Action Plan for Industrial Cluster in Severely Polluted Areas

Monitoring, sampling, analysis of Stack, Ambient Air Quality, Surface Water, Ground Water, Waste Water

पिंपरी-चिंचवाड़ Pimpri-Chinchwad

Maharashtra Pollution Control Board

महाराष्ट्र प्रदूषण नियंत्रण मंडळ

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We also thank our sampling team members for conducting the sampling in this vast area.

Abbreviations:

APHA	American Public Health Association
BDL	Below Detection Limit
BOD	Biochemical Oxygen Demand
CEPI	Comprehensive Environmental Pollution Index
CETP	Common Effluent Treatment Plant
COD	Chemical Oxygen Demand
CPA	Critically Polluted Areas
SPA	Severely Polluted Areas
DO	Dissolved Oxygen
ETP	Effluent Treatment Plant
MIBK	Methyl Isobutyl Ketone
MPCB	Maharashtra Pollution Control Board
NAAQS	National Ambient Air Quality Standards
NO_x	Oxides of Nitrogen
ND	Not Detected
PAH	Poly Aromatic Hydrocarbons
PCB	Poly Chlorinated Biphenyls
PCT	Poly Chlorinated Terphenyls
PM_{10}	Particulate Matter (size less than 10 µm)
$PM_{2.5}$	Particulate Matter (size less than 2.5 µm)
SO_2	Sulphur Dioxide
STAP	Short Term Action Plan
WHO	World Health Organization

1. Introduction:

Although industries contribute significantly to India's economic growth and development, the increase in pollution of land, water, air, noise and resulting degradation of environment that they have caused, cannot be overlooked. Industries are responsible for four types of pollution: a) Air b) water c) land d) noise. Rapid industrialization carries with it the seeds of environmental damage. Pollution of natural environment not only affects people but also have adverse impact on economic growth in the long run. Analysis of pollution load shows that there are few industries in the country which contribute to more than 90percent of the pollution. Hence, scientists are exploring the quantum of pollution load as well as to device certain strategies and technologies so that our sustainable development would not be jeopardized otherwise our long cherished dream of establishing eco-socialism on this watery planet could not come true.

Industrial pollution takes on many faces. It contaminates many sources of drinking water, releases unwanted toxins into the air and reduces the quality of soil all over the world. Every litre of waste water discharged by our industries pollute eight times the quantity of fresh water. The extent of pollution varies with the size of the industry, the nature of the industry, the type of products used and produced etc. In view of this, Central Pollution Control Board (CPCB) has evolved the concept of Comprehensive Environmental Pollution Index (CEPI) during 2009-10 as a tool for comprehensive environmental assessment of prominent industrial clusters and formulation of remedial Action Plans for the identified critically polluted areas. Later-on proposals were received from the SPCBs, State Governments, and Industrial Associations and concerned Stakeholders for revisiting the criteria of assessment under CEPI concept. After careful examination and consideration of the suggestions of concerned stake-holders, it was decided to prepare the revised concept of CEPI by eliminating the subjective factors but retaining the factors which can be measured precisely. Hence, revised concept came into existence, which is termed as Revised CEPI Version 2016.

The present report is also based on the revised CEPI version 2016. The results of the application of the Comprehensive Environmental Pollution Index (CEPI) to selected industrial clusters or areas are presented in this report. The main objective of the study is to identify polluted industrial clusters or areas in order to take concerted action and to centrally monitor them at the national level to improve the current status of their environmental components such as air and water quality data, ecological damage, and visual environmental conditions. A total of 88 industrial areas or clusters have been selected by the Central Pollution Control Board (CPCB) in consultation with the Ministry of Environment & Forests Government of India for the study. The index captures the various dimensions of environment including air, water and land. Comprehensive Environmental Pollution Index (CEPI), which is a rational number to characterize the environmental quality at a given location following the algorithm of source, pathway and receptor have been developed.

Pimpri-Chinchwad is part of Pune Metropolitan City in the state of Maharashtra, India. Pimpri-Chinchwad today is one of the major industrial hubs in Asia. Industrialization started in 1954 with the arrival of Hindustan Antibiotics Limited. PCMC is now home to the Indian operations of major automobile companies like Premier Limited, Mahindra & Mahindra Ltd., Mahindra Engineering services, Bajaj Auto, BEL Optronic Devices Limited, TATA Motors (formerly TELCO), Kinetic Engineering, Force Motors (formerly Bajaj Tempo) Daimler Chrysler, Thermax and Autoline Industries. In addition to this, several heavy industries such as Forbes-Marshall, ThyssenKrupp and GEA Ecoflex, Alfa Laval & Sandvik Asia have their manufacturing units in the town and also the German company KSB Pumps, Swedish bearing company SKF.

2. Scope of Work

The Scope of Work consisted of the following:

Monitoring, Sampling, Analysis for Stack, Ambient Air Quality, Surface Water, Waste Water, and Ground Water Quality for identified five Critically Polluted areas (CPAs) in Maharashtra i.e. **Chandrapur, Dombivli, Aurangabad, Navi Mumbai,** and **Tarapur** and 3 Severely Polluted areas (SPAs) in Maharashtra i.e. **Chembur, Pimpri-Chinchwad and Nashik** as per standard methods.

- At each of the 5 CPAs and 3 SPAs, 24 hourly ambient air quality monitoring to be carried out.

- Representative samples for surface water quality, waste water quality and ground water quality to be collected from prominent surface and ground water bodies located in and around the clusters/areas.

- Submission of complete monitoring, sampling and analysis reports including the summary of the parameters exceeding the prescribed standards/norms for all the 5 CPAs and 3 SPAs.

- Submission of 3 copies of final report with photographs at prominent locations and the CD (soft copy) on completion of the project for every critically polluted and severely polluted area separately.

Monitoring, Sampling, Analysis for Stack, Ambient Air Quality, Surface Water, Waste Water and Ground Water Quality for Pimpri-Chinchwad:

- The sampling was carried out in 6 days i.e. on 2nd to & 8th January 2019 for Pimpri-Chinchwad region.

- A total of 6 Stack Monitoring Samples, 6 Ambient Air Quality Monitoring Samples, 6 Waste Water Samples, 6 Ground Water Samples and 2 VOC Samples from Stack were collected and analysed.

2.1 Stack Emission Parameters

The Stack Emissions were analysed with the following parameters:

1. Acid Mist
2. Ammonia
3. Carbon Monoxide
4. Chlorine
5. Fluoride(gaseous)
6. Fluoride (particulate)
7. Hydrogen Chloride
8. Hydrogen Sulphide
9. Oxides of Nitrogen
10. Oxygen
11. Polyaromatic Hydrocarbons (Particulate)

12. Suspended Particulate Matter
13. Sulphur Dioxide
14. Benzene
15. Toluene
16. Xylene
17. Volatile Organic Compounds (VOCs)

2.2 Ambient Air Quality Parameters

The Ambient Air Quality was analyzed with the following parameters:

1. Sulphur Dioxide (SO_2)
2. Nitrogen Dioxide (NO_2)
3. Particulate Matter (PM10)
4. Particulate Matter (PM2.5)
5. Ozone (O_3)
6. Lead (Pb)
7. Carbon Monoxide (CO)
8. Ammonia (NH_3)
9. Benzene (C_6H_6)
10. Benzo (a) Pyrene (BaP) (Particulate Phase Only)
11. Arsenic (As)
12. Nickel (Ni)

2.3 Water/Waste Water Parameters

The Water/Waste Water was analyzed with the following parameters:

a. Prominent Surface Water bodies such as outfalls of CETPs, ETPs, treated effluent drainage, river, canal, ponds, lakes and other such water supply resources flowing through the area or flowing adjoining the CPA.

b. Ground Water Quality data of prominent ground water resources such as observation wells of Central Ground Water Board, drinking water wells, hand pumps, bore wells, hand pumps, bore wells and other such water supply resources located in the industrial cluster/area under consideration or in the peripheral areas.

Basic water quality parameters for surface water and ground water both are as follows:

i. Simple Parameters:

1. Sanitary Survey
2. General Appearance
3. Colour
4. Smell
5. Transparency
6. Ecological(Presence of animals like fish, insects) (Applicable to only surface water)

ii. Regular Monitoring Parameters:

7. pH
8. Oil & Grease
9. Suspended Solids
10. Dissolved Oxygen (% saturation) (Not applicable for ground waters)
11. Chemical Oxygen Demand
12. Biochemical Oxygen Demand
13. Electrical Conductivity
14. Nitrite-Nitrogen
15. Nitrate-Nitrogen
16. (NO_2 + NO_3)-Nitrogen
17. Free Ammonia
18. Total Residual Chlorine
19. Cyanide
20. Fluoride
21. Sulphide
22. Dissolved Phosphate
23. Sodium Absorption Ratio (SAR)
24. Total Coliforms (MPN/100 ml)
25. Faecal Coliforms (MPN/100 ml)

iii. Special Parameters:

26. Total Phosphorous
27. Total Kjeldahl Nitrogen(TKN)
28. Total Ammonia (NH_4 +NH_3)-Nitrogen
29. Phenols
30. Surface Active Agents
31. Organo Chlorine Pesticides
32. Polynuclear aromatic hydrocarbons (PAH)
33. Polychlorinated Biphenyls (PCB)and Polychlorinated Terphenyls (PCT)
34. Zinc
35. Nickel
36. Copper
37. Hexavalent Chromium
38. Chromium (Total)
39. Arsenic (Total)
40. Lead
41. Cadmium
42. Mercury
43. Manganese
44. Iron
45. Vanadium

46. Selenium

47. Boron

iv. Bioassay (Zebra Fish) Test: For specified samples only.

2.3 Methodology followed in Sampling and Analysis

Industries, places and locations that have been chosen for the sampling are representative of the city/area. Sampling has been done at the potential polluted areas so as to arrive at the CEPI. This will further help the authorities to monitor the areas in order to improve the current status of their environmental components such as air and water quality data, ecological damage and visual environmental conditions. Methodology for sampling, preservation and analysis have been done according to the references incorporated. Methodology of various types of parameters is presented under following annexure:

1. Stack Emission Sampling and Analysis Methodology – **Annexure I**
2. Ambient Air Sampling and Analysis Methodology **- Annexure II**
3. Water/Wastewater Sampling and Analysis Methodology - **Annexure III**

3. Result of Analysis:

Results of Analysis are tabulated below for Stack Emission Monitoring, Ambient Air Quality Monitoring, Waste Water Analysis and Water Analysis. These are followed by their respective graphical representation.

***Kindly note:**

- NA specifies the sample is not analysed for the specific parameter.
- BDL specifies that the result obtained is below detection limit.

3.1 Stack Emission:

Stack Emission Monitoring Results are compared against The Environment (Protection) Rules, 1986 General Emission Standard - Part D.

Sr.	Name of Industry	Stack Identity	Table No.
1.	Tata Motors	Boiler	**I**
2.	Amhpehnol Interconnect	Stack 1	**I**
3.	Alfa Laval (I) Pvt. Ltd.	Plant Booth	**I**
4.	Atlas Castalloy Ltd.	Melting Furnace	**II**
5.	Exide Industries	Stack No. 5 Strip Caster & Casting	**II**
6.	Rich Graviss Products	Boiler	**II**

*** The VOC result of stack emission is provided in Table No. III**

Table No. I

Name of Industry			**Tata Motors**	**Amhpehnol Interconnect**	**Alfa Laval (I) Pvt. Ltd.**
Sr.	**Parameter**	**Unit**	**Results**		
1.	Particulate Matter (as PM)	mg/Nm^3	10.4	11	11
	Std. Limit	**mg/Nm^3**	**150**	**150**	**150**
2.	Sulphur Dioxide (as SO_2)	mg/Nm^3	BDL	BDL	BDL
		kg/day	BDL	BDL	BDL
	Std. Limit	**mg/Nm^3**			
3.	Nitrogen Dioxide (NO_2)	mg/Nm^3	11.7	11.8	BDL
	Std. Limit	**mg/Nm^3**	**50**	**50**	
4.	Acid Mist (as H_2SO_4)	mg/Nm^3	BDL	BDL	BDL
	Std. Limit	**mg/Nm^3**			

Table No. II

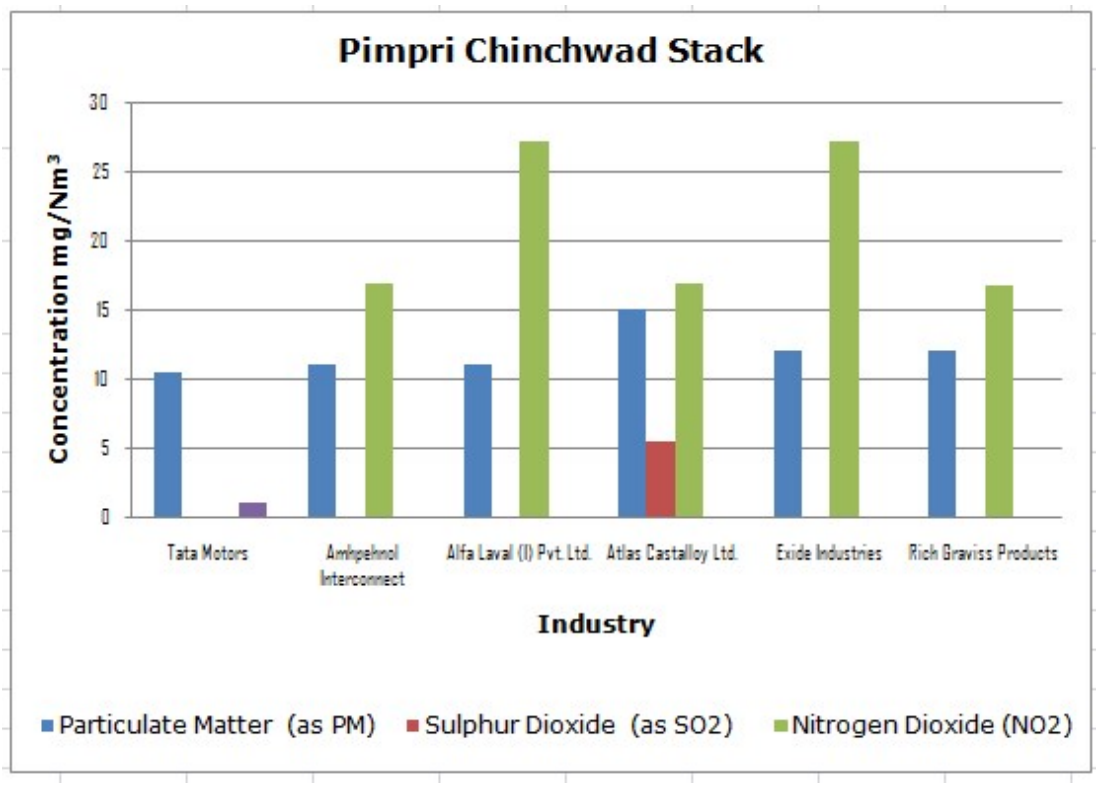
Name of Industry			**Atlas Castalloy Ltd.**	**Exide Industries**	**Rich Graviss Products**
Sr.	**Parameter**	**Unit**	**Results**		
1.	Particulate Matter (as PM)	mg/Nm^3	15	12	12
	Std. Limit	**mg/Nm^3**	**150**	**150**	**150**
2.	Sulphur Dioxide (as SO_2)	mg/Nm^3	5.42	BDL	BDL
		kg/day	0.917	BDL	BDL
	Std. Limit	**mg/Nm^3**	**100**		
3.	Nitrogen Dioxide (NO_2)	mg/Nm^3	19.9	15.6	15.9
	Std. Limit	**mg/Nm^3**	**50**	**50**	**50**
4.	Acid Mist (as H_2SO_4)	mg/Nm^3	BDL	BDL	BDL

Name of Industry			**Atlas Castalloy Ltd.**	**Exide Industries**	**Rich Graviss Products**
Sr.	**Parameter**	**Unit**	**Results**		
	Std. Limit	**mg/Nm^3**			

Table No. III

Name of Industry			**Atlas Castalloy Ltd.**	**Exide Industries**
Sr.	**Parameter**	**Unit**	**Results**	
1.	VOC			
I.	Methyl Isobutyl Ketone	mg/Nm^3	ND	ND
II.	Benzene	mg/Nm^3	ND	ND
III.	Toulene	mg/Nm^3	ND	ND
IV.	Xylene	mg/Nm^3	ND	ND
V.	Ethyl Benzene	mg/Nm^3	ND	ND
VI.	Ethyl Acetate	mg/Nm^3	ND	ND

Graphs: Stack Monitoring for Pimpri-Chinchwad:



3.2 Ambient Air Quality:

In order to arrive at conclusions, the Ambient Air Quality Monitoring Results are compared against National Ambient Air Quality Standards, 2009 (**Annexure IV**).

