BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL
WESTERN ZONE BENCH, PUNE

ORIGINAL APPLICATION NO. 77 OF 2016 (WZ)
IN
ORIGINAL APPLICATION NO. 33 OF 2013 (THC)
(DISPOSED OF ON 19/08/2015)

NOTARY
MANISHA SAMEER CHITNIS
PUNE (MAHARASHTRA)
REGD. NO. 20258
EXP. DATE 07/03/2025
GOVERNMENT OF INDIA

IN THE MATTER OF: -

JANARDAN CHANDAR PATIL & ANR. **APPLICANT(S)**

VERSUS

UNION OF INDIA & ORS. **RESPONDENT(S)**

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Pratik D. Bharne

(Pratik D. Bharne)

Scientist 'E' & Regional Director

Place: Pune

Date: 27/02/2025

क्षेत्रीय निदेशक / Regional Director
केंद्रीय प्रदूषण नियंत्रण बोर्ड
Central Pollution Control Board
क्षेत्रीय निदेशालय, पुणे/Regional Directorate, Pune
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार
M/o Envt. Forest & Climate Change, Govt. of India
सर्वे नं. ११०, हीराबाई धनकुडे हॉल, बाणेर रोड, बाणेर, पुणे – 411045
Sr. No. 110, Hirabai Dhankude Hall, Baner Road, Baner, Pune-411045

BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL
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REPLY ON BEHALF OF CENTRAL POLLUTION CONTROL BOARD (CPCB) IN COMPLIANCE TO THE HON'BLE NGT ORDER DATED 16/08/2024

1. That, Central Pollution Control Board (hereinafter referred as CPCB) is a Statutory Board, which is constituted under Section 3 of the Water (Prevention and Control of Pollution) Act, 1974. It performs the functions under The Water (Prevention and Control of Pollution) Act 1974, The Air (Prevention and Control of Pollution) Act 1981, and The Environment (Protection) Act, 1986.

2. That, Hon'ble NGT (WZ) in the instant Original Application has passed an order vide dated 16/08/2024. Relevant para of the order vide dated 16/08/2024 for compliance is reproduced as below:

   "...5. Looking to the fact that no timeline has been fixed as to by when, the entire work would be completed, we deem it appropriate to direct the CPCB to hold a meeting in consultation with the MPCB and Authorities of TTC Industrial Area and arrive on a timeline as to by

when, the said work would be completed, the said period would not be more than six months and submit a consolidated affidavit in this regard before the next date…"

In compliance of the above, the following are submitted.

3. That, CPCB vide email dated 17/09/2024 communicated a letter to Maharashtra Pollution Control Board (hereinafter referred as MPCB) and authorities of Trans Thane Creek (TTC) industrial area, Navi Mumbai to review the status with respect to time line bound implementation of CEPI action plan of Navi Mumbai (TTC industrial area). Copy of the letter addressed to MPCB is given at **Annexure-I**.

4. That, CPCB convened a meeting with MPCB and authorities of TTC industrial Area, Navi Mumbai on 19/09/2024 through video conferencing to review the status and time-bound implementation of CEPI action plan of Navi Mumbai (TTC industrial area). Wherein, CPCB made a detailed presentation on the status of percentage progress of action plan with time targets submitted by MPCB on CEPI Action Plan Review Portal. Percentage completion of implementation action plan of Navi Mumbai (TTC industrial area) as per the information uploaded by MPCB in the CEPI Action Plan Review Portal developed by CPCB was also discussed.

5. That, during the said review meeting, the concerned stakeholder(s) was requested to revise the timelines for implementation of each of the ongoing CEPI action plan in an expeditious manner in compliance to the Hon'ble NGT order vide dated 16/08/2024.

6. That, MPCB also requested all the concerned stakeholders to prepare detailed plan, status of implementation, steps to be taken for implementation of CEPI action plan of Navi Mumbai (TTC industrial area). Further, MPCB submitted that they shall compile and review the status of implementation of CEPI action plan prior submission to CPCB.

7. That, further MPCB submitted that CEPI action plan shall be completed within six months by MPCB and concerned stakeholder(s), as applicable and the status of the same shall also be reviewed at MPCB-HO level. Copy of the minutes of the meeting dated 19/09/2024 is given at **Annexure-II**.

8. That, a follow-up communication letter vide dated 25/10/2024 is also addressed to MPCB with a request submit the Action Taken Report along with technical details on the status of time bound implementation of CEPI action plan of Navi Mumbai (TTC industrial area) in compliance to the decisions/deliberations taken/made during the VC meeting dated 19/09/2024. Copy of the letter addressed to MPCB vide dated 25/10/2024 is given at **Annexure-III**.

9. That, further second meeting through VC along with MPCB and authorities of TTC industrial area, Navi Mumbai convened on 13/11/2024 for expediting the submission of Action Taken Report along with technical details on the status of time bound implementation of CEPI action plan.

10. That, further, in the affidavit submitted by CPCB in compliance with the order dated 19/02/2024, completion of 9 action plans by MPCB in the area were submitted. Further, in compliance to the Hon'ble NGT order dated 16/08/2024, MPCB has submitted the status of implementation of each of the CEPI action plan of Navi Mumbai (TTC industrial area) along with the percentage progress and timelines for its completion to CPCB on 04/12/2024 which is given **at Annexure-IV**.

It is further humbly submitted that, the progress in respect of following 04 CEPI action points are still under various stages of completion which are given as below:

Action Point	Responsible Agency	Percent	Timeline	Compliance
Vehicle pollution and traffic management plan	NMMC/RTO/MIDC	90	31.03.2025	1. In the MIDC TTC Navi Mumbai the length of the total road is 136 Km. Total constructed road in MIDC TTC Navi Mumbai is 136 Km. 2. In Navi Mumbai Municipal Corporation Area total road length is 595 Km, total length of road constructed is 595 Km. The corporation has repaired/constructed for last one year is 108 km. 3. Presently in Navi Mumbai city area 58 No of traffic signals/diversion provided for smooth movement of traffic to avoid air pollution – 58 Locations are installed with Traffic Signals in Navi Mumbai City. New signals were installed as and when required. 4. Navi Mumbai Municipal Corporation carried out daily road cleaning (Including small measures and inside lane) – Manual Sweeping of 482.2 km and Mechanical Seeping of 113.8 km is done daily. 5.Electric buses: The population of Navi Mumbai was 11,20,547 in 2011 as per the Census of India. • Accordingly, as per Guidelines 672 Buses are required to be fleeting in the city. Currently, NMMT has Total 531 Buses comprising of 251 Diesel, 85 CNG and

Action Point	Responsible Agency	Percent	Timeline	Compliance
				195 Electric Buses. • NMMT provided information that till FY 2027-28 all Diesel Buses will be scrapped and converted to Green Fuel (Electric & CNG). Additionally, 100 E buses have been planned to be procured from 15th Finance Commission Grants. Till date, 40 E buses are procured and 25 E buses are awaited to be delivered till December 2024 from 15th Finance Commission Grants. 6.The Navi Mumbai Municipal Transport (NMMT) has 154 CNG buses in its fleet. 7. In the year 2023-24 about 219 Nos. of vehicles scraped. 8. In the year 2023-24 about 39296 Nos. of new vehicle registered. 9. In the year 2023-24 about 4461 (CNG) & 2096 (E vehicle) registered. 10. There are 129 PUC station for last 1 year 1890 vehicles imposed fine.
To provide proper sewerage system for slum pockets & connects the sewage to	MIDC/NMMC	30	Min. 3 years 31.12.2027	The Navi Mumbai Municipal Corporation (NMMC) area there are 7 Nos. of STP's at different locations having total capacity 454 MLD. Total sewage generation from NMMC area is 230 MLD and same is treated in

Action Point	Responsible Agency	Percent	Timeline	Compliance
STPs & use of treated sewage for gardening & industrial purpose & Reuse of Treated Sewage				07 STPs. About 67.62 MLD treated water is being used for various purposes like gardening etc. washing of roads, divider etc. Further NMMC has proposed recycling of water in TTC MIDC area of 40 MLD. The sewage enerated from the MIDC slum pocket is approximately 4 to 5 MLD and the corporation & MIDC has planned to provide sewage treatment plant for the same. The Board has issued direction to MIDC and Municipal Corporation for submission of timebound program dated 18.11.2024. The Corporation has allotted the work to IIT Bombay for study and provide solutions for such as interception and diversion of sewage in slum pockets of MIDC. And after the study they are proposed for grey water collection and treatment and requested MIDC for suitable land for same.
Health Impact Assessment Study.	DISH District Health Officer MPCB	-	31.12.2026	The Navi Mumbai Municipal corporation has submitted the health data related to respiratory illnesses. From the data it reveals that there is decrease in number of patients in 2024 compare to 2023 & the recovery percentage is higher than previous year. MPC Board has decided to allot Health Impact Assessment Study to the

Action Point	Responsible Agency	Percent	Timeline	Compliance
				agency.
Monitoring of The Industries for compliance of CEPI norms	MPCB	90	Continuous	Its ongoing process.

11. It is to submit that, MPCB requested time for aforesaid CEPI action points and MPCB has issued communication/directions to concerned Stakeholder(s) for completion of same.

12. In view of the above facts and circumstances, this Answering Respondent i.e. CPCB shall abide by any order(s) or direction(s) passed by this Hon'ble NGT in the present Original Application.

