
Annexure 10.1: Environmental Monitoring Plan

10.1 Monitoring Parameters and Standards

The Environmental monitoring of the parameters involved and the threshold limits specified are discussed below:

10.1.1 Ambient Air Quality Monitoring (AAQM)

The air quality parameters viz: Sulphur Dioxide (SO₂), Oxides of Nitrogen (NO_x), Carbon Monoxide (CO), Hydro-Carbons (HC), Suspended Particulate Matter (SPM) and Respirable Particulate Matter (RPM) shall be regularly monitored at identified locations from the start of the construction activity. The air quality parameters shall be monitored in accordance with the National Ambient Air Quality Standards as given in Table 1. The location, duration and the pollution parameters to be monitored and the responsible institutional arrangements are detailed in the Environmental Monitoring Plan Table 5.

Table 1: National Ambient Air Quality Standards

Pollutants	Time-weighted average	Concentration in Ambient Air		
		Industrial Areas	Residential, Rural & other Areas	Sensitive Areas
Sulphur Dioxide (SO ₂)	Annual Average*	80 µg/m ³	60 µg/m ³	15 µg/m ³
	24 hours**	120 µg/m ³	80 µg/m ³	30 µg/m ³
Oxides of Nitrogen as (NO ₂)	Annual Average*	80 µg/m ³	60 µg/m ³	15 µg/m ³
	24 hours**	120 µg/m ³	80 µg/m ³	30 µg/m ³
Suspended Particulate Matter (SPM)	Annual Average*	360 µg/m ³	140 µg/m ³	70 µg/m ³
	24 hours**	500 µg/m ³	200 µg/m ³	100 µg/m ³
Respirable Particulate Matter (RPM) (size less than 10 microns)	Annual Average*	120 µg/m ³	60 µg/m ³	50 µg/m ³
	24 hours**	150 µg/m ³	100 µg/m ³	75 µg/m ³
Lead (Pb)	Annual Average*	1.0 µg/m ³	0.75 µg/m ³	0.50 µg/m ³
	24 hours**	1.5 µg/m ³	1.00 µg/m ³	0.75 µg/m ³
Ammonia	Annual Average*	0.1 mg/ m ³	0.1 mg/ m ³	0.1 mg/m ³
	24 hours**	0.4 mg/ m ³	0.4 mg/m ³	0.4 mg/m ³
Carbon Monoxide (CO)	8 hours**	5.0 mg/m ³	2.0 mg/m ³	1.0 mg/ m ³

Pollutants	Time-weighted average	Concentration in Ambient Air		
		Industrial Areas	Residential, Rural & other Areas	Sensitive Areas
	1 hour	10.0 mg/m ³	4.0 mg/m ³	2.0 mg/m ³

* Annual Arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval.

** 24 hourly/8 hourly values should be met 98% of the time in a year. However, 2% of the time, it may exceed but not on two consecutive days.

Source: Central Pollution Control Board

10.1.2 Noise Quality Monitoring

The noise levels shall be monitored at already designated locations in accordance with the Ambient Noise Quality standards given in Table 2 below. The location, duration and the noise pollution parameters to be monitored and the responsible institutional arrangements are detailed in the Environmental Monitoring Plan Table 5.

Table 2: National Ambient Noise Quality Standards

Category of Area / Zone	Limits in dB(A) Leq	
	Day Time	Night Time
Industrial area	75	70
Commercial area	65	55
Residential area	55	45

Silence Zone	50	40
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Note: (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 an area comprising not less than 100 metres around hospitals, educational institutions, courts, religious places or any other area which is 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.

10.1.3 Water Quality Monitoring

Water quality parameters such as pH, BOD, COD, DO, coliform count, total suspended solids, total dissolved solids, Iron, Fluorides etc. shall be monitored at all identified locations during the construction stage as per standards prescribed by Central Pollution Control Board and Indian Standard Drinking water specifications IS 10500, 1991, presented in Table 3 & 4 respectively. The location, duration and the pollution parameters to be monitored and the responsible institutional arrangements are detailed out in the Environmental Monitoring Plan 5.

