	20.39	82	0.8	320	0
26/12/2015 - 22:00	19.88	85.29	2	209	0
26/12/2015 - 23:00	19.68	86.71	2.2	226	0
27/12/2015 - 00:00	19.69	85.4	1.6	250	0
27/12/2015 - 01:00	18.72	88.79	0.8	235	0
27/12/2015 - 02:00	18.73	89.05	0.9	176	0
27/12/2015 - 03:00	18.61	89.11	0.4	117	0
27/12/2015 - 04:00	18.84	87.91	0.3	84	0
27/12/2015 - 05:00	19.16	89.37	1.9	227	0
27/12/2015 - 06:00	19.18	90.66	2.4	247	0
27/12/2015 - 07:00	19.61	88.48	3.7	267	0
27/12/2015 - 08:00	20.71	84.74	4.1	93	0
27/12/2015 - 09:00	22.63	76.41	4.4	215	0
27/12/2015 - 10:00	22.5	73.03	5.1	217	0
27/12/2015 - 11:00	23.93	69.51	6.1	244	0
27/12/2015 - 12:00	23.78	69.14	3.9	228	0
27/12/2015 - 13:00	25.24	65.31	3.5	66	0
27/12/2015 - 14:00	25.89	59.17	3.5	232	0
27/12/2015 - 15:00	25.01	62.1	3.4	250	0
27/12/2015 - 16:00	25.5	62.77	2.6	200	0
27/12/2015 - 17:00	23.82	69.89	3.8	216	0
27/12/2015 - 18:00	22.64	74.48	2.5	210	0
27/12/2015 - 19:00	21.32	79.27	1.6	231	0
27/12/2015 - 20:00	20.45	82.45	0.8	300	0
27/12/2015 - 21:00	20.06	84.42	1.4	233	0
27/12/2015 - 22:00	19.34	87.38	0.7	300	0
27/12/2015 - 23:00	19.08	89.68	1.2	270	0
28/12/2015 - 00:00	18.62	90.64	0.9	241	0
28/12/2015 - 01:00	17.77	92.26	1	6	0
28/12/2015 - 02:00	18.0	92.22	1.1	227	0
28/12/2015 - 03:00	17.84	90.35	1.6	232	0
28/12/2015 - 04:00	17.42	91.28	1.2	280	0
28/12/2015 - 05:00	16.86	92.07	0.6	307	0
28/12/2015 - 06:00	16.4	93.38	0	169	0
28/12/2015 - 07:00	16.29	92.73	0	182	0
28/12/2015 - 08:00	18.53	84.32	1.8	193	0
28/12/2015 - 09:00	20.08	74.5	3.4	201	0
28/12/2015 - 10:00	23.14	56.09	3.9	226	0
28/12/2015 - 11:00	26.03	47.01	3.7	319	0
28/12/2015 - 12:00	25.91	45.58	3.7	336	0
28/12/2015 - 13:00	27.02	38.94	4	288	0
28/12/2015 - 14:00	28.54	36.4	3.6	316	0

Date & Time	Air Temperature (°C)	RH (%)	Wind Speed (m/sec)	Wind Direction (°)	Rainfall (mm)
DD/MM/YYYY HH:MM					
28/12/2015 - 15:00	28.29	39.34	5.1	277	0
28/12/2015 - 16:00	27.92	38.96	3.8	218	0
28/12/2015 - 17:00	25.78	46.52	2.3	225	0
28/12/2015 - 18:00	23.32	56.94	2.3	223	0
28/12/2015 - 19:00	21.61	65.57	1.2	209	0
28/12/2015 - 20:00	19.86	72.96	0.7	215	0
28/12/2015 - 21:00	18.69	78.84	1	13	0
28/12/2015 - 22:00	17.85	82.97	0	83	0
28/12/2015 - 23:00	17.58	84.59	0	276	0
29/12/2015 - 00:00	16.83	87.76	0	0	0
29/12/2015 - 01:00	16.44	86.43	0	30	0
29/12/2015 - 02:00	15.5	91.29	0	28	0
29/12/2015 - 03:00	14.1	90.93	0	76	0
29/12/2015 - 04:00	13.84	92.14	0	350	0
29/12/2015 - 05:00	13.9	94.26	0	23	0
29/12/2015 - 06:00	13.36	92.76	0.2	5	0
29/12/2015 - 07:00	13.97	91.71	0	312	0
29/12/2015 - 08:00	19.61	73.1	0	244	0
29/12/2015 - 09:00	23.91	54.45	1.5	272	0
29/12/2015 - 10:00	26.11	48.65	3.9	137	0
29/12/2015 - 11:00	26.73	41.7	4.1	146	0
29/12/2015 - 12:00	28.94	36.78	5	200	0
29/12/2015 - 13:00	28.4	34.92	4.6	101	0
29/12/2015 - 14:00	29.07	32.44	4	267	0
29/12/2015 - 15:00	28.43	33.52	5.3	210	0
29/12/2015 - 16:00	28.22	33.5	4.1	217	0
29/12/2015 - 17:00	27.86	36.89	3.4	288	0
29/12/2015 - 18:00	23.76	52.93	2.4	209	0
29/12/2015 - 19:00	21.94	58.51	1.4	38	0
29/12/2015 - 20:00	20.38	65.22	0	199	0
29/12/2015 - 21:00	19.74	68.13	0	280	0
29/12/2015 - 22:00	19.08	71.88	0.5	289	0
29/12/2015 - 23:00	16.9	80.61	0.4	15	0
30/12/2015 - 00:00	16.64	83.47	0	6	0
30/12/2015 - 01:00	15.33	85.23	0	5	0
30/12/2015 - 02:00	14.12	86.85	0	13	0
30/12/2015 - 03:00	14.56	82.63	0	353	0
30/12/2015 - 04:00	14.59	77.92	0	295	0
30/12/2015 - 05:00	12.75	82.85	0	33	0
30/12/2015 - 06:00	12.54	84.13	0	27	0
30/12/2015 - 07:00	13.16	80.09	0	358	0
30/12/2015 - 08:00	21.48	54.58	0	356	0
30/12/2015 - 09:00	24.67	32.9	2.2	264	0
30/12/2015 - 10:00	27.52	26.07	4.1	344	0
30/12/2015 - 11:00	27.78	24.78	4.9	233	0
30/12/2015 - 12:00	29.88	21.07	5	209	0

Date & Time	Air Temperature (°C)	RH (%)	Wind Speed (m/sec)	Wind Direction (°)	Rainfall (mm)
DD/MM/YYYY HH:MM					
30/12/ 2015 - 13:00	30.01	22.42	5.3	186	0
30/12/ 2015 - 14:00	30.61	22.76	4.9	213	0
30/12/ 2015 - 15:00	29.54	25.41	5.5	321	0
30/12/ 2015 - 16:00	28.92	27.04	5.4	165	0
30/12/ 2015 - 17:00	26.96	30.27	4	245	0
30/12/ 2015 - 18:00	24.08	41.38	3.1	282	0
30/12/ 2015 - 19:00	21.72	50.88	0.9	294	0
30/12/ 2015 - 20:00	20.49	61.76	1.2	290	0
30/12/ 2015 - 21:00	18.93	67.65	0.7	27	0
30/12/ 2015 - 22:00	17.44	73.33	0	93	0
30/12/ 2015 - 23:00	16.35	77.03	0	60	0
31/12/ 2015 - 00:00	15.9	78.12	0	19	0
31/12/ 2015 - 01:00	14.48	85.11	0.2	0	0
31/12/ 2015 - 02:00	13.9	87.24	0	2	0
31/12/ 2015 - 03:00	12.99	89.41	0	50	0
31/12/ 2015 - 04:00	12.77	87.94	0	0	0
31/12/ 2015 - 05:00	12.72	88.11	0	5	0
31/12/ 2015 - 06:00	12.27	90.22	0	349	0
31/12/ 2015 - 07:00	12.1	86.57	0	341	0
31/12/ 2015 - 08:00	18.89	67.02	0	85	0
31/12/ 2015 - 09:00	25.3	44.88	0	340	0
31/12/ 2015 - 10:00	25.52	31.36	3.3	310	0
31/12/ 2015 - 11:00	27.64	26.3	4.5	167	0
31/12/ 2015 - 12:00	28.32	26.71	4.8	111	0
31/12/ 2015 - 13:00	29.03	31.87	5.1	272	0
31/12/ 2015 - 14:00	28.17	37.26	4.1	307	0
31/12/ 2015 - 15:00	29.11	35.86	4.7	43	0
31/12/ 2015 - 16:00	29.26	34.44	4.3	355	0
31/12/ 2015 - 17:00	26.64	42.3	3.9	197	0
31/12/ 2015 - 18:00	23.83	51.19	3.5	250	0
31/12/ 2015 - 19:00	21.5	63.34	0.7	328	0
31/12/ 2015 - 20:00	19.96	71.8	0.7	285	0
31/12/ 2015 - 21:00	19.16	78.71	1.1	319	0
31/12/ 2015 - 22:00	18.43	83.48	0.6	330	0
31/12/ 2015 - 23:00	17.34	87.84	0	20	0
01/01/ 2016 - 00:00	16.2	91.31	0	346	0
01/01/ 2016 - 01:00	15.58	93.57	1.1	290	0
01/01/ 2016 - 02:00	16.1	94.32	2.1	314	0
01/01/ 2016 - 03:00	15.48	94	1.4	8	0
01/01/ 2016 - 04:00	14.17	95.19	0	51	0
01/01/ 2016 - 05:00	14.55	96.44	0.7	324	0
01/01/ 2016 - 06:00	14.07	96.08	0	80	0
01/01/ 2016 - 07:00	14.26	94.91	0	328	0
01/01/ 2016 - 08:00	17.82	87.95	0	179	0
01/01/ 2016 - 09:00	20.4	80.06	1.5	201	0
01/01/ 2016 - 10:00	21.78	69.4	3.1	145	0

Date & Time	Air Temperature (°C)	RH (%)	Wind Speed (m/sec)	Wind Direction (°)	Rainfall (mm)
DD/MM/YYYY HH:MM					
01/01/ 2016 - 11:00	24.68	53.81	4.2	205	0.2
01/01/ 2016 - 12:00	24.65	54.12	4.3	229	0
01/01/ 2016 - 13:00	26.26	46.74	5.6	232	0
01/01/ 2016 - 14:00	26.14	46.83	5.7	224	0
01/01/ 2016 - 15:00	25.53	49.71	5.5	161	0
01/01/ 2016 - 16:00	26.49	42.21	6.2	221	0
01/01/ 2016 - 17:00	25.07	44.13	4.8	168	0
01/01/ 2016 - 18:00	22.52	47.01	4.8	215	0
01/01/ 2016 - 19:00	20.67	52.57	1.5	253	0
01/01/ 2016 - 20:00	18.65	59.36	0	112	0
01/01/ 2016 - 21:00	17.69	62.65	0	101	0
01/01/ 2016 - 22:00	16.41	68.51	0	27	0
01/01/ 2016 - 23:00	15.2	75.46	0	0	0
02/01/ 2016 - 00:00	14.74	76.51	0	12	0
02/01/ 2016 - 01:00	14.64	75.89	0	293	0
02/01/ 2016 - 02:00	13.8	77.83	0	351	0
02/01/ 2016 - 03:00	12.86	81.73	0	21	0
02/01/ 2016 - 04:00	12.8	83.03	0	67	0
02/01/ 2016 - 05:00	12.67	83	0	332	0
02/01/ 2016 - 06:00	11.86	84.82	0	348	0
02/01/ 2016 - 07:00	11.91	84.93	0	16	0
02/01/ 2016 - 08:00	19.52	66.25	0	77	0
02/01/ 2016 - 09:00	23.53	45.14	1.7	324	0
02/01/ 2016 - 10:00	25.96	28.05	4.2	289	0
02/01/ 2016 - 11:00	27.4	27.08	4.9	283	0
02/01/ 2016 - 12:00	28.21	26.77	4.6	304	0
02/01/ 2016 - 13:00	29.12	22.88	4	294	0
02/01/ 2016 - 14:00	28.77	25.14	4.1	213	0
02/01/ 2016 - 15:00	29.36	22.6	4.3	294	0
02/01/ 2016 - 16:00	28.72	25.39	4.1	280	0
02/01/ 2016 - 17:00	26.6	33.7	4.8	207	0
02/01/ 2016 - 18:00	24.0	42.61	2.3	285	0
02/01/ 2016 - 19:00	21.02	53.49	0.5	280	0
02/01/ 2016 - 20:00	19.6	56.31	0.8	302	0
02/01/ 2016 - 21:00	18.68	61.91	0.7	300	0
02/01/ 2016 - 22:00	17.27	67.8	0.5	326	0
02/01/ 2016 - 23:00	16.36	70.27	0	353	0
03/01/ 2016 - 00:00	14.86	77.11	0	40	0
03/01/ 2016 - 01:00	14.36	79.22	0	23	0
03/01/ 2016 - 02:00	13.59	83.07	0	12	0
03/01/ 2016 - 03:00	13.31	86.3	0.6	5	0
03/01/ 2016 - 04:00	13.34	87.66	0.2	8	0
03/01/ 2016 - 05:00	12.91	90.54	0.3	13	0
03/01/ 2016 - 06:00	12.98	92.31	0.5	354	0
03/01/ 2016 - 07:00	12.14	92.97	0	357	0
03/01/ 2016 - 08:00	18.88	77.13	0.8	343	0

Date & Time	Air Temperature (°C)	RH (%)	Wind Speed (m/sec)	Wind Direction (°)	Rainfall (mm)
DD/MM/YYYY HH:MM					
03/01/ 2016 - 09:00	22.52	50.61	2.1	285	0
03/01/ 2016 - 10:00	26.42	28.55	3.5	303	0
03/01/ 2016 - 11:00	28.22	26.99	4	291	0
03/01/ 2016 - 12:00	29.02	26.83	3.6	131	0
03/01/ 2016 - 13:00	29.77	24.1	5.1	287	0
03/01/ 2016 - 14:00	29.04	19.45	3.9	282	0
03/01/ 2016 - 15:00	28.44	23.06	4.6	179	0
03/01/ 2016 - 16:00	28.82	22.86	3.4	214	0
03/01/ 2016 - 17:00	27.62	26.51	3.9	214	0
03/01/ 2016 - 18:00	24.42	36.97	2.2	246	0
03/01/ 2016 - 19:00	21.32	49.72	0.8	321	0
03/01/ 2016 - 20:00	20.17	58.39	1.1	307	0
03/01/ 2016 - 21:00	19.47	65.64	1	294	0
03/01/ 2016 - 22:00	19	68.9	1.1	319	0
03/01/ 2016 - 23:00	17.73	75.07	1	342	0
04/01/ 2016 - 00:00	16.62	79.56	0.6	349	0
04/01/ 2016 - 01:00	16.04	84.21	0.7	4	0
04/01/ 2016 - 02:00	15.61	89.42	0.8	345	0
04/01/ 2016 - 03:00	16.7	94.54	2.7	324	0
04/01/ 2016 - 04:00	16.46	94.06	2.4	356	0
04/01/ 2016 - 05:00	16.08	93.28	3	306	0
04/01/ 2016 - 06:00	15.83	93.92	2.4	337	0
04/01/ 2016 - 07:00	15.4	93.39	2.3	303	0
04/01/ 2016 - 08:00	17.43	85.36	2.7	356	0
04/01/ 2016 - 09:00	20.95	66.38	2.5	322	0
04/01/ 2016 - 10:00	25.44	33.6	3.4	257	0
04/01/ 2016 - 11:00	25.96	32.03	3.9	311	0
04/01/ 2016 - 12:00	12.77	87.94	0	0	0
04/01/ 2016 - 13:00	12.72	88.11	0	5	0
04/01/ 2016 - 14:00	12.27	90.22	0	349	0
04/01/ 2016 - 15:00	12.1	86.57	0	341	0
04/01/ 2016 - 16:00	18.89	67.02	0	85	0
04/01/ 2016 - 17:00	25.3	44.88	0	340	0
04/01/ 2016 - 18:00	25.52	31.36	3.3	310	0
04/01/ 2016 - 19:00	27.64	26.3	4.5	167	0
04/01/ 2016 - 20:00	28.32	26.71	4.8	111	0
04/01/ 2016 - 21:00	29.03	31.87	5.1	272	0
04/01/ 2016 - 22:00	28.17	37.26	4.1	307	0
04/01/ 2016 - 23:00	29.11	35.86	4.7	43	0
05/01/ 2016 - 00:00	29.26	34.44	4.3	355	0
05/01/ 2016 - 01:00	26.64	42.3	3.9	197	0
05/01/ 2016 - 02:00	23.83	51.19	3.5	250	0
05/01/ 2016 - 03:00	21.5	63.34	0.7	328	0
05/01/ 2016 - 04:00	19.96	71.8	0.7	285	0
05/01/ 2016 - 05:00	19.16	78.71	1.1	319	0
05/01/ 2016 - 06:00	18.43	83.48	0.6	330	0