Sr.	Location	Location detail	Table No.
1.	Amphenol Interconnect India Pvt Ltd.	Near ETP	**I**
2.	Alfa Laval (I) Pvt. Ltd.	HSS factory	**I**
3.	Alicon Atlas Castalloy Ltd.	Near Main Gate	**I**
4.	Exide Industries Limited	Near Main Gate	**II**
5.	Rich Graviss Products Pvt Ltd.	Near Material Receiving Area	**II**
6.	Tata Motors	Near ETP	**II**

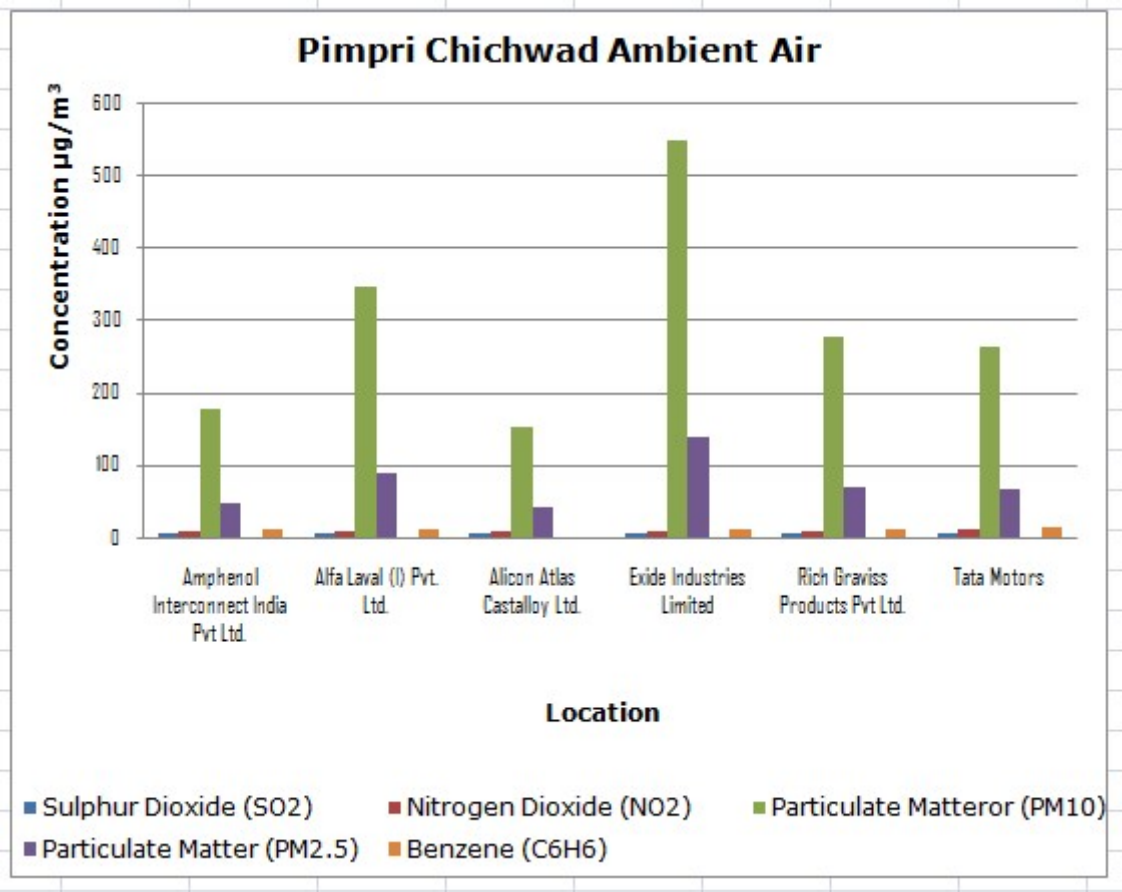
Table No. I

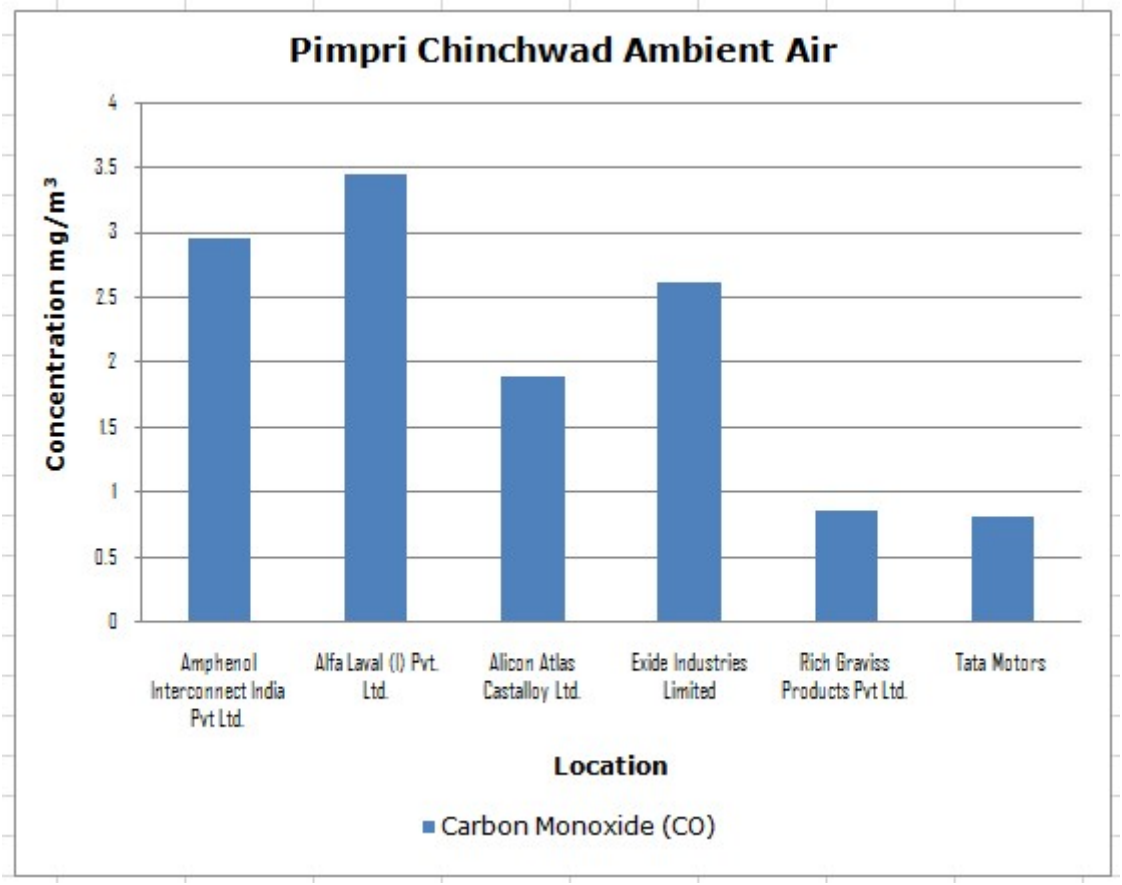
Location				**Amphenol Interconnect India Pvt Ltd.**	**Alfa Laval (I) Pvt. Ltd.**	**Alicon Atlas Castalloy Ltd.**
Sr.	**Parameters**	**Unit**	**Std. Limit (NAAQS 2009)**	**Results**		
1.	Sulphur Dioxide (SO_2)	$\mu g/m^3$	**80**	5.47	5.64	6.45
2.	Nitrogen Dioxide (NO_2)	$\mu g/m^3$	**80**	8.21	8.46	8.94
3.	Particulate Matter (size less than 10 µm) or PM_{10}	$\mu g/m^3$	**100**	177	345	152
4.	Particulate Matter (size less than 2.5 µm) or $PM_{2.5}$	$\mu g/m^3$	**60**	46	88	41
5.	Ozone (O_3)	$\mu g/m^3$	**180**	BDL	BDL	BDL
6.	Lead (Pb)	$\mu g/m^3$	**1**	BDL	BDL	BDL
7.	Carbon Monoxide (CO)	mg/m^3	**4**	2.95	3.44	1.9
8.	Ammonia (NH_3)	$\mu g/m^3$	**400**	BDL	BDL	BDL
9.	Benzene (C_6H_6)	$\mu g/m^3$	**5**	10.3	10.6	BDL
10.	Benzo (a) Pyrene (BaP) – particulate phase only	ng/m^3	**1**	BDL	BDL	BDL
11.	Arsenic (As)	ng/m^3	**6**	2.13	3.64	3.16
12.	Nickel (Ni)	ng/m^3	**20**	BDL	BDL	BDL

Table No. II

Location				**Exide Industries Limited**	**Rich Graviss Products Pvt Ltd.**	**Tata Motors**
Sr.	**Parameters**	**Unit**	**Std. Limit (NAAQS 2009)**	**Results**		
1.	Sulphur Dioxide (SO_2)	$\mu g/m^3$	**80**	6.05	6.51	6.45
2.	Nitrogen Dioxide (NO_2)	$\mu g/m^3$	**80**	8.69	9.43	9.92
3.	Particulate Matter (size less than 10 µm) or PM_{10}	$\mu g/m^3$	**100**	547	277	263
4.	Particulate Matter (size less than 2.5 µm) or $PM_{2.5}$	$\mu g/m^3$	**60**	138	70.2	66
5.	Ozone (O_3)	$\mu g/m^3$	**180**	BDL	BDL	BDL
6.	Lead (Pb)	$\mu g/m^3$	**1**	BDL	BDL	BDL
7.	Carbon Monoxide (CO)	mg/m^3	**4**	2.61	0.86	0.81
8.	Ammonia (NH_3)	$\mu g/m^3$	**400**	BDL	BDL	BDL
9.	Benzene (C_6H_6)	$\mu g/m^3$	**5**	9.77	10.4	14.1
10.	Benzo (a) Pyrene (BaP) – particulate phase only	ng/m^3	**1**	BDL	BDL	BDL
11.	Arsenic (As)	ng/m^3	**6**	BDL	BDL	BDL
12.	Nickel (Ni)	ng/m^3	**20**	BDL	BDL	BDL

Graphs: Ambient Air Quality Monitoring for Pimpri-Chinchwad:





3.3 Water/ Waste Water Quality:

Water Analysis Results are compared against CPCB document on criteria for Comprehensive Environmental Assessment of Industrial Clusters-Water Quality Parameters Requirement and Classification (Annexure VI), CPCB Water Quality Criteria (Annexure V) and Drinking Water Specification, IS 10500:2012 (Annexure IV), Wastewater Analysis Results are compared with General Standards for Discharge of Environmental Pollutants Part A: Effluents, The Environment (Protection) Rules, 1986, Schedule VI.