Pratik D. Bharne
(Scientist 'E' & Regional Director)
Central Pollution Control Board, Pune

क्षेत्रीय निदेशक / Regional Director
केंद्रीय प्रदूषण नियंत्रण बोर्ड
Central Pollution Control Board
क्षेत्रीय निदेशालय, पुणे/Regional Directorate, Pune
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार
M/o Envt. Forest & Climate Change, Govt. of India
सर्वे नं. ११०, हीराबाई धनकुडे हॉल, बाणेर रोड, बाणेर, पुणे - 411045
Sr. No. 110, Hirabai Dhankude Hall, Baner Road, Baner, Pune-411045

NOTARY ★ MANISHA SAMEER CHITNIS PUNE (MAHARASHTRA) REGD. NO. 20258 EXP. DATE 07/03/2025 GOVERNMENT OF INDIA

Noted & Registered
At.Sr.No. 124/2025

BEFORE ME

MANISHA SAMEER CHITNIS
NOTARY
GOVERNMENT OF INDIA
27 FEB 2025

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BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL

WESTERN ZONE BENCH, PUNE

ORIGINAL APPLICATION NO. 77 OF 2016 (WZ)

IN

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(DISPOSED OF ON 19/08/2015)

IN THE MATTER OF: -

JANARDAN CHANDAR PATIL & ANR. APPLICANT(S)

VERSUS

UNION OF INDIA & ORS. RESPONDENT(S)

AFFIDAVIT

I, Pratik D. Bharne, working as Scientist 'E' & Regional Director in Central Pollution Control Board, Regional Directorate, Survey No. 110, Hirabai Dhankude Multipurpose Hall, Baner Road, Baner, Pune, do hereby solemnly affirm anddeclare as under:

1. That, the deponent is authorized representative to represent the Respondent CPCB in the present case, and as such, I am well conversant with the facts and circumstances of the present case on the basis of the information derived from the official records, and hence, I am competent and authorized to verify, sign and swear this affidavit on behalf of the Respondent CPCB.

2. That, the accompanying reply may be read part and parcel of the present affidavit as I am competent to swear this affidavit.

3. That, the contents there of are true and correct on the basis of the record maintained during ordinary course of business of CPCB

and available records and documents and the contents of the same are read over and explained to me and are not repeated herein for the sake of brevity.

Prakash

DEPONENT

VERIFICATION

Verified at Pune on this day.....of February, 2025 that the contents of the above reply are correct and true on the basis of the record of the cases as mentioned in the day to day affairs of the CPCB. Nothing has been concealed therefrom or mis-stated.

NOTARY
MANISHA SAMEER CHITNIS
PUNE (MAHARASHTRA)
REGD. NO. 20258
EXP. DATE 07/03/2025
GOVERNMENT OF INDIA

Prakash

DEPONENT

COUNSEL FOR RESPONDENT

क्षेत्रीय निदेशक / Regional Director
केंद्रीय प्रदूषण नियंत्रण बोर्ड
Central Pollution Control Board
क्षेत्रीय निदेशालय, पुणे/Regional Directorate, Pune
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार
M/o Envt. Forest & Climate Change, Govt. of India
सर्वे नं. ११०, हीराबाई धनकुडे हॉल, बाणेर रोड, बाणेर, पुणे - 411045
Sr. No. 110, Hirabai Dhankude Hall, Baner Road, Baner, Pune-411045

Noted & Registered
At.Sr.No...125/2025

NOTARIAL NOTARIAL NOTARIAL NOTARIAL NOTARIAL

BEFORE ME

MANISHA SAMEER CHITNIS
NOTARY
GOVERNMENT OF INDIA

27 FEB 2025

Annexure-I

Fwd: Meeting with the MPCB-HO, MPCB-RO, CPCB RD-Pune and Authorities of TTC industrial area to discuss about the implementation of CEPI Action Plan in the TTC Industrial Area – reg.

PB
Pratik Bharne <pratik.cpcb@gov.in>
Tue, 17 Sep 2024 12:45:13 PM +0530 •
To "NISHCHAL C" <nischal.cpcb@nic.in>
Cc "SHAILENDRA BANSAL" <shailendra.cpcb@gov.in>

कृपया, आवश्यक जानकारी और उचित कार्यवाही के लिए।

प्रतीक भरणे/PRATIK BHARNE
क्षेत्रीय निदेशक/Regional Director,
क्षेत्रीय निदेशालय, पुणे/Regional Directorate, Pune
केंद्रीय प्रदूषण नियंत्रण बोर्ड/Central Pollution Control Board
पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय/Ministry of Environment, Forest & Climate Change
भारत सरकार/Govt of India
09428167876/020-29912772

============ Forwarded message ============
From: IPC- VII <ipc7.cpcb@gov.in>
To: "ms"<ms@mpcb.gov.in>, "ronavimumbai"<ronavimumbai@mpcb.gov.in>, "mpcbnavimumbai" <mpcbnavimumbai@mpcb.gov.in>, "Pratik Bharne"<pratik.cpcb@gov.in>
Cc: "P K GUPTA"<pkgupta.cpcb@nic.in>, "AMIT THAKKAR"<amitthakkar.cpcb@nic.in>, "Gokul Kannan T"<gokulkannan.cpcb@gov.in>, "Ms Chitrakshi"<chitrakshi.cpcb@gov.in>
Date: Tue, 17 Sep 2024 12:40:16 +0530
Subject: Meeting with the MPCB-HO, MPCB-RO, CPCB RD-Pune and Authorities of TTC industrial area to discuss about the implementation of CEPI Action Plan in the TTC Industrial Area – reg.
============ Forwarded message ============

Sir/Madam,

This has reference to the Hon'ble NGT order (as attached) vide dated 16.08.2024 in the Original Application No. 77/2016 (WZ), Pune regarding the CEPI action plan implemented in the TTC industrial area.

In the above-said order, it is stated in the para 5 that "Looking to the fact that no timeline has been fixed as to by when, the entire work would be completed, we deem it appropriate to direct the CPCB to hold a meeting in consultation with the MPCB and Authorities of TTC Industrial Area and arrive on a timeline as to by when, the said work would be completed, the said period would not be more than six months and submit a consolidated affidavit in this regard before the next date."

In compliance of the above-mentioned order, a meeting is scheduled with the MPCB-HO, MPCB-RO, CPCB RD-Pune and Authorities of TTC industrial area to discuss about the implementation of Action Plan on **19.09.2024 at 11 AM through VC**.

It is requested to MPCB-HO, MPCB-RO, CPCB RD-Pune and Authorities of TTC industrial area to kindly make it convenient to attend the meeting. A line of confirmation will be appreciated.

VC link will be shared shortly.

With Regards,
IPC - VII Division

Central Pollution Control Board
Delhi.

2 Attachment(s) • Download as Zip • Add To ›

MPCB Letter.pdf
696.4 KB •

Honble NGT order.pdf
631.9 KB •

केन्द्रीय प्रदूषण नियंत्रण बोर्ड
CENTRAL POLLUTION CONTROL BOARD
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार
MINISTRY OF ENVIRONMENT, FOREST & CLIMATE CHANGE, GOVT. OF INDIA

To

As per the list

Subject: **Meeting with the MPCB-HO, MPCB-RO, CPCB RD-Pune and Authorities of TTC industrial area to discuss about the implementation of CEPI Action Plan in the TTC Industrial Area – reg.**

Sir/Madam,

This has reference to the Hon'ble NGT order (as attached) vide dated 16.08.2024 in the Original Application No. 77/2016 (WZ), Pune regarding the CEPI action plan implemented in the TTC industrial area. In the above-said order, it is stated in the para 5 that "Looking to the fact that no timeline has been fixed as to by when, the entire work would be completed, we deem it appropriate to direct the CPCB to hold a meeting in consultation with the MPCB and Authorities of TTC Industrial Area and arrive on a timeline as to by when, the said work would be completed, the said period would not be more than six months and submit a consolidated affidavit in this regard before the next date." In compliance of the above-mentioned order, a meeting is scheduled with the MPCB-HO, MPCB-RO, CPCB RD-Pune and Authorities of TTC industrial area to discuss about the implementation of Action Plan on **19.09.2024 at 11 AM through VC**. The agenda items for consideration are as follows:

Sl. No.	Agenda Item
1	**To discuss about the implementation of CEPI action plan in the TTC industrial area within the timeline**

A presentation will be made by the concerned Division of CPCB, followed by discussion.

It is requested to MPCB-HO, MPCB-RO, CPCB RD-Pune and Authorities of TTC industrial area to kindly make it convenient to attend the meeting. A line of confirmation will be appreciated.

VC link will be shared shortly.

Yours faithfully,

(P.K Gupta)
Director
IPC-VII Division

'परिवेश भवन' पूर्वी अर्जुन नगर, दिल्ली-110032
Parivesh Bhawan, East Arjun Nagar, New Delhi - 110032
दूरभाष/Tel: 43102030, 22305792, वेबसाईट/Website : www.cpbc.nic.in

To:

1.	The Member Secretary Maharashtra Pollution Control Board Kalpataru Point, 2nd – 4th Floor Opp. Cine Planet Cinema, Nr. Sion Circle Sion (E), Mumbai – 400 022	:	MPCB is also requested to invite the stakeholders (viz. Navi Mumbai Municipal Corporation (NMMC), Thane Belapur Industries Association (TBIA), Maharashtra Industrial Development Corporation (MIDC), Mahanagar Gas Ltd (MNGL), Regional Transport Officer (RTO) and Directorate of Industrial Safety & Health (DISH) - District Health Officer) for attending the meeting.
2.	The Regional Officer (Navi Mumbai) Maharashtra Pollution Control Board Raigad Bhavan, 7th floor Sector - 11, C.B.D Belapur, Navi Mumbai	:	……………………do…………………………
3.	The Regional Director (Pune) Central Pollution Control Board Survey No. 110, Dhankude Multi-Purpose Hall Baner Road, Baner Pune - 411045	:	With the request to attend the meeting and follow up, please.

Annexure-II

CPCB

Central Pollution Control Board, Delhi
(IPC- VII Division)

Minutes of the meeting to review the status of implementation of the CEPI Action Plan in TTC Industrial area held on 19.09.2024, through video conferencing

A meeting was held with the officials of the Maharashtra Pollution Control Board (MPCB), the stakeholders of TTC Industrial area and the CPCB RD- Pune on 19.09.2024, at 11:00 AM through video conferencing to review the status of the implementation of the CEPI action plan in the TTC Industrial Area. A list of participants is attached as ***Annexure I.***

At the outset, Shri P K. Gupta, Director & Divisional Head-IPC-VI&VII, welcomed all the participants. He informed that the objective of the meeting is to review the status of implementation of the CEPI action plan in the TTC Industrial Area in compliance with the **Hon'ble NGT order vide dated 16.08.2024 in the Original Application No. 77/2016 (WZ), Pune.**

He further revealed that in the above-mentioned order, it is stated in the para 5 that

"….Looking to the fact that no timeline has been fixed as to by when the entire work would be completed, we deem it appropriate to direct the CPCB to hold a meeting in consultation with the MPCB and Authorities of TTC Industrial Area and arrive on a timeline as to by when, the said work would be completed, the said period would not be more than six months and submit a consolidated affidavit in this regard before the next date (13.12.2024)…"

He also emphasized setting a timeline for the completion of the CEPI Action Plan in the TTC Industrial Area within 6 months.