Date & Time	Air Temperature (°C)	RH (%)	Wind Speed (m/sec)	Wind Direction (°)	Rainfall (mm)
DD/MM/YYYY HH:MM					
05/01/ 2016 - 07:00	17.34	87.84	0	20	0
05/01/ 2016 - 08:00	16.2	91.31	0	346	0
05/01/ 2016 - 09:00	15.58	93.57	1.1	290	0
05/01/ 2016 - 10:00	16.1	94.32	2.1	314	0
05/01/ 2016 - 11:00	15.48	94	1.4	8	0
05/01/ 2016 - 12:00	14.17	95.19	0	51	0
05/01/ 2016 - 13:00	19.08	89.68	1.2	270	0
05/01/ 2016 - 14:00	18.62	90.64	0.9	241	0
05/01/ 2016 - 15:00	17.77	92.26	1	6	0
05/01/ 2016 - 16:00	18	92.22	1.1	227	0
05/01/ 2016 - 17:00	17.84	90.35	1.6	232	0
05/01/ 2016 - 18:00	17.42	91.28	1.2	280	0
05/01/ 2016 - 19:00	16.86	92.07	0.6	307	0
05/01/ 2016 - 20:00	16.4	93.38	0	169	0
05/01/ 2016 - 21:00	16.29	92.73	0	182	0
05/01/ 2016 - 22:00	18.53	84.32	1.8	193	0
05/01/ 2016 - 23:00	20.08	74.5	3.4	201	0
06/01/ 2016 - 00:00	23.14	56.09	3.9	226	0
06/01/ 2016 - 01:00	26.03	47.01	3.7	319	0
06/01/ 2016 - 02:00	25.91	45.58	3.7	336	0
06/01/ 2016 - 03:00	27.02	38.94	4	288	0
06/01/ 2016 - 04:00	28.54	36.4	3.6	316	0
06/01/ 2016 - 05:00	28.29	39.34	5.1	277	0
06/01/ 2016 - 06:00	27.92	38.96	3.8	218	0
06/01/ 2016 - 07:00	25.78	46.52	2.3	225	0
06/01/ 2016 - 08:00	23.32	56.94	2.3	223	0
06/01/ 2016 - 09:00	21.61	65.57	1.2	209	0
06/01/ 2016 - 10:00	19.86	72.96	0.7	215	0
06/01/ 2016 - 11:00	18.69	78.84	1	13	0
06/01/ 2016 - 12:00	17.85	82.97	0	83	0
06/01/ 2016 - 13:00	17.58	84.59	0	276	0
06/01/ 2016 - 14:00	16.83	87.76	0	0	0
06/01/ 2016 - 15:00	16.44	86.43	0	30	0
06/01/ 2016 - 16:00	15.5	91.29	0	28	0
06/01/ 2016 - 17:00	14.1	90.93	0	76	0
06/01/ 2016 - 18:00	13.84	92.14	0	350	0
06/01/ 2016 - 19:00	13.9	94.26	0	23	0
06/01/ 2016 - 20:00	13.36	92.76	0.2	5	0
06/01/ 2016 - 21:00	13.97	91.71	0	312	0
06/01/ 2016 - 22:00	19.61	73.1	0	244	0
06/01/ 2016 - 23:00	23.91	54.45	1.5	272	0
07/01/ 2016 - 00:00	26.11	48.65	3.9	137	0

ANNEX 4.4 ON-SITE AIR QUALITY MONITORING RESULTS

Table-A.4.4.1 On-Site Ambient Air Quality Monitoring Results

SN	Date	AAQMS Code	Location	PM10 ($\mu\text{g}/\text{m}^3$)	PM2.5 ($\mu\text{g}/\text{m}^3$)	SO ₂ ($\mu\text{g}/\text{m}^3$)	NO ₂ ($\mu\text{g}/\text{m}^3$)	CO (mg/m^3)
1.	08.12.2015	AQ1	Thadigal Cross	48	12	8.6	22	0.34
2.	11.12.2015	AQ1	Thadigal Cross	40	10	11.3	26	0.40
3.	15.12.2015	AQ1	Thadigal Cross	55	13	9.4	32	0.38
4.	18.12.2015	AQ1	Thadigal Cross	50	12	8.8	24	0.30
5.	22.12.2015	AQ1	Thadigal Cross	56	14	10.6	30	0.36
6.	25.12.2015	AQ1	Thadigal Cross	60	15	8.2	27	0.33
7.	29.12.2015	AQ1	Thadigal Cross	54	13	12.6	25	0.43
8.	31.12.2015	AQ1	Thadigal Cross	46	12	11.2	28	0.41
9.	09.12.2015	AQ2	Manchineela Kotte	62	30	13.8	22	0.32
10.	12.12.2015	AQ2	Manchineela Kotte	56	34	15.2	32	0.28
11.	16.12.2015	AQ2	Manchineela Kotte	60	38	10.2	24	0.30
12.	19.12.2015	AQ2	Manchineela Kotte	68	40	12.6	30	0.24
13.	23.12.2015	AQ2	Manchineela Kotte	58	36	10.9	24	0.28
14.	26.12.2015	AQ2	Manchineela Kotte	60	28	12.8	20	0.31
15.	30.12.2015	AQ2	Manchineela Kotte	66	34	16.2	22	0.33
16.	02.01.2016	AQ2	Manchineela Kotte	62	30	13.4	26	0.30

ANNEX 4.5 DETAILS OF EXISTING TREES

Table-A.4.5.1 Chainage wise Number of Existing Trees on LHS

Chainage		Side	No of Trees in Girth Class (in cm)					Total	Predominant Species
From	To		<30	31-59	60-119	120-180	>180		
47+203	48+000	LHS	6	3	4	4	4	21	Tamarind
48+000	49+000	LHS	35	13	9	1	0	58	Tamarind, Pipal, Arjun
49+000	50+000	LHS	10	8	11	15	16	60	Neem, Eucalyptus, Copper pod
50+000	51+000	LHS	8	1	3	3	23	38	Tamarind, Copper pod
51+000	52+000	LHS	51	5	0	0	4	60	Banyan
52+000	53+000	LHS	27	4	0	0	7	38	Banyan, Tamarind
53+000	54+000	LHS	37	6	6	3	2	54	Banyan, Neem, Tamarind
54+000	55+000	LHS	31	31	35	37	9	143	Tamarind, Copper pod
55+000	56+000	LHS	10	45	41	7	2	105	Arjun, Tamarind
56+000	57+000	LHS	10	17	12	4	8	51	Tamarind, Neem, Copper pod
57+000	58+000	LHS	19	36	4	6	1	66	Shisham, Tamarind, Copper pod
58+000	59+000	LHS	0	13	10	8	9	40	Neem, Tamarind, Shisham
59+000	60+000	LHS	1	5	7	5	0	18	Babool, Jamoon
60+000	61+000	LHS	8	24	10	10	1	53	Shisham, Tamarind
61+000	62+000	LHS	6	24	12	4	2	48	Babool, Neem, Tamarind, Copper pod
62+000	63+000	LHS	2	9	6	4	12	33	Jamun, Shisham, Tamarind
63+000	64+000	LHS	3	10	16	5	1	35	Tamarind, Jamun, Copper pod
64+000	65+000	LHS	16	38	5	0	1	60	Neem, Shisham
65+000	66+000	LHS	12	33	12	4	2	63	Tamarind, Neem, Shisham
66+000	67+000	LHS	7	8	12	7	4	38	Tamarind, Jamun
67+000	68+000	LHS	8	17	23	5		53	Tamarind, Copper pod
68+000	69+000	LHS	1	1	8	4	16	30	Tamarind, Coconut, Neem
69+000	70+000	LHS	6	13	7	3	5	34	Tamarind, Shisham, Pipal
70+000	71+000	LHS	13	13	2	3	4	35	Neem, Copper pod
71+000	72+000	LHS	11	7	7	2	4	31	Pipal, Neem, Shisham
72+000	73+000	LHS	9	7	5	3	11	35	Acacia, Tamarind
73+000	74+000	LHS	2	3	2	1	10	18	Tamarind, Banyan
74+000	75+000	LHS	2	1	1	2	24	30	Tamarind, Copper pod
75+000	76+000	LHS	18	14	22	6	4	64	Tamarind
76+000	77+000	LHS	19	24	10	4	10	67	Tamarind, Eucalyptus

Chainage		Side	No of Trees in Girth Class (in cm)					Total	Predominant Species
From	To		<30	31-59	60-119	120-180	>180		
77+000	78+000	LHS	5	15	17	8	12	57	Neem, Eucalyptus, Tamarind,
78+000	79+000	LHS	10	25	63	26	7	131	Eucalyptus, Shirish
79+000	80+000	LHS	18	36	7	2	3	66	Neem, Banyan
80+000	81+000	LHS	3	10	3	3	6	25	Neem, Banyan
81+000	82+000	LHS	4	6	9	4	10	33	Tamarind, Neem
82+000	83+000	LHS	9	8	4	1	2	24	Neem, Shisham
83+000	84+000	LHS	17	29	21	3	11	81	Eucalyptus, Tamarind, Silver Oak
84+000	85+000	LHS	19	25	8	6	2	60	Banyan, Silver Oak
85+000	86+000	LHS	10	16	10	2	5	43	Arjun, Jamun, Banyan, Silver Oak
86+000	87+331	LHS	21	14	5	1	2	43	Silver Oak, Copper pod
Total			504	617	449	216	256	2042	

Table-A.4.5.2 Chainage wise Chainage wise Number of Existing Trees on RHS

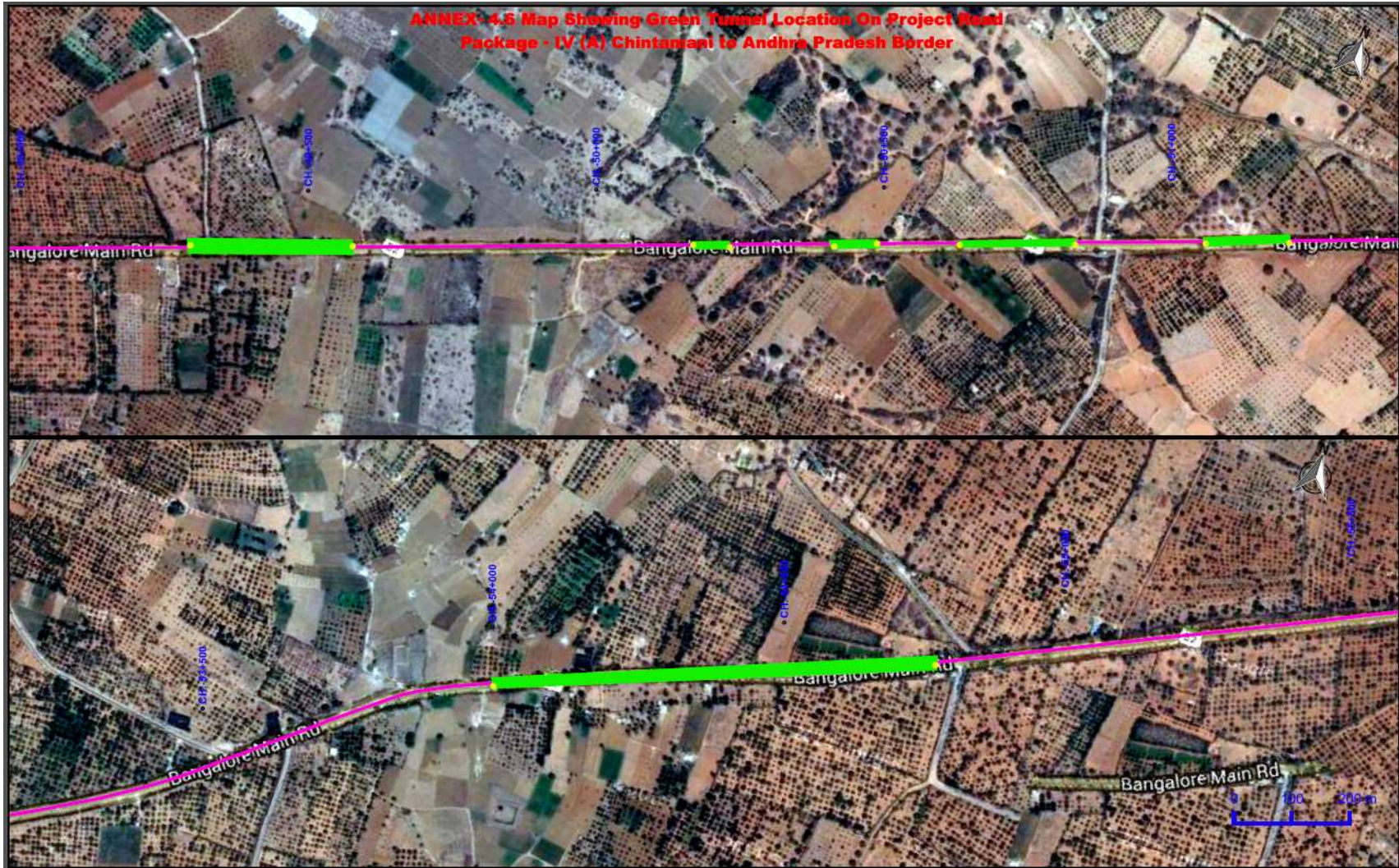
Chainage		Side	No of Trees in Girth Class (in cm)					Total	Predominant Species
From	To		<30	31-59	60-119	120-180	>180		
47+203	48+000	RHS	8	13	49	1	0	71	Neem, Tamarind, Pipal
48+000	49+000	RHS	26	24	16	0	0	66	Neem, Tamarind, Pipal
49+000	50+000	RHS	32	10	13	4	14	73	Neem, Tamarind
50+000	51+000	RHS	9	7	17	9	6	48	Neem, Tamarind, Pipal
51+000	52+000	RHS	44	3	0	5	0	52	Banyan, Neem, Tamarind
52+000	53+000	RHS	85	1	0	0	2	88	Banyan, Eucalyptus, Tamarind
53+000	54+000	RHS	64	17	1	0	2	84	Banyan, Eucalyptus, Tamarind
54+000	55+000	RHS	17	28	91	6	2	144	Copper pod, Tamarind, Ashoka, Coconut
55+000	56+000	RHS	34	72	16	2	0	124	Copper pod, Tamarind
56+000	57+000	RHS	19	48	39	3	0	109	Copper pod, Tamarind
57+000	58+000	RHS	23	43	15	5	3	89	Banyan, Tamarind
58+000	59+000	RHS	5	25	8	7	2	47	Neem, Pipal, Tamarind
59+000	60+000	RHS	13	11	15	1	0	40	Neem, Tamarind
60+000	61+000	RHS	3	18	9	1	5	36	Banyan, Tamarind
61+000	62+000	RHS	6	12	3	2	5	28	Copper pod, Banyan, Neem
62+000	63+000	RHS	0	1	13	8	8	30	Copper pod, Tamarind, Shisham
63+000	64+000	RHS	12	12	11	7	1	43	Tamarind, Banyan, Shisham



Chainage		Side	No of Trees in Girth Class (in cm)					Total	Predominant Species
From	To		<30	31-59	60-119	120-180	>180		
64+000	65+000	RHS	33	33	5	3	1	75	Tamarind, Neem
65+000	66+000	RHS	35	9	7	0	1	52	Tamarind, Neem
66+000	67+000	RHS	17	9	15	11	2	54	Tamarind, Banyan
67+000	68+000	RHS	24	18	16	0	0	58	Eucalyptus, Neem, Tamarind
68+000	69+000	RHS	14	19	19	6	4	62	Copper pod, Silver oak, Tamarind, Neem
69+000	70+000	RHS	8	12	21	5	4	50	Copper pod, Silver oak, Tamarind, Neem
70+000	71+000	RHS	3	7	16	4	3	33	Tamarind
71+000	72+000	RHS	15	26	14	9	0	64	Silver oak
72+000	73+000	RHS	3	22	9	16	3	53	Copper pod, Tamarind, Shisham
73+000	74+000	RHS	3	17	8	8	8	44	Tamarind, Banyan
74+000	75+000	RHS	0	11	5	4	10	30	Tamarind, Banyan
75+000	76+000	RHS	22	13	6	5	0	46	Jamun, Gulmohar, Neem
76+000	77+000	RHS	86	38	13	4	4	145	Eucalyptus, Neem, Tamarind
77+000	78+000	RHS	205	176	13	5	0	399	Eucalyptus, Neem, Tamarind
78+000	79+000	RHS	109	60	72	9	3	253	Eucalyptus, Neem, Tamarind
79+000	80+000	RHS	1	31	13	5	1	51	Tamarind, Banyan, Neem, Jamun
80+000	81+000	RHS	0	12	3	4	3	22	Eucalyptus, Neem, Tamarind, Banyan
81+000	82+000	RHS	9	7	6	4	2	28	Eucalyptus, Neem, Banyan
82+000	83+000	RHS	0	13	15	4	2	34	Eucalyptus, Neem
83+000	84+000	RHS	9	6	12	2	1	30	Eucalyptus, Neem, Banyan
85+000	86+000	RHS	6	14	10	3	1	34	Eucalyptus, Neem, Mango
86+000	87+331	RHS	9	23	52	0	1	85	Eucalyptus, Tamarind
Total			1017	935	672	173	106	2903	

Table-A.4.5.3 Total Number of Existing Trees

Side	No of Trees in Girth Class (in cm)					Total
	<30	31-59	60-119	120-180	>180	
LHS	504	617	449	216	256	2,042
RHS	1,017	935	672	173	106	2,903
	1,521	1,552	1,121	389	362	4,945

ANNEX 4.6 GREEN TUNNEL LOCATIONS ALONG PROJECT ROAD



<p>CLIENT</p>  <p>Government of Karnataka Public Works, ports & IWT Department Karnataka State Highway Improvement Project</p>	<p>PROJECT</p> <p>Consultancy Services for Detailed Project Report cum Transaction Advisory Services for Karnataka State Highway Improvement Project-III - (Group-II) Package - IVA Chintamani to Andhra Pradesh Border</p>	<p>Legend</p> <p>█ Location of Green Tunnel</p> <p>█ Project Road</p>	<p>CONSULTANT</p>  <p>Intercontinental Consultants & Technocrats Pvt. Ltd, A-8, Green Park, New Delhi-110016 in Joint venture with Pricewater house Coopers Pvt. Ltd 4th Floor, Tower-D, The Millenia, 1-2 Murphy Road, Ulsoor, Bangalore-560008 in association with Dhir & Dhir Associates D-55, Defence Colony, New Delhi - 110024</p>
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ANNEX 4.7 RESULTS OF BIODIVERSITY STUDY