Sr.	Location	Source	Table No.
1.	Alfa Laval (India) Ltd.	STP Outlet	**I**
2.	Amphenol Intrconnect India Pvt Ltd.	STP Outlet	**I**
3.	Rich Gravis Product Pvt. Ltd.	STP Outlet	**I**
4.	Exide Industries Ltd.	STP Outlet	**II**
5.	Alicon Atlas Cast Alloy Ltd.	Combined Outlet	**II**
6.	Tata Motors Ltd.	STP Outlet	**II**

Table No. I

Location				**Alfa Laval (India) Ltd.**	**Amphenol Intrconnect India Pvt Ltd.**	**Rich Gravis Product Pvt. Ltd.**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
1.	Sanitary Survey			Reasonably clean neighbourhood	Reasonably clean neighbourhood	Reasonably clean neighbourhood
2.	Colour	Hazen		1	1	1
3.	Smell	-		Agreeable	Agreeable	Agreeable
4.	pH	-	**5.5 -9.0**	7.59	7.84	5.25
5.	Oil & Grease	mg/L	**10.0**	BDL	BDL	BDL
6.	Suspended Solids	mg/L	**100.0**	14	22	10
7.	Dissolved Oxygen (% Saturation)	%		63	53	44

Location				**Alfa Laval (India) Ltd.**	**Amphenol Intrconnect India Pvt Ltd.**	**Rich Gravis Product Pvt. Ltd.**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
8.	Chemical Oxygen Demand	mg/L	**250.0**	40	60	40
9.	Biochemical Oxygen Demand (3 days,27° C)	mg/L	**30.0**	14	20	13
10.	Electrical Conductivity (at 25° C)	µmho/cm		1168	4590	621
11.	Nitrite Nitrogen (as NO_2)	mg/L		BDL	0.05	BDL
12.	Nitrate Nitrogen (as NO_3)	mg/L	**10.0**	7.4	53.8	2.78
13.	(NO_2 + NO_3)-Nitrogen	mg/L	**5.0**	7.4	53.8	2.78
14.	Free Ammonia (as NH_3-N)	mg/L	**5.0**	BDL	BDL	BDL
15.	Total Residual Chlorine	mg/L	**1.0**	BDL	BDL	BDL
16.	Cyanide (as CN)	mg/L	**0.2**	BDL	BDL	BDL
17.	Fluoride (as F)	mg/L	**2.0**	0.1	1.04	1.3
18.	Sulphide (as S^{2-})	mg/L	**2.0**	BDL	BDL	BDL
19.	Dissolved Phosphate (as P)	mg/L	**5.0**	0.74	0.8	BDL
20.	Sodium Absorption Ratio	mg/L		0.58	BDL	0.34
21.	Total Coliforms	MPN index/ 100 ml	**100.0**	17	BDL	17

Location				**Alfa Laval (India) Ltd.**	**Amphenol Intrconnect India Pvt Ltd.**	**Rich Gravis Product Pvt. Ltd.**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
22.	Faecal Coliforms	MPN index/ 100 ml	**1000.0**	BDL	BDL	BDL
23.	Total Phosphorous (as P)	mg/L	**1.0**	2	1.8	BDL
24.	Total Kjeldahl Nitrogen (as TKN)	mg/L	**100.0**	7.50	61.6	2.13
25.	Total Ammonia (NH_4+NH_3)-Nitrogen	mg/L	**5.0**	BDL	0.56	BDL
26.	Phenols (as C_6H_5OH)	mg/L	**3.0**	BDL	BDL	BDL
27.	Surface Active Agents (as MBAS)	mg/L	**3.0**	BDL	BDL	BDL
28.	Organo Chlorine Pesticides					
I.	Alachlor	µg/L	**2.0**	BDL	BDL	BDL
II.	Atrazine	µg/L	**0.2**	BDL	BDL	BDL
III.	Aldrin	µg/L	**0.1**	BDL	BDL	BDL
IV.	Dieldrin	µg/L	**2.0**	BDL	BDL	BDL
V.	Alpha HCH	µg/L	**0.01**	BDL	BDL	BDL
VI.	Beta HCH	µg/L	**2.0**	BDL	BDL	BDL
VII.	Delta HCH	µg/L	**3.0**	BDL	BDL	BDL
VIII.	Butachlor	µg/L	**0.2**	BDL	BDL	BDL
IX.	p,p DDT	µg/L	**0.05**	BDL	BDL	BDL
X.	o,p DDT	µg/L	**100.0**	BDL	BDL	BDL
XI.	p,p DDE	µg/L	**250.0**	BDL	BDL	BDL

Location				**Alfa Laval (India) Ltd.**	**Amphenol Intrconnect India Pvt Ltd.**	**Rich Gravis Product Pvt. Ltd.**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
XII.	o,p DDE	µg/L	**30.0**	BDL	BDL	BDL
XIII.	p,p DDD	µg/L		BDL	BDL	BDL
XIV.	o,p DDD	µg/L		BDL	BDL	BDL
XV.	Alpha Endosulfan	µg/L	**10.0**	BDL	BDL	BDL
XVI.	Beta Endosulfan	µg/L		BDL	BDL	BDL
XVII.	Endosulfan Sulphate	µg/L	**5.0**	BDL	BDL	BDL
VIII.	Y HCH (Lindane)	µg/L	**1.0**	BDL	BDL	BDL
29.	Polynuclear aromatic hydrocarbons (as PAH)	mg/L	**0.2**	BDL	BDL	BDL
30.	Polychlorinated Biphenyls (PCB)	mg/L	**2.0**	BDL	BDL	BDL
31.	Zinc (as Zn)	mg/L	**5.0**	BDL	BDL	BDL
32.	Nickel (as Ni)	mg/L	**3.0**	6.57	6.55	BDL
33.	Copper (as Cu)	mg/L		0.299	0.286	BDL
34.	Hexavalent Chromium (as Cr^{6+})	mg/L	**0.1**	BDL	BDL	4.05
35.	Total Chromium (as Cr)	mg/L	**2.0**	BDL	BDL	0.040
36.	Total Arsenic (as As)	mg/L	**0.2**	BDL	BDL	BDL
37.	Lead (as Pb)	mg/L	**0.1**	BDL	BDL	BDL

Location				**Alfa Laval (India) Ltd.**	**Amphenol Intrconnect India Pvt Ltd.**	**Rich Gravis Product Pvt. Ltd.**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
38.	Cadmium (as Cd)	mg/L	**2.0**	1.39	1.39	BDL
39.	Mercury (as Hg)	mg/L	**0.01**	BDL	BDL	BDL
40.	Manganese (as Mn)	mg/L	**2.0**	0.112	0.112	0.072
41.	Iron (as Fe)	mg/L	**3.0**	BDL	BDL	1.56
42.	Vanadium (as V)	mg/L	**0.2**	BDL	BDL	BDL
43.	Selenium (as Se)	mg/L	**0.05**	BDL	BDL	BDL
44.	Boron (as B)	mg/L		0.109	BDL	BDL
45.	Bioassay Test on fish	% survival	**90% survival after 96h in 100%effluent**	90	100	80

Table No. II

Location				**Exide Industries Ltd.**	**Alicon Atlas Cast Alloy Ltd.**	**Tata Motors Ltd.**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
1.	Sanitary Survey			Reasonably clean neihborhood	Very clean neighborhood and catchment	Very clean neighborhood and catchment
2.	Colour	Hazen		1	1	4
3.	Smell	-		Agreeable	Disagreeable	Disagreeable
4.	pH	-	**5.5 -9.0**	8.03	7.28	7.15

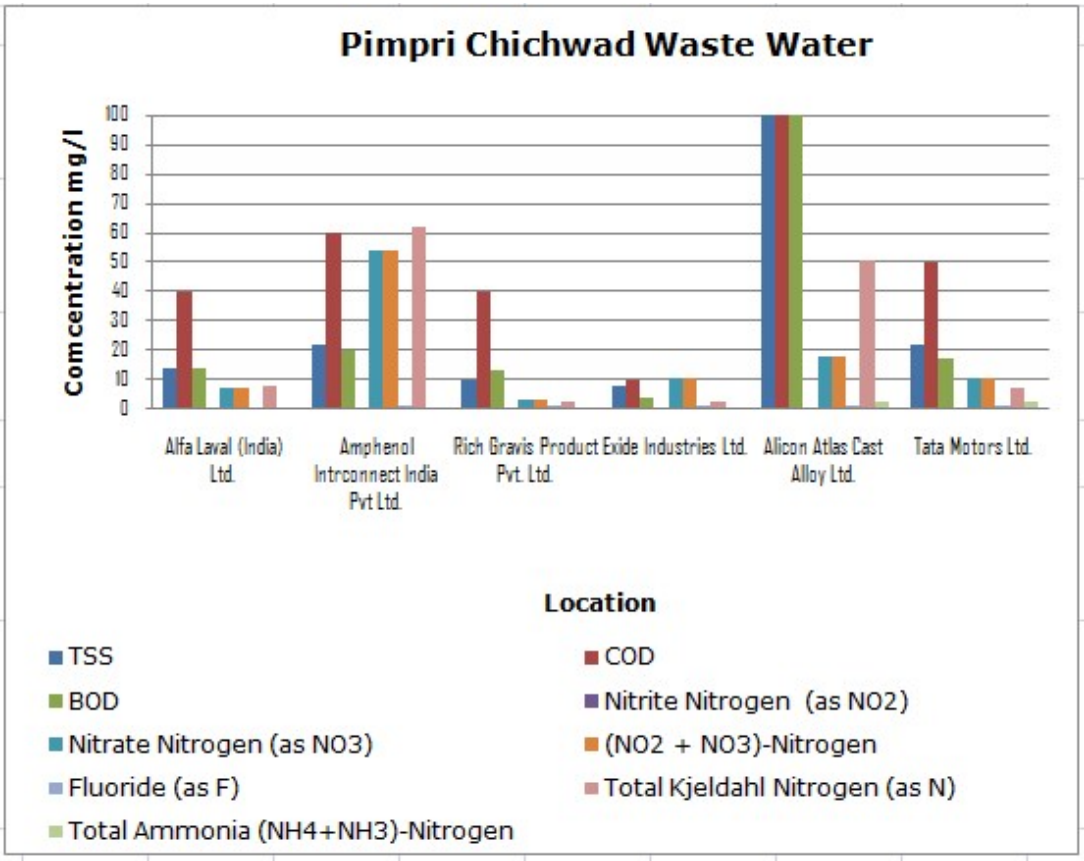
Location				**Exide Industries Ltd.**	**Alicon Atlas Cast Alloy Ltd.**	**Tata Motors Ltd.**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
5.	Oil & Grease	mg/L	**10.0**	BDL	BDL	BDL
6.	Suspended Solids	mg/L	**100.0**	8	136	22
7.	Dissolved Oxygen (% Saturation)	%		72	0	47
8.	Chemical Oxygen Demand	mg/L	**250.0**	10	4600	50
9.	Biochemical Oxygen Demand (3 days,27^{o} C)	mg/L	**30.0**	4	1522	17
10.	Electrical Conductivity (at 25^{o} C)	µmho/cm		1442	1068	531
11.	Nitrite Nitrogen (as NO_2)	mg/L		BDL	0.21	BDL
12.	Nitrate Nitrogen (as NO_3)	mg/L	**10.0**	10.2	17.5	10.4
13.	(NO_2 + NO_3)-Nitrogen	mg/L	**5.0**	10.2	17.7	10.4
14.	Free Ammonia (as NH_3-N)	mg/L	**5.0**	BDL	BDL	BDL
15.	Total Residual Chlorine	mg/L	**1.0**	BDL	BDL	BDL
16.	Cyanide (as CN)	mg/L	**0.2**	BDL	BDL	BDL
17.	Fluoride (as F)	mg/L	**2.0**	0.83	1.1	1.11
18.	Sulphide (as S^{2-})	mg/L	**2.0**	BDL	0.16	BDL
19.	Dissolved Phosphate (as P)	mg/L	**5.0**	BDL	1	0.34

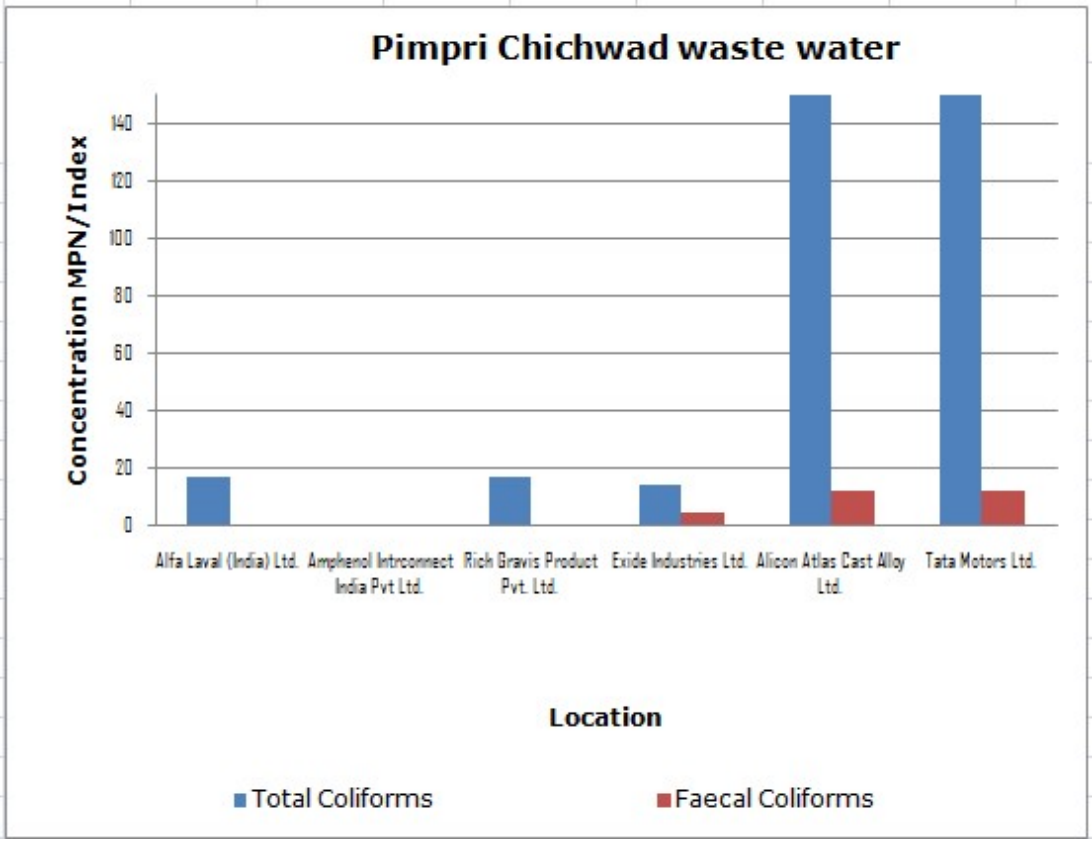
Location				**Exide Industries Ltd.**	**Alicon Atlas Cast Alloy Ltd.**	**Tata Motors Ltd.**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
20.	Sodium Absorption Ratio	mg/L		0.3	0.51	0.29
21.	Total Coliforms	MPN index/ 100 ml	**100.0**	14	220	220
22.	Faecal Coliforms	MPN index/ 100 ml	**1000.0**	4.5	12	12
23.	Total Phosphorous (as P)	mg/L	**1.0**	0.18	3	0.6
24.	Total Kjeldahl Nitrogen (as TKN)	mg/L	**100.0**	2.24	50.4	6.94
25.	Total Ammonia (NH_4+NH_3)-Nitrogen	mg/L	**5.0**	0.6	2.7	2.1
26.	Phenols (as C_6H_5OH)	mg/L	**3.0**	BDL	BDL	BDL
27.	Surface Active Agents (as MBAS)	mg/L	**3.0**	BDL	BDL	BDL
28.	Organo Chlorine Pesticides					
I.	Alachlor	µg/L	**2.0**	BDL	BDL	BDL
II.	Atrazine	µg/L	**0.2**	BDL	BDL	BDL
III.	Aldrin	µg/L	**0.1**	BDL	BDL	BDL
IV.	Dieldrin	µg/L	**2.0**	BDL	BDL	BDL
V.	Alpha HCH	µg/L	**0.01**	BDL	BDL	BDL
VI.	Beta HCH	µg/L	**2.0**	BDL	BDL	BDL
VII.	Delta HCH	µg/L	**3.0**	BDL	BDL	BDL