Shri Amit Thakkar, Additional Director, IPC-VI & VII Div. CPCB, gave a presentation on the status of implementation of time bond CEPI Action Plan as per CEPI Portal in Navi Mumbai. He informed that CPCB carried out CEPI monitoring in Navi Mumbai during the year 2018 and the CEPI score was calculated to be 66 (Severely Polluted Area) with Air EPI, Surface water EPI and Groundwater EPI as 56.00, 63.00 and 16.00 respectively. As per KML Map of Navi Mumbai Area submitted by MPCB, TTC Industrial area is part of Navi Mumbai SPA Area and also includes Navi Mumbai, and Taloja Industrial Areas. Further, MPCB prepared the action plan for reducing the CEPI score in Navi Mumbai including TTC Area and information regarding the implementation of the action plan is uploaded on the CEPI portal by MPCB which is reviewed by CPCB.

He also presented about the existing status of implementation of CEPI Action Plan in TTC Area as per the information submitted by MPCB on the CEPI portal. Each action points were discussed in detail. CPCB RD Pune suggested, NMMC shall also include reuse of treated sewage in building construction projects for completion of action point regarding utilization of treated sewage. Further, it was discussed with the representatives of MPCB, CPCB RD-Pune and the concerned stakeholders regarding the completion of the implementation of CEPI Action Plan in the TTC Industrial area within the timeline of 6 months. The power point presentation is attached as ***Annexure-II.***

CPCB RD Pune suggested that for submission of consolidated affidavit, details of completion with supporting document may be required. In this regard, MPCB was requested to submit details including statistics in support of implementation of action points.

Dr. V.M. Motghare, Joint Director (APC), Maharashtra PCB & State Nodal Officer for NCAP, informed that the implementation of all the CEPI action points in the TTC Industrial Area shall be completed within 6 months by MPCB and stakeholders the status will be reviewed at MPCB HO level as well. He requested all stakeholders of the area to prepare detailed plan, status of implementation, steps to be taken for implementation of action plan. He also informed that the meeting will be conducted by MPCB officials to review the status of implementation of CEPI action in the area. Furthermore, he also mentioned that the MPCB shall submit the technical details of the CEPI action plan to the CPCB-HO and CPCB RD-Pune. The status will be shared to CPCB.

CPCB RD Pune suggested that for submission of consolidated affidavit, details of completion with supporting document may be required. In this regard, MPCB was requested to submit details including statistics in support of implementation of action points.

After the presentation, Shri Gupta requested to MPCB to complete the CEPI action plan in the TTC Industrial area within the period of 6 months in compliance of the Hon’ble NGT order. Further, it was also informed to MPCB for submitting the report of technical details on the status of implementation of each CEPI action point in the TTC Industrial area with the justification by 15.10.2024. Further, he requested to CPCB RD-Pune for follow-up and review the status of implementation of CEPI action plan. CPCB will conduct review meeting during the timeline of 6 months.

The meeting ended with thanks to the chair.

Annexure-I

LIST OF PARTICIPANTS ATTENDED THE MEETING

1	Sh. P.K Gupta, Department Head & Director, IPC VI & VII CPCB, Delhi
2	Sh. Pratik Bharne, RD CPCB Pune (Joined Through VC)
2	Sh. Amit Thakkar, Add. Director, IPC VI & VII CPCB, Delhi
2	Ms. Chitrakshi, Scientist B, VII CPCB, Delhi
3	Sh. Gokul . T. Kanan, Scientist B, VII CPCB, Delhi
4	Dr. Piyush Soni, Consultant, IPC VI & VII CPCB, Delhi
5	Dr. V. M Mothghare, J.D. APC, MPCB (Joined Through VC)
6	RO MPCB, Navi Mumbai (Joined Through VC along with other officials of MPCB and Stakeholders as listed below)

Sub: Implementation of CEPI progress report
Date: 19.09.2024 **Time:** 11:00 AM.

Sr. No.	Name and Designation	Organization	Contact Number	Signature
1	AKHILESH SINGH, DGM-EHS	HINDUSTAN PLATINUM PVT LTD.	9769047722	
2	Mohit Gharat Head-HSES	Lubrizol India Pvt. Ltd.	9136932263	
3	Dattatraya Gutte Dy manager-HSES	Lubrizol India Pvt Ltd	9768459480	
4	MAHESH KORE SENIOR MANAGER	MAHANAGAR GAS LTD	9167997939	
5	Sanjiv R Sawale Deputy Engineer MIDC	MIDC, Mahape	8108119186	
6	Ravi Alok Deputy Manager	Mahanagar Gas	9967174204	
7	Sweta Sonule Assistant Engg. MIDC	MIDC, Mahape	8999883680	
8	Uttam S. Kadam Plant Head	Precise biopharma Pvt Ltd. Turbhe	7021502192	
9	Akhil RAO (Partner) Beetachem Ind	Beetachem Ind TTC MIDC	9821110132	
10	Raghavendra Pastey Env. Dept NMMC.	NMMC	9870083483	
11	Ajinkya Patil NMM	NMMC	8237753538	
12	Sarthak Dange	NMMC Consultant	9930083917	
13	Sandeep-HOD	[illegible]	[illegible]	
14	Purva Mahajan JE Trainee	NMMC	9167835963	
15	M.M. BRAHME G.M.	TBIA	9820118501	
16	Teerthraj Adhav Dy. G.M.	CETP (TTC & ASS)	9821911127	
17	Sunil Mhetre I.M.V.	Dy RTO Navi Mumbai	9930914976	
18	Abhijit Ramesh Patil - HOD-EHS	RPG Life Sci Pawane, Navi Mum.	8888363322	Abhijit
19	Prakash Kadam MGR-EHS	Zydus Takeda Healthcare Pvt Ltd	8879642324	
20	Durgesh S. Sonar Sr. officer EHS	NOCIL LTD, Navi-mumbai	8652128517	
21	Dr. Vikrant Khalekar	SRO-Taloja	8983320725	

Maharashtra Pollution Control Board
Attendance Sheet

Sub: Implementation of CEPI progress report

Date: 19.09.2024 **Time:** 11:00 AM.

Sr. No.	Name and Designation	Organization	Contact Number	Signature
1	V. M. Motghare	J.D. APC MPCB	online	
2	S. H. Padwal	RO MPCB Navimumbai		[signature]
3	A. B. Durgule	SRO MPCB Navimumbai-I		[signature]
4				

ANNEXURE - II

Meeting with MPCB and RD-Pune for implementation of Action plan in the TTC Industrial Area

Central Pollution Control Board

September 19, 2024

Agenda of the meeting

- To review the status of implementation of CEPI action plan in the TTC industrial area

Introduction

- CPCB conducted CEPI monitoring in Navi Mumbai during the year 2018 and the CEPI score was calculated to be **66 (Severely Polluted Area)**.
- MPCB prepared the action plan for reducing the CEPI score in Navi Mumbai and approved by CPCB for implementation.
- Information regarding the implementation of action plan is uploaded on the CEPI portal by MPCB and reviewed by CPCB

CEPI scores of Navi Mumbai

Components	Score during CEPI monitoring by CPCB during 2018
Air EPI	56.00
Surface water EPI	63.00
Groundwater EPI	16.00
Overall CEPI score	66.00

Introduction

- In the **Hon'ble NGT order vide dated 16.08.2024 in the Original Application No. 77/2016 (WZ),** Pune regarding the CEPI action plan implementation in the TTC industrial area, it is stated in the para 5 that

"….Looking to the fact that no timeline has been fixed as to by when, the entire work would be completed, we deem it appropriate to direct the CPCB to hold a meeting in consultation with the MPCB and Authorities of TTC Industrial Area and arrive on a timeline as to by when, the said work would be completed, the said period would not be more than six months and submit a consolidated affidavit in this regard before the next date (13.12.2024)…"

Action plan in progress in the Navi Mumbai & TTC Industrial area (CEPI portal information)

S.no	Category	Action Point	Responsible Ageancy	Timeline	Present Status
1	Water Environment	Reuse of Treated Sewage.	NMMC & MPCB	31-12-2024	80%
2	Water Environment	Recovery of Solvent by solvent using units.	Industries	31-03-2025	80%
3	Water Environment	Performance Evaluation of ETPs	Industry	31-03-2025	80%
4	Water Environment	Upgradtion of Individual ETPs	Industries	31-03-2025	90%
5	Water Environment	Improvement in ECS	Industries	31-03-2025	80%
6	Water Environment	To provide proper sewerage system for slum pockets & connects the sewage to STPs & use of treated sewage for gardening & industrial purpose	MIDC/ NMMC	31-03-2026	10%
7	Water Environment	Installation of Supervisory control and data acquisition (SCADA)	Industry, MPCB and CETP	31-12-2024	80%
8	Water Environment	Monitoring of ground water at MSW/TSDF site.	MPCB	31-12-2024	70%
9	Water Environment	Monitoring of the Industries for compliance of CEPI norms	MPCB	31-12-2024	70%

Action plan in progress in the TTC Industrial area (CEPI portal information)