Table 3: Primary Water Quality Standards

S. No.	Designated Best Use	Class of Water	Criteria
1	Drinking Water source (with conventional treatment)	A	<ul style="list-style-type: none"> ① Total Coliform MPN/100 ml shall be 50 or less ① pH between 6.5 to 8.5 ① Dissolved Oxygen 6 mg / 1 or more ① Biochemical Oxygen demand (BOD) 5 days 200C 2 mg/1 or less
2	Outdoor bathing (organised)	B	<ul style="list-style-type: none"> ① Total Coliform MPN/100 ml shall be 500 or less ① pH between 6.5 to 8.5 ① Dissolved Oxygen 5 mg / 1 or more ① Biochemical Oxygen demand (BOD) 5 days 200C 3 mg/1 or less
3	Drinking Water source (without conventional treatment)	C	<ul style="list-style-type: none"> ① Total Coliform MPN/100 ml shall be 5000 or less ① pH between 6 to 9 ① Dissolved Oxygen 4 mg / 1 or more ① Biochemical Oxygen demand (BOD) 5 days 200C 3 mg/1 or less
4	Propagation of Wildlife	D	<ul style="list-style-type: none"> ① pH between 6.5 to 8.5 for fisheries ① Dissolved Oxygen 4 mg / 1 or more ① Free Ammonia (as N) 1.2 mg/1 or less

S. No.	Designated Best Use	Class of Water	Criteria
5	Irrigation, Industrial Cooling, Controlled Waste	E	⌚ pH between 6.0 to 8.5 ⌚ Electrical Conductivity at 250C μ mhos/cm Max. 2250 ⌚ Sodium absorption rations Max. 26 ⌚ Boron, Max.2 mg/1

Ref: CPCB (1999). Bio mapping of rivers, Parivesh New Letter, 5 (iv), Central Pollution Control Board, Delhi, PP.20.

Table 4: Indian Standard Drinking Water Specifications: IS 10500: 1994

S. No.	Substance / Characteristics	Requirement (desirable limit)	Undesirable effect outside the desirable limit	Permissible limit in the absence of alternate source	Methods of Test (ref. To IS)	Remarks
Essential Characteristics						
1	Colour, Hazen Units, Max.	5	Above 5, consumer acceptance decreases	25	3025 (part4) 1983	Extended to 25 only if toxic substances, in absence of alternate sources.
2	Odour	Unobjectionable	-	-	3025 (parts 5): 1984	A test cold and when heated. Test at several dilution
3	Taste	Agreeable	-	-	3025 (part 8): 1984	Test to be conducted only after safety has been established
4	Turbidity NTU, Max.	5	Above 5, consumer acceptance decreases	10	3025 (part 7): 1984	
5	PH value	6.5 to 8.5	Beyond this range the water will not effect the mucous membrane and /or water supply system	No relaxation	3025 (part 11): 1984	
6	Total hardness (as CaCo3) mg/1, Max.	300	Encrustation in water supply structures an adverse effect on domestic use	600	3025 (part 21): 1983	
7	Iron (as Fe) mg /l Max.	0.3	Beyond this limit taste/appearance are affected has adverse effect on domestic uses and water supply structures and promotes iron bacteria	1	3025 (part 21): 1983	
8	Chlorides (as Cl) mg/1 Max.	250	Beyond this limit, taste corrosion and palatability are affected	1000	3025 (part 32): 1988	
9	Residual, free chloride, mg/1 Min.	0.2			3025 (part 26): 1986	To be applicable only when water is chlorinated. Tested at consumer end. When protection against viral infection is required, it should be Min. 0.5 mg/1
Desirable characteristics						
1	Dissolved solids mg/1 Max.	500	Beyond the palatability decreases and may cause gastro intestinal irritation	2000	3025 (part 16): 1986	
2	Calcium (as Ca) mg/1 Max.	75	Encrustation in water supply structure and adverse effects on domestic use	200	3025 (Part 16) 1986	
3	Magnesium (as Mg) mg/1, Max.	30	Encrustation in water supply structure and adverse effects on domestic use	1.5	16,33,34 of IS 3025: 1964	
4	Copper (as Cu) mg/1 Max.	0.05	Beyond taste, discoloration of pipes, fitting and utensils will be caused beyond this	0.3	35 of 3025: 1964	
5	Manganese (as Mn) mg/1, Max.		Beyond this limit taste/appearance are affected, has adverse effect on domestic uses and water supply structures.	0.3	35 of 3025: 1964	