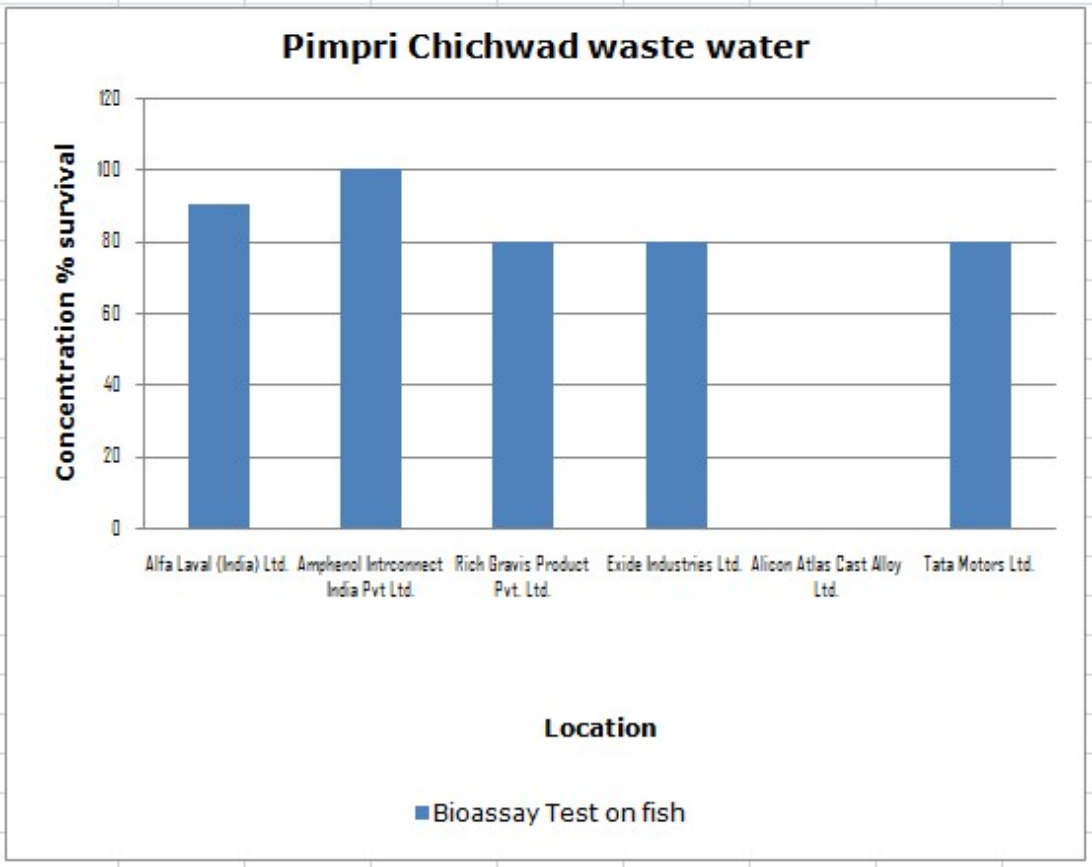
Location				**Exide Industries Ltd.**	**Alicon Atlas Cast Alloy Ltd.**	**Tata Motors Ltd.**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
VIII.	Butachlor	µg/L	**0.2**	BDL	BDL	BDL
IX.	p,p DDT	µg/L	**0.05**	BDL	BDL	BDL
X.	o,p DDT	µg/L	**100.0**	BDL	BDL	BDL
XI.	p,p DDE	µg/L	**250.0**	BDL	BDL	BDL
XII.	o,p DDE	µg/L	**30.0**	BDL	BDL	BDL
XIII.	p,p DDD	µg/L		BDL	BDL	BDL
XIV.	o,p DDD	µg/L		BDL	BDL	BDL
XV.	Alpha Endosulfan	µg/L	**10.0**	BDL	BDL	BDL
XVI.	Beta Endosulfan	µg/L		BDL	BDL	BDL
XVII.	Endosulfan Sulphate	µg/L	**5.0**	BDL	BDL	BDL
VIII.	Y HCH (Lindane)	µg/L	**1.0**	BDL	BDL	BDL
29.	Polynuclear aromatic hydrocarbons (as PAH)	mg/L	**0.2**	BDL	BDL	BDL
30.	Polychlorinated Biphenyls (PCB)	mg/L	**2.0**	BDL	BDL	BDL
31.	Zinc (as Zn)	mg/L	**5.0**	BDL	0.397	BDL
32.	Nickel (as Ni)	mg/L	**3.0**	0.015	BDL	0.104
33.	Copper (as Cu)	mg/L		BDL	0.031	BDL
34.	Hexavalent Chromium (as Cr^{6+})	mg/L	**0.1**	BDL	BDL	BDL
35.	Total Chromium (as Cr)	mg/L	**2.0**	0.026	0.039	BDL

Location				**Exide Industries Ltd.**	**Alicon Atlas Cast Alloy Ltd.**	**Tata Motors Ltd.**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
36.	Total Arsenic (as As)	mg/L	**0.2**	BDL	BDL	BDL
37.	Lead (as Pb)	mg/L	**0.1**	0.067	BDL	BDL
38.	Cadmium (as Cd)	mg/L	**2.0**	BDL	BDL	BDL
39.	Mercury (as Hg)	mg/L	**0.01**	BDL	BDL	BDL
40.	Manganese (as Mn)	mg/L	**2.0**	BDL	0.126	0.449
41.	Iron (as Fe)	mg/L	**3.0**	BDL	0.073	BDL
42.	Vanadium (as V)	mg/L	**0.2**	BDL	BDL	BDL
43.	Selenium (as Se)	mg/L	**0.05**	BDL	BDL	BDL
44.	Boron (as B)	mg/L		BDL	BDL	3.15
45.	Bioassay Test on fish	% survival	**90% survival after 96h in 100%effluent**	80	0	80

Graphs: Water/Waste Water Quality Monitoring for Pimpri-Chinchwad:







3.4 Ground Water Quality:

Sr.	Location	Source	Table No.
1.	Mohan Nagar	Bore well	**I**
2.	Shantaram Laximan Borate	Open well water	**I**
3.	Ram Hari Borate	Well water	**I**
4.	Ramdas Borate	Well water	**II**
5.	Raju Saste-Bhosri	Open well water	**II**
6.	Mula-Mutha River	Surface water	**II**

Table No. I

Location				**Mohan Nagar**	**Shantaram Laximan Borate**	**Ram Hari Borate**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
1.	Sanitary Survey			Very clean neighbourhood and catchment	Very clean neighbourhood and catchment	Generally clean neighbourhood
2.	Colour	Hazen		1	1	1
3.	Smell	-	**Agreeable**	Agreeable	Agreeable	Agreeable
4.	pH	-	**6.5-8.5**	7.91	7.28	7.37
5.	Oil & Grease	mg/L		BDL	BDL	BDL
6.	Suspended Solids	mg/L	**100**	5	BDL	BDL
7.	Dissolved Oxygen (%Saturation)	%		86	83	89
8.	Chemical Oxygen Demand	mg/L	**500**	BDL	BDL	BDL
9.	Biochemical Oxygen Demand (3 days,27^{o}C)	mg/L	**10 (WHO, 1993)**	BDL	BDL	BDL
10.	Electrical Conductivity (at 25^{o}C)	µmho/cm		601	910	911
11.	Nitrite Nitrogen (as NO_2)	mg/L	**0.3 (WHO, 1993)**	BDL	BDL	0.14
12.	Nitrate Nitrogen (as NO_3)	mg/L		0.87	11.7	11.6
13.	(NO_2 + NO_3)-Nitrogen	mg/L	**45**	0.87	11.7	11.7

Location				**Mohan Nagar**	**Shantaram Laximan Borate**	**Ram Hari Borate**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
14.	Free Ammonia (as NH_3-N)	mg/L	**1.0**	BDL	BDL	BDL
15.	Total Residual Chlorine	mg/L	**0.5**	BDL	BDL	BDL
16.	Cyanide (as CN)	mg/L	**0.2**	BDL	BDL	BDL
17.	Fluoride (as F)	mg/L		BDL	BDL	BDL
18.	Sulphide (as S_{2-})	mg/L	**1**	BDL	BDL	BDL
19.	Dissolved Phosphate (as P)	mg/L	**0.05**	BDL	BDL	BDL
20.	Sodium Absorption Ratio	mg/L		2.51	0.57	0.88
21.	Total Coliforms	MPN index/ 100 ml		BDL	BDL	49
22.	Faecal Coliforms	MPN index/ 100 ml	**ND**	BDL	BDL	BDL
23.	Total Phosphorous (as P)	mg/L	**ND**	BDL	BDL	0.1
24.	Total Kjeldahl Nitrogen	mg/L	**0.5**	4.59	7.39	2.91
25.	Total Ammonia (NH_4+NH_3)-Nitrogen	mg/L	**0.001**	BDL	BDL	BDL
26.	Phenols (as C_6H_5OH)	mg/L	**0.5**	BDL	BDL	BDL
27.	Surface Active Agents (as MBAS)	mg/L	**0.001**	BDL	BDL	BDL

Location				**Mohan Nagar**	**Shantaram Laximan Borate**	**Ram Hari Borate**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
28.	Organo Chlorine Pesticides					
I.	Alachlor	µg/L	**0.05**	BDL	BDL	BDL
II.	Atrazine	µg/L	**20**	BDL	BDL	BDL
III.	Aldrin	µg/L	**2**	BDL	BDL	BDL
IV.	Dieldrin	µg/L	**0.03**	BDL	BDL	BDL
V.	Alpha HCH	µg/L	**0.03**	BDL	BDL	BDL
VI.	Beta HCH	µg/L	**0.01**	BDL	BDL	BDL
VII.	Delta HCH	µg/L	**0.04**	BDL	BDL	BDL
VIII.	Butachlor	µg/L	**125**	BDL	BDL	BDL
IX.	p,p DDT	µg/L	**0.04**	BDL	BDL	BDL
X.	o,p DDT	µg/L	**1**	BDL	BDL	BDL
XI.	p,p DDE	µg/L	**1**	BDL	BDL	BDL
XII.	o,p DDE	µg/L	**1**	BDL	BDL	BDL
XIII.	p,p DDD	µg/L	**1**	BDL	BDL	BDL
XIV.	o,p DDD	µg/L	**1**	BDL	BDL	BDL
XV.	Alpha Endosulfan	µg/L	**1**	BDL	BDL	BDL
XVI.	Beta Endosulfan	µg/L	**0.4**	BDL	BDL	BDL
XVII.	Endosulfan Sulphate	µg/L	**0.4**	BDL	BDL	BDL
VIII.	Y HCH (Lindane)	µg/L	**0.4**	BDL	BDL	BDL
29.	Polynuclear aromatic hydrocarbons (as PAH)	mg/L	**2.0**	BDL	BDL	BDL

Location				**Mohan Nagar**	**Shantaram Laximan Borate**	**Ram Hari Borate**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
30.	Polychlorinated Biphenyls (PCB)	mg/L	**0.0001**	BDL	BDL	BDL
31.	Zinc (as Zn)	mg/L	**0.0005**	BDL	BDL	0.095
32.	Nickel (as Ni)	mg/L	**5.0**	BDL	BDL	0.048
33.	Copper (as Cu)	mg/L	**0.02**	BDL	BDL	BDL
34.	Hexavalent Chromium (as Cr^{6+})	mg/L	**0.05**	BDL	BDL	BDL
35.	Total Chromium (as Cr)	mg/L	**1**	BDL	0.025	0.285
36.	Total Arsenic (as As)	mg/L	**0.05**	BDL	BDL	BDL
37.	Lead (as Pb)	mg/L	**0.01**	BDL	BDL	BDL
38.	Cadmium (as Cd)	mg/L	**0.01**	BDL	BDL	BDL
39.	Mercury (as Hg)	mg/L	**0.003**	BDL	BDL	BDL
40.	Manganese (as Mn)	mg/L	**0.001**	0.133	BDL	0.119
41.	Iron (as Fe)	mg/L	**0.1**	BDL	BDL	BDL
42.	Vanadium (as V)	mg/L	**0.3**	BDL	0.027	BDL
43.	Selenium (as Se)	mg/L		BDL	BDL	BDL
44.	Boron (as B)	mg/L	**0.01**	BDL	BDL	BDL
45.	Bioassay Test on fish	% survival		90	100	100

Table No. II

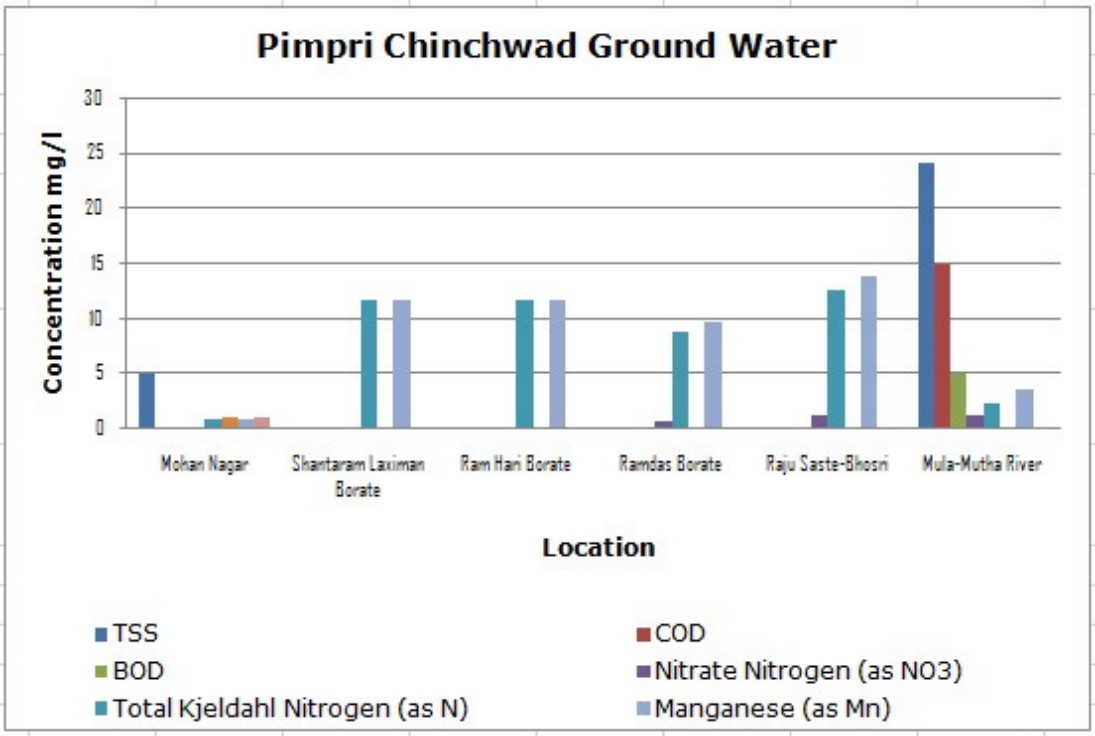
Location				**Ramdas Borate**	**Raju Saste-Bhosri**	**Mula-Mutha River**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
1.	Sanitary Survey			Very clean neighbourhood and catchment	Reasonably clean neighbourhood	Generally clean neighbourhood
2.	Colour	Hazen		1	1	1
3.	Smell	-	**Agreeable**	Agreeable	Agreeable	Agreeable
4.	pH	-	**6.5-8.5**	7.21	7.41	7.28
5.	Oil & Grease	mg/L		BDL	BDL	BDL
6.	Suspended Solids	mg/L	**100**	BDL	BDL	24
7.	Dissolved Oxygen (%Saturation)	%		70	89	56
8.	Chemical Oxygen Demand	mg/L	**500**	BDL	BDL	15
9.	Biochemical Oxygen Demand (3 days,27^{o}C)	mg/L	**10 (WHO, 1993)**	BDL	BDL	5
10.	Electrical Conductivity (at 25^{o}C)	µmho/cm		910	653	497
11.	Nitrite Nitrogen (as NO_2)	mg/L	**0.3 (WHO, 1993)**	0.76	1.24	1.20
12.	Nitrate Nitrogen (as NO_3)	mg/L		8.88	12.6	2.33
13.	(NO_2 + NO_3)-Nitrogen	mg/L	**45**	9.64	13.8	3.53