S.no	Category	Action Point	Responsible Ageancy	Timeline	Present Status
10	Air Environment	Air Quality Monitoring and Emission Source apportionment Study of Navi Mumbai City	NMMC / MPCB	31-03-2025	30%
11	Air Environment	Inventory of Hazardous air Pollutant emitting units and installation of Leak detection & repair (LDAR) in Case pesticide & bulk drug manufacturing units	MPCB/Individual industry	31-03-2025	70%
12	Air Environment	Performance Evaluation of ECS	Industries	31-03-2025	80%
13	Air Environment	Online display of AAQM data	MPCB	31-12-2023	80%
14	Air Environment	Installation of VOC analyzer	Industry	31-12-2024	90%
15	Air Environment	Air pollution control measures for stone crusher units.	MPCB	31-12-2017	60%
16	Air Environment	Change in Fuel.	MNGL	31-12-2024	70%
17	Land Environment	Development of green belt & garden.	MIDC & TBIA	31-12-2024	80%
18	Infrastructure/renewal measures	Replacement of Damaged pipeline. The replacement of old/damaged pipelines by the new one has not been completed.	MIDC	31-12-2024	90%

Action plan in progress in the TTC Industrial area (CEPI portal information)

S.no	Category	Action Point	Responsible Ageancy	Timeline	Present Status
19	Infrastructure/renewal measures	Repairs of Internal Roads in MIDC area.	NMMC	31-12-2024	60%
20	Other	Health Impact Assessment Study.	DISH District Health Officer MPCB	31-03-2025	80%
21	Other	Awareness program	MPCB	31-12-2024	80%
22	Other	Vehicle pollution and traffic management plan	NMMC/RTO/MIDC	31-03-2025	80%

Action plan in progress in the Taloja Industrial area (CEPI portal information)

S.no	Category	Action Point	Responsible Ageancy	Timeline	Present Status
1	Water Environment	Performance Evaluation of CETP	CETP & MPCB	31-12-2024	20%
2	Water Environment	Performance Evaluation of ETPs	Industries	31-12-2024	70%
3	Water Environment	Taking possession of drainage pipeline carrying effluent to CETP.	CETP MIDC MPCB as per Nodal Agency	31-12-2024	90%
4	Water Environment	Improvements in CETP.	CETP	31-12-2024	40%
5	Water Environment	Replacement of Damaged pipeline. The replacement of old/damaged pipelines by the new one has not been completed.	MIDC MPCB as Nodal Agency	31-12-2024	90%
6	Water Environment	Installation of Supervisory control and data acquisition (SCADA)	Industry CETP MPCB	31-12-2024	10%
7	Water Environment	Installation of Online monitoring system to 13 nos. of highly polluting (17th Category) industries.	Industry MPCB	31-12-2024	90%
8	Water Environment	Monitoring of the Industries for compliance of CEPI norms	MPCB	31-12-2024	50%
9	Water Environment	Improvements in CETP.	CETP	31-12-2024	50%

Action plan in progress in the Taloja Industrial area (CEPI portal information)

S.no	Category	Action Point	Responsible Ageancy	Timeline	Present Status
10	Air Environment	Performance Evaluation of ECS.	Industries	31-12-2024	50%
11	Air Environment	Repairs of Internal Roads in MIDC area.	MIDC	31-12-2024	60%
12	Air Environment	Installation of VOC analyzer.	Industries	31-12-2024	80%
13	Air Environment	Change in fuel	Industries	31-12-2024	70%
14	Air Environment	Improvement in ECS	Industries	31-12-2024	60%
15	Air Environment	Inventory of Hazardous air Pollutant emitting units and installation of Leak detection & repair (LDAR) in Case pesticide & bulk drug manufacturing units	MPCB	31-12-2024	10%

Status of action plan as per the CEPI portal information

Compliance verification report by RD-Pune

CPCB
LiFE Lifestyle for Environment
G20 भारत 2023 INDIA वसुधैव कुटुम्बकम् ONE EARTH • ONE FAMILY • ONE FUTURE
केन्द्रीय प्रदूषण नियंत्रण बोर्ड
CENTRAL POLLUTION CONTROL BOARD
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार
MINISTRY OF ENVIRONMENT, FOREST & CLIMATE CHANGE, GOVT. OF INDIA

CPCB/IPC-VII/CEPI/2024 **Date: 25.10.2024**

To

Annexure-III

The Member Secretary
Maharashtra Pollution Control Board
Kalpataru Point, 2nd – 4th Floor Opp. Cine Planet Cinema
Nr. Sion Circle
Sion (E) Mumbai – 400 022

Subject: Submission of Action Taken Report on the status of implementation of the CEPI Action Plan in TTC industrial area - Reg.

Reference:
1. Hon'ble NGT order vide dated 16.08.2024 in the Original Application No. 77/2016 (WZ), Pune.
2. Meeting notice shared through email dated 17.09.2024 for the meeting held on 19.09.2024
3. Minutes of the meeting shared through email dated 04.10.2024

Sir / Madam,

This has reference to the meeting held with the officials of MPCB, the stakeholders of TTC Industrial area and the CPCB RD- Pune on 19.09.2024 to review the status of implementation of the CEPI Action Plan in TTC Industrial Area in compliance with the Hon'ble NGT order vide dated 16.08.2024 in the Original Application No. 77/2016 (WZ), Pune.

In the meeting, MPCB was requested to complete the CEPI action plan in the TTC Industrial area within the period of 6 months in compliance of the above-mentioned order and to submit the report of technical details on the status of implementation of each CEPI action point in the TTC Industrial area with the justification by 15.10.2024. In addition, the details of completion with supporting document may be required for submission of consolidated affidavit by CPCB before the next hearing date of 13.12.2024. The minutes of the meeting was shared through above referred mail dated 04.10.2024.

In this regard, MPCB is requested to submit the Action Taken Report in line with the deliberations made during the meeting on the status of implementation of each CEPI action point in the TTC Industrial area at earliest.

Yours sincerely

Amit R Thakkar
Additional Director, IPC-VII

Copy to:

1. **The Regional Director (Pune)**
Central Pollution Control Board
Survey No. 110, Dhankude Multi
Purpose Hall, Baner Road, Baner,
Pune - 411045 : for kind information and follow up, please.

Fwd: Fw: Draft report of CEPI compliance wrt the NGT matter OA No.77/2016 with all relevant information and Annexures.

Annexure-IV

PB Pratik Bharne <pratik.cpcb@gov.in>
Thu, 21 Nov 2024 3:48:27 PM +0530 •
To "NISHCHAL C" <nischal.cpcb@nic.in>
Cc "SHAILENDRA BANSAL" <shailendra.cpcb@gov.in>

Please consider this email and ignore earlier e-mail in his matter forwarded to u before noon today.

प्रतीक भरणे/PRATIK BHARNE
क्षेत्रीय निदेशक/Regional Director,
क्षेत्रीय निदेशालय, पुणे/Regional Directorate, Pune
केंद्रीय प्रदूषण नियंत्रण बोर्ड/Central Pollution Control Board
पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय/Ministry of Environment, Forest & Climate Change
भारत सरकार/Govt of India
09428167876/020-29912772

============ Forwarded message ============
From: CPCB, Pune <rdpune.cpcb@gov.in>
To: "Pratik Bharne"<pratik.cpcb@gov.in>
Date: Thu, 21 Nov 2024 14:58:40 +0530
Subject: Fwd: Fw: Draft report of CEPI compliance wrt the NGT matter OA No.77/2016 with all relevant information and Annexures.
============ Forwarded message ============

धन्यवाद,
केंद्रीय प्रदूषण नियंत्रण बोर्ड
क्षेत्रीय निदेशालय, पुणे
020-29912773

============ Forwarded message ============
From: <sronavimumbai1@mpcb.gov.in>
To: <ronavimumbai@mpcb.gov.in>
Cc: "CPCB, RD Pune"<rdpune.cpcb@gov.in>
Date: Thu, 21 Nov 2024 14:18:55 +0530
Subject: Fw: Draft report of CEPI compliance wrt the NGT matter OA No.77/2016 with all relevant information and Annexures.
============ Forwarded message ============

Sir,

Please find attached herewith the revised draft report of CEPI compliance wrt the NGT matter OA No.77/2016 with all relevant information and Annexures.

Regards,
Amar B Durgule.
Sub-Regional Officer,
Maharashtra Pollution Control Board,
Email: -
sronavimumbai1@mpcb.gov.in

From: SRO Navimumbai 1 <sronavimumbai1@mpcb.gov.in>
Sent: Tuesday, November 19, 2024 6:40 PM
To: RO Navimumbai
Cc: rdpune.cpcb@gov.in
Subject: Draft report of CEPI compliance wrt the NGT matter OA No.77/2016 with all relevant information and Annexures.

Sir,

Please find attached herewith the draft report of CEPI compliance wrt the NGT matter OA No.77/2016 with all relevant information and Annexures.

Regards,
Amar B Durgule.
Sub-Regional Officer,
Maharashtra Pollution Control Board,
Email: -
sronavimumbai1@mpcb.gov.in

13 Attachment(s) • Download as Zip • Add To ›

Annexure II.pdf
10.1 MB •

Annexure III.pdf
416.5 KB •

Annexure IV.pdf
442.2 KB •

Annexure IX (2).pdf
176.6 KB •

Annexure V.pdf
388.9 KB •

Annexure VI.pdf
607.4 KB •

Annexure VII (2).pdf

407.4 KB •

Annexure VIII (2).pdf
447.2 KB •

Annexure X.pdf
179.7 KB •

Annexure XII.xlsx
15.3 KB •

Annexure XIII.pdf
176.7 KB •

New Annexure XI.pdf
189.5 KB •

CEPI action point complian… .xlsx
17.2 KB •

ACTION PLAN STATUS SUBMITTED BY MPCB

S.No.	Action Points	Responsible Agency	Completion Status	Timeline	Remark
1	Noise mapping of Navi Mumbai Mumbai City	NMMC/MPCB	100	-	The Board has carried out Ambient Noise Monitoring of Navi Mumbai Municipal Corporation Area during the year 2023. (**Annexure I)** The Board has installed Real Time Noise Monitoring Stations (RTMS) at different location in the Navi Mumbai Municipal Corporation area as follows- 1. Mango Garden , Belapur, Navi Mumbai. 2.Tortoise Garden ,Vashi, Navi Mumbai. 3. Rabale ,Belapur, Navi Mumbai. Noise monitoring during Diwali and Ganesh festival is carried out by MPCB through MoEF approved agency.
2	Air Quality Monitoring and Emission Source apportionment Study of Navi Mumbai City	NMMC/MPCB	100	-	Board has carried out Air Quality Monitoring and Emission Source apportionment Study of Navi Mumbai by IIT (B), Mumbai and CSIR NERI. Report enclosed. **(Annexure II)**