Table-A.4.7.1 Relative Frequency (RF), Relative Density (Rd), Important Value Index (IVI) and Species Abundance for Trees

Sl. No.	Species Name	Common Name	RF	Rd	IVI	Abundance
1	<i>Eucalyptus tereticornis</i>	Forest Red Gum	7.81	12.19	20.00	6.80
2	<i>Pongamia pinnata</i>	Karanja	6.25	10.75	17.00	7.50
3	<i>Azadirachta indica</i>	Neem	4.69	9.68	14.36	9.00
4	<i>Cassia fistula</i>	Golden Shower	7.81	6.45	14.26	3.60
5	<i>Wrightia tinctoria</i>	Veppali	6.25	6.09	12.34	4.25
6	<i>Acacia catechu</i>	Black cutch	6.25	5.38	11.63	3.75
7	<i>Holoptelea integrifolia</i>	Banchilla/Elm	6.25	3.94	10.19	2.75
8	<i>Gliricidia maculata</i>	Quick stick	3.13	6.81	9.94	9.50
9	<i>Annona squamosa</i>	Custared Apple	6.25	1.79	8.04	1.25
10	<i>Grevillea robusta</i>	Silver Oak	3.13	4.30	7.43	6.00
11	<i>Terminalia bellerica</i>	Bahera	3.13	4.30	7.43	6.00
12	<i>Ziziphus mauritiana</i>	Indian jujube	3.13	3.58	6.71	5.00
13	<i>Syzigium cumini</i>	Jamoon	3.13	2.51	5.63	3.50
14	<i>Butea monosperma</i>	Palash	3.13	1.79	4.92	2.50
15	<i>Dalbergia sissoo</i>	Shisham	3.13	1.79	4.92	2.50
16	<i>Peltophorum pterocarpum</i>	Copper pod	1.56	3.23	4.79	9.00
17	<i>Phoenix sylvestris</i>	Kanjoor	3.13	1.43	4.56	2.00
18	<i>Tamarindus indica</i>	Imli	3.13	1.43	4.56	2.00
19	<i>Acacia mangium</i>	Acacia	1.56	2.87	4.43	8.00
20	<i>Vitex altissima</i>	Myrole	1.56	1.43	3.00	4.00
21	<i>Cassia siamea</i>	Kassod tree	1.56	1.08	2.64	3.00
22	<i>Ficus bengaliensis</i>	Banyan	1.56	1.08	2.64	3.00
23	<i>Ficus mysorensis</i>	Paras Pipal	1.56	1.08	2.64	3.00
24	<i>Leucaena leucocephala</i>	Subabul	1.56	1.08	2.64	3.00
25	<i>Samanea saman</i>	Rain Tree	1.56	1.08	2.64	3.00
26	<i>Acacia nilotica</i>	Babool	1.56	0.72	2.28	2.00
27	<i>Gmelina arborea</i>	Gamar	1.56	0.72	2.28	2.00
28	<i>Melia dubia</i>	Malabar Neem	1.56	0.72	2.28	2.00
29	<i>Albizia amara</i>	Chujjulu	1.56	0.36	1.92	1.00
30	<i>Bauhinia racemose</i>	Kachnar	1.56	0.36	1.92	1.00

Table-A.4.7.2 Relative Frequency (RF), Relative density (Rd), Important Value Index (IVI) and Species Abundance for Shrub Species

Sl. No.	Species Name	Common Name	RF	Rd	IVI	Abundance
1	<i>Lantana camara</i>	Ghaneri	5.68	14.53	20.22	18.40
2	<i>Stachytarpheta indica</i>	Kaadu uttarani	5.68	13.59	19.27	17.20
3	<i>Sida acuta</i>	Blue okra	4.55	9.48	14.02	15.00
4	<i>Pterolobium hexapetalum</i>	Baadubakka	5.68	4.11	9.79	5.20
5	<i>Securinega virosa</i>	Dalme	5.68	3.48	9.16	4.40
6	<i>Agave americana</i>	American aloe	5.68	2.69	8.37	3.40
7	<i>Chromolaena odorata</i>	Siamweed	4.55	3.79	8.34	6.00
8	<i>Tephrosia purpurea</i>	Sarapunkha	1.14	7.11	8.25	45.00
9	<i>Sida rhombifolia</i>	Queensland hemp	4.55	3.63	8.18	5.75
10	<i>Cassia tora</i>	Coffee Cassia	3.41	4.42	7.83	9.33
11	<i>Canthium parviflorum</i>	Kadbar	4.55	3.00	7.55	4.75
12	<i>Sida cordifolia</i>	Bala panchaang	3.41	4.11	7.52	8.67

Sl. No.	Species Name	Common Name	RF	Rd	IVI	Abundance
13	<i>Argyreia cuneate</i>	Kallana gida	4.55	2.69	7.23	4.25
14	<i>Cassia auriculata</i>	Anval	3.41	3.79	7.20	8.00
15	<i>Tarenna asiatica</i>	Paapatige gida	4.55	2.37	6.92	3.75
16	<i>Opuntia dillenii</i>	Nagphana	4.55	1.74	6.28	2.75
17	<i>Toddalia asiatica</i>	Lopez root	4.55	1.74	6.28	2.75
18	<i>Dodonaea viscosa</i>	Hop-bush	3.41	2.69	6.09	5.67
19	<i>Solanum indicum</i>	Ban Tobacco	3.41	1.74	5.15	3.67
20	<i>Calotropis procera</i>	French Cotton	3.41	1.58	4.99	3.33
21	<i>Ziziphus oenoploea</i>	Kakal-ber	3.41	1.42	4.83	3.00
22	<i>Grewia hirsuta</i>	Phrongli	2.27	0.63	2.90	2.00
23	<i>Carissa carandas</i>	Karonda	1.14	1.11	2.24	7.00
24	<i>Prosopis juliflora</i>	Indian Mesquite	1.14	1.11	2.24	7.00
25	<i>Stylosanthes fruticosa</i>	Pencil flower	1.14	1.11	2.24	7.00
26	<i>Tylophora asthamatica</i>	Antamul	1.14	1.11	2.24	7.00
27	<i>Erythroxylum monogynum</i>	Bastard sandal	1.14	0.47	1.61	3.00
28	<i>Jatropha curcas</i>	Physic nut	1.14	0.47	1.61	3.00
29	<i>Randia dumetorum</i>	Fish poison	1.14	0.32	1.45	2.00

Table-A.4.7.3 Relative Frequency (RF), Relative density (Rd), Important Value Index (IVI) and Species Abundance for Herb Species

Sl. No.	Species Name	Common Names	RF	Rd	IVI	Abundance
1	<i>Hybanthus enneaspermus</i>	Ratanpurus	6.94	9.25	16.19	15.20
2	<i>Spilanthes acmella</i>	Toungue cleaner	5.56	9.98	15.53	20.50
3	<i>Phyllanthus amara</i>	Bhumi-amla	6.94	8.39	15.34	13.80
4	<i>Mimosa pudica</i>	Touch me not	5.56	9.61	15.17	19.75
5	<i>Parthenium hysterophorus</i>	Congress grass	5.56	8.15	13.71	16.75
6	<i>Tridax procumbens</i>	Coatbuttons	6.94	6.45	13.39	10.60
7	<i>Cynodon dactylon</i>	Bermuda grass	5.56	6.08	11.64	12.50
8	<i>Mitracarpus verticillatus</i>	Girdlepod	6.94	4.38	11.32	7.20
9	<i>Desmodium triflorum</i>	Matty desmodium	5.56	4.74	10.30	9.75
10	<i>Vernonia cinerea</i>	Ash-coloured fleabane	5.56	3.89	9.45	8.00
11	<i>Hemidesmus indicus</i>	Nannari	5.56	2.92	8.48	6.00
12	<i>Dolichos falcatus</i>	Kaduhurali	5.56	1.95	7.50	4.00
13	<i>Phyllanthus urinaria</i>	Hazarmani	4.17	3.16	7.33	8.67
14	<i>Leucas aspera</i>	Chhota-halkusa	4.17	3.04	7.21	8.33
15	<i>Commelina benghalensis</i>	Tropical Spider wort	2.78	4.01	6.79	16.50
16	<i>Sopubia delphinifolia</i>	Dudhali	2.78	3.28	6.06	13.50
17	<i>Ichnocarpus frutescens</i>	Bakarbel	4.17	1.58	5.75	4.33
18	<i>Evolvulus alsinoides</i>	English speedwheel	2.78	2.92	5.70	12.00
19	<i>Asparagus racemosus</i>	Shathaavari	2.78	2.19	4.97	9.00
20	<i>Ocimum americanum</i>	Jangali-tulsi	2.78	1.70	4.48	7.00
21	<i>Achyranthes aspera</i>	Prickly Chaff-flower	1.39	2.31	3.70	19.00

Table-A.4.7.4 Relative Frequency (RF), Relative Density (Rd), Important Value Index (IVI) for overall Faunal Species

Sl. No.	Species Name	Kind	RF	RD	IVI	Abundance
1	<i>Coptotermes formosanus</i>	Insect	4.08	12.08	16.16	25.00
2	<i>Dicrurus leucophaeus</i>	Bird	3.06	9.06	12.12	25.00
3	<i>Saxicola caprata</i>	Bird	3.06	9.06	12.12	25.00
4	<i>Euploea core</i>	Insect	3.06	9.06	12.12	25.00
5	<i>Dicrurus caerulescens</i>	Bird	3.06	6.52	9.58	18.00
6	<i>Acridotheres tristis</i>	Bird	2.04	6.04	8.08	25.00
7	<i>Duttaphrynus melanostictus</i>	Amphibian	2.04	6.04	8.08	25.00
8	<i>Atrophaneura aristolochiae</i>	Insect	3.06	3.02	6.08	8.33
9	<i>Casmerodius albus</i>	Bird	5.10	0.72	5.83	1.20
10	<i>Psittacula krameri</i>	Bird	4.08	1.21	5.29	2.50
11	<i>Calotes versicolor</i>	Reptile	4.08	0.72	4.81	1.50
12	<i>Chorthippus brunneus</i>	Insect	2.04	2.66	4.70	11.00
13	<i>Ischnura hecterostica</i>	Insect	3.06	1.45	4.51	4.00
14	<i>Vanellus indicus</i>	Bird	1.02	3.02	4.04	25.00
15	<i>Tirumala limniace</i>	Insect	1.02	3.02	4.04	25.00
16	<i>Sympetrum flavolum</i>	Insect	1.02	3.02	4.04	25.00
17	<i>Gangara thyrasis</i>	Insect	1.02	3.02	4.04	25.00
18	<i>Junonia atlites</i>	Insect	1.02	3.02	4.04	25.00
19	<i>Lampropholis guichenoti</i>	Reptile	1.02	3.02	4.04	25.00
20	<i>Pycnonotus cafer</i>	Bird	2.04	1.45	3.49	6.00
21	<i>Dicaeum agile</i>	Bird	2.04	0.97	3.01	4.00
22	<i>Parantica aglea</i>	Insect	2.04	0.97	3.01	4.00
23	<i>Ictinaetus malayensis</i>	Bird	2.04	0.85	2.89	3.50
24	<i>Zizeeria karsandra</i>	Insect	2.04	0.85	2.89	3.50
25	<i>Psuedocoladenia dan</i>	Insect	2.04	0.72	2.77	3.00
26	<i>Pycnonotus jocosus</i>	Bird	2.04	0.48	2.52	2.00
27	<i>Alcedo atthis</i>	Bird	2.04	0.48	2.52	2.00
28	<i>Pteropus giganteus</i>	Mammal	2.04	0.36	2.40	1.50
29	<i>Funambulus palmarum</i>	Mammal	2.04	0.36	2.40	1.50
30	<i>Eurema hecabe</i>	Insect	2.04	0.24	2.28	1.00
31	<i>Atrophaneura hector</i>	Insect	2.04	0.24	2.28	1.00
32	<i>Actitis hypoleucos</i>	Bird	1.02	0.85	1.87	7.00
33	<i>Ixias pyrene</i>	Insect	1.02	0.85	1.87	7.00
34	<i>Turdoides striatus</i>	Bird	1.02	0.48	1.50	4.00
35	<i>Egretta garzetta</i>	Bird	1.02	0.36	1.38	3.00
36	<i>Streptopelia chinensis</i>	Bird	1.02	0.36	1.38	3.00
37	<i>Bubulcus ibis</i>	Bird	1.02	0.24	1.26	2.00
38	<i>Ardeola grayii</i>	Bird	1.02	0.24	1.26	2.00
39	<i>Phalanta phalanta</i>	Insect	1.02	0.24	1.26	2.00
40	<i>Apis cerana</i>	Insect	1.02	0.24	1.26	2.00
41	<i>Zizina otis</i>	Insect	1.02	0.24	1.26	2.00
42	<i>Vespula vulgaris</i>	Insect	1.02	0.24	1.26	2.00
43	<i>Muscicapa dauurica</i>	Bird	1.02	0.12	1.14	1.00
44	<i>Upupa epops</i>	Bird	1.02	0.12	1.14	1.00
45	<i>Centropus sinensis</i>	Bird	1.02	0.12	1.14	1.00
46	<i>Apus affinis</i>	Bird	1.02	0.12	1.14	1.00
47	<i>Saxicoloides fulicata</i>	Bird	1.02	0.12	1.14	1.00
48	<i>Nectarinia zeylonica</i>	Bird	1.02	0.12	1.14	1.00
49	<i>Accipiter badius</i>	Bird	1.02	0.12	1.14	1.00

Sl. No.	Species Name	Kind	RF	RD	IVI	Abundance
50	<i>Halcyon smyrnensis</i>	Bird	1.02	0.12	1.14	1.00
51	<i>Xylocopa violacea</i>	Insect	1.02	0.12	1.14	1.00
52	<i>Catopsilia pomona</i>	Insect	1.02	0.12	1.14	1.00
53	<i>Delias eucharis</i>	Insect	1.02	0.12	1.14	1.00
54	<i>Papillio polytes</i>	Insect	1.02	0.12	1.14	1.00
55	<i>Sarangesa dasahara</i>	Insect	1.02	0.12	1.14	1.00
56	<i>Hypolimnas misippus</i>	Insect	1.02	0.12	1.14	1.00
57	<i>Apis dorsata</i>	Insect	1.02	0.12	1.14	1.00
58	<i>Macaca radiata</i>	Mammal	1.02	0.12	1.14	1.00

ANNEX 4.8 SECONDARY DATA FROM STATE FOREST DEPARTMENT

Table-A.4.8.1 Floral Species of Natural Forests of Kolar Forest Division

S. No.	Botanical Names	Local Names
1.	<i>Acacia catechu</i>	Kaggali, Katchu
2.	<i>Acacia concinna</i>	Seege
3.	<i>Acacia ferruginea</i>	Banni
4.	<i>Acacia leucophloea</i>	Blijjali, Najbela
5.	<i>Acacia nilotica</i>	Gobli, Karijali
6.	<i>Acacia caesia</i>	Kadu Seege
7.	<i>Aegle marmelos</i>	Bilpathre
8.	<i>Ailanthus excelsa</i>	Boddamara
9.	<i>Alangium lamarckii</i>	Ankote
10.	<i>Albizia amara</i>	Chujjalu
11.	<i>Albizia lebeck</i>	Bage
12.	<i>Albizia odoratissima</i>	Bilwara
13.	<i>Albizia procera</i>	Bellatte
14.	<i>Albutilon indicum</i>	-
15.	<i>Anacardium occidentale</i>	Geru
16.	<i>Anogeissus latifolia</i>	Dindiga, Dindlu
17.	<i>Annona squamosa</i>	Seethaphala
18.	<i>Artocarpus heterophyllus</i>	Halasu
19.	<i>Asparagus racemosus</i>	Majjigegida
20.	<i>Azadirachta indica</i>	Bevu
21.	<i>Bambusa arundinacea</i>	Boombu, Hebbiduru
22.	<i>Bauhinia racemosa</i>	Kenchuvala, Achiga
23.	<i>Bombax ceiba</i>	Buruga
24.	<i>Boswellia serrate</i>	Bllidhupa, Maddi
25.	<i>Buchanania angustifolia</i>	Maradi
26.	<i>Butea monosperma</i>	Muthuga
27.	<i>Caesalpinia bonduc</i>	Gujjga
28.	<i>Casearia tomentosa</i>	Hesara
29.	<i>Calotropis gigantea</i>	Yekke
30.	<i>Calotropis pocera</i>	Yekke
31.	<i>Canthium dicocuum</i>	Therane, Pyre
32.	<i>Canthium parviflorum</i>	Kare, Achherumullu
33.	<i>Capparis horrida</i>	Kathrihambu
34.	<i>Capparis sylosa</i>	Hunsadlimullu
35.	<i>Caryota uens</i>	Bagani
36.	<i>Cassia auriculata</i>	Avarike, Thangadi
37.	<i>Cassia fistula</i>	Kakke
38.	<i>Cassia siamea</i>	Seemathangadi
39.	<i>Cassia tora</i>	Chagache
40.	<i>Casurina equisetifolia</i>	Survey, Chambakumrara
41.	<i>Celastrus paniculata</i>	Gengungeballi
42.	<i>Chloroxylon swietenia</i>	Hurugalu, Birligida
43.	<i>Cipadessa baccifera</i>	Chittunde
44.	<i>Clematis gouriana</i>	Arkanambu Telajadari
45.	<i>Cochlospermum gossypium</i>	Bettadavare
46.	<i>Cordia macleodli</i>	Hadaga
47.	<i>Cordia myxa</i>	Challe
48.	<i>Cryptolepis buchanani</i>	Halubatti
49.	<i>Curcuma longa</i>	Arasina