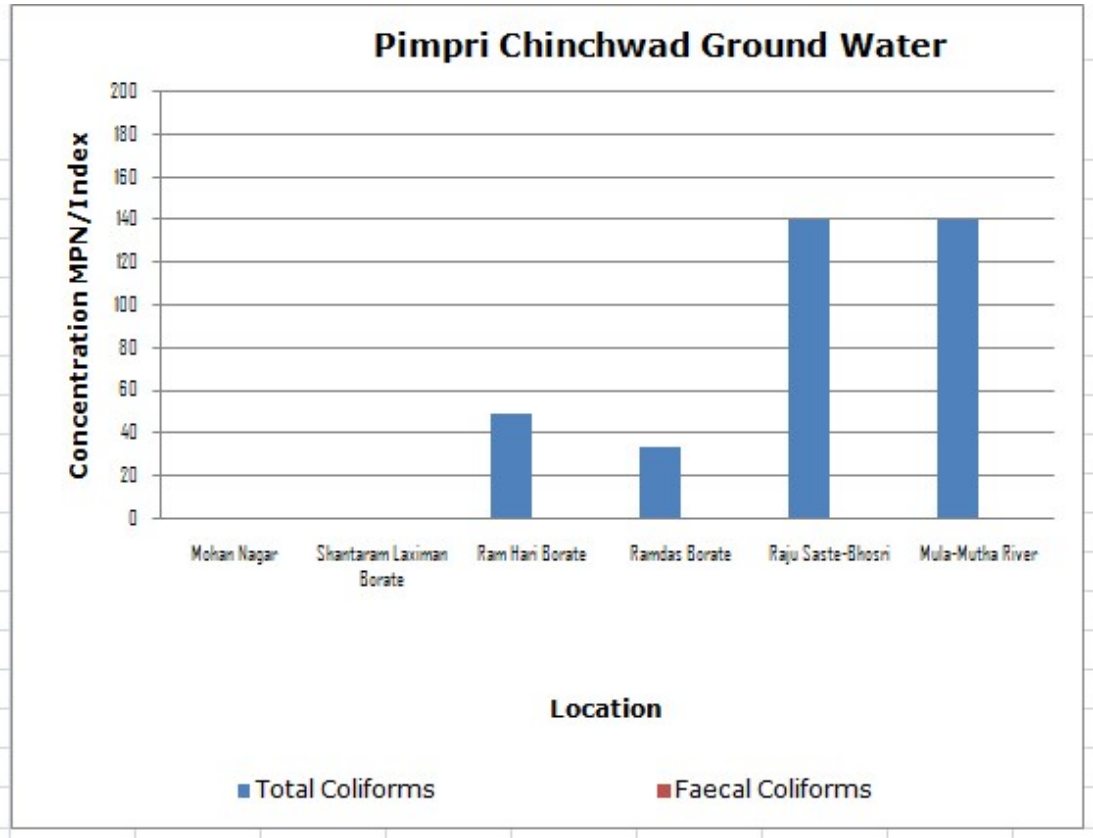
Location				**Ramdas Borate**	**Raju Saste-Bhosri**	**Mula-Mutha River**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
14.	Free Ammonia (as NH_3-N)	mg/L	**1.0**	BDL	BDL	BDL
15.	Total Residual Chlorine	mg/L	**0.5**	BDL	BDL	BDL
16.	Cyanide (as CN)	mg/L	**0.2**	BDL	BDL	BDL
17.	Fluoride (as F)	mg/L		1.7	BDL	BDL
18.	Sulphide (as S_{2-})	mg/L	**1**	BDL	BDL	BDL
19.	Dissolved Phosphate (as P)	mg/L	**0.05**	BDL	BDL	BDL
20.	Sodium Absorption Ratio	mg/L		0.74	0.96	1.21
21.	Total Coliforms	MPN index/ 100 ml		33	140	140
22.	Faecal Coliforms	MPN index/ 100 ml	**ND**	BDL	BDL	BDL
23.	Total Phosphorous (as P)	mg/L	**ND**	BDL	BDL	BDL
24.	Total Kjeldahl Nitrogen	mg/L	**0.5**	2.35	4.98	6.50
25.	Total Ammonia (NH_4+NH_3)-Nitrogen	mg/L	**0.001**	BDL	BDL	2.21
26.	Phenols (as C_6H_5OH)	mg/L	**0.5**	BDL	BDL	BDL
27.	Surface Active Agents (as MBAS)	mg/L	**0.001**	BDL	BDL	BDL

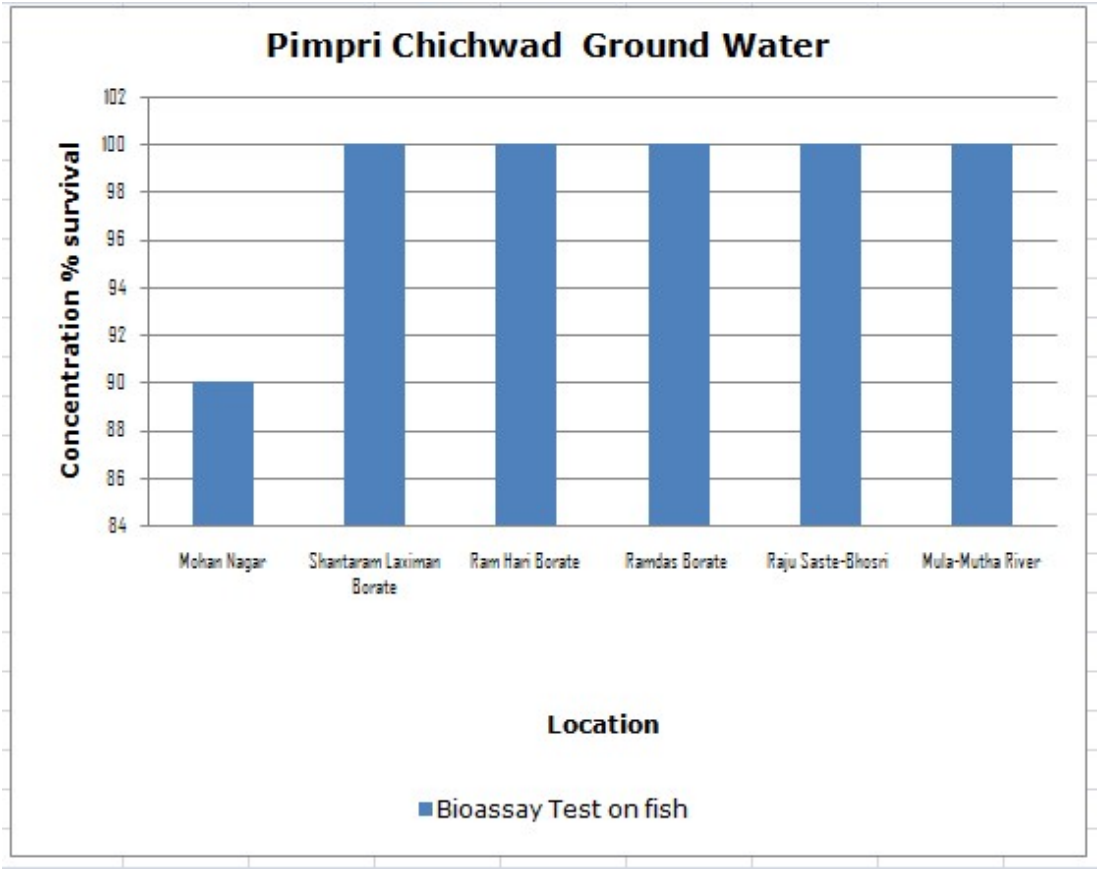
Location				**Ramdas Borate**	**Raju Saste-Bhosri**	**Mula-Mutha River**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
28.	Organo Chlorine Pesticides					
I.	Alachlor	µg/L	**0.05**	BDL	BDL	BDL
II.	Atrazine	µg/L	**20**	BDL	BDL	BDL
III.	Aldrin	µg/L	**2**	BDL	BDL	BDL
IV.	Dieldrin	µg/L	**0.03**	BDL	BDL	BDL
V.	Alpha HCH	µg/L	**0.03**	BDL	BDL	BDL
VI.	Beta HCH	µg/L	**0.01**	BDL	BDL	BDL
VII.	Delta HCH	µg/L	**0.04**	BDL	BDL	BDL
VIII.	Butachlor	µg/L	**125**	BDL	BDL	BDL
IX.	p,p DDT	µg/L	**0.04**	BDL	BDL	BDL
X.	o,p DDT	µg/L	**1**	BDL	BDL	BDL
XI.	p,p DDE	µg/L	**1**	BDL	BDL	BDL
XII.	o,p DDE	µg/L	**1**	BDL	BDL	BDL
XIII.	p,p DDD	µg/L	**1**	BDL	BDL	BDL
XIV.	o,p DDD	µg/L	**1**	BDL	BDL	BDL
XV.	Alpha Endosulfan	µg/L	**1**	BDL	BDL	BDL
XVI.	Beta Endosulfan	µg/L	**0.4**	BDL	BDL	BDL
XVII.	Endosulfan Sulphate	µg/L	**0.4**	BDL	BDL	BDL
VIII.	Y HCH (Lindane)	µg/L	**0.4**	BDL	BDL	BDL
29.	Polynuclear aromatic hydrocarbons (as PAH)	mg/L	**2.0**	BDL	BDL	BDL

Location				**Ramdas Borate**	**Raju Saste-Bhosri**	**Mula-Mutha River**
Sr.	**Parameters**	**Unit**	**Std. Limit**	**Results**		
30.	Polychlorinated Biphenyls (PCB)	mg/L	**0.0001**	BDL	BDL	BDL
31.	Zinc (as Zn)	mg/L	**0.0005**	BDL	BDL	BDL
32.	Nickel (as Ni)	mg/L	**5.0**	0.018	BDL	BDL
33.	Copper (as Cu)	mg/L	**0.02**	BDL	BDL	BDL
34.	Hexavalent Chromium (as Cr^{6+})	mg/L	**0.05**	BDL	BDL	BDL
35.	Total Chromium (as Cr)	mg/L	**1**	BDL	0.043	0.037
36.	Total Arsenic (as As)	mg/L	**0.05**	BDL	BDL	BDL
37.	Lead (as Pb)	mg/L	**0.01**	BDL	BDL	BDL
38.	Cadmium (as Cd)	mg/L	**0.01**	BDL	BDL	BDL
39.	Mercury (as Hg)	mg/L	**0.003**	BDL	BDL	BDL
40.	Manganese (as Mn)	mg/L	**0.001**	BDL	BDL	BDL
41.	Iron (as Fe)	mg/L	**0.1**	BDL	BDL	BDL
42.	Vanadium (as V)	mg/L	**0.3**	BDL	0.023	BDL
43.	Selenium (as Se)	mg/L		BDL	BDL	BDL
44.	Boron (as B)	mg/L	**0.01**	BDL	BDL	BDL
45.	Bioassay Test on fish	% survival		100	100	100

Graphs: Ground Water Quality Monitoring for Pimpri-Chinchwad:







4. Summary and Conclusion

Based on the study done, the results are summarised and concluded as follows:

4.1 Stack Emission Monitoring:

Six industries from Pimpri-Chinchwad were selected for Stack emission monitoring.

1. **Particulate matter (PM):** The concentration of PM is within the standard emission for the specified industry.

2. **Sulphur dioxide (SO_2):** The concentration of SO_2 is also within the standard emission for the specified industry.

3. **Nitrogen dioxide (NO_2):** The highest level of NO_2 was observed at Atlas Cast Alloy with 19 mg/Nm^3 emission.

4. **Acid Mist (as H_2SO_4):** All 6 stacks had concentration of Acid mist below the detectable limit.

4.2 Ambient Air Quality Monitoring:

Six ambient air samples were collected from Pimpri-Cinchwad region. The parameters monitored were studied as per the NAAQ standards. The variations of each parameter within the area under study are discussed below:

1. **Sulphur dioxide (SO_2):** All the locations are observed with very low concentrations of SO_2. The highest level of SO_2 was observed at Rich Graviss Products with 6.51 µg/m^3 which is very much lower than the standard limit of NAAQS i.e. 80 µg/m^3.

2. **Nitrogen dioxide (NO_2):** Values of nitrogen dioxide are also observed below the standard limit of 80 µg/m^3 at all the 6 locations. The highest level of NO_2 was observed at Tata Motors with a result of 9.92 µg/m^3.

3. **Particulate Matter (PM_{10}):** PM_{10} concentration of all 6 locations was higher than the standard limit of 100 µg/m^3. The highest concentration of PM_{10} was observed at Sandvik Asia Ltd. with 208 µg/m^3

4. **Particulate Matter ($PM_{2.5}$):** Values of $PM_{2.5}$ are also observed below the standard limit of 60 µg/m^3 at all the 6 locations. The highest level of $PM_{2.5}$ was observed at Exide Industries with a result of 547 µg/m^3.

5. **Ozone (O_3):** Ozone was found to be below detectable limit in all location.

6. **Lead (Pb):** Lead also was found to be below detectable limit in all location.

7. **Carbon Monoxide (CO):** Concentration of carbon monoxide has been found to well within the limits in all 6 locations monitored with the highest concentration at Alfa Lava India Pvt. Ltd. with 3.44 mg/m^3.

8. **Ammonia (NH_3):** Ammonia was below the detectable limit in all 6 locations monitored.

9. **Benzene (C_6H_6):** 5 out of 6 locations monitored had Benzene concentration higher than 5 µg/m^3 which is the standard limit as per NAAQS. The highest level of was observed at Tata Motors with 14.1 ng/m^3.

10. **Benzo(a)pyrene (BaP):** BaP was below detectable limit in all 6 locations monitored.