S.No.	Action Points	Responsible Agency	Completion Status	Timeline	Remark
3	Vehicle pollution and traffic management plan	NMMC/RTO/MIDC	90	31.03.2025	1. In the MIDC TTC Navi Mumbai the length of the total road is 136 Km. Total constructed road in MIDC TTC Navi Mumbai is 136 Km. 2. In Navi Mumbai Municipal Corporation Area total road length is 595 Km, total length of road constructed is 595 Km. The corporation has repaired/constructed for last one year is 108 km. 3. Presently in Navi Mumbai city area 58 No of traffic signals/diversion provided for smooth movement of traffic to avoid air pollution – 58 Locations are installed with Traffic Signals in Navi Mumbai City. New signals were installed as an when required. 4. Navi Mumbai Municipal Corporation carried out daily road cleaning (Including small measures and inside lane) – Manual Sweeping of 482.2 km and Mechanical Seeping of 113.8 km is done daily. 5.Electric buses: The population of Navi Mumbai was 11,20,547 in 2011 as per the Census of India. • Accordingly, as per Guidelines 672 Buses are required to be fleeting in the city. Currently, NMMT has Total 531 Buses comprising of 251 Diesel, 85 CNG and 195 Electric Buses. • NMMT provided information that till FY 2027-28 all Diesel Buses will be scrapped and converted to Green Fuel (Electric & CNG). Additionally, 100 E buses have been planned to be procured from 15th Finance Commission Grants. Till date, 40 E buses are procured and 25 E buses are awaited to be delivered till December 2024 from 15th Finance Commission Grants. 6.The Navi Mumbai Municipal Transport (NMMT) has 154 CNG buses in its fleet. 7. In the year 2023-24 about 219 Nos. of vehicles scraped. 8. In the year 2023-24 about 39296 Nos. of new vehicle registered. 9. In the year 2023-24 about 4461 (CNG) & 2096 (E vehicle) registred.

S.No.	Action Points	Responsible Agency	Completion Status	Timeline	Remark
					10. There are 129 PUC station for last 1 year 1890 vehicles imposed fine.
4	Installation of Online monitoring system to 13 nos. of highly polluting (17th Category) industries.	Industry/ MPCB	100	Verified by CPCB in April, 2024	In TTC MIDC industrial area all 5 Nos. of 17 category industries has installed Online Monitoring System (OCEMS To waste water treatment plant) and connected to MPCB and CPCB server and 08 groslly polluting industries has installed Online Monitoring System (OCEMS) system and connected to the MPCB server. Work is completed. **(Annexure III).**
5, 27 & 31	Installation of CAAQM Stations with digital display on screen. & Online display of AAQM data & Set up new AAQM Station, Navi Mumbai.	TBIA	100	Verified by CPCB in April, 2024	In RO Navi Mumbai jurisdiction there are 7 OCEM stations and 2 manual AAQM stations are operational for strengthening of Air monitoring in Navi Mumbai area and display board are installed along road side. The data transfer to CPCB/MPCB server. 1. Fire Station, CBD Belapur. 2. Sewage Treatment Plant, Nerul. 3. Tortoise Amusement Park, Kopari Gaon. 4. Sensory Garden, Sanpada. 5. Nirmal Bhavan, Mahape. 6. Rabale (manual) 7.Nerul (manual) Along with these, Regional Office MPCB (Navi Mumbai) is having 2 nos. of Mobile Ambient air quality monitoring vans in respective areas.

S.No.	Action Points	Responsible Agency	Completion Status	Timeline	Remark
6 & 22	To provide proper sewerage system for slum pockets & connects the sewage to STPs & use of treated sewage for gardening & industrial purpose & Reuse of Treated Sewage.	MIDC/NMMC	30	Min. 3 years 31.12.2027	The Navi Mumbai Municipal Corporation (NMMC) area there are 7 Nos. of STP's at different locations having total capacity 454 MLD. Total sewage generation from NMMC area is 230 MLD and same is treated in 07 STPs. About 67.62 MLD treated water is being used for various purposes like gardening etc. washing of roads, divider etc. Further NMMC has proposed recycling of water in TTC MIDC area of 40 MLD. The sewage generated from the MIDC slum pocket is approximately 4 to 5 MLD and the corporation & MIDC has planned to provide sewage treatment plant for the same. The Board has issued direction to MIDC and Municipal Corporation for submission of timebound program dated 18.11.2024. The Corporation has allotted the work to IIT Bombay for study and provide solutions for such as interception and diversion of sewage in slum pockets of MIDC. And after the study they are proposed for grey water collection and treatment and requested MIDC for suitable land for same. JVS reports of STP is attached as **Annexure IV.**
7, 14 & 30	Improvement & performance of ECS, Change in Fuel.	Industries	100	-	In TTC MIDC industrial area there are 166 Industries using fuel (coal, LDO, FO Diesel, HSD etc.) before 2018. Now, 150 Nos. of industries has change their fuel pattern to cleaner fuel like PNG, CNG. Other 11 Nos of industries are using LDO as a fuel with stack of sufficient height and 5 No. industries using coal as fuel and provided ESP and MDC. All the Air emitting industries has provided Air Pollution Control System like dust collector, scrubber, etc. The board has directed five (coal using) industries to change the fuel pattern. List of clean fuel using industry - **Annexure V.**

S.No.	Action Points	Responsible Agency	Completion Status	Timeline	Remark
8 & 15	Upgradtion of Individual ETPs and Performance Evaluation of ETPs	Industries	100	-	All the SSI generating effluent has provided primary and tertiary treatment and discharging treated effluent to CETP for further treatment. There are total 48 no. of Large and Medium Scale Industries generating trade effluent and have provided necessary ETPs. ETPs of LSI & MSI are being operated regularly. Most industries generally meeting the consented standards. 12 number of industries has provided ZLD. Total 48 number of industries has provided OCEMS system at outlet of ETP. The CETP, Thane Belapur Industrial Association (TBIA) is achieving the consented standard. During the randomized verification if any deviation into the discharged standard Board has issue appropriate direction for upgradation of effluent treatment plant (ETP). Board has issued last 3 years directions as are below- Proposed Direction- 205 Interim Direction- 145 Its on going process. The Board officers visit to the industries as per randomized visit schedule and collect the treated Water samples also verifies the performance of ETP and OCEMS data. **(Annexure VI).**
9	Improvements in CETP.	CETP	100	Verified by CPCB in April, 2024	1. Installation & Commissioning of Additional Clarifier cum Clariflocculator at P–60 completed in Dec.-2019 for an standby operation during any emergency maintenance work required by the existing Clarifier, Clarifoculator, Thickener or any of the tank and also for better treatment of effluent during shock load. 2. Installation and Commissioning 2 nos. each of new technology single screw & double screw Volute at P–60 done in the year 2023 for efficient sludge handling and is in operation giving maximum sludge rejection. 3. Constructed an additional inlet effluent collection tank of 500 m3 in the year 2023 to handle the inlet shock load mostly during monsoon season. 4. Reinforcement civil work done of

S.No.	Action Points	Responsible Agency	Completion Status	Timeline	Remark
					Platform, Pathways, of Aeration Tank at 12 MLD and 15 MLD plant in the year 2023 to enhance the structural life of an aeration tank 5. Compound wall constructed in the year – 2022 & 23 from slum area side to avoid further encroachment at P–60 (15 MLD) side. 6. Installation and commissioning of the 67 kw Solar panel project on the roof of Admin Building done in the year 2023. 7. Installation of 10 KL capacity pilot plant completed in Dec. 2023 to study the process need to support the small scale Industries being operated by CETP. 8. Double stage Scrubber system at the inlet sump has been installed and commissioned in the month of August – 2024 to avoid Air pollution. JVS reports attached as **Annexure VII.**
10	Health Impact Assessment Study.	DISH District Health Officer MPCB	-	31.12.2026	The Navi Mumbai Municipal corporation has submitted the health data related to respiratory illnesses. From the data it revels that there is decrease in number of patients in 2024 compare to 2023 & the recovery percentage is higher than previous year. MPC Board has decided to allot Health Impact Assessment Study to the agency. **(Annexure VIII).**
11	Recovery of Solvent by solvent using units.	Industries	100	-	In TTC Industrial area there are 11 solvent recovery units in operation and provided Air pollution Control System as per CPCB SOP prepared under Rule-9 of HOW (M & TM) Rules 2016 for solvent recovery. There are 4 Nos. of Bulk Drug manufacturing industries. They are sending their spent solvent to the authorized solvent recovery units. Also all the industries has provided Air Pollution Control System for VOC emission. **(Annexure IX).**

S.No.	Action Points	Responsible Agency	Completion Status	Timeline	Remark
12	Inventory of Hazardous air Pollutant emitting units and installation of Leak detection & repair (LDAR) in Case pesticide & bulk drug manufacturing units	MPCB/Individual Industry	100	-	Board has issued direction to all Bulk Drug, pesticides and solvent using/processing industries for specific mitigation measures to provide LDAR. In TTC Industrial area all 20 Nos. of industries provided LDAR. **(Annexure X).**
13	Taking possession of drainage pipeline carrying effluent to CETP.	CETP MIDC/MPCB as nodal agency	100	Verified by CPCB in April, 2024	In TTC MIDC the CETP drainage pipeline carrying effluent and disposal pipeline is in the possession of MIDC and all the operation and maintenance has been carried out by MIDC authorities.
14	Uncovered area will be connected to CETP	MPCB/CETP/MPCB	100	Verified by CPCB in April, 2024	All the industries generating effluent are member of CETP and connected there treated effluent to CETP drainage network for further treatment.
15	Awareness program	MPCB	100	-	Awareness program under Mission LiFE, NCAP, CEPI are jointly conducted with NMMC, MIDC, CETP, DISH, MNGL and Industry association on the occasion of various environmental days. MPC Board has also conducted aware ness programs such as – World Environment day (5 June), World Ozone Day (22 Sep), Eco friendly Ganesh Festival, Vasundhara Awards, & Fire Cracker testing during Diwali.