S. No.	Botanical Names	Local Names
50.	<i>Curcuma spp.</i>	Sulli
51.	<i>Cymbopogon citratus</i>	Lemon Grass
52.	<i>Dalbergia latifolia</i>	Beete
53.	<i>Dalbergia paniculata</i>	Pachali, Belaga
54.	<i>Dalbergia sissoo</i>	Sissoo
55.	<i>Dendrocalamus strictus</i>	Kiribiduru
56.	<i>Diospyros montana</i>	Jagalaganti
57.	<i>Diospyros melanoxylon</i>	Thupra, Bidiele
58.	<i>Dodonaea viscosa</i>	Kanagalu
59.	<i>Marsadenia volubilis</i>	Akeseppu
60.	<i>Elaeodendron glaucum</i>	Mukartha
61.	<i>Emblica officinalis</i>	Nelli
62.	<i>Entada phaseoloides</i>	Ganapeballi
63.	<i>Erythroxylon monogynum</i>	Devadari
64.	<i>Eucalyptus hybrid</i>	Neelagiri
65.	<i>Euphorbia tirucalli</i>	Kalli
66.	<i>Feronia elephantum</i>	Bela
67.	<i>Ficus asperrima</i>	Garagatti
68.	<i>Ficus glomerata</i>	Athi
69.	<i>Ficus lacor</i>	Karibasari
70.	<i>Ficus mysorensis</i>	Goni
71.	<i>Ficus tsiela</i>	Basari (Bili)
72.	<i>Flacourtia ramontchi</i>	Sannagojjahkey
73.	<i>Flacourtia sepiaria</i>	Bilehuli
74.	<i>Flueggea leucopyrus</i>	Hukigida
75.	<i>Flueggea microcarpa</i>	Haggajallikey
76.	<i>Gardenia gummifera</i>	Bikke
77.	<i>Gardenia latifolia</i>	Rebbikke
78.	<i>Givotia rottleriformis</i>	Bhutale, Bettathavare
79.	<i>Gmelina asiatica</i>	Roboli, Heggulla, Gulamavu
80.	<i>Grevillea orbustia</i>	Silveroak
81.	<i>Grewia hirsuta</i>	Chikkudipe, Ganda Udipe
82.	<i>Grewia salviflora</i>	Uipi
83.	<i>Grewia tiliaefolia</i>	Tadasalu
84.	<i>Gymnosporia montana</i>	Thandarasi
85.	<i>Hardwickia binata</i>	Kamara, Karachi
86.	<i>Helicteris isora</i>	Kowry, Edamuri, Baimuri
87.	<i>Hemidesmus indicus</i>	Segadeberu
88.	<i>Holarrhena antidysentrica</i>	Kodachiga
89.	<i>Holoptelia intergrifolia</i>	Thapasi
90.	<i>Ichnocarpus frutescens</i>	Karihambu
91.	<i>Imperata arundinacea</i>	Elephant Grass
92.	<i>Indigofera pulchella</i>	Neeli
93.	<i>Ixora arborea</i>	Goravi
94.	<i>Jasminum augustifolium</i>	Kadu Mallige
95.	<i>Jatropha curcas</i>	Turkkuharalu
96.	<i>Lagerstroemia speciosa</i>	Holedasavala
97.	<i>Lagerstroemia lanceolata</i>	Nandi
98.	<i>Lagerstroemia parviflora</i>	Channangi
99.	<i>Lantana camara</i>	Rojagida, Lantana
100.	<i>Leucas aspera</i>	Thumbe
101.	<i>Limnonia acidissima</i>	Naibela

S. No.	Botanical Names	Local Names
102.	<i>Loranthus indica</i>	Badanike
103.	<i>Madhuca indica</i>	Ippe, Helippe
104.	<i>Madhuca logifolia</i>	Kadippe
105.	<i>Mangifera indica</i>	Mavu
106.	<i>Melia composita</i>	Huenbevu
107.	<i>Morinda tinctoria</i>	Maddi
108.	<i>Ocimum sanctum</i>	Sritulasi
109.	<i>Lannea coromandalica</i>	Arenalli
110.	<i>Opuntia dillenii</i>	Papaskalli
111.	<i>Pavetta indica</i>	Pavatte
112.	<i>Phoenix humillis</i>	Kirichalu
113.	<i>Pongamia pinnata</i>	Honge
114.	<i>Premna tomentosa</i>	Ije
115.	<i>Prosopis spicigera</i>	Banki
116.	<i>Prosopis juliflora</i>	Prosopis, Ballari jali
117.	<i>Commiphora caudata</i>	Kondamavu/Kadamavu
118.	<i>Pterocarpus marsupium</i>	Honne
119.	<i>Randia dumetorum</i>	Kare
120.	<i>Santalum album</i>	Sandal, Gandha
121.	<i>Shorea talura</i>	Jalari
122.	<i>Schrebera swietenoidies</i>	Gante
123.	<i>Scutia myrtina</i>	Kurudi
124.	<i>Semicarpus anacardium</i>	Kadu Geru, Marking nut
125.	<i>Schleichera oleosa</i>	Sagade, Kendala
126.	<i>Solanum indicum</i>	Sonde, Gulla
127.	<i>Soymida febrifuga</i>	Some
128.	<i>Stereospermum suaveolens</i>	Kaladri Padri, Hunse
129.	<i>Streblus asper</i>	Mitli
130.	<i>Strychnos potaterum</i>	Chilla
131.	<i>Syzygium cumini</i>	Neralu
132.	<i>Tamarindus indica</i>	Hunse
133.	<i>Tectona grandis</i>	Sagavani, Tega
134.	<i>Terminalia arjuna</i>	Toramatti, Bilimatti
135.	<i>Terminalia bellerica</i>	Shanti, Tare
136.	<i>Terminalia chebula</i>	Alale
137.	<i>Terminalia paniculate</i>	Huluve matti, Hunal
138.	<i>Terminalia alata</i>	Matti
139.	<i>Ventilago maderaspatana</i>	Poppli
140.	<i>Vitex negundo</i>	Lakki
141.	<i>Wrightia tinctoria</i>	Hale
142.	<i>Zizyphus mauratiana</i>	Bore, Yelachi
143.	<i>Zizyphus oenoplia</i>	Chotte
144.	<i>Zizyphus rugosa</i>	Paragi
145.	<i>Zizyphus glabrata</i>	Chotte
146.	<i>Zizyphus xylopyrus</i>	Chotte

Source: Forest Working Plan, Kolar Forest Division

Table-A.4.8.2 List of Wild Animals found in Kolar Division

S. No.	Scientific Name	Common Name
1.	<i>Antilope cervicapra</i>	Black buck
2.	<i>Canis aureus</i>	Jackal
3.	<i>Elephas maximus</i>	Indian Elephant

S. No.	Scientific Name	Common Name
4.	<i>Felis chaus,</i>	Jungle Cat
5.	<i>Funambulus palmarum</i>	Palm Squirrel
6.	<i>Golunda ellioti</i>	Indian Bush Rat
7.	<i>Herpestes edwardsii</i>	Common Mongoose
8.	<i>Hyaena hyaena</i>	Stripped Hyena
9.	<i>Hystriix indica</i>	Indian Porcupine
10.	<i>Lepus nigricollis</i>	Blacknaped Hare
11.	<i>Loris lydekkerianus</i>	Slender Loris
12.	<i>Lutrogale perspicillata</i>	Smooth Indian Offer
13.	<i>Macaca mulatta</i>	Bonnet Macaque
14.	<i>Madromys blanfordi</i>	White Tailed Wood Rat
15.	<i>Manis crassicaudata</i>	Pangolin
16.	<i>Mellivora capensis</i>	Ratel
17.	<i>Melursus ursinus</i>	Sloth Bear
18.	<i>Panthera pardus</i>	Leopard
19.	<i>Paradoxurus hermaphroditus</i>	Common Palm Civet or Toddy Cat
20.	<i>Sus scrofa</i>	Wild Boar
21.	<i>Tatera indica</i>	Indian Gerbills
22.	<i>Tetracerus quadricornis</i>	Four- horned Antelope
23.	<i>Viverricula indica</i>	Small Indian Civet
24.	<i>Vulpes bengalensis</i>	Indian Fox

Source: Forest Working Plan, Kolar Forest Division

ANNEX 6.1 ADB RAPID ENVIRONMENTAL ASSESSMENT CHECKLIST

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	Yes		▪ Reserved Forest
▪ 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		<ul style="list-style-type: none"> ▪ 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		No	Impacts on air quality during construction stage are transitory in nature and can be limited by mitigating

Screening questions	Yes	No	Remarks
filling works, and chemicals from asphalt processing?			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
Dislocation or involuntary resettlement of people		No	
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

Screening questions	Yes	No	Remarks
			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		<ul style="list-style-type: none"> ▪ 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



ಕರ್ನಾಟಕ ರಾಜ್ಯ ಪಬ್ಲಿಕ್ ವರ್ಕ್ಸ್ ಡಿಪಾರ್ಟ್‌ಮೆಂಟ್ - ಹಂಪಿ ||

ವರಸರದ ಬಗ್ಗೆ ಹೊಡಿಕೆವಾರದ ಪ್ರತಿಕ್ರಿಯೆ

ಸ್ಥಳ	ಸ್ವರ್ಧನಾಯ ವಿವರಗಳು
1 ಸ್ಥಳ	4 ಹೆಸರು
2 ದಿನಾಂಕ	5 ಹಳ
3 ರಸ್ತೆ	6 ದೂರವಾಣಿ ಸಂಖ್ಯೆ :

ಸೂಕ್ತವಾದುದನ್ನು ಆಯ್ಕೆ ಮಾಡಿ (✓)

ಶಬ್ದ ಮಾರ್ಪೆ	1 ನಿಮಗೆ ಸಂಬಂಧಿತ ತಬ್ಬದಿಂದ ತೊಂದರೆಯಾಗುತ್ತದೆ ಎಂದು ಅನಿಸುತ್ತದೆಯೆ	ಹೌದು <input type="checkbox"/>				ಇಲ್ಲ <input type="checkbox"/>
	ಹೌದು ಎನ್ನುವುದಾದರೆ, ಸಂಕರ ಪರಿಣಾಮದ ಪ್ರಮಾಣ >	ಉತ್ತಮ	ಮಧ್ಯಮ	ಕಡಿಮೆ	ಅತ್ಯಲ್ಪ	ಹೇಳಲು ಸಾಧ್ಯವಿಲ್ಲ
	ಪ್ರಸ್ತುತ ಸಂಬಂಧಿತ ತಬ್ಬದಿಂದ ತೊಂದರೆಯೇ					
	ಪ್ರಸ್ತುತ ಸಂಬಂಧಿತ ಹಾರ್ಡ್ ತಬ್ಬದಿಂದ ತೊಂದರೆಯೇ					
	2 ಯೋಜನೆಯ ಅನುಷ್ಠಾನದ ಸಂಕರ ಸಂಬಂಧಿತ ಪರಿಮಾಣವನ್ನು ಹೆಚ್ಚಿಸುವುದು					
	3 ನೀವು ಯೋಜನೆಯ ಕಾರಣ ತಬ್ಬ ಮಟ್ಟದಲ್ಲಿ ಯಾವುದೇ ಬದಲಾವಣೆ ನಿರೀಕ್ಷಿಸುತ್ತೀರಾ	ಹೆಚ್ಚಿಸುವುದು <input type="checkbox"/>	ಇಳಿಸುವುದು <input type="checkbox"/>		ಬದಲಾವಣೆ ಇಲ್ಲ <input type="checkbox"/>	
	ನಿರೀಕ್ಷಣೆಯ ಹೆಚ್ಚಾದರೆ, ಸಂಕರ ಪರಿಣಾಮದ ಪ್ರಮಾಣ >	ಉತ್ತಮ	ಮಧ್ಯಮ	ಕಡಿಮೆ	ಅತ್ಯಲ್ಪ	ಹೇಳಲು ಸಾಧ್ಯವಿಲ್ಲ
	ಯೋಜನೆಯ ಅನುಷ್ಠಾನದ ಸಂಕರ ತಬ್ಬವನ್ನು ಹೆಚ್ಚಿಸುವುದು					
	ಯೋಜನೆಯ ಅನುಷ್ಠಾನದ ಸಂಕರ ಹಾರ್ಡ್ ಹೆಚ್ಚಿಸುವುದು					
	ಯಂತ್ರಗಳು ಮತ್ತು ನಿರ್ಮಾಣ ವಾಹನಗಳಿಂದ ತೊಂದರೆಯೇ					
4 ಯಾವುದಾದರೂ ಸಂಕರಗಳು ತಬ್ಬ ಮಾರ್ಪಡವನ್ನು ತಗ್ಗಿಸಲು :						

ಸೂಕ್ತವಾದುದನ್ನು ಆಯ್ಕೆ ಮಾಡಿ (✓)

ವಾಯು ಮಾರ್ಪೆ	5 ನಿಮಗೆ ವಾಯು ಮಾರ್ಪಡದಿಂದ ತೊಂದರೆಯಾಗುತ್ತದೆ ಅನಿಸುತ್ತದೆಯೆ	ಹೌದು <input type="checkbox"/>				ಇಲ್ಲ <input type="checkbox"/>
	ಹೌದು ಎನ್ನುವುದಾದರೆ, ಸಂಕರ ಪರಿಣಾಮದ ಪ್ರಮಾಣ >	ಉತ್ತಮ	ಮಧ್ಯಮ	ಕಡಿಮೆ	ಅತ್ಯಲ್ಪ	ಹೇಳಲು ಸಾಧ್ಯವಿಲ್ಲ
	ಪ್ರಸ್ತುತ ಸಂಬಂಧಿತ ಗಾಳಿ ಹೊರಸೂಸುವಿಕೆಯಿಂದ ತೊಂದರೆಯೇ					
	ಪ್ರಸ್ತುತ ಸಂಬಂಧಿತ ಧೂಳಿಯಿಂದ ತೊಂದರೆಯೇ					
	6 ಸಂಬಂಧಿತ ಹೊರಸೂಸುವಿಕೆ ಬೇರೆ ಯಾವುದಾದರೂ ವಾಯು ಮಾರ್ಪಡದ ಮೂಲಗಳಿವೆಯೇ? ಇದ್ದರೆ, ಆ ಮೂಲಗಳನ್ನು ಹೆಚ್ಚಿಸಿ:					
	7 ನೀವು ಯೋಜನೆಯ ಕಾರಣದಿಂದ ವಾತಾವರಣದ ಗುಣಮಟ್ಟದಲ್ಲಿ ಯಾವ ನಿರೀಕ್ಷೆಯಿದೆ	ಹೆಚ್ಚಿಸುವುದು <input type="checkbox"/>	ಇಳಿಸುವುದು <input type="checkbox"/>		ಬದಲಾವಣೆ ಇಲ್ಲ <input type="checkbox"/>	
	ನಿರೀಕ್ಷಣೆಯ ಹೆಚ್ಚಾದರೆ, ಸಂಕರ ಪರಿಣಾಮದ ಪ್ರಮಾಣ >	ಉತ್ತಮ	ಮಧ್ಯಮ	ಕಡಿಮೆ	ಅತ್ಯಲ್ಪ	ಯಾವುದೇ ಬೇಕಿಲ್ಲ
	ಸಂಬಂಧಿತ ಹಾವಳಿಯಿಂದ ವಾಯು ಮಾರ್ಪಡ ಹೆಚ್ಚಾಗಿದೆಯೇ					
	ಸಂಬಂಧಿತ ಹಾವಳಿಯಿಂದ ಧೂಳಿ ಹೆಚ್ಚಾಗಿದೆಯೇ					
	8 ನಿರ್ಮಾಣದ ಕಾರ್ಯಗಳಿಂದ ಧೂಳಿ ಹೆಚ್ಚಾಗಿದೆಯೇ					
ಯಾವುದಾದರೂ ಸಂಕರಗಳು ವಾಯು ಮಾರ್ಪಡವನ್ನು ತಗ್ಗಿಸಲು :						

ಇಂಟರ್ ನೆಟ್‌ನಲ್ಲಿ ಕೆಲವು ದತ್ತಿಗಳನ್ನು ತಿಳಿಸುತ್ತಾ ರಿಮಾರ್ಕ್ಸ್, ಸೂಚನೆ, ವಿವರಿಸುವುದು ವರಸರದ ಬಗ್ಗೆ ಸಾಮಾನ್ಯ ಸೂಚನೆ.