11. **Arsenic (As):** As was detected on in 3 locations out of the 6 locations monitored and was well within the standard limit of 6 ng/m^3.

12. **Nickel (Ni):** Concentration of Nickel was below detectable limit in all 6 locations monitored.

4.3 Waste Water Quality Monitoring:

To understand the quality of treated effluent, samples were collected from 6 industries of Pimpri-Chinchwad. Considering the general parameters of all the industries mentioned, following are the conclusions:

1. **Colour:** Colour units are found high with 4 Hazen unit in the water sample collected from Tata Power.

2. **Odour**: odour of 2 samples is found disagreeable at 6 water samples collected.

3. **pH**: it is observed in between 5.25 and 8.03.

4. **Suspended Solids**: Suspended solids of Alicon Atlas Cast Alloy Ltd. had the highest concentration with 136 mg/L.

5. **Chemical Oxygen Demand**: The highest COD was observed at Alicon Atlas Cast Alloy Ltd. with 4600 mg/L concentration.

6. **Biochemical Oxygen Demand**: The highest BOD was observed at Alicon Atlas Cast Alloy Ltd. with 1522 mg/L concentration.

7. **Sulphide**: 5 samples out of 6 samples collected were found to have below detectable limit.

8. **Total Ammoia**: 6 water samples collected was well within the standards of Ammonia ranging in between 0.56 mg/L to 2.7 mg/L.

9. **Total Kjeldahl Nitrogen**: All samples collected, were well within the limit required as per standard.

10. **Fish Bioassay**: 100% Survival was attained in only one water samples collected for Bioassay test.

11. **Heavy metals**: All the heavy metals are found below the standard limits in all the samples.

4.3 Ground Water Quality Monitoring:

Four ground water samples were collected from Pimpri-Chichwad region.

1) **Colour** (Hazen Units): Colour units are below the acceptable standard of all water samples collected.

2) **Odour**: odour of all the samples is found agreeable.

3) **Chemical Oxygen Demand:** COD was detected only at Mula -Mutha river with 15 mg/L.

4) **Biological Oxygen Demand:** BOD was also detected only at Mula -Mutha river with 5 mg/L.

5) Following are the parameters which are compared with ISO 10500:2012 Drinking water specifications.

1) **Nitrite**: Values of Nitrite at all location was well within the standard.

2) **Nitrate:** Results of Nitrate are also observed below standard limit.

3) **Residual Free Chlorine**: Values are below the detectable limit in all 6 samples collected.

4) **Total Ammonia**: Values are below the detectable limit in all samples collected.

5) **Fluoride:** Values are below the acceptable standards, below <0.05mg/L.

6) **Sulphide:** All the readings of sulphide are below detectable limit in all 6 samples collected.

7) **Sodium Absorption Ratio:** These values fit within range of water quality criteria of CPCB.

8) **Total Kjeldahl nitrogen:** Results of TKN are also observed below standard limit.

9) .**Fish Bioassay**: 5 out 6 location sample collected had 100% survival of fish.

10) Surface Active Agents: All 6 samples showed below detectable limit.

11) Metals: All the metals except Copper, Lead and Total Chromium at few locations are observed within the acceptable limits of drinking water standards.

5. CEPI Score

Comprehensive Environmental Pollution Index (CEPI) is intended to act as early warning tool which helps in categorization of industrial clusters/areas in terms of priority of needing attention.

CPCB had evolved certain methodology to calculate CEPI, in which a score has been fixed for different environmental components based on the level of pollution. The scoring system involves an algorithm that takes into account the basic selection criteria. This approach is based on the basic hazard assessment logic that can be summarized as below.

Hazard = pollutant source, pathways, and receptor

CPCB has calculated CEPI for the identified critically polluted industrial clusters. It is calculated separately for air, water, and land. The basic framework and scoring system of the CEPI – based on three factors namely pollutant, pathway, and receptor – has been described further under this section.

To overcome the subjectivity, revised concept is proposed by eliminating the subjective factors as described in the previous section but retaining the factors which can be measured precisely.

I. Revised concept is prepared by eliminating the debatable factors but retaining the factors which can be measured precisely.

II. It is decided to develop the Comprehensive Environmental Pollution Index (CEPI) retaining the existing algorithm of Source, Pathway and Receptor.

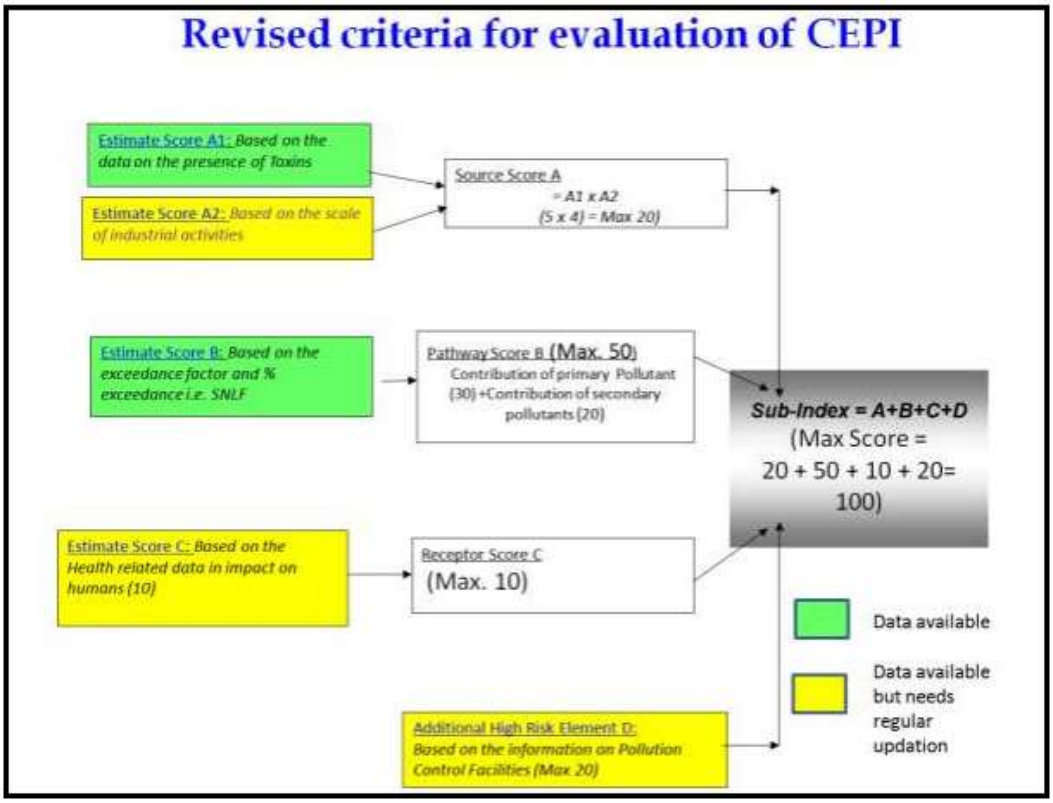
III. Health component was also retained in the revised concept in line with the suggestions of Secretary, MoEFCC during the meeting held in MoEF.

Outlines of revised CEPI 2016 criteria

The outlines of the revised CEPI criteria are as follows:

1. It is proposed to develop the Comprehensive Environmental Pollution Index (CEPI) based on Sources of pollution, real time observed values of the pollutants in the ambient air, surface water and ground water in & around the industrial cluster and health related statistics.
2. For assessment of the environmental quality of the area i.e. CEPI score, the concept of SNLF i.e. a surrogate number which represents the level of exposure (a function of percentage sample Exceedance & Exceedance Factor) shall be used.
3. Health component to be evaluated based on the health data available from major hospitals in the area was also retained in the revised concept.

The evaluation criterion of the revised CEPI version 2016 is described in the flowchart given below:



Here, health data collected for Receptor Score C is included in **Annexure I**

Based on Sub-Index Score (score of individual environmental component like air, water etc.):

- **Score more than 63:** A Critical Level of Pollution in the respective level of environmental component
- **Score between 51-63:** Severe to critical level of pollution with reference to respective environmental component

Cut-off Score

- **Score 50:** Severely Polluted Industrial Clusters/areas
- **Score 60:** Critically Polluted Industrial Clusters/areas

Based on Aggregated CEPI Score (score includes sub-index score of all individual environmental components together):

- **Aggregated CEPI score >70:** Critically polluted areas
- **Aggregated CEPI score between 60-70:** Severely polluted areas

Since the inception of the programme, MPCB has also formulated Action Plans to mitigate the environmental pollution problems for each of the 8 Critically Polluted Areas (CPAs) in Maharashtra. Based on available information, parameters selected and monitored in continuation with this, CEPI has been calculated and Short-Term Action Plan (STAP) as well as Long Term Action Plan (LTAP) was prepared in 2010.

Subsequently NAAQS 2009 came in force. List of parameters to be considered increased and expanded including more critical and hazardous pollutants like benzene, BaP, Metals, etc. existing in the environment. There was revision of standards (limiting values) as well. In this present report of February, 2019 prepared by MPCB, CEPI is calculated considering all these revised standards' limiting values, list of parameters and complete scope of monitoring.

5.1 Comparison of CEPI scores:

Results show that present CEPI score (42.4) of Pimpri-Chinchwad considering all revised standards is less the CPCB CEPI Score of 2009 (66.06) report.

Detailed results of Air, Water and Land are given below:

Air

	A1	A2	A	B1	B2	B3	B	C1	C2	C3	C	D	CEPI
CEPI score February 2019	2.1	5	10.5	-	-	-	10.8	-	-	-	5	10	**36.3**
CEPI score June 2018	2.4	3.8	9.12	-	-	-	12.4	-	-	-	5	10	**37**
CEPI score February 2018	2	4	8	-	-	-	11.45	-	-	-	5	10	**34.5**
CEPI score June 2017	2.9	3	8.7	-	-	-	12.8	-	-	-	0	10	**31.5**
CEPI score February 2017	2	5	10	5	0	0	5	4	2.9	0	11.6	10	**36.6**
CPCB Report 2009	5.75	5	28.75	6	0	0	6	3	3.50	0	10.50	10	**55.25**

Water:

	A1	A2	A	B1	B2	B3	B	C1	C2	C3	C	D	CEPI
CEPI score February 2019	2.8	5	14	-	-	-	8.9	-	-	-	0	10	**32.9**
CEPI score June 2018	3.1	1.5	4.65	-	-	-	10.5	-	-	-	0	10	**25.15**
CEPI score February 2018	4	3.58	15.2	-	-	-	12.2	-	-	-	0	10	**37.4**
CEPI score June 2017	3.9	4.55	17.55	-	-	-	10.1	-	-	-	0	10	**37.65**
CEPI score February 2017	2.9	6	17.4	5	0	4	9	4	2	3	11	10	**47.4**
CPCB Report 2009	3	5	15	7	0	3	10	5	3.5	0	17.5	10	**52.5**

Land:

	A1	A2	A	B1	B2	B3	B	C1	C2	C3	C	D	CEPI
CEPI score February 2019	2	5	10	-	-	-	9.2	-	-	-	0	10	**29.2**
CEPI score June 2018	3.1	2.74	8.49	-	-	-	8.5	-	-	-	0	10	**26.99**
CEPI score February 2018	2.9	4.6	13.34	-	-	-	10.57	-	-	-	3	10	**36.91**
CEPI score June 2017	3.3	4.8	15.84	-	-	-	10.2	-	-	-	0	10	**36.04**

	A1	A2	A	B1	B2	B3	B	C1	C2	C3	C	D	CEPI
CEPI score February 2017	4	5	20	3	4	0	7	4	2	0	8	10	**45.0**
CPCB Report 2009	3	5	15	6	0	3	9	3	4	0	12	10	**46.0**

Aggregated CEPI:

	Air Index	Water Index	Land Index	CEPI
CEPI score February 2019	36.3	32.9	29.2	**42.4**
CEPI score June 2018	37	25.15	26.99	**40.82**
CEPI score February 2018	34.45	37.4	36.91	**43.49**
CEPI score June 2017	31.5	37.65	36.04	**40.79**
CEPI score February 2017	36.6	47.4	45.0	**50.1**
CPCB Report 2009	55.25	52.50	46.00	**66.06**

6. References

1) Criteria for Comprehensive Environmental Assessment of Industrial Clusters, December 2009, CPCB, EIAS/4/2009-10

2) Comprehensive Environmental Assessment of Industrial Clusters, December 2009, CPCB, EIAS/5/2009-10

3) Action Plan for Industrial Cluster: Chandrapur, November 2010, MPCB

4) Action Plan for Industrial Cluster: Chembur, November 2010, MPCB

5) Action Plan for Industrial Cluster: Aurangabad, November 2010, MPCB

6) Action Plan for Industrial Cluster: NaviMumbai, November 2010, MPCB

7) Action Plan for Industrial Cluster: Navi Mumbai, November 2010, MPCB

8) Standard Methods for the Examination of Water and Waste Water, American Public Health Association, 22nd Edition, 2012.