S.No.	Action Points	Responsible Agency	Completion Status	Timeline	Remark
16	Replacement of Damaged pipeline. The replacement of old/damaged pipelines by the new one has not been completed.	MIDC	100	-	MIDC authority has already initiated steps towards providing new HDPE Pipeline in TTC MIDC Area. About 100% of pipelines is completed. In the TTC MIDC area the total pipeline network of CETP is 113 Km.
17	Repairs of Internal Roads in MIDC area.	NMMC	100	-	There are internal roads of 108 km in TTC MIDC area, Navi Mumbai Municipal Corporation authority informed that 100% construction work of internal roads in MIDC area is completed. NMMC regularly repaired the internal Road of MIDC, if damaged.
18	Scientific Disposal of MSW.	NMMC	100	Verified by CPCB in April, 2024	NMMC generates 750 TPD MSW and provided scientific treatment at MIDC Turbhe also provided leachate treatment plant of capacity 60 CMD. The total land available for MSW treatment 65 Acres. The treatment consisting of collection segregation at source and at site windrow composting, RDF, scientific landfill, leachate collection and treatment.

S.No.	Action Points	Responsible Agency	Completion Status	Timeline	Remark
19	Development of green belt & garden.	MIDC & TBIA	100	-	As per BCC Condition, it is mandatory to plant one tree per 100 sq.m. Also MIDC has handed over plots to NMMC for tree plantation and handing over plots to Industrialist as per environmental clearance condition. The NMMC total green belt coverage area details are as below: 1) No of Gardens – 197 Nos (10,04,561 Sq Mtr) 2) No of Green Belts – 52 Nos (1,81,580 Sq Mtr) 3) No of Trees Planted and survived – 42800 Nos **Details of Tree plantation done by industries is as follows-** 1. Hindustan Platinum- **6420 Nos.** 2. Satyam Pharma-Chem Pvt. Ltd- **26 Nos.** 3. Amines & Plasticizers Ltd **-1065 Nos.** 4. Glenmark Pharmaceuticals Limited **-995 Nos.** 5. Savita Oil Technologies- **59 Nos.** 6. Croda (I) Co. Pvt. Ltd.- **2247 Nos.** 7. Parker hannifin- **221 Nos.** 8. NOCIL Ltd.- **4639 Nos.** 9. Pradeep Metals Ltd**-195 Nos.**
20	Installation of Supervisory control and data acquisition (SCADA)	Industry, MPCB and CETP	100	-	In the TTC MIDC Industrial area there are total 80 number of industries having more than 25 CMD effluent generation provided SCADA system at outlet of ETP. **(Annexure XI).**
21	Monitoring of ground water at MSW/TSDF site.	MPCB	100	-	Analysis reports of ground water monitoring at MSW/TSDF is enclosed On going continuous activity. **(Annexure XII)**
22	Monitoring of the Industries for compliance of CEPI norms	MPCB	90	Continuous	Its ongoing process.

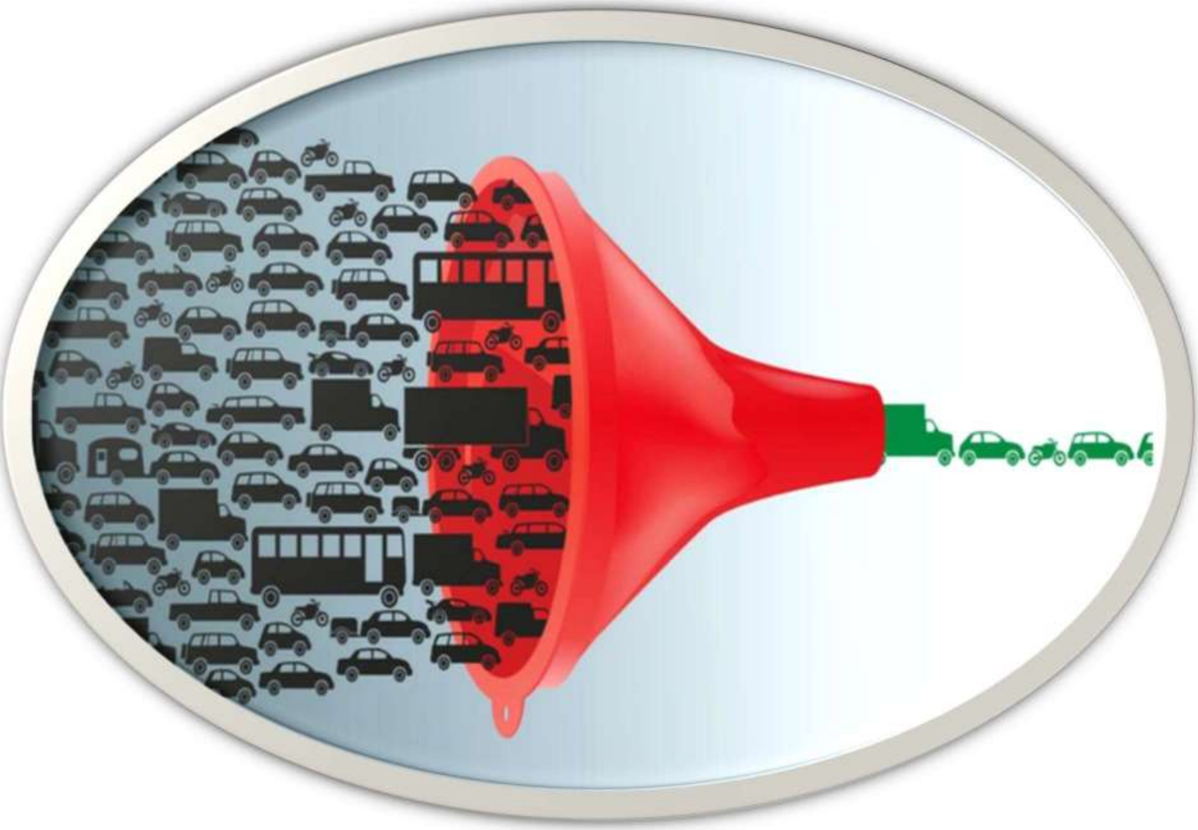
S.No.	Action Points	Responsible Agency	Completion Status	Timeline	Remark
23	Performance Evaluation of CETP	CETP & MPCB	100	Verified by CPCB in April, 2024	CETP, TTC Navi Mumbai is falls under confirming category. CETP has already submitted the performance evaluation report to MPCB done by Energy Enviro Pvt. Ltd. by SINE IIT Bombay Company at 2020. Board has collected the sample of inlet and outlet of CETP every week in the month, the result of samples are well within consented limit. CETP is complying with the consented standard. Monthly sampling is on going for monitoring.
24	Installation of VOC analyzer	Industry	100	-	11 number of solvent recovery units are operational and they have installed VOC analyser. **(Annexure XIII)**
25	Air pollution control measures for stone crusher units.	MPCB	100	-	There is no Stone crushing units operational in TTC area since 2017 in respect of order passed by Hon'ble NGT order dated 14.11.2017.

Annexure-I

R E P O R T

ON

AMBIENT NOISE MONITORING IN METRO CITIES OF MAHARASHTRA-2023



MAHARASHTRA

MAHARASHTRA POLLUTION CONTROL BOARD

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December- 2023

PREFACE

Urban noise pollution poses a critical threat to human and animal well-being, demanding immediate attention and action. With millions affected globally, this pervasive issue induces significant stress and disturbance. The escalating problem can be attributed to the forces of urbanization, population growth, and technological advancements. The persistent presence of noise not only disrupts sleep but also contributes to worry, fatigue, elevated blood pressure, and reduced productivity. Various factors contribute to noise pollution, encompassing social events, industrial operations, residential activities, and diverse forms of traffic (air, rail, and road). However, the most prominent and distressing source in urban settings is the incessant traffic noise and unnecessary honking from vehicles.

In response to this pressing concern, the Maharashtra Pollution Control Board (MPCB) undertook an Ambient Noise Level Monitoring Programme across 27 municipal corporations in the state. The study involved continuous monitoring at 104 locations over a 24-hour period, encompassing both day (06:00 am to 10:00 pm) and night (10:30 pm to 6:00 am), conducted over two days—Sunday, December 17, 2023, a non-working day, and Monday, December 18, 2023, a working day.

This report provides an in-depth analysis of the recorded data from the study. Metrics such as Leq daytime, Leq nighttime, L10, L50, L90, Lmax, and Lmin are utilized to quantify results in dB(A), with comparisons against standard limits for the corresponding zones (Industrial, Commercial, Residential, or Silence).

The field monitoring for this study was conducted by M/s Ashwamedh Engineers and Consultants, Nashik, with support from all Regional offices of the Board. Noteworthy contributions were received from the State Police, Traffic Police Media, and NGOs, providing substantial support during surveillance. The Board's APC division spearheaded the study, handling all aspects, including planning, coordination, and report preparation. Special acknowledgment is extended to Dr. V.M Motghare (Joint Director, Air) and Mr. Prakash Jadhav for their invaluable contributions to the study.

December 2023

(Dr. Avinash Dhakne, I.A.S)
Member Secretary

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ABBREVIATIONS

CPCB	Central Pollution Control Board
dB	Decibel
dB(A)	Decibels with "A" weighting
EPA	Environmental Protection Act, 1986
Hz	Hertz
MPCB	Maharashtra Pollution Control Board
KHz	Kilo Hertz
L_{Aeq}	Equivalent continuous A-weighted sound pressure level (dB)
L_{max}	Maximum sound pressure level (dB)
L_{min}	Minimum sound pressure level (dB)
SPL	Sound Pressure Level

1 INTRODUCTION

Noise pollution, defined as disturbing or excessive noise with the potential to harm human or animal life, is a growing concern exacerbated by factors such as population growth, urbanization, and the increased use of powerful and mobile noise sources. This issue is particularly pronounced in contemporary urban settings, where rapid urbanization, industrialization, and population expansion contribute to elevated noise levels across various Indian cities. While noise pollution does not directly harm life-supporting systems like air, water, and soil, its adverse effects are more direct on human well-being. Traffic noise pollution, stemming from factors like increased vehicular traffic, inadequate road networks, and urbanization, has become a significant problem, with many cities surpassing prescribed noise standards.