ಕೋಟಿಕ ರಾಜ್ಯ ಪೆನ್ಸನ್ ಸುಧಾರಣೆ ಯೋಜನೆ - ಪಂತೆ ||

ಪರಿಶರದ ಬಗ್ಗೆ ಹೊರತಿದಾರರ ಪ್ರತಿಕ್ರಿಯೆ

ಸೂಕ್ತವಾದುದನ್ನು ಅಡ್ಡೆ ಮಾಡಿ (✓)

9 ರಸ್ತೆ ಅವಧಾತವು ನೀಡಿತವೇ ?		ಹೌದು <input type="checkbox"/>				ಇಲ್ಲ <input type="checkbox"/>
ಹೌದು ಎನ್ನುವುದಾದರೆ, ನಂತರ	ಪರಿಣಾಮದ ಪ್ರಮಾಣ >	ಉತ್ತಮ	ಮಧ್ಯಮ	ಕಡಿಮೆ	ಅತ್ಯಲ್ಪ	ಯಾವುದೇ ಬಾಕಿಗಳಿಲ್ಲ
ಸಣ್ಣ ಅವಧಾತದ ಅವರ್ತನ						
ಮಾರಣಾಂತಿಕ ಅವಧಾತದ ಅವರ್ತನ						
10 ನೀವು ಅವಧಾತದ ಅವರ್ತನದಲ್ಲಿ ಯೋಜನೆಯಿಂದ ಯಾವುದಾದರೂ ಬದಲಾವಣೆಯನ್ನು ನಿರೀಕ್ಷಿಸುತ್ತೀರಾ?		ಹೆಚ್ಚಿಸುವುದು <input type="checkbox"/>		ಇಳಿಸುವುದು <input type="checkbox"/>		ಬದಲಾವಣೆ ಇಲ್ಲ <input type="checkbox"/>
ನಿರೀಕ್ಷಣೆಯ ಹೆಚ್ಚಾದರೆ, ನಂತರ	ಪರಿಣಾಮದ ಪ್ರಮಾಣ >	ಉತ್ತಮ	ಮಧ್ಯಮ	ಕಡಿಮೆ	ಅತ್ಯಲ್ಪ	ಯಾವುದೇ ಬಾಕಿಗಳಿಲ್ಲ
ನಿರ್ಮಾಣದ ಹಂತದಲ್ಲಿ ಅವಧಾತ ಹೆಚ್ಚಾದಿಯೇ						
ಕಾರ್ಯಾಚರಣೆ ಹಂತದಲ್ಲಿ ಅವಧಾತ ಹೆಚ್ಚಾದಿಯೇ						
11 ರಸ್ತೆ ಅವಧಾತ ಕಡಿಮೆ ಮಾಡಲು ರಸ್ತೆ ಸುರಕ್ಷತಾ ಕ್ರಮಗಳನ್ನು ಅಡ್ಡೆ ಮಾಡಿ						
	ವೇಗದ ಬ್ರೇಕ್/ ರೋಡ್ ಹಂಪ್					
	ಪಾದಚಾರಿಗಳು ದಾಟುವ ಸ್ಥಳ					
	ರಸ್ತೆ ರುಬುಗಳು					
	ಸುಧಾರಣೆ ಕುರ್ಚಿ ಸೇವೆಗಳು					
	ಪೊಲೀಸ್ ವೆಹಿಕಲ್					
	ವೇಗದ ಕ್ಯಾಮೆರಾ					
	ರಸ್ತೆ ಸುರಕ್ಷತಾ ತಿಳಿಸು ಕ್ಯಾಂಪ್					
	ಚಾಲಕ ಚಾಗ್ಗಿಸಿ ಕಾರ್ಯಕ್ರಮಗಳು					
ಇತರೆ ಕ್ರಮಗಳನ್ನು (ಸಂಖ್ಯೆ ನೀಡಿ)						
12 ಇತರೆ ಯಾವುದೇ ಸಲಹೆಗಳು :						

13 ಕಾಡು ಪ್ರಾಣಿಗಳು ಸುತ್ತಮುತ್ತಲಿನ ಪ್ರದೇಶಗಳಲ್ಲಿ ಗುರುತಿಸಲ್ಪಡುತ್ತದೆಯೇ?		ಹೌದು <input type="checkbox"/>				ಇಲ್ಲ <input type="checkbox"/>
ಹೌದು ಎನ್ನುವುದಾದರೆ, ನಂತರ	ಪರಿಣಾಮದ ಪ್ರಮಾಣ >	ಉತ್ತಮ	ಮಧ್ಯಮ	ಕಡಿಮೆ	ಅತ್ಯಲ್ಪ	ಯಾವುದೇ ಬಾಕಿಗಳಿಲ್ಲ
ಕಾಡು ಪ್ರಾಣಿಗಳ ದೃಶ್ಯದ ಅವರ್ತನ						
ಕಾಡು ಪ್ರಾಣಿಗಳು, ಬೆಳೆ / ಅಡ್ಡುಗಳಿಗೆ ಹಾನಿ ಮಾಡಿದ ಘಟನೆ						
ವನ್ಯಜೀವಿ ಒಳಗೊಂಡ ಅವಧಾತ						
ಮನುಷ್ಯ ವನ್ಯಜೀವಿ ಭೀಕರಭಾವನೆಯಿಂದ ಘಟನೆ						
ಹತ್ತಿರದ ಪ್ರದೇಶದಲ್ಲಿ ಆಕ್ರಮಣಕಾರರಿಂದ ವನ್ಯಜೀವಿ ಕಳ್ಳನಾಗಣೆ ಘಟನೆ						
14 ದಯವಿಟ್ಟು ನೀವು ಈಗಾಗ್ಗೆ ನೋಡುವ ವನ್ಯಜೀವಿಗಳ ಹೆಸರು ತಿಳಿಸಿ	15 ನೀವು ಯಾವುದೇ ಕೆಲವು ಅಂತ್ಯವನ್ನು ಬಳಸುತ್ತೀರಾ? ಬಳಸುವುದಾದರೆ ಅವುಗಳ ಹೆಸರು :					
16 ದಯವಿಟ್ಟು ಯಾವುದಾದರೂ ಈಗಾಗ್ಗೆ ಈಗುವ ವನ್ಯಜೀವಿ ಅವಧಾತ ತೋರಣ ಹೆಸರು ತಿಳಿಸಿ	17 ಗಾಂವುಗಳಿಗೆ ನಿಮ್ಮ ಪ್ರದೇಶದಲ್ಲಿರುವ ಔಷಧೀಯ ಸಸ್ಯಗಳು ಯಾವುವು ?					
18 ನಿಮ್ಮ ಇಪ್ಪದ ಯಾವ ಪಾತಿಯ ಮರಗಳನ್ನು ಕೃಷಿ ಭೂಮಿಯಲ್ಲಿ ಅಥವಾ ಗಡಿಗಳಲ್ಲಿ ಹಾಕಬಹುದು	19 ರಸ್ತೆ ಬದಿಯಲ್ಲಿ ನೆಡಲು ನಿಮ್ಮ ಇಪ್ಪವಾದ ತಳಿಯ ಹೆಸರುಗಳು?					
20 ಬೇರೆಯಾವುದಾದರೂ ಸಲಹೆಗಳು ನೀಡುವುದನ್ನು ಮತ್ತು ಪರಿಶರದ ಬಗ್ಗೆ						

ಇಂಟರ್ ಅಂತರಜಾಲದ ಕೆಳಭಾಗದಲ್ಲಿ ಮತ್ತು ಟೆಲಿಫೋನ್ ಪ್ರಿವೆಂಟ್ ರಿವಾಟಿವ್, ಸೂಚನೆ ವಿವರಿಸಬಹುದಾದ ಪರಿಶರ ವಿಷಯದ ಬಗ್ಗೆ ಸಹಾಯ ನೀಡಿ ಸಹಜ

ANNEX 7.2 REGISTRATION OF PARTICIPANTS IN PCM

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

Name of the Project Road	Chinlamanu 1 st AP Border
Place of Public Consultation	Govt. Primary School, Seegalapallya
Date of Public Consultation	8/12/15 at 10:30 a.m

S. N.	Name of the Participant	Village	Mobile No.	Signature
1.	S.K. Manjunath	Seegalapallya	870074588	
2.	S.M. Marali	- 1 -	963245423	
3.	ಎಸ್.ವಿ.ವಿಜಯಲಕ್ಷ್ಮಿ	- 11 -	9945376703	S.V. Mad
4.	S.N Venkatesh	- 11 -	907131289	S.N Venkatesh
5.	Nagaraja. K.M	Seegalapallya	9611861460	
6.	ಎಂ.ಪ್ರಭಾಕರ		8884533448	
7.	Rajyappa	Seegalapallya	8277410325	
8.	Srinivas.	- 11 -	8050101410	
9.	S. H. Anand	- 11 -	9972520538	S.H.A
10.	ಎಂ.ಎ.ಎ.ಎ.ಎ.	- 11 -	9964829946	
11.	ಹೆ.ಎ.ಎ.ಎ.ಎ.ಎ.	- 11 -	9740175269	ಹೆ.ಎ.ಎ.ಎ.ಎ.ಎ.
12.	ಎ.ಎ.ಎ.ಎ.ಎ.		9880861707	ಎ.ಎ.ಎ.ಎ.ಎ.
13.	ಎ.ಎ.ಎ.ಎ.			
14.	ಎ.ಎ.ಎ.			
15.	ಎ.ಎ.ಎ.ಎ.ಎ.	- 11 -	7090945889	
16.	ಎ.ಎ.ಎ.		8261770566	ಎ.ಎ.ಎ.
17.	ಎ.ಎ.ಎ.ಎ.		9743068599	ಎ.ಎ.ಎ.ಎ.
18.	ಎ.ಎ.ಎ.		7022267588	ಎ.ಎ.ಎ.

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

Name of the Project Road	Chintamani to AP Border
Place of Public Consultation	Seegalapallya, Govt. Primary School
Date of Public Consultation	8/12/2015 at 10:30 a.m

S. N.	Name of the Participant	Village	Mobile No.	Signature
19	ಮೊಕದ್ದೂರು ಮಠ	ಚಿಂತಾಣಿ		ಮೊಕದ್ದೂರು ಮಠ
20	ಶಶಿಪತಿ	- - -	9633151611	ಶಶಿಪತಿ
21	S.R. Nagaraja	- - -	9663837152	S.R. Nagaraja
22	ಕೊಪ್ಪೆ	- - -		
23	ಕೊಪ್ಪೆ	- - -		ಕೊಪ್ಪೆ
24	ಕೊಪ್ಪೆ	- - -		
25	ಕೆ.ಎನ್.ಮನುಜ	- - -	9880864983	K.S.M. Manu
26	ಕೊಪ್ಪೆ	- - -		ಕೊಪ್ಪೆ
27	ಕೊಪ್ಪೆ			ಕೊಪ್ಪೆ
28	ಕೊಪ್ಪೆ			
29	ಕೊಪ್ಪೆ			
30	ಕೊಪ್ಪೆ			Akkalyamma
31	ಕೊಪ್ಪೆ S.R.			S.R. Koppa
32	ಕೊಪ್ಪೆ			
33	ಕೊಪ್ಪೆ			
34	ಕೊಪ್ಪೆ			ಕೊಪ್ಪೆ
35	Lakshminarayana		9481214818	
36	ಕೊಪ್ಪೆ		9902239653	ಕೊಪ್ಪೆ

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

Name of the Project Road	Chintamani to AP Border
Place of Public Consultation	Sharda Shrunga P.U. College, Thadigal cross
Date of Public Consultation	8/12/15 at 11:45 a.m

S. N.	Name of the Participant	Village	Mobile No.	Signature
1	T.M. Venkatesh babu	Thadigal	9844099924	
2	Mamatha K	Thadigal	99101384903	
3	Mannurath T.A	S.V.PUR	9938135939	T.A. Mittl
4	Shubasiram T.S.	Govindapally	9848654239	
5	ವಿಷ್ಣು ಗಿ.ನ	ವಿಷ್ಣು ಗಿ.ನ	9591200671	Ushua
6	Gokul L.V	Lakshimpura	9964392265	Gokul L.V.
7	Srinatha I.E	Reddempalle	9008629011	Srinath I.E
8	Amaravathi T.E	Thadigal	8861162447	Amaravathi T.E
9	HaseenTaj	Thadigal	7259516022	HaseenTaj
10	Tejshwini T.M	Thadigal	9743396950	Tejshwini
11	Ganithri K.N	KadiRola	9164609647	Ganithri
12	Ayesha Khanam T.S	Thadigal	8184039469	Ayeshakhanam
13	Shafiyakhanam	Thadigal	8184039469	Shafiyakhanam
14	Bhavanee K.V	Kaddirolagadda	8496963372	Bhavanee K.V
15	JAYASHREE K.J	Kaddirolagadda	862041703	Jayashree K.J
16	S. N. edge	Thadigal	-	S.N. edge
17	munjt T.N	Thadigal	9743396950	munjt T.N
18	ವಿಷ್ಣು ಗಿ.ನ	- " -	7259516022	ವಿಷ್ಣು ಗಿ.ನ
19	ವಿಷ್ಣು ಗಿ.ನ	- " -	714167520	ವಿಷ್ಣು ಗಿ.ನ

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

Name of the Project Road	Chintamani to AP Border
Place of Public Consultation	Shanta Shringa P.V. College, Thadigal cross
Date of Public Consultation	8/12/15 at 11:15 a.m.

S. N.	Name of the Participant	Village	Mobile No.	Signature
1	T.M. Venkatesh babu	Thadigal	9844099934	
2	Mamatha. K	Thadigal	9901384903	
3	Mamunah T.A	P.V. pur	9958135939	T.A. Masth
4	Shubasiram T.S.	Kowalapally	9843654239	
5	ವಿಷ್ಣು ಗಿ.ನಿ	ಕೂರಗಿರಿಯ	9591200671	Ushwa
6	Gokul L.V	Lakshimpura	9964392265	Gokul L.V.
7	Sainatha I.E	Reddempalle	9008629011	Sainath I.E
8	Amaravathi T.E	Thadigal	8861162447	Amaravathi T.E
9	HaseenTaj	Thadigal	7259516022	HaseenTaj
10	Tejashwini T.M	Thadigal	9743396950	Tejashwini
11	Ganithri K.N	Kadirolagada	9164 609647	Ganithri
12	Ayesha Khanam T.S	Thadigal	8184039469	Ayeshakhanam
13	Shafiyakhanam	Thadigal	8184039469	Shafiyakhanam
14	Bhavanee K.V	Kaddirivallagadda	8496963372	Bhavanee K.V.
15	JAYASHRREEK.J	Kaddirivallagadda	862041703	Jayashreek.J
16	K.N. Raju	Thadigal	-	K.N. Raju
17	Munish T.N	Thadigal	9743396950	Munish T.N
18	ವಿಷ್ಣು ಗಿ.ನಿ	- " -	7259516022	ವಿಷ್ಣು ಗಿ.ನಿ
19	ಕೂರಗಿರಿಯ	- " -	714167520	ಕೂರಗಿರಿಯ

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

Name of the Project Road	Chintamani to AP Border
Place of Public Consultation	Shantala Shringa P. U. College, Theodigal Cross
Date of Public Consultation	8/12/15 at 11:45 a.m

S. N.	Name of the Participant	Village	Mobile No.	Signature
20.	C. N. Krishnamurthy AEE, KSHIP	PWD KSHIP	9945180252	
21.	Vikroth. K AE, KSHIP	Hosajuric SDN	9742916393	
22.	Az. Lakshmi Rawat	ICT, New Delhi	—	
23.	Subhrajit Mitra	ICT, New Delhi	9873351737	
24.	Manoj Kumar M	ICT, Bangalore	9916659919	
25.	Tirthankar Baneija	ICT, New Delhi	9599233384	

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

Name of the Project Road	Chintamani to AP Border
Place of Public Consultation	Bhagwan Buddha High School & ITI College
Date of Public Consultation	8/12/15 at 1:00 p.m.

S. N.	Name of the Participant	Village	Mobile No.	Signature
1	ಶ್ರೀನಾಥ	ಅಣ್ಣೇಶಿ ಗ್ರಾಂ	8970897526	Shree
2	ಗೋಪ	- 1 -	8546907156	Anil.M.R.
3	ಲಕ್ಷ್ಮಣ ರೆಡ್ಡಿ	ಬೀದೇನೂರು	9964484838	Laxman
4	ಶೇಷ	- 1 -	9141168636	ಶೇಷ
5	ಮಲ್ಲಿಕಾರ್ಜುನ	ಬೀದೇನೂರು	-	ಮಲ್ಲಿಕಾರ್ಜುನ
6	ಶಾಂತ	- 1 -	-	ಶಾಂತ
7	ಶ್ರೀನಾಥ ಎ	ಬೀದೇನೂರು	9008175108	Shree
8	ನಾಳ ರೆಡ್ಡಿ	ಬೀದೇನೂರು	8495010005	Naal
9	K.V. ಬಾಲೇಶ್	ಕುಂದೇನೂರು	9743691005	K.V. Balish
10	K. ಶೇಷ	- 1 -	9844691708	Keshava
11	ಶೇಷ	- 1 -	9482771104	Chimara
12	ನಾಳ	- 1 -	-	Naal
13	ಶೇಷ	ಬೀದೇನೂರು	9743676918	Shalibor
14	R.B. ನಾರಾಯಣ್	ಬೀದೇನೂರು	9844750012	R.B. Narayan
15	K.V. ರವೀಶ್	ಬೀದೇನೂರು	8788507888	K.V. Raveesh
16	ನಾಳ	ಬೀದೇನೂರು	9740270880	Naal
17	ಶೇಷ	ಬೀದೇನೂರು	914153063	ಶೇಷ
18	ನಾರಾಯಣ್ ರೆಡ್ಡಿ K.S.	ಬೀದೇನೂರು	9141460178	K.S. Narayana

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

Name of the Project Road	chintamani to AP Border
Place of Public Consultation	Bhagawan Buddha High School & ITJ College
Date of Public Consultation	8/12/15 at 1:00 P.M

S. N.	Name of the Participant	Village	Mobile No.	Signature
19	ನವನಿಂಜಳ್ಳಿ	ಮೋಕೇ ಗಿರ್ದಿ	8105801145	Navaninjappa
20	ಶ್ರೀನಿವಾಸೇ ಗೃಹಿ	ನಿಮಲಾಪುರವಿಲ್ಲೆ	9591718986	Shrinivasappa
21	ನವನಿಂಜಾ ಶಾಕಿ	ಕೊಂಬಾಪುರವಿಲ್ಲೆ	9449338404	Navaninjappa
22	ನೂರಾಪುರ	ಹಿರಿಯಾಪುರ	9966424232	Nurappa
23	ವಸಂತಪುರ	ಗುಂದೇದು	7090212215	K.N. Vasanthappa
24	V. Anudhyayamma	ಕುಂದೇದು	8861431405	V. Anudhyayamma
25	ಶಿವಪುರವಿಲ್ಲೆ	ಶಿರಿಯಾಪುರ	2453935822	Shivappa
26	ರಾಜನಿ	ಕೊಂಬಾಪುರವಿಲ್ಲೆ	9494598948	Rajani
27	ಶಿವಪುರ	-,-,-	-,-,-	Shivappa
28	ನಾಗಮಠ	-,-,-	-,-,-	Nagamath
29	ಬಿರಾಡ	ಕೊಂಬಾಪುರವಿಲ್ಲೆ	9731583696	Birada
30	ನೀಲಾಪುರ	ಕೊಂಬಾಪುರವಿಲ್ಲೆ	-	Neelappa
31	ಅರಿಯಾಪುರ	-,-,-	-	Ariyappa
32	ಬಿರಾಡ	-,-,-	-	Birada
33	ಶ್ರೀನಿವಾಸೇ	-,-,-	-	Shrinivasappa
34	ನಿಮಲಾಪುರ	-,-,-	9902067989	Sumalatha
35	ನಾಗಮಠ	-,-,-	-	Nagamath
36	ಯಮುನಾ	-,-,-	-	Yamuna