9) IS 3025 (various parts)

10) www.mpcb.gov.in

11) www.cpcb.gov.in

7. Annexure

Annexure I: Stack Emission Sampling and Analysis Methodology

Sr.	Parameters	Method References	Techniques	Detection Limit
1.	Acid Mist (as Sulphuric Acid)	US EPA Method no.m-8	Barium thorine titration Method	0.6 mg/Nm^3
2.	Ammonia	IS 11255 (Part 6):1999, Reaffirmed 2003	Titration/Nessler Reagent / Spectrophotometric Method	1 mg/Nm^3
3.	Carbon Monoxide	USEPA Method 10B	GC-FID Method	0.2 mg/Nm^3
4.	Chlorine	US EPA Method 26 for sampling	Titrimetric	0.001 mg/Nm^3
5.	Fluoride (Gaseous)	US EPA Method 13 A	SPADNS Zirconium Lake Spectrophotometric Method	0.025 mg/Nm^3
6.	Fluoride (Particulate)	US EPA Method 13 A	SPADNS Zirconium Lake Spectrophotometric Method	0.005 mg/Nm^3
7.	Hydrogen Chloride	US EPA Method 26 for sampling	Titrimetric	0.25 mg/Nm^3
8.	Hydrogen Sulphide	IS 11255 (Part 4):1985	Titrimetric	1 mg/Nm^3
9.	Oxides of Nitrogen	IS 11255 (Part 7): 2005	PDSA Colorimetric Method	10 mg/Nm^3
10.	Oxygen	IS 13270 : 1992	ORSAT Apparatus	1 %
11.	Poly Aromatic Hydrocarbons (Particulate)	IS 5182 (Part 12) : 2004, Reaffirmed 2009 CPCB Guidelines, May 2011, Page No.39	GC-FID Method	0.25 mg/Nm^3
12.	Suspended Particulate Matter	IS 11255 (Part 1):1985, Reaffirmed 2003	Gravimetric Method	10 mg/Nm^3

Sr.	Parameters	Method References	Techniques	Detection Limit
13.	Sulphur Dioxide	IS 11255 (Part 2): 1985, Reaffirmed 2003	Titrimetric IPA thorine Method	5.0mg/Nm^3
				0.02kg/day
14.	BTX (Benzene, Toluene, Xylene)	NIOSH (NMAM) 1501	Adsorption and Desorption followed by GC-FID analysis	0.001 mg/Nm^3
15.	VOC (Volatile Organic Compounds)	NIOSH (NMAM) 1501 for sampling	Adsorption and Desorption followed by GC-FID or GC/MS analysis	-
i	Methyl Isobutyl Ketone	-	-	0.001 mg/Nm^3
ii	Benzene	-	-	0.001 mg/Nm^3
iii	Toluene	-	-	0.001 mg/Nm^3
iv	Xylene	-	-	0.001 mg/Nm^3
v	Ethyl Benzene	-	-	0.001 mg/Nm^3
vi	Ethyl Acetate	-	-	0.001 mg/Nm^3

Annexure II: Ambient Air Sampling and Analysis Methodology

Sr.	Parameters	Method References	Techniques	Detection Limit
1.	Sulphur Dioxide (SO_2)	CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No.1	Improved West & Gaeke Method	4 µg/m^3
2.	Nitrogen Dioxide (NO_2)	CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No.7	Modified Jacob & Hochheiser Method	3 µg/m^3
3.	Particulate Matter (size less than 10 µm) or PM_{10}	CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No.11	Gravimetric Method	2 µg/m^3
4.	Particulate Matter (size less than 2.5 µm) or $PM_{2.5}$	CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No. 15	Gravimetric Method	0.4 µg/m^3
5.	Ozone (O_3)	APHA, Method No. 820, Page no. 836	Chemical Method	19.6 µg/m^3
6.	Lead (Pb)	CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No. 47	AAS Method	0.02 µg/m^3
7.	Carbon Monoxide (CO)	CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume II, May 2011, Page No. 16	Non Dispersive Infra Red (NDIR) spectroscopy	0.05 mg/m^3
8.	Ammonia (NH_3)	CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No. 35	Indophenol Blue Method	4.0µg/m^3
9.	Benzene (C_6H_6)	IS 5182 (Part 11):2006	Adsorption and Desorption followed by GC-FID analysis	1.0 µg/m^3
10.	Benzo (a) Pyrene (BaP) – particulate phase only,	CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No. 39	Solvent extraction followed by GC-FID analysis	0.2 ng/m^3
11.	Arsenic (As)	CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No. 47	AAS Method	0.3ng/m^3

Sr.	Parameters	Method References	Techniques	Detection Limit
12.	Nickel (Ni)	CPCB Guidelines for the Measurement of Ambient Air Pollutants, Volume I, May 2011, Page No. 47	AAS Method	3.0ng/m^3

Annexure III: Water/Wastewater Sampling and Analysis Methodology

Sr.	Parameters	Methods References	Techniques	Detection Limit
1.	Sampling Procedure for Chemical Parameters	IS 3025 (Part 1): 1987, Reaffirmed 1998, Amds.1& APHA, 22nd Ed., 2012, 1060 B, 1-39	-	-
2.	Sampling Procedure for Microbiological Parameters	APHA, 22nd Ed., 2012,1060 B, 1-39, 9040, 9-17, and 9060B, 9-35	-	-
3.	Temperature	APHA, 22nd Ed., 2012, 2550-B, 2-69	By Thermometer	-
4.	Colour	APHA, 22nd Ed., 2012 , 2120-B, 2-26	Visible Comparison Method	1 Hazen Unit
5.	Odour	IS 3025 (Part 5): 1983, Reaffirmed 2006	Qualitative Method	-
6.	pH	APHA, 22nd Ed., 2012, 4500-H^+- B, 4-92	By pH Meter	1
7.	Oil & Grease	APHA, 22nd Ed., 2012, 5520-B, 5-40	Liquid -liquid Partition-Gravimetric Method	1.0 mg/L
8.	Suspended Solids	IS 3025(Part 17): 1984, Reaffirmed 2006,Amds.1	Filtration /Gravimetric Method	5.0 mg/L
9.	Dissolved Oxygen	IS 3025(Part 38): 1989, Reaffirmed 2009	Iodometric Method-Azide modification	0.05 mg/L
10.	Chemical Oxygen Demand	APHA,22nd Ed., 2012 , 5220-B, 5-17	Open Reflux Method	5.0 mg/L
11.	Biochemical Oxygen Demand	IS 3025(Part 44): 1993,Reaffirmed 2009,Amds.1	Iodometric Method	5.0 mg/L
12.	Electrical Conductivity	APHA, 22nd Ed., 2012, 2510- B, 2-54	By Conductivity Meter	0.1 µmho/cm
13.	Nitrite-Nitrogen	APHA, 22nd Ed., 2012, 4500-NO_2-B, 4-120	Colorimetric Method	0.006 mg/L

Sr.	Parameters	Methods References	Techniques	Detection Limit
14.	Nitrate-Nitrogen	APHA,22nd Ed.,2012 ,4500-NO_3,B-4-122	UV Spectrophotometer Screening Method	0.2 mg/L
15.	(NO_2 + NO_3)-Nitrogen	APHA, 22nd Ed., 2012, 4500-NO_2-B, 4-120 APHA,22nd Ed.,2012,4500-NO_3,B-4-122	Colorimetric Method V Spectrophotometer Screening Method	0.2 mg/L
16.	Free Ammonia	APHA, 22nd Ed., 2012 , 4500 NH_3, F, 4 -115	Colorimetric Method	0.006 mg/L
17.	Total Residual Chlorine	IS 3025 (Part 26) :1986 , Reaffirmed 2009, Ed. 2.1(2004-02)	Iodometric Method	0.1 mg/L
18.	Cyanide (CN)	APHA, 22nd Ed., 2012 ,4500-CN, C & E, 4-41 & 4-43	Colorimetric Method	0.001 mg/L
19.	Fluoride (F)	APHA, 22nd Ed., 2012, 4500-F^-, D, 4-87	SPADNS Method	0.05 mg/L
20.	Sulphide (S^{2-})	APHA, 22nd Ed., 2012, 4500 –S^2 , C-4-175, F-4-178	IodometricMethod	0.08 mg/L
21.	Dissolved Phosphate (P)	APHA,22nd Ed., 2012 , 4500 P,E, 4-155	Ascorbic Acid Method	0.03 mg/L
22.	Sodium Absorption Ratio	IS11624 :1986, Reaffirmed 2006	By Calculation	0.3
23.	Total Phosphorous (P)	APHA,22nd Ed., 2012 , 4500 P,E, 4-155	Ascorbic Acid Method	0.03 mg/L
24.	Total Kjeldahl Nitrogen	APHA, 22nd Ed., 2012, 4500 NH_3, B & C, 4 -110, 4-112	Titrimetric Method	0.1 mg/L
25.	Total Ammonia (NH_4 +NH_3)-Nitrogen	APHA,22d Ed., 2012 , 4500 NH_3, F, 4 -115	Colorimetric Method	0.001 mg/L
26.	Phenols (C_6H_5OH)	APHA,22nd Ed., 2012 , 5530- B & C, 5-44 & 5-47	Chloroform Extraction Method	0.001 mg/L

Sr.	Parameters	Methods References	Techniques	Detection Limit
27.	Surface Active Agents	APHA,22nd Ed., 2012 , 5540-B & C,5-50	Methylene Blue Extraction Method	0.1 mg/L
28.	Organo Chlorine Pesticides	APHA, 22nd Ed., 2012,6410B,6-74	GC MS-MS Method	0.01 µg/L
29.	Polynuclear aromatic hydrocarbons (PAH)	APHA, 22nd Ed., 2012,6410B,6-74	GC MS-MS Method	0.01 µg/L
30.	Polychlorinated Biphenyls (PCB)	APHA, 22nd Ed., 2012,6410B,6-74	GC MS-MS Method	0.01 µg/L
31.	Zinc (Zn)	IS 3025(Part 2): 2004	ICP Method	0.1 mg/L
32.	Nickel (Ni)	IS 3025(Part 2): 2004	ICP Method	0.05 mg/L
33.	Copper (Cu)	IS 3025(Part 2): 2004	ICP Method	0.03 mg/L
34.	Hexavalent Chromium (Cr^{6+})	APHA, 22ndEd., 2012,3500-Cr,B,3-69	Colorimetric Method	0.02 mg/L
35.	Total Chromium (Cr)	IS 3025(Part 2): 2004	ICP Method	0.02 mg/L
36.	Total Arsenic (As)	IS 3025(Part 2): 2004	ICP Method	0.005 mg/L
37.	Lead (Pb)	IS 3025(Part 2): 2004	ICP Method	0.008 mg/L
38.	Cadmium (Cd)	IS 3025(Part 2): 2004	ICP Method	0.002 mg/L
39.	Mercury (Hg)	IS 3025(Part 2): 2004	ICP Method	0.0008 mg/L
40.	Manganese (Mn)	IS 3025(Part 2): 2004	ICP Method	0.02 mg/L
41.	Iron (Fe)	IS 3025(Part 2): 2004	ICP Method	0.06 mg/L
42.	Vanadium (V)	IS 3025(Part 2): 2004	ICP Method	0.05 mg/L
43.	Selenium (Se)	IS 3025(Part 2): 2004	ICP Method	0.005 mg/L

Sr.	Parameters	Methods References	Techniques	Detection Limit
44.	Boron (B)	IS 3025(Part 2): 2004	ICP Method	0.1 mg/L
45.	Total Coliforms	APHA, 22nd Ed., 2012,9221-B, 9-66	Multiple tube fermentation technique (MPN/100ml)	1.1 MPN/100ml
46.	Faecal Coliforms	APHA, 22nd Ed., 2012,9221-E, 9-74	Multiple tube fermentation technique (MPN/100ml)	1.1 MPN/100ml
47.	Bioassay (Zebra Fish) Test	IS 6582, 1971, Reaffirmed 1987	Static Technique	-

Annexure IV: National Ambient Air Quality Standards, 2009

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National Ambient Air Quality Standards: Central Pollution Control Board

In exercise of the powers conferred by Sub-section (2) (h) of section 16 of the Air (Prevntion and Control of Pollution) Act, 1981 (Act No.14 of 1981), and in suppression of the Notification No(s). S.O.384(E), dated 11th April, 1994 and S.O.935(E), dated 14th October, 1998, the Central Pollution Control Board hereby notify the National Ambient Air Quality Standards **with immediate effect**, namely:

Sr. No.	Pollutant	Time Weighted Average	Concentration in Ambient Air		
			Industrial, Residential, Rural and Other Areas	Ecologically Sensitive Areas (Notified by Central Government)	Methods of Measurement
(1)	(2)	(3)	(4)	(5)	(6)
1	Sulphur Dioxide (SO_2) µg/m^3	Annual *	50	20	– Improved West and Gaeke – Ultraviolet fluorescence
		24 hours **	80	80	
2	Nitrogen Dioxide (NO_2) µg/m^3	Annual *	40	30	– Modified Jacob & Hochheiser (Na-Arsenite) – Chemilminescence
		24 hours **	80	80	
3	Particulate Matter (size less than 10 µm) or PM_{10} µg/m^3	Annual *	60	60	– Gravimetric – TOEM – Beta attenuation
		24 hours **	100	100	
4	Particulate Matter (size less than 2.5 µm) or $PM_{2.5}$ µg/m^3	Annual *	40	40	– Gravimetric – TOEM – Beta attenuation
		24 hours **	60	60	
5	Ozone (O_3) µg/m^3	8 hours **	100	100	– UV photometric – Chemiluminescence – Chemical Method
		1 hour **	180	180	
6	Lead (Pb) µg/m^3	Annual *	0.50	0.50	– AAS/ICP method after sampling on EPM 2000 or equivalent filter paper – EDXRF using Teflon filter
		24 hours **	1.0	1.0	
7	Carbon Monoxide (CO) mg/m^3	8 hours **	02	02	– Non Dispersive Infra Red (NDIR) spectroscopy
		1 hour **	04	04	
8	Ammonia (NH_3) µg/m^3	Annual *	100	100	– Chemiluminescence – Indophenol blue method
		24 hours **	400	400	
9	Benzene (C_6H_6) µg/m^3	Annual *	05	05	– Gas Chromatography based continuous analyzer – Adsorption and Desorption followed by GC analysis
10	Benzo (a) Pyrene (BaP) – particulate phase only, ng/m^3	Annual *	01	01	– Solvent extraction followed by HPLC/GC analysis
11	Arsenic (As) ng/m^3	Annual *	06	06	– AAS/ICP method after sampling on EPM 2000 or equivalent filter paper.
12	Nickel (Ni) ng/m^3	Annual *	20	20	– AAS/ICP method after sampling on EPM 2000 or equivalent filter paper.

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

** 24 hourly or 08 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.

SANT PRASAD GAUTAM, Chairman, Central Pollution Control Board [ADVT-III/4/184/09/Exty.]

Note: The notifications on National Ambient Air Quality Standards were published by the Central Pollution Control Board in the Gazette of India. Extraordinary vide notification No(s). S.O. 384(E), dated 11th April, 1994 and S.O. 935(E), dated 14th October,1998.