The rise in urban noise levels is not solely attributable to vehicles and their honks; the presence of crowds on the roads and contributions from hawkers also play a substantial role. This environmental threat interferes with sleep, concentration, communication, and recreation, impacting residential, social, working, and learning environments. Noise pollution poses numerous potential health risks that are both pervasive and medically and socially significant. As a by-product of modern technological developments, noise extends both vertically and horizontally, with adverse effects on the environment, flora, wildlife, and human health, leading to issues such as stress, high blood pressure, speech impairment, and hearing loss. Unwanted or disturbing sounds from various sources, including industrial facilities, transportation, and construction activities, contribute to urban noise pollution, emphasizing the need for comprehensive noise management strategies and public awareness.

The Maharashtra Pollution Control Board has been researching the ambient noise levels in metropolitan areas throughout the state of Maharashtra for a long time in order to assess the effects of noise pollution. MPCB has carried out the ambient noise monitoring survey at 104 places throughout 27 Maharashtra Municipal Corporations for two days this year as well. viz. 17th December (non-working day) and 18th December (working day) 2023. The monitoring was carried out continously for 24 hours during day time (06:00am to 10:00pm) and night time (10:00pm to 06:00am). The locations on the list fell into four categories: residential, business, industrial, and quiet zone. Following that, the measured noise levels were contrasted with the corresponding Noise Pollution (Regulation & Control) Rules, 2000 standards.

1.1 Measurement Scale

Typically, sound is composed of a large variety of frequencies. One of the elements that contributes to sound energy's ability to be perceived by the human ear is its distribution throughout the audible frequency "spectrum," which is roughly 20Hz–20kHz. The human ear has a wide dynamic range and is an extremely sensitive system. To accommodate this very large range, sound levels are measured using the **decibel (dB) scale**.

Theoretically, a sound level meter responds flatly, meaning that it behaves the same way over a range of frequencies. Since the human ear reacts differently at different frequencies than a sound level meter does, it is possible to employ a weighting, or filter, to make the meter behave more like the human ear. The most commonly used weighting is referred to as the **'A'** weighting and readings are usually measured in dBA.The **"Sound Pressure Level"** (SPL) is twenty times the logarithm to the base 10 of the ratio of the effective pressure (p) of a sound to the reference pressure (Pr) of 20 µPa. Thus the sound pressure level in dB = 20 log10 P/Pr.

2 NOISE LEVEL MEASUREMENT

Noise measurement is typically done using a sound level meter (SLM), which is a specialized device designed to quantify and assess the intensity of sound or noise. When conducting noise measurements, it's essential to follow established protocols to ensure accurate and representative results. Taking measurements from a tripod at a specific height and distance from the noise source is an important part of this process.

a) Stability: Tripods provide stability to the sound level meter, ensuring that it remains steady during measurements. This is crucial for obtaining accurate and reliable results, as any movement or vibration can introduce errors in the measurements.

b) Height of Measurement: It's common to take noise measurements at a height that corresponds to the average ear level of humans, which is typically about 1.2 to 1.5 meters (4 to 5 feet) above the ground. This height is chosen because it represents the typical position of a person's ears, making the measurements more relevant to human exposure.

c) Distance from the Source: When measuring noise, it's a good idea to set up your equipment about 10-13 feet away from the noisy thing you're checking. This distance is chosen because it helps us get a sense of how loud the noise is over an entire area, instead of just right next to the noisy thing itself. It's like stepping back from a speaker at a concert to get a better idea of how loud the music is in the whole room, rather than right next to the speaker where it's super loud.

d) Safety: When measuring noise levels at a close distance to a very loud source, the sound level meter could be damaged, and the person taking measurements could be at risk of hearing damage. Maintaining a safe distance ensures the equipment's longevity and the safety of the operator.

In some cases, such as industrial noise assessments, measurements may be taken at specific locations where people are likely to be exposed to noise. The measurements may be taken at ear level, closer to the source, or farther away depending on the specific circumstances and regulations governing noise exposure.

Ultimately, the choice of measurement height and distance from the source depends on the objectives of the measurement and the specific standards and guidelines being followed. Accurate and consistent measurements are essential for assessing and mitigating the impact of noise on human health and the environment.

Noise is measured in decibels (dB): A decibel is the standard for the measurement of noise. The zero on a decibel scale is at the threshold of hearing, the lowest sound pressure that can be heard. According to D.B. Smith, 20 dB is whisper, 40 dB is quiet office, 60 dB is normal conversation and 80 dB is the level at which sound becomes physically painful.

Decibels (dBA): 'A' symbol indicates a measurement of a logarithmic scale. In each case, the actual measurement 'a' is compared to a fixed reference level 'r' and the "decibel" value is defined to be 10 log 10 (a/r). 'A' weighing filters out lower frequencies very severely. Fast responses closely match to the simulations of Human ear sensitivity.

Leq (Equivalent Continuous Sound Level): Leq is the preferred method to describe sound levels that vary over time, resulting in a single decibel value that takes into account the total sound energy over the period of time of interest.

Leq - equivalent continuous sound level: Sound levels often fluctuate over a wide range with time. For example, in the middle of the night, the level might go down as low as 30dB(A) with occasional passing vehicles of 70dB(A) or more. Later comes the dawn chorus followed by the general noises of the day before relative peace returns in the late evening.

Alternatively, it may be a festival location with different noise emissions (for eg, DJs, Dhols, music, firecrackers, etc.) throughout the day or week, with deliveries, intermittent compressors, and lots of varying noisy processes on top of the routine production noise levels. How do you measure these noise levels and come up with an overall value?

This is where the Leq or equivalent continuous Sound level or an average value of sound comes. When we say average, this is not a simple arithmetic average because we are measuring in decibels which are logarithmic values. So the sound level meter converts the dB values to sound pressure levels, adds them all up then divides by the number of samples and finally converts this equivalent level back to decibels - dBs.

Lmax: It is the highest time-weighted sound level measured by the meter during a given period of time (the maximum of the output of the time-weighted sound level equation above). The time constant used can be fast or slow

Lmin: It is the lowest time-weighted sound level measured by the meter over a given period of time (the minimum of the output of the time weighted sound level equation above). Just like for Lmax, the value is based on the time weighted sound level in dB. The time constant used can be fast or slow.

Noise Pollution (Regulation and Control) Rules, 2000

The Noise Pollution (Regulation and Control) Rules, 2000 govern each type of noise pollution (Annexure. Prior to this, noise pollution and its causes were addressed by the Air (Prevention and Control of Pollution) Act of 1981.

- On February 14, 2000, the Union Government passed the Noise Pollution (Regulation and Control) Rules, 2000 in an effort to reduce the increasing ambient noise level coming from diverse sources in public areas. According to the authority granted to it by the Environment (Protection) Act of 1986, this was done.
- As stated in Rule 5 of the Noise Rules 2000, the use of loudspeakers and public address systems is restricted.
- Rule 5 was altered in 2010 to forbid the use of sound-producing equipment. Before using this technology in any of these situations, written consent is necessary.
- The District Magistrate, Police Commissioner, and any other person not below the level of Deputy Superintendent of Police are designated as the Noise Rules, 2000's implementing authorities.

• The State Government has the power to permit the use of loudspeakers on or during any annual religious or cultural celebration with a maximum duration of fifteen days. The hours between 10:00 p.m. and 12:00 a.m. are not suitable for such recreation.

2.1 Noise Descriptors

- **LAeq** is used to quantify the noise where the Lp varies over time. In most situations, the LAeq is the most appropriate descriptor used to investigate environmental noise complaints.
- **The n-percent** exceeded level, L_n, is the sound pressure level exceeded for n percent of the time. In other words, for n percent of the time, the fluctuating sound pressure levels are higher than the L_n level. L_n can be obtained by analyzing a given noise by statistical means. The commonly used value of n for the n-percent exceeded level, L_n, are 10, 50, and 90.
- **L_{10}** is the level exceeded for 10% of the time. For 10% of the time, the sound or noise has a sound pressure level above L_{10}. For the rest of the time, the sound or noise has a sound pressure level at or below L_{10}.
- **L_{50}** is the level exceeded for 50% of the time. It is statistically the mid-point of the noise readings. It represents the median of the fluctuating noise levels.
- **L_{90}** is the level exceeded for 90% of the time. For 90% of the time, the noise level is above this level. It is generally considered to be representing the background or ambient level of a noise environment.
- For a varying sound, L_{10} is greater than L_{50} which in turn is greater than L_{90}.

3 OBJECTIVES

The major objectives of the study are enlisted below:

- To monitor and assess the ambient noise levels at 104 locations in the metro cities of Maharashtra across 27 Municipal Corporations covering Industrial, Commercial, Residential & Silence zones at day time and night time.
- To assess the extent of the violation by comparing the measured noise levels against ambient noise standards (Noise Pollution (Regulation & Control) Rules, 2000)-Annexure II.
- To identify the significant contributors or factors of noise levels so as to take proper mitigation measures.
- To assist in developing policy to formulate legal action for punishment, prohibiting, and preventing noise pollution.
- To educate the public about the noise pollution and its negative impacts.

4 METHODOLOGY OF PROJECT

The ambient noise monitoring was carried out at Metropolitan cities in the state of Maharashtra for 104 locations covering 27 Municipal Corporations across Maharashtra. The monitoring was carried out for 2 days considering the noise that generate for the non-working day December 17, 2023 (Sunday), and the working day December 18, 2023 (Monday) for 24 hours. The noise monitoring was carried out using calibrated Sound Level Meters (Type-II).