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

Name of the Project Road	Chintamani to AP Border
Place of Public Consultation	Bhagawan Buddha High School & ITI college Thadigal cross
Date of Public Consultation	8/12/15 at 1:00 PM

S. N.	Name of the Participant	Village	Mobile No.	Signature
37	ಶಿವಪ್ಪ	ಕೊಡಲೆ ಪೇಟೆ	-	
38	ಮಂಜುಳೆ	ಕ. ಕೆ. ಪೇಟೆ	-	
39	ಶಿವಪ್ಪ	ಇಸರಂದಿ ಪೇಟೆ	-	
40	ಮಂಜುಳೆ	-11-	-	
41	ಕುಲಕರ್ಣಿ	ಮಂಜುಳೆ	-	
42	ಸುಜಾತಾ	-11-	9973648784	ಸುಜಾತಾ
43	ಮಂಜುಳೆ	ಕೊಡಲೆ ಪೇಟೆ	8892474743	ಮಂಜುಳೆ
44	C. ಮಂಜುಳೆ	-11-	9844425039	C. Manjunale
45	ಶಿವಪ್ಪ	ಕೊಡಲೆ ಪೇಟೆ	886158751	ಶಿವಪ್ಪ
46	ಶಿವಪ್ಪ	-11-	8970478589	ಶಿವಪ್ಪ
47	ಸುಲೋಚನಾ	-11-	9900297062	Sulochana
48	ಸುಜಾತಾ	-11-	9611740637	ಸುಜಾತಾ
49	ಶಿವಪ್ಪ	ನರಸೀಪುರ	8067458388	ಶಿವಪ್ಪ
50	ಸುಜಾತಾ	ಸೋಲೆ	9901308065	ಸುಜಾತಾ
51	ಸುಜಾತಾ	-11-	7760479147	U. Suganya
52	ವೆಂಕಟೇಶ್	ಮಂಜುಳೆ	-	V. Venkatesh
53	ಶಿವಪ್ಪ	-11-	-	ಶಿವಪ್ಪ
54	ಶಿವಪ್ಪ	ಸೋಲೆ	-	ಶಿವಪ್ಪ

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

Name of the Project Road	Chintamani to AP Border
Place of Public Consultation	Bhagawan Buddha High School & ITI college Theodigal cross
Date of Public Consultation	8/12/15 at 1:00 P.M

S. N.	Name of the Participant	Village	Mobile No.	Signature
55	ನರಸಿಂಹ	ನೀವಳ್ಳಿ	9900657604	Narasimha
56	ನಿವನವಳ್ಳಿ	ನಿವನವಳ್ಳಿ	9980962593	R. ನಿವನವಳ್ಳಿ
57	ನಾಗರವಳ್ಳಿ	ನೀವಳ್ಳಿ	8971821508	nagaravalli
58	ಕೀಮಲ	ನೀವಳ್ಳಿ	9964137900	C.komala
59	ಪಿ.ಕೆ. ಶಾನ್	ನೀವಳ್ಳಿ	9743319663	P.K. Shana
60	R.E. ಮಾರ್ತುಕ	ನೀವಳ್ಳಿ	9902433101	R.E. Marthuk
61	ಅಮಲವಳ್ಳಿ	ನೀವಳ್ಳಿ	-	ಅಮಲವಳ್ಳಿ
62	ಪೆಡ್ಡೆ ಹಾರ್ತಿ ಕೆ.ಬಿ	ನೀವಳ್ಳಿ	9449406656	Peddy hartu
63	ಶಾಬಾನ	ನೀವಳ್ಳಿ	8970063407	Shabana
64	V. ರಾಜೇಶ್	T. ಶಾನ್	9591457451	V. Rajesh
65	ಬಿ.ನ.ಕೆ. ಕೆ.ಎಸ್	ನೀವಳ್ಳಿ	9964143059	B.N.K. K.S.
66	N. ಸುಜಾತ	ನೀವಳ್ಳಿ	8762916463	N. Sujata
67	ನೀಲವಳ್ಳಿ ಜಿ.ವೈ	ನೀವಳ್ಳಿ	9663629123	N. Nilavalli
68	ಅಲವಳ್ಳಿ	ನೀವಳ್ಳಿ	8880785340	Alavalli
69	ಶರಣ ಕೆ.ಎನ್	T. ಶಾನ್	8971143586	Sharan K.N.
70	ನಂಜನ್. ಕೆ.	T. ಶಾನ್	9964120160	Nanjana K.
71	C.N. ರಾಮನಾಥ	ನೀವಳ್ಳಿ	8970148810	C.N. Ramana
72	ನರಸಿಂಹ	ನೀವಳ್ಳಿ	9663016885	Narasimha

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

Name of the Project Road	Chintamani to AP Border
Place of Public Consultation	Bhagevan Buddha High School & ITI College Thadigah Gram
Date of Public Consultation	8/12/15 at 1:00 P.M

S. N.	Name of the Participant	Village	Mobile No.	Signature
72	ಶೋಭಿತ ರಾಜ್	ಶೋಭಿತ ರಾಜ್	9663789391	ಶೋಭಿತ ರಾಜ್
73	U. M. K.	Venkatachalapaty	9406966962	U. M. K.
74	JAYAPALAREDDY	T. COSS	9729658307	JAYAPALAREDDY
75	Vikranth. K AE	KSHIP Hosur	944216122	Vikranth. K AE
76	KRISHNAMURTHY, AEG	SUB-DIVISY	- - -	KRISHNAMURTHY, AEG
78	Dr. Lakshmi Rawat	ICT, New Delhi	-	Dr. Lakshmi Rawat
79	Subhagjit Mitra	ICT, New Delhi	9873351737	S. Mitra
80	Manojkumar M	ICT, Bangalore	9916659919	Manojkumar M
81	Tirthankar Banerjee	ICT Newdelhi	9599233384	Tirthankar

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

Name of the Project Road	Chintamani to AP Border
Place of Public Consultation	Govt. Lower Primary School, Manchinelakare
Date of Public Consultation	8/12/15 at 3:00 P.M.

S. N.	Name of the Participant	Village	Mobile No.	Signature
1	Mallappa.			
2	MT ತುಂಬಲಿವ	ಮಂಡಗನವಳ್ಳಿ	8970192686	
3	ಶುಭನ	ಮಂಡಗನವಳ್ಳಿ		ಶುಭನ
4	K.N.ಲಕ್ಷ್ಮೀನಾರಾಯಣ	ಮಂಡಗನವಳ್ಳಿ	8453708001	laxman
5	ನಾಗಮ್ಮ	ಮಂಡಗನವಳ್ಳಿ	9449378538	
6	Shanivasa.	ಮಂಡಗನವಳ್ಳಿ	7204513645	Shanivasa
7	Venkateshramanna	ಮಂಡಗನವಳ್ಳಿ	9748941961	venkateshramanna
8	Lakshmi?	ಮಂಡಗನವಳ್ಳಿ	9743386453	lakshmi
9	Shashikala.	ಮಂಡಗನವಳ್ಳಿ	-	shashikala
10	ಮಂಡಗನವಳ್ಳಿ	ಮಂಡಗನವಳ್ಳಿ	972565447	ಮಂಡಗನವಳ್ಳಿ
11	ಶಂಕರವೆಂಪು			ಶಂಕರವೆಂಪು
12	S.R.VENKATASU -BARBARA	Manchinelelake	9611457367	S.R.Venkatasa
13	ಶಂಕರವೆಂಪು	ಮಂಡಗನವಳ್ಳಿ		shankar
14	Shobha M.C	ಮಂಡಗನವಳ್ಳಿ	8151893609	Shobha M.C
15	Vijay Kumar M.	Manchinilakole	8105020598	Vijay M.
16	M.S. Ganeshwara	Manchinilakole	7353002539	Ganeshwara
17	ಮಂಡಗನವಳ್ಳಿ	ಮಂಡಗನವಳ್ಳಿ	-	
18	ನಾಗಮ್ಮ	ಮಂಡಗನವಳ್ಳಿ	8158983133	ನಾಗಮ್ಮ

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

Name of the Project Road	Chintamani To AP Border
Place of Public Consultation	Govt. Lower Primary School, Manchineelakate
Date of Public Consultation	8/12/15 at 3:00 P.M

S. N.	Name of the Participant	Village	Mobile No.	Signature
19.	ಶೇಷ್ವರ್	ಮಂಚಿನೇಲಕಾಟೆ	-	ಶೇಷ್ವರ್
20.	ಶೇಷ್ವರ್	-	-	
21.	ಎಚ್.ಎ.ಎ	AEE KSHIP Hosur	9742916593	
22.	C.N. Krishnamoorthy AEE	AEE KSHIP Hosur	9945180252	
23.	Dr. Lakshmi Rawat	ICT, Pvt. Ltd, New Delhi	-	
24.	Subhrajit Mitra	ICT, New Delhi	9873351737	
25.	Manoj Kumar M	ICT, Bangalore	9916659919	
26.	Tirthankar Banerjee	ICT, New Delhi	9599233384	

ANNEX 8.1 GUIDELINES FOR TOP SOIL CONVERSATION 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:
 - Slope 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 far 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 sloped 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 powder 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 to avoid 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.

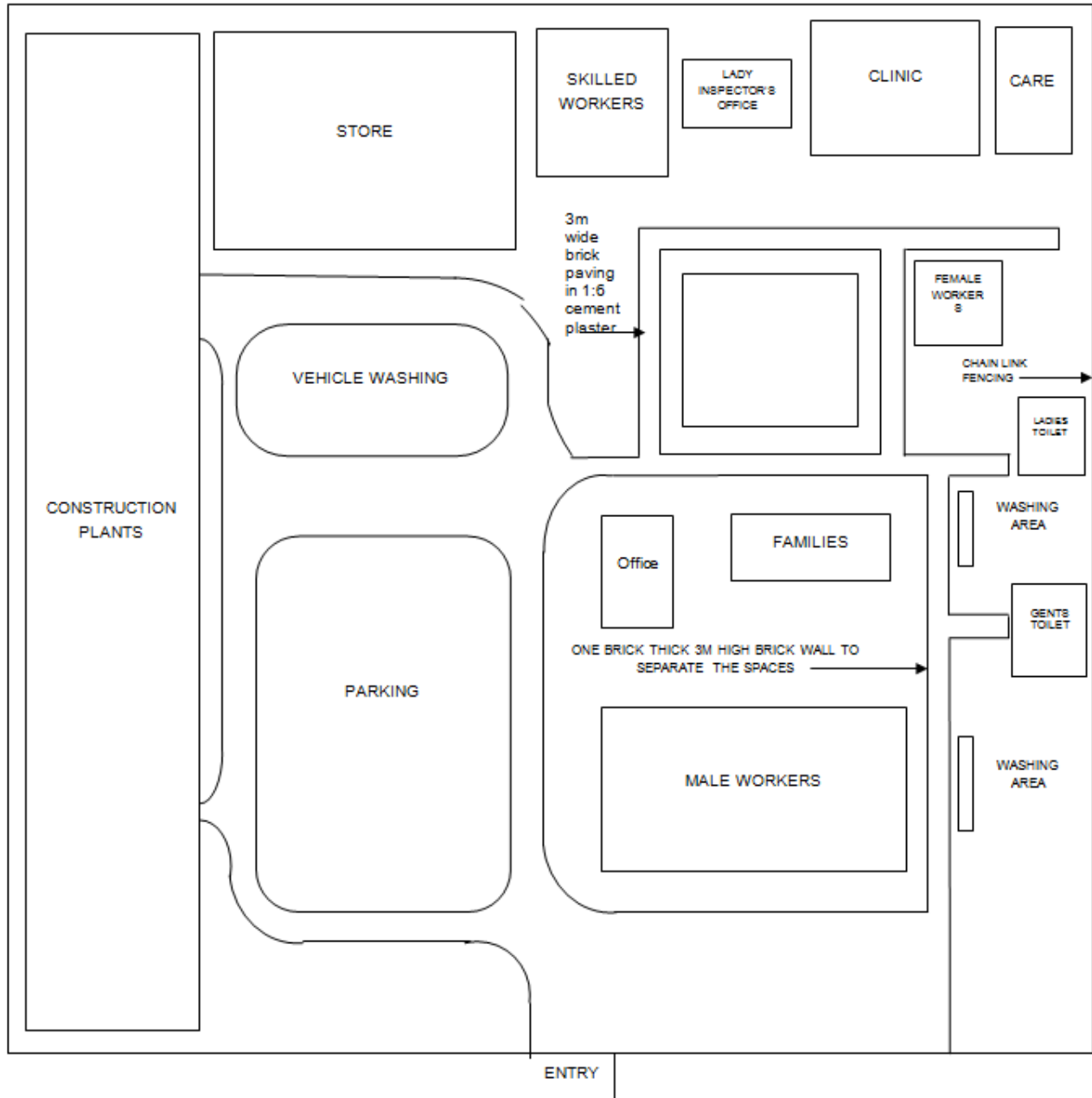


Figure-A Typical Layout of Construction Camp

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. Trees, 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 bio-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.

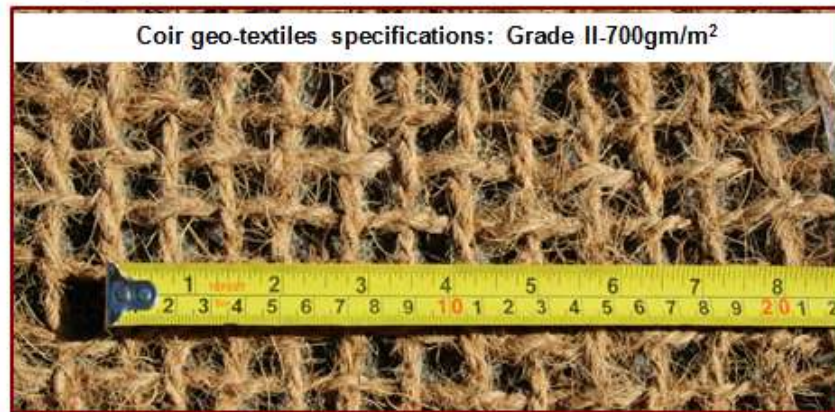
C. Role of Coir Geotextile in Slope Stabilization

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/m²



Coir geo-textiles specifications: Grade II-700gm/m²



Coir geo-textiles specifications: Grade III-900gm/m²

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 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 Grass used for Slope Stabilization in Bridge ↑ & Road ↓ Embankment



- 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, its 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.



- 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.	Ch. of Nearest Point on Project Road (km)	Side	Village Name	Lead From Nearest Point on Project Road (km)
1	50+500	LHS	Imareddyhalli	1.30
2	55+600	LHS	Nandigenahalli	1.20
3	59+600	RHS	Kamatampalli	0.60
4	64+800	LHS	Thadigol Cross	0.20
5	70+300	RHS	Chakappli	0.20
6	75+800	LHS	Thoopalli	0.10
7	80+500	LHS	Madarangpalli	0.10
8	85+300	RHS	Hakki Pikki Colony	0.50

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 safety 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 by 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 by 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 with 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 (existing)

- 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. Two 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	Location / Village Name	Lead From Nearest Point on Project Road (km)	Approx. Quantity
1	47+000	LHS	SNR stone crusher, Raguttahalli	18.0	70,00,000 cum
2	60+500	LHS	JNS stone crusher Gandhi Nagar	5.50	80,00,000 cum

2. Two sources of natural sand are identified along the project road as presented below:

Table-2.12 Location of Fine Aggregate Material

S. No.	Chainage of Nearest Point on Project Road (km)	Side	Location / Village Name	Lead From Nearest Point on Project Road (km)	Approx. Quantity
1	47+000	LHS	Raguttahalli	30.0	Huge
2	55+600	LHS	Pallikunte	7.70	Huge

3. 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. Following guideline is to be followed for siting, operation and re-development of quarrying and stone crushing operation.

B. Overview

4. 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

5. 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

6. 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

7. 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:

Site Preparation

8. 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.

Setting up of a Quarry Site

9. 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:

- 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
- control of air pollution through provision of in-built dust extraction systems in the crusher unit and all transfer points
- a chimney of appropriate height for the DG set (as specified by SPCB)
- water sprinkling facilities for the camp premises
- facilities to store water required for 3 days use

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

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.

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.

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.

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.

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.

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.
- Storm 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.

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

- The sound level (Leq) 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

12. 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

13. 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

14. 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 from 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 where 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 Engineer / Supervision Consultant, 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 biodegradable, 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.

- Non-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.

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.



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

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.

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.

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.

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.

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.

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 pulley with a bucket.

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.