S. No.	Substance / Characteristics	Requirement (desirable limit)	Undesirable effect outside the desirable limit	Permissible limit in the absence of alternate source	Methods of Test (ref. To IS)	Remarks
6	Sulphate (as 200 So ₂), mg/1, Max.	200	Beyond this causes gastro intestinal irritation when magnesium or sodium are present	400	3025(part 24): 1986	May be extended up to 400 provided (as Mg) does not exceed 30
7	Nitrate (as No ₂) mg/l, Max.	45	Beyond this methaemoglobinemia take place	100	3025 (part24): 1988	To be tested when pollution is suspected
8	Fluoride (as F) mg/1, Max.	1	Fluoride may be kept as low as possible. High fluoride may cause fluorosis	1.5	23 of 3025:1964	To be tested when pollution is suspected
9	Phenolic compounds (as C ₆ H ₅ OH) mg/1, Max.	0.001	Beyond this it may cause objectionable taste and odour	0.002	54 of 3025:1964	To be tested when pollution is suspected
10	Mercury (as Hg) mg/1, Max.	0.001	Beyond this the water becomes toxic	No relaxation	(See not mercury ion analyses)	To be tested when pollution is suspected
11	Cadmium (as cd), mg/1, Max.	0.01	Beyond this the water becomes toxic	No relaxation	(See note)	To be tested when pollution is suspected
12	Selenium, (as Se). mg/1, Max.	0.01	Beyond this the water becomes toxic	No relaxation	28 of 3025:1964	To be tested when pollution is suspected
13	Arsenic (As) mg/1, Max.	0.05	Beyond this the water becomes toxic	No relaxation	3025 (part 37); 1988	To be tested when pollution is suspected
14	Cyanide (as CN) mg/1, Max.	0.05	Beyond this the water becomes toxic	No relaxation	3025 (part 27) 1988	To be tested when pollution is suspected
15	Lead (as Pb), mg/1, Max.	0.05	Beyond this the water becomes toxic	No relaxation	(See note)	To be tested when pollution is suspected
16	Zinc (as Zn) mg/1, Max.	5	Beyond this limit it can cause astringent taste and an opalescence taste and an opalescence in water	15	39 of 3025:1964	To be tested when pollution is suspected
17	Anionic detergents (as MBAS) mg/1, Max.	0.2	Beyond this it can cause a light froth in water	1	Methylene-blue extraction method	To be tested when pollution is suspected
18	Chromium (as Cr ₆ ⁺) mg/1, Max.	0.05	May be carcinogenic above this limit	No relaxation	38 of 3025:1964	To be tested when pollution is suspected
19	Poly nuclear aromatic hydro carbons (as PAH) mg/1, Max.	-	May be carcinogenic above this limit	-	-	-
20	Mineral oil mg/1, Max.	0.01	Beyond this limit undesirable taste and odour after chlorination take place.	0.03	Gas Chromatography method	-
21	Pesticides mg/1, Max.	Absent	Toxic	0.001	-	-
22	Radioactive material	-	-	-	58 of 3025:1964	-
23	Alpha emitters bq/1, Max.	-	-	0.1	-	-
24	Beta emitter pci/1, Max.	-	-	1	-	-
25	Aluminium (as Al) mg/1, Max.	200	Beyond this limit taste becomes unpleasant	600	13 of 3025:1964	-
26	Aluminium (as Al) mg/1, Max.	0.03	Cumulate effect is reported to cause dementia	0.2	31 of 3025:1964	-

S. No.	Substance / Characteristics	Requirement (desirable limit)	Undesirable effect outside the desirable limit	Permissible limit in the absence of alternate source	Methods of Test (ref. To IS)	Remarks
27	Boron mg/1, Max.	1	-	5	29 of 3029:1964	-

Source: Indian Standard Drinking Water Specification – IS 10500, 1994

10.2 Environmental Monitoring Plan

The environmental monitoring plan is given below in table 5.