µg/m^3: micro-gram/m^3 i.e. 10^{-6}gm/m^3 ng/m^3 : nano-gram/m^3 i.e. 10^{-9}gm/m^3

Annexure V: General Standards for Discharge of Environmental Pollutants, Part A: Effluents (The Environment (Protection) Rules, 1986, Schedule VI)

Sr.	Parameter	Standards			
		Inland surface Water	**Public Sewers**	**Land for Irrigation**	**Marine Coastal Areas**
1.	Colour and Odour	See Note 1	--	See Note I	See Note 1
2.	Suspended solids, mg/L, Max.	100	600	200	a. For process waste water - 100 b. For cooling water effluent- 10 percent above total suspended mailer of influent cooling water.
3.	Particle size of suspended solids	Shall pass 850 micron IS Sieve			a. Floatable solids, Max 3 mm b. Settleable solids Max 850 microns
4.	Dissolved solids (Inorganic), mg/L, Max.	2100	2100	2100	--
5.	pH value	5.5 -9.0	5.5 -9.0	5.5 -9.0	5.5-9.0

Sr.	Parameter	Standards			
		Inland surface Water	**Public Sewers**	**Land for Irrigation**	**Marine Coastal Areas**
6.	Temperature °C, Max	Shall not exceed 40 in any section of the stream within 15 mts. Downstream from the effluent outlet	45 at the point of discharge	--	45 at the point of discharge
7.	Oil and Grease, mg/L, Max	10	20	10	20
8.,	Total Residual chlorine, mg/L, Max	1.0	--	--	1.0
9.	Ammonical Nitrogen (as N), mg/L, Max	50	50	--	50
10.	Total Kjeldahl Nitrogen (as N), mg/L, Max.	100	--	--	100
11.	Free Ammonia (as NH_3), mg/L, Max	5.0	--	--	5.0
12.	Biochemical oxygen demand (5 days, at 20° c) mg/L, Max	30	350	100	100
13.	Chemical oxygen demand, mg/L, Max	250	--	--	250
14.	Arsenic (as As), mg/l, Max	0.2	0.2	0.2	0.2
15.	Mercury (as Hg). Mg/L, Max	0.01	0.01	--	0.01
16.	Lead (as Pb), mg/L, Max	0.1	1.0	-	1.0
17.	Cadmium (as Cd), mg/L,	2.0	1.0	--	2.0

Sr.	Parameter	Standards			
		Inland surface Water	**Public Sewers**	**Land for Irrigation**	**Marine Coastal Areas**
18.	Hexavalent Chromium (as Cr^{+6}) mg/L, Max	.1	2.0	--	1.0
19.	Total Chromium (as Cr), mg/L, Max	2.0	2.0	--	2.0
20.	Copper (as Cu), mg/L, Max.	3.0	3.0	--	3.0
21.	Zinc (as Zn), mg/L, Max.	5.0	15	0--	15
22	Selenium (as Se), mg/l, Max.	0.05	0.05	--	0.05
23	Nickel (as Ni), mg/l, Max.	3.0	3.0	--	5.0
24	Boron (as B), mg/l, Max.	2.0	2.0	2.0	--
25.	Percent Sodium, Max.	--	60	60	--
26.	Residual Sodium carbonate, mg/l, Max.	--	--	5.0	--
27.	Cyanide (as Cn), mg/L, Max.	0.2	2.0	0.2	0.2
28.	Chloride (as Cl), mg/L, Max.	1000	1000	600	--
29.	Fluoride (as F), mg/IL, Max.	2.0	15	--	15
30.	Dissolved Phosphate (as P), mg/L, Max.	5.0	--	--	--
31.	Sulphate (as SO_4), mg/L, Max.	1000	1000	1000	--
32.	Sulphide (as S), mg/L, Max.	2.0	--	--	5.0

Sr.	Parameter	Standards			
		Inland surface Water	**Public Sewers**	**Land for Irrigation**	**Marine Coastal Areas**
33.	Pesticides	Absent	Absent	Absent	Absent
34.	Phenolic compounds (as C_6H_5OH), mg/L, Max.	1.0	5.0	--	5.0
35.	Radioactive materials:				
	a. Alpha emitters MC/ml., Max.	10^{-7}	10^{-7}	10^{-8}	10^{-7}
	b. Beta emitters µc/ml., Max	10^{-6}	10^{-6}	10^{-7}	10^{-6}

Annexure VI: Drinking Water Specification-IS 10500:2012

Sr.	Characteristic	Unit	Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
Table 1	**Organoleptic and Physical Parameters**			
1.	Colour	Hazen units	Max 5	Max 15
2.	Odour	-	Agreeable	Agreeable
3.	pH value	-	6.5-8.5	No relaxation
4.	Taste	-	Agreeable	Agreeable
5.	Turbidity	NTU	Max 1	Max 5
6.	Total dissolved solids	mg/L	Max 500	Max 2000
Table 2	**General parameters concerning substances undesirable in excessive amounts**			
7.	Aluminium (as Al)	mg/L	Max 0.03	Max 0.2
8.	Ammonia (as total ammonia- N)	mg/L	Max 0.5	No relaxation
9.	Anionic detergents (as MBAS)	mg/L	Max 0.2	Max 1.0
10.	Barium (as Ba)	mg/L	Max 0.7	No relaxation
11.	Boron (as B)	mg/L	Max 0.5	Max 1.0
12.	Calcium (as Ca)	mg/L	Max 75	Max 200
13.	Chloramines (as $C1_2$)	mg/L	Max 4.0	No relaxation
14.	Chlorides (as Cl)	mg/L	Max 250	Max 1000
15.	Copper (as Cu)	mg/L	Max 0.05	Max 1.5
16.	Fluoride (as F)	mg/L	Max 1.0	Max 1.5
17.	Free residual chlorine	mg/L	Min 0.2	Min 1
18.	Iron (as Fe)	mg/L	Max 0.3	No relaxation

Sr.	Characteristic	Unit	Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
19.	Magnesium (as Mg)	mg/L	Max 30	Max100
20.	Manganese (as Mn)	mg/L	Max 0.1	Max 0.3
21.	Mineral Oil	mg/L	Max 0.5	No relaxation
22.	Nitrate (as NO_3)	mg/L	Max 45	No relaxation
23.	Phenolic compounds (as C_6H_5OH)	mg/L	Max 0.001	Max 0.002
24.	Selenium (as Se)	mg/L	Max 0.01	No relaxation
25.	Silver (as Ag)	mg/L	Max 0.1	No relaxation
26.	Sulphate (as SO_4)	mg/L	Max 200	Max 400
27.	Sulphide (as H_2S)	mg/L	Max 0.05	No relaxation
28.	Total Alkalinity as calcium carbonate	mg/L	Max 200	Max600
29.	Total hardness (as $CaCO_3$)	mg/L	Max 200	Max 600
30.	Zinc (as Zn)	mg/L	Max 5	Max15
Table 3	**Parameters Concerning Toxic Substances**			
31.	Cadmium (asCd)	mg/L	Max 0.003	No relaxation
32.	Cyanide (asCN)	mg/L	Max 0.05	No relaxation
33.	Lead (as Pb)	mg/L	Max 0.01	No relaxation
34.	Mercury (asHg)	mg/L	Max 0.001	No relaxation
35.	Molybdenum (as Mo)	mg/L	Max 0.07	No relaxation
36.	Nickel (as Ni)	mg/L	Max 0.02	No relaxation
37.	Pesticides	mg/L	See Table 5	No relaxation
38.	Polychlorinatedbiphenyls	mg/L	Max 0.0005	No relaxation
39.	Poly nuclear aromatic Hydrocarbons (as PAH)	mg/L	Max 0.0001	No relaxation

Sr.	Characteristic	Unit	Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
40.	Total Arsenic(as As)	mg/L	Max 0.01	Max0.05
41.	Total Chromium (as Cr)	mg/L	Max 0.05	No relaxation
42.	Trihalomethanes			
a)	Bromoform	mg/L	Max 0.1	No relaxation
b)	DibromochloroMethane	mg/L	Max 0.1	No relaxation
c)	Bromodichloromethane	mg/L	Max 0.06	No relaxation
d)	Chloroform	mg/L	Max 0.2	No relaxation
Table 4	**Parameters Concerning Radioactive Substances**			
43.	Radioactive Materials			
a)	Alpha emitters	Bq/L	Max 0.1	No relaxation
b)	Beta emitters	Bq/L	Max 1.0	No relaxation
Table 5	**Pesticide Residues Limits and Test Method**			
i)	Alachor	µg/L	20	No relaxation
ii)	Atrazine	µg/L	2	No relaxation
iii)	Aldrin/ Dieldrin	µg/L	0.03	No relaxation
iv)	Alpha HCH	µg/L	0.01	No relaxation
v)	Beta HCH	µg/L	0.04	No relaxation
vi)	Butachlor	µg/L	125	No relaxation
vii)	Chlorpyriphos	µg/L	30	No relaxation
viii)	Delta HCH	µg/L	0.04	No relaxation
ix)	2,4- Dichlorophenoxyacetic acid	µg/L	30	No relaxation
x)	DDT (o,p&p,p — Isomers of DDT, DDE and DDD)	µg/L	1	No relaxation
xi)	Endosulfan (α,β & sulphate)	µg/L	0.4	No relaxation

Sr.	Characteristic	Unit	Requirement (Acceptable Limit)	Permissible Limit in the Absence of Alternate Source
xii)	Ethion	µg/L	3	No relaxation
xiii)	Gamma - HCH (Lindane)	µg/L	2	No relaxation
xiv)	Isoproturon	µg/L	9	No relaxation
xv)	Malathion	µg/L	190	No relaxation
xvi)	Methyl parathion	µg/L	0.3	No relaxation
xvii)	Monocrotophos	µg/L	1	No relaxation
xviii)	Phorate	µg/L	2	No relaxation
Table 6	**Bacteriological Quality of Drinking Water**			
44.	E.coli or thermotolerant coliform bacteria	/100	Not detectable	-
45.	Total coliform bacteria	/100 mL	Not detectable	-
	Virological Requirements			
46.	MS2 phage	/1 L	Absent	-
	Biological Requirements			
47.	Cryptosporidium	/10 L	Absent	-
48.	Giardia	/10 L	Absent	-
49.	Microscopic organisms such as algae, zooplanktons, flagellates, parasites and toxin producing organisms		Free from microscopic organisms	-

Annexure VII: CPCB Water Quality Criteria:

Designated best use	Quality Class	Primary Water Quality Criteria
Drinking water source without conventional treatment but with chlorination	A	➢ Total coliform organisms (MPN*/100 ml) shall be 50 or less ➢ pH between 6.5 and 8.5 ➢ Dissolved Oxygen 6 mg/Lor more, and ➢ Biochemical Oxygen Demand 2 mg/Lor less
Outdoor bathing (organized)	B	➢ Total coliform organisms (MPN/100 ml) shall be 500 or less ➢ pH between 6.5 and 8.5 ➢ Dissolved Oxygen 5 mg/Lor more, and ➢ Biochemical Oxygen Demand 3 mg/Lor less
Drinking water source with conventional treatment	C	➢ Total coliform organisms (MPN/100ml) shall be 5000 or less ➢ pH between 6 and 9 ➢ Dissolved Oxygen 4 mg/Lor more, and ➢ Biochemical Oxygen Demand 3 mg/Lor less
Propagation of wildlife and fisheries	D	➢ pH between 6.5 and 8.5 ➢ Dissolved Oxygen 4 mg/Lor more, and ➢ Free ammonia (as N) 1.2 mg/Lor less
Irrigation, industrial cooling, and controlled disposal	E	➢ pH between 6.0 and 8.5 ➢ Electrical conductivity less than 2250 micro mhos/cm, ➢ Sodium Absorption Ratio less than 26, ➢ and Boron less than 2 mg/l.
	Below E	➢ Not Meeting A, B, C, D & E Criteria

Annexure VIII: Water Quality Parameters Requirements and Classification

Water quality parameters are classified into three categories, given in Table (i), (ii) and (iii) (Source: CPCB, 2002, "Water Quality Criteria and Goals", Monitoring of Indian National aquatic Resources Series: MINARS/17/2001-2002).

Table: Basic Water Quality Requirement and Classification (Surface Water + Ground Water)

i) Simple Parameters:

Sr.	Parameters	Requirement for Waters of Class		
		A-Excellent	**B-Desirable**	**C-Acceptable**
(i)	Sanitary Survey	Very Clean neighborhood and catchment	Reasonably clean neighborhood	Generally clean neighborhood
(ii)	General Appearance	No floating matter	No floating matter	No floating matter
(iii)	Colour	Absolutely Colourless	Almost colourless, very light shade if any	No colour of anthropogenic origin
(iv)	Smell	Odourless	Almost odourless	No unpleasant odour
(v)	Transparency	>1.0 depth	>0.5 to 0.1m depth	>0.2 to 0.5 m depth
(vi)	Ecological* (Presence of Animals)	Fish & Insects	Fish & Insects	Fish & Insects

* Applicable to only surface water

ii) Regular Monitoring Parameters:

Sr.	Parameters	Requirement for Waters of Class		
		A Excellent	**B-Desirable**	**C-Acceptable**
(i)	pH	7.0 to 8.5	6.5 to 9.0	6.5 to 9.0
(ii)	DO (% Saturation)	90-110	80-120	60-140
(iii)	BOD, mg/l	Below 2	Below 5	Below 8
(iv)	EC, µmhos/cm	<1000	<2250	<4000
(v)	(NO_2+NO_3)-Nitrogen, mg/l	<5	<10	<15
(vi)	Suspended solid, mg/l	<25	<50	<100

Sr.	Parameters	Requirement for Waters of Class		
		A Excellent	B-Desirable	C-Acceptable
(vii)	Fecal Coliform, MPN/ 100 ml	<20 per 100 ml	<200 per 100 ml	<2000 per 100 ml
(viii)	Bio-assay (Zebra Fish)	No death in 5 days	No death in 3 days	No death in 2 days

Note:

1. Dissolved Oxygen (DO) not applicable for ground waters.
2. Dissolved Oxygen in eutrophicated waters should include measurement for diurnal variation.
3. Suspended solid limit is applicable only during non-monsoon period.
4. Faecal Coliform values should meet for 90% times.
5. Static Bio-Assay method may be adopted.

iii) Specific Parameters: (Only in case of need/apprehensions)

Sr.	Parameters	Requirement for Waters of Class		
		A- Excellent	B-Desirable	C-Acceptable
(i)	Total Phosphorous	<0.1 mg/l	< 0.2 mg/l	< 0.3 mg/l
(ii)	T.K.N	< 1.0 mg/l	<2.0 mg/l	<3.0 mg/l
(iii)	Total Ammonia (NH4 + NH3)-Nitrogen	< 0.5 mg/l	< 1.0 mg/l	< 1.5 mg/l
(iv)	Phenols	< 2µg/l	< 5µg/l	<10 µg/l
(v)	Surface Active Agents	<20 µg/l	<100µg/l	< 200µg/l
(vi)	Organo Chlorine Pesticides	< 0.05µg/l	< 0.1µg/l	< 0.2µg/l
(vii)	PAH	< 0.05µg/l	<0.1 µg/l	<0.2 µg/l
(viii)	PCB and PCT	< 0.01µg/l	< 0.01µg/l	< 0.02µg/l
(ix)	Zinc	< 100µg/l	< 200µg/l	<300 µg/l
(x)	Nickel	< 50µg/l	< 100µg/l	< 200µg/l
(xi)	Copper	< 20µg/l	< 50µg/l	<100µg/l
(xii)	Chromium (Total)	< 20µg/l	< 50µg/l	< 100µg/l

Sr.	Parameters	Requirement for Waters of Class		
		A- Excellent	B-Desirable	C-Acceptable
(xiii)	Arsenic (Total)	< 20µg/l	<50 µg/l	<100 µg/l
(xiv)	Lead	< 20µg/l	< 50µg/l	< 100µg/l
(xv)	Cadmium	< 1.0µg/l	<2.5 µg/l	< 5.0µg/l
(xvi)	Mercury	< 0.2µg/l	< 0.5µg/l	< 1.0µg/l

v.