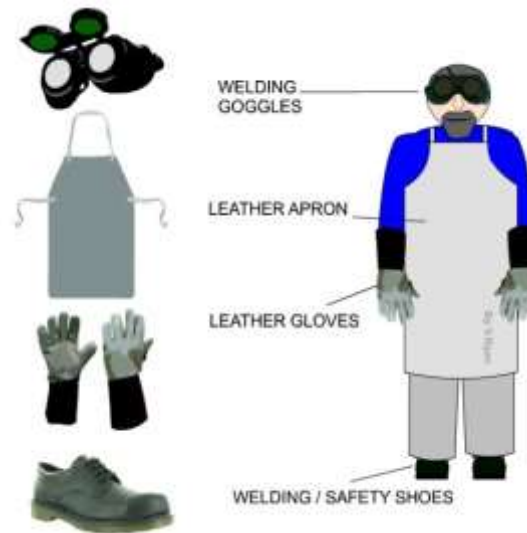
Operation of Trucks and Dumpers

- 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.

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.



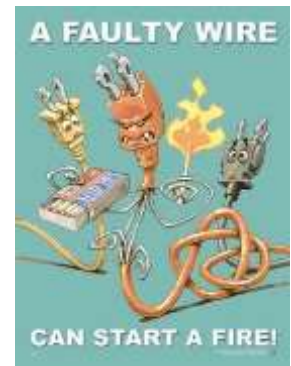
Gas Welding

- 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.
- Use and Storage of Gas (LPG)

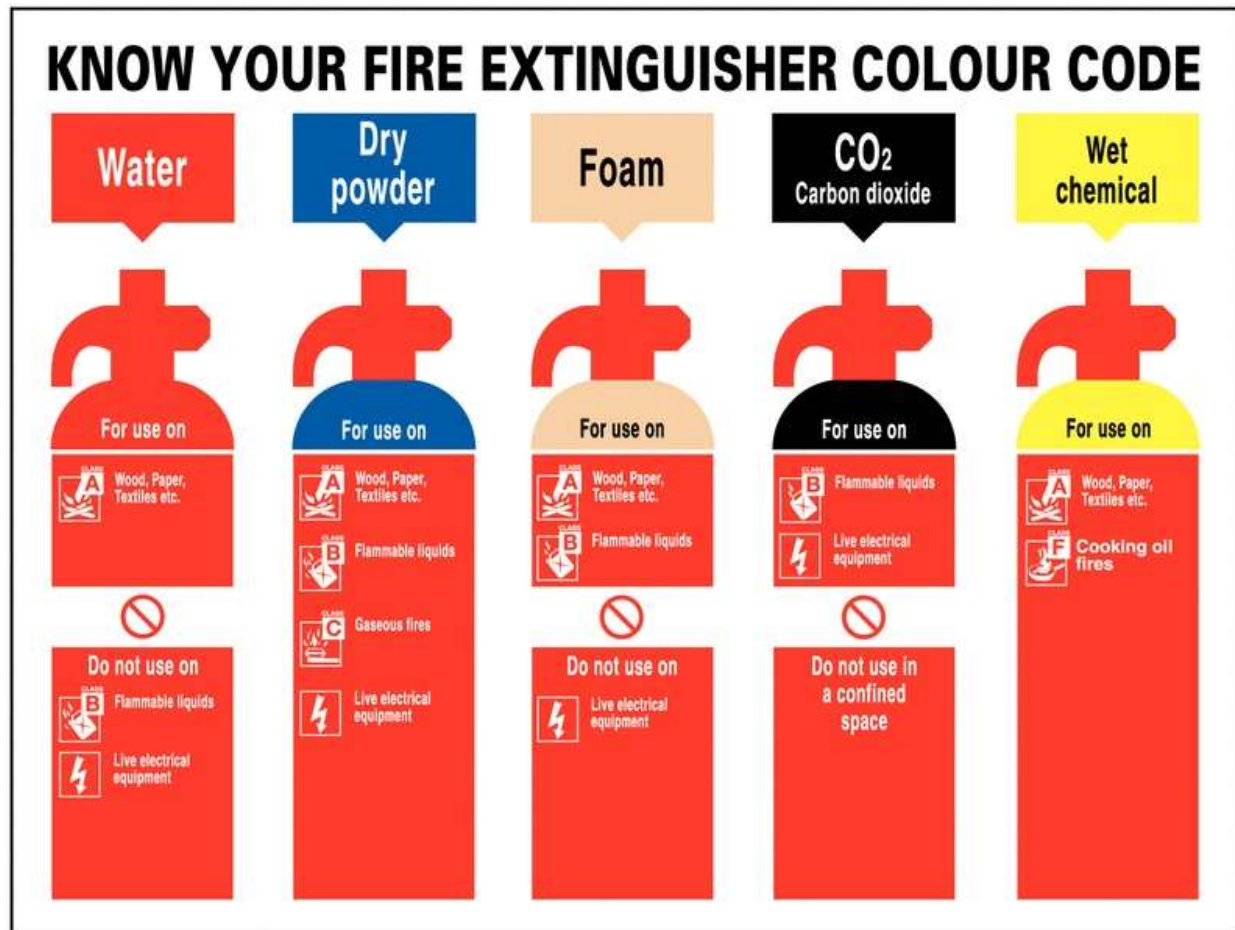


- Store filled LPG cylinder in a secure area – mark this as a no smoking area.
- Transport, store, use and secure cylinders in upright position
- Ensure proper ventilation at the ground level in locations where LPG is in use.
- Avoid physical damage to the cylinders
- Never weld near the cylinder
- Store 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.



G. 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.



H. 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.

I. 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.



Eye Protection

- 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.

Head Protection

- 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.

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.

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

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.

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.

J. 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.

K. 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:

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.

- a. Stop the flow
 - Stop the release into the stream waterway
 - 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. 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
- d. Cleanup and Disposal
 - Emergency Services will be engaged for the containment, cleanup and disposal of contamination release into the environment.
- e. 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.
- f. 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.

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
 - e. 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.
 - f. 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)
 - g. 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.	<i>Albizia amara</i>	Chigare
2.	<i>Albizia lebbeck</i>	Sirish
3.	<i>Annona squamosa</i>	Custard Apple
4.	<i>Azadirachta indica</i>	Neem
5.	<i>Bauhinia racemosa</i>	Kachnar
6.	<i>Butea monosperma</i>	Palash
7.	<i>Cassia fistula</i>	Amaltas
8.	<i>Cassia siamea</i>	Kassod

S.No.	Scientific name	Common Name
9.	<i>Dalbergia sissoo</i>	Seesham
10.	<i>Delonix regia</i>	Gulmohar
11.	<i>Ficus benghalensis</i>	Banyan
12.	<i>Ficus microcarpa</i>	Indian Laurel
13.	<i>Ficus mysorensis</i>	Goni Mara
14.	<i>Ficus religiosa</i>	Peepal
15.	<i>Mangifera indica</i>	Mango
16.	<i>Peltophorum pterocarpum</i>	Radhachura
17.	<i>Phoenix sylvestris</i>	Khajur
18.	<i>Polyalthia longifolia</i>	Ashok
19.	<i>Pongamia pinnata</i>	Karanj
20.	<i>Syzigium cumini</i>	Jamun
21.	<i>Tamarindus indica</i>	Imli
22.	<i>Terminalia arjuna</i>	Arjun
23.	<i>Ziziphus mauritiana</i>	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 casualties, 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 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 8.14 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.		

SI. No	Item	Unit	Details	Remarks by CSC if any
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		
	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

Approved

Signature

Signature

Name

Name

Designation

Sr. Environmental Specialist

Contractor

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

Approved

Signature

Signature

Name

Name

Designation

Sr. Environmental Specialist

Contractor

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

Signature

Name

Designation

Contractor

Approved

Signature

Name

Sr. Environmental Specialist

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							

Particulars	Location-1			Location-2			Remarks
	A	B	C	A	B	C	
▪ Dangerous Goods Store							
▪ Gas Welding Cylinders							
Others							
▪ Dust Control							
▪ Noise Control							
▪ First Aid Equipment							
▪ Washing Facility							
▪ Latrine							
▪ Canteen							
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 MEASUREMENTS 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				

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

Submitted

Approved

Signature

Signature

Name

Name

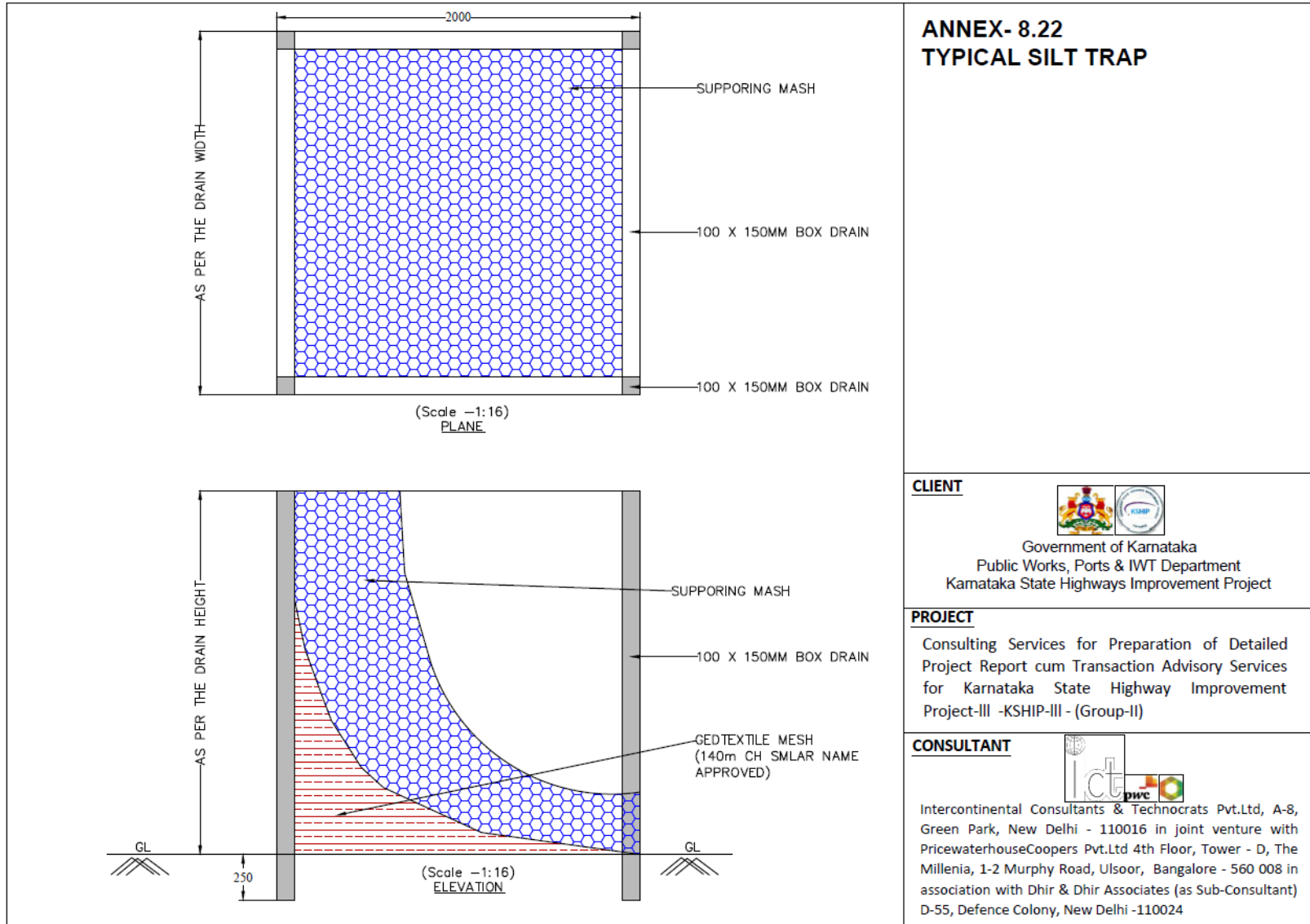
Designation

Sr. Environmental Specialist

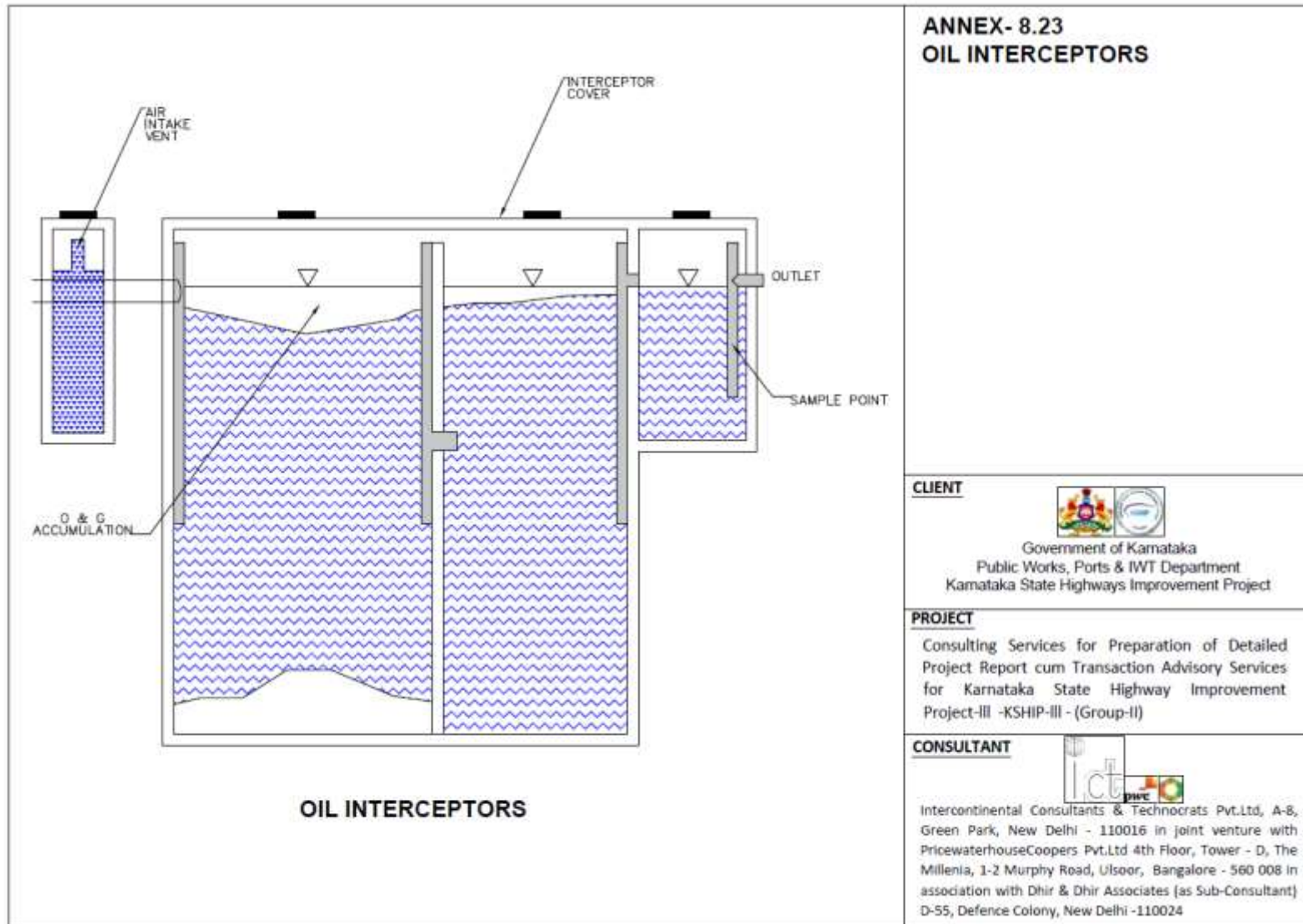
Contractor

Independent Engineer

ANNEX 8.22 DRAWING OF TYPICAL SILT TRAP



ANNEX 8.23 DRAWING OF TYPICAL OIL INTERCEPTOR



**ANNEX- 8.23
OIL INTERCEPTORS**

CLIENT



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

PROJECT

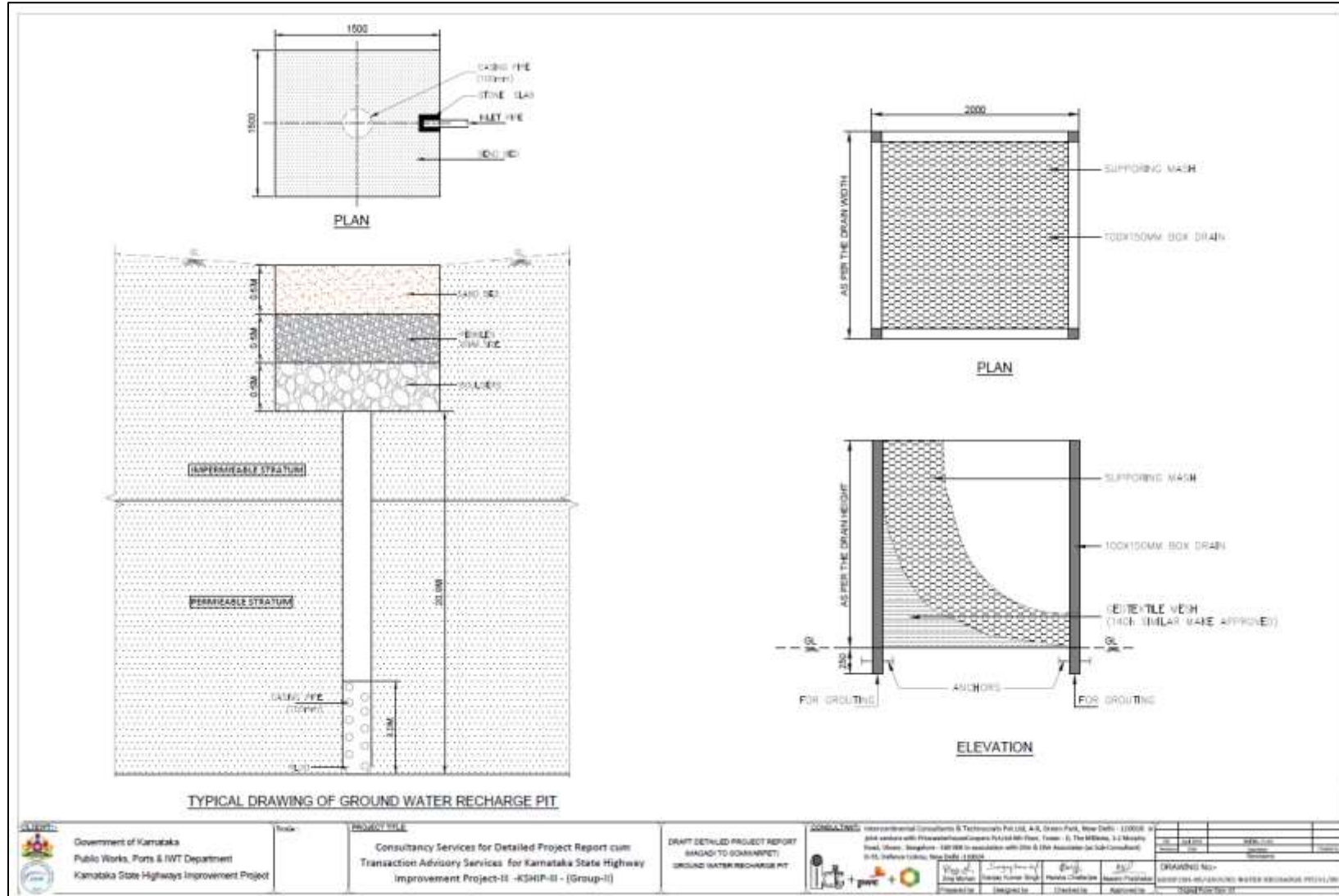
Consulting Services for Preparation of Detailed Project Report cum Transaction Advisory Services for Karnataka State Highway Improvement Project-III -KSHIP-III - (Group-II)