Table 5: Environmental Monitoring Plan

Environmental Component	Project Stage	Monitoring						Institutional Responsibility	
		Parameters	Special Guidance	Standards	Location	Frequency	Duration	Implementation	Supervision
Air	Construction Stage	SPM, RSPM, SO ₂ , NO _x , CO, HC, Fugitive emissions from Hot mix plants	High volume sampler to be located 50 m from the plant in the downwind direction. Use method specified by CPCB for analysis	Air (Prevention and Control of Pollution) Rules, CPCB, 1994	Hot mix Plant / Batching Plant, Quarry sites	Three seasons annually for three years	Continuous 24 hours / or for 1 full working day	Contractor through approved monitoring agency	Engineer, APRDC
	Construction Stage	SPM, RSPM	High volume Sampler to be located 40 m from the earthworks site downwind direction. Use method specified by CPCB for analysis	Air (Prevention and Control of Pollution) Rules, CPCB, 1994	Stretch of the road where construction is in progress near settlement / habitation area	Moves with progress of construction during the three years	Continuous 24 hours/or for 1 full working day	Contractor through approved monitoring agency	Engineer, APRDC
Water Quality	Construction Stage	pH, TSS, TDS, Turbidity, Cl, Hardness, Coliform, Fe, Fluorides BOD, COD, Oil & Grease and (initially) NO ₃ ,	Grab sample collected from source and analyse as per Standard Methods for Examination of Water and Wastewater	Water quality standards by CPCB	At locations identified by the engineer	End of summer / before the onset of monsoon every year for 3 years	-	Contractor through approved monitoring agency	Engineer, APRDC
	Operation Stage	pH, TSS, TDS, Turbidity, Oil & Grease Cl, Hardness, Coliform, Fe, Fluorides BOD, COD	Grab sample collected from source and analyse as per Standard Methods for Examination of Water and Wastewater	Water quality standards by CPCB	At locations identified by the engineer	End of summer / before the onset of monsoon in the first three alternate years	-	APRDC	APRDC

Environmental Component	Project Stage	Monitoring						Institutional Responsibility	
		Parameters	Special Guidance	Standards	Location	Frequency	Duration	Implementation	Supervision
Noise Levels	Construction Stage	Noise levels on dB (A) scale	Free field at 1 m from the equipment whose noise levels are being determined.	Noise standards by CPCB	At construction yards	As required by the Engineer	Readings to be taken at 15 seconds interval for 15 minutes every hour and then averaged	Contractor through approved monitoring agency	Engineer, APRDC
		Noise levels on dB (A) scale	Equivalent Noise levels using an integrated noise level meter kept at a distance of 15 m from edge of Pavement within settlements	Noise standards by CPCB	As directed by the Engineer (At maximum 12 locations)	Thrice a year for 3 years during the construction period	Readings to be taken at 15 seconds interval for 15 minutes every hour and then averaged.	Contractor through approved monitoring agency	Engineer, APRDC
Soil Erosion	Construction Stage	Turbidity in Storm Water Silt load in water courses		Water quality standards	At locations identified by the engineer	Pre-monsoon and post-monsoon seasons for 3 years		Supervision Consultant	APRDC
Construction Sites and Construction Camps	Construction Stage	Monitoring of: Storage Area Drainage arrangements Sanitation in Construction Camps	The parameters mentioned are further elaborated in the reporting formats. These are to be checked for adequacy.	To the satisfaction of the APRDC and the standards given in the reporting form.	As storage area and construction camps	Quarterly in the construction stage		Engineer	APRDC