CONSULTANT



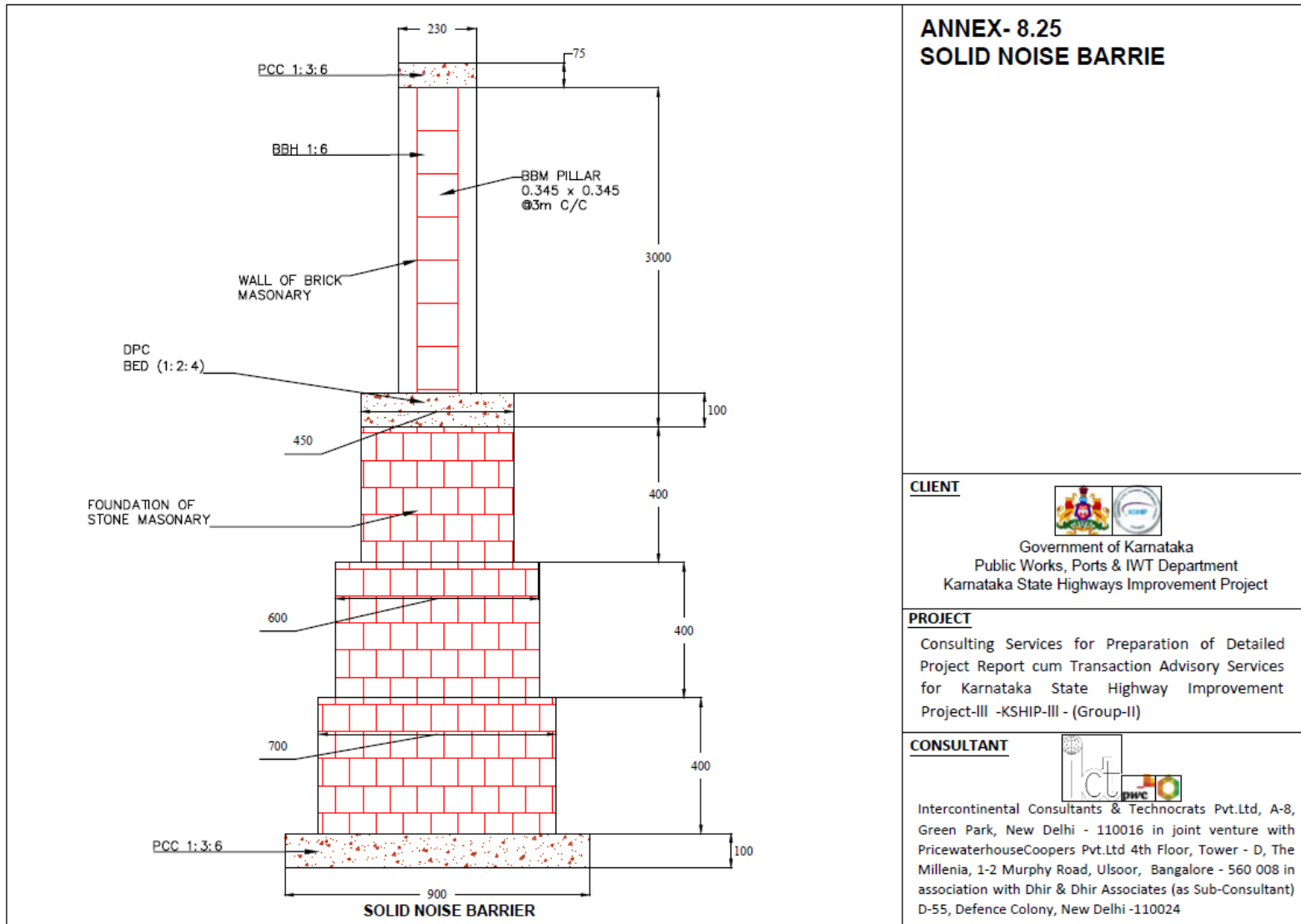
Intercontinental Consultants & Technocrats Pvt.Ltd, A-8, Green Park, New Delhi - 110016 in joint venture with PricewaterhouseCoopers Pvt.Ltd 4th Floor, Tower - D, The Millenia, 1-2 Murphy Road, Ulsoor, Bangalore - 560 008 in association with Dhir & Dhir Associates (as Sub-Consultant) D-55, Defence Colony,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

ANNEX 8.24 DRAWING OF GROUND WATER RECHARGE PIT



	<p>Government of Karnataka Public Works, Ports & IWT Department Karnataka State Highways Improvement Project</p>	<p>PROJECT TITLE Consultancy Services for Detailed Project Report cum Transaction Advisory Services for Karnataka State Highway Improvement Project-II -KSHIP-II - (Group-II)</p>	<p>DRAFT DETAILED PROJECT REPORT BAGADU TO GOMMANPETI GROUND WATER RECHARGE PIT</p>	<p>CONSULTANTS Environmental Consultants & Technocrats Pvt Ltd, A-16, Green Park, New Delhi - 110016 Joint venture with Waterways Consultants Pvt Ltd 4th Floor, Tower - 5, The Meadows, 3-2 Mysore Road, Shree, Bangalore - 560 066 in association with 20th & 15th Associates (as Sub-Consultant) B-15, Indira Colony, New Delhi-110008</p> <p>Project Mgr. Zing Wilson</p> <p>Project Engineer Srinivas Kumar Singh</p> <p>Project Designer Pranav Chatterjee</p> <p>Project Checker Ajay Prasad</p> <p>Project Approver Ajay Prasad</p>	<table border="1"> <tr> <td>NO.</td> <td>DATE</td> <td>BY</td> <td>REVISION</td> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </table> <p>DRAWING No- GWRP/194-RECHARGING WATER RECHARGE PIT-I/II/III 2024/05/01/27</p>	NO.	DATE	BY	REVISION				
NO.	DATE	BY	REVISION										

ANNEX 8.25 DRAWING OF TYPICAL SOLID 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-REMEDICATION OF POLLUTED WATER USING NULAGI

A) Phyco - Remediation

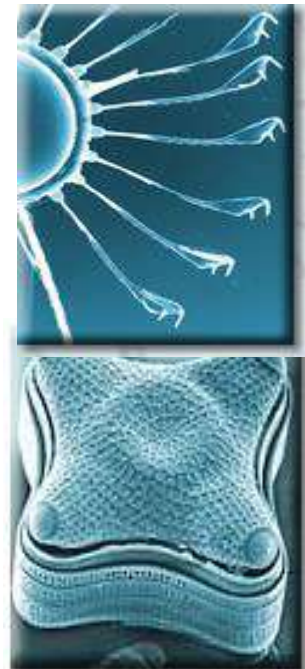
1. Phyco- remediation is the use of algae to remediate polluted waters. Among all the algae, diatoms are the most prolific photosynthesizers because of their silica shells, which are translucent. This helps the diatoms to photosynthesize even in low light conditions. In that sense they outcompete cyanobacteria 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.

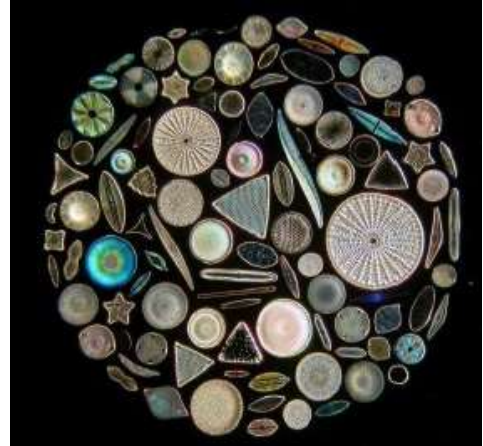
3. Diatoms are a widespread, diverse group of microalgae found in all aquatic systems. They represent a major component at the base of the marine food web, responsible for up to 50% of total oceanic primary production (*Mann, 1999*) and 25% of all Oxygen produced on the planet. In fact, without their 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.

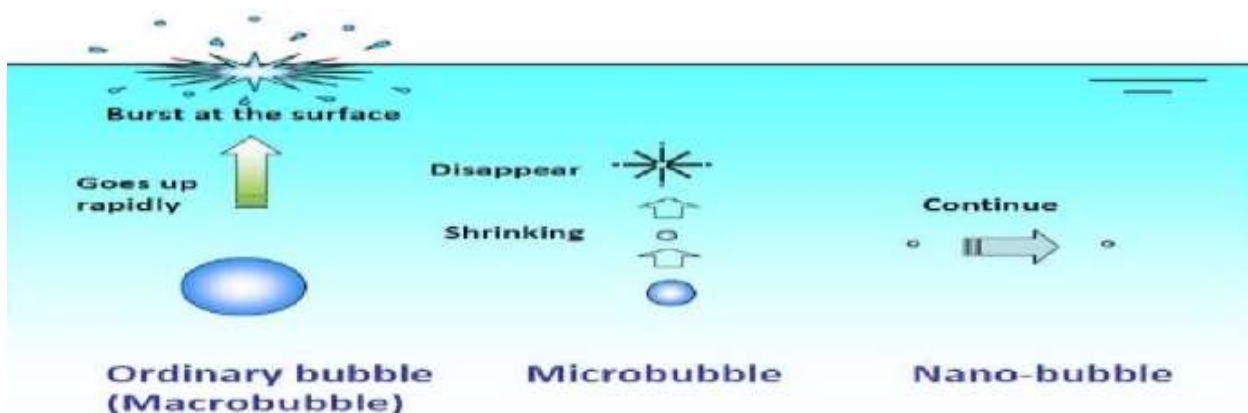
9. During photosynthesis, diatoms consume Nitrates and Phosphorous, as also uses up CO₂ from the atmosphere. In the process, they release oxygen (pure oxygen in water) to almost saturation levels, which will help the water body regain its original levels of Dissolved Oxygen. The absorption of CO₂ will 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.

Dosing & Dosage:

- 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	<ul style="list-style-type: none"> ▪ 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 a healthy manner in ponds and lakes dosed with NUALGI

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 classified 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.

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.

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

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

15. 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

Viraj Clean Sea Enterprises (P) Ltd.

D-440, 2nd floor, Vashi Plaza, Sector-17, Navi Mumbai - 400 703, Maharashtra

Telephone: 022 2765 7811

Website: www.virajces.com

Contact Person:

Ms. Supriya Varadhan, Business Development Manager, Mobile: +91 9920322351

Mr. Subodh Kumar, In-charge (North India), Mobile: +91 9999130073

16. **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

17. **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.

18. **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

19. **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.

20. **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.

21. **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

22. **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
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

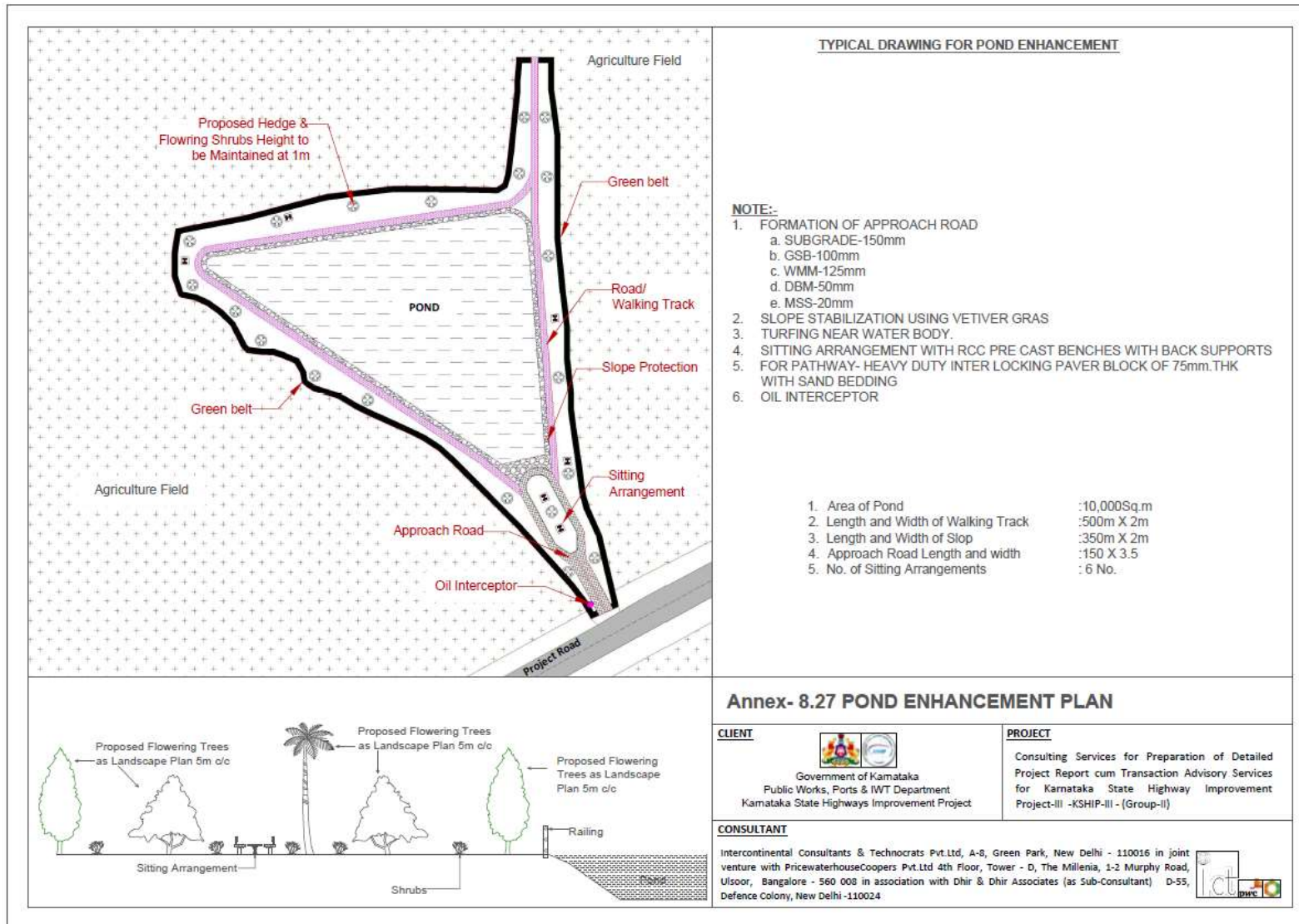
23. **Conclusions:** The treatment using NUALGI has shown very significant effect on reducing BGA contamination and also resulted in resurrecting biological activity. It has also shown a positive effect on improving the water quality by reducing nutrient levels, increased DO and controlling foul odour. 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





ANNEX 8.27 POND ENHANCEMENT PLAN




TYPICAL DRAWING FOR POND ENHANCEMENT

NOTE:-

1. FORMATION OF APPROACH ROAD
 - a. SUBGRADE-150mm
 - b. GSB-100mm
 - c. WMM-125mm
 - d. DBM-50mm
 - e. MSS-20mm
2. SLOPE STABILIZATION USING VETIVER GRAS
3. TURFING NEAR WATER BODY.
4. SITTING ARRANGEMENT WITH RCC PRE-CAST BENCHES WITH BACK SUPPORTS
5. FOR PATHWAY- HEAVY DUTY INTER LOCKING PAVER BLOCK OF 75mm.THK WITH SAND BEDDING
6. OIL INTERCEPTOR

1. Area of Pond	:10,000Sq.m
2. Length and Width of Walking Track	:500m X 2m
3. Length and Width of Slope	:350m X 2m
4. Approach Road Length and width	:150 X 3.5
5. No. of Sitting Arrangements	: 6 No.

Annex- 8.27 POND ENHANCEMENT PLAN

CLIENT	 Government of Karnataka Public Works, Ports & IWT Department Kamataka State Highways Improvement Project	PROJECT	Consulting Services for Preparation of Detailed Project Report cum Transaction Advisory Services for Kamataka State Highway Improvement Project-III -KSHIP-III - (Group-II)
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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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