The details of the number of noise monitoring locations in different Municipal Corporations are provided in **Table 4.1** below:

Table 4.1: Noise Monitoring Locations in Metro/Major Cities of Maharashtra: 2023

Sr.	Municipal Corporation	Number of locations
1.	Mumbai South	15
2.	Navi Mumbai	03
3.	Thane	05
4.	Pune	05
5.	Nashik	05
6.	Aurangabad	05
7.	Nagpur	05
8.	Kalyan	03
9.	Amravati	03
10.	Jalgaon	03
11.	Kolhapur	04
12.	Sangli	03
13.	Mira – Bhayander	03
14.	Vasai – Virar	03
15.	Ulhas nagar	03
16.	Bhiwandi – Nizampur	03
17.	Chandrapur	03
18.	Nanded – Waghala	03
19.	Ahmednagar	03
20.	Dhule	03
21.	Malegaon	03
22.	Pimpiri – Chinchwad	03
23.	Parbhani	03
24.	Latur	03
25.	Akola	03
26.	Solapur	03
27.	Panvel	03
Total no. of Locations		**104**

The detailed list of locations is given in **Annexure I.**

5 RESULTS

Hourly Noise Levels on 17th and 18th December in Metropolitan cities at different locations in Maharashtra is given in **Annexure III**. The equivalent steady sound level of a noise energy-averaged over time was calculated represented as L_{eq} based on which the impact of noise created during the festival is measured. The formula for calculating L_{eq} is as given below:

$$L_{eq,T} = 10 \log \left(1/n \sum_{i=1}^{n} 10^{\frac{L_i}{10}} \right)$$

where, L_i = levels observed at n equally spaced times during interval T

In the present study average noise values (L_{eq}) of hourly data, day time (06:00am to 10:00pm) and night time (10:00pm to 06:00am) has been calculated to compare the results with the noise standards mentioned under Noise Pollution (Regulation & Control) Rules, 2000 for their respective zones i.e. Industrial, Commercial, Residential & Silence.

5.1 Mumbai

In Mumbai, a total of 15 locations were monitored continuously for 24 hours.The highest average noise level during day time on 17th December and 18th December 2023 was observed with 83.3dB(A) and 87.0dB(A) at Hindu Colony, Dadar and Mumba Devi temple, Mumbai respectively. During night time the highest noise level on 17th December was observed again at Hindu Colony, Dadar with 82.9dB(A) and on 18th December, it was observed highest at Malabar Hills with 76.1 dB(A).

Table 5.1: Ambient Noise Levels in Mumbai

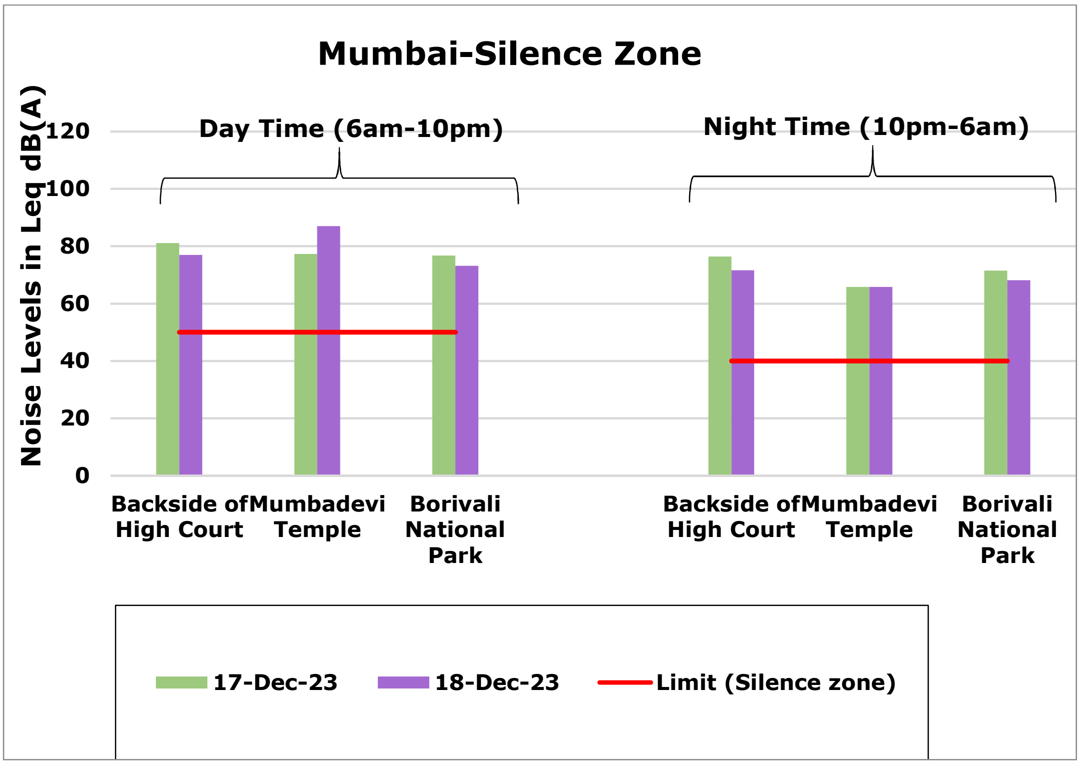
Ambient Noise Monitoring on 17th December 2023 – MUMBAI												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Backside of High Court	81.1	50.4	89.6	85.3	79.2	59.8	76.4	36.1	88.4	81.3	49.1	40.0
Mumbadevi Temple	77.3	58.2	84.7	80.5	76.0	64.4	65.8	57.8	72.9	69.4	62.9	59.3
Borivali National Park	76.7	59.5	87.7	79.7	71.2	66.4	71.4	50.3	84.6	75.8	60.8	53.2
Antop Hill	78.7	44.3	94.8	82.5	69.2	51.4	71.5	50.5	84.6	75.5	60.4	53.3
Shivaji Park, Dadar	73.8	52.2	87.9	76.3	69.8	61.1	69.9	59.5	79.8	74.5	65.9	60.5

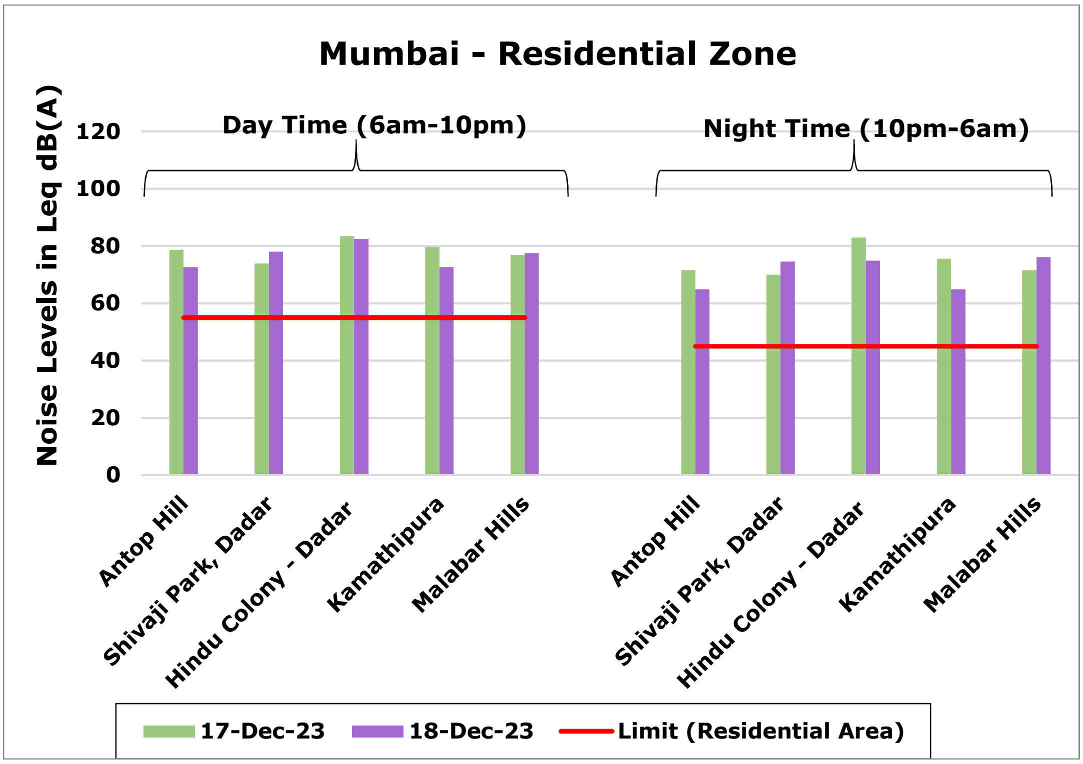
Ambient Noise Monitoring on 17th December 2023 – MUMBAI												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Santacruz Airport	75.9	58.2	87.3	79.5	71.2	66.2	73.4	56.4	86.7	75.5	68.5	60.8
Ghatkopar (W)	77.4	48.0	88.0	82.0	72.0	59.0	68.1	43.4	78.7	71.4	56.4	46.4
Vashi Naka, Chembur	82.0	62.9	89.9	87.1	76.8	69.6	70.5	42.8	82.7	73.9	59.4	49.1
Goregaon (E)	70.8	56.4	79.6	74.2	69.7	62.4	63.5	54.9	71.7	67.0	61.4	56.8
Charkop, Kandivali	77.1	56.9	86.2	81.5	73.6	63.7	65.0	44.1	75.4	69.5	53.6	46.4
Sion	79.0	58.2	88.3	82.3	77.3	71.6	68.0	41.4	78.7	71.1	54.5	46.4
Hindu Colony	83.3	61.5	94.4	86.7	78.6	68.3	82.9	53.1	92.9	88.2	76.0	65.0
Matunga	75.3	35.5	85.8	79.8	67.8	52.4	74.9	45.0	88.9	75.0	63.7	53.2
Kamathipura	79.5	54.8	89.9	84.4	74.7	64.9	75.5	47.5	86.6	80.2	60.1	51.1
Malabar Hills	76.9	30.4	88.5	81.9	69.2	49.2	71.5	50.5	84.6	75.5	60.4	53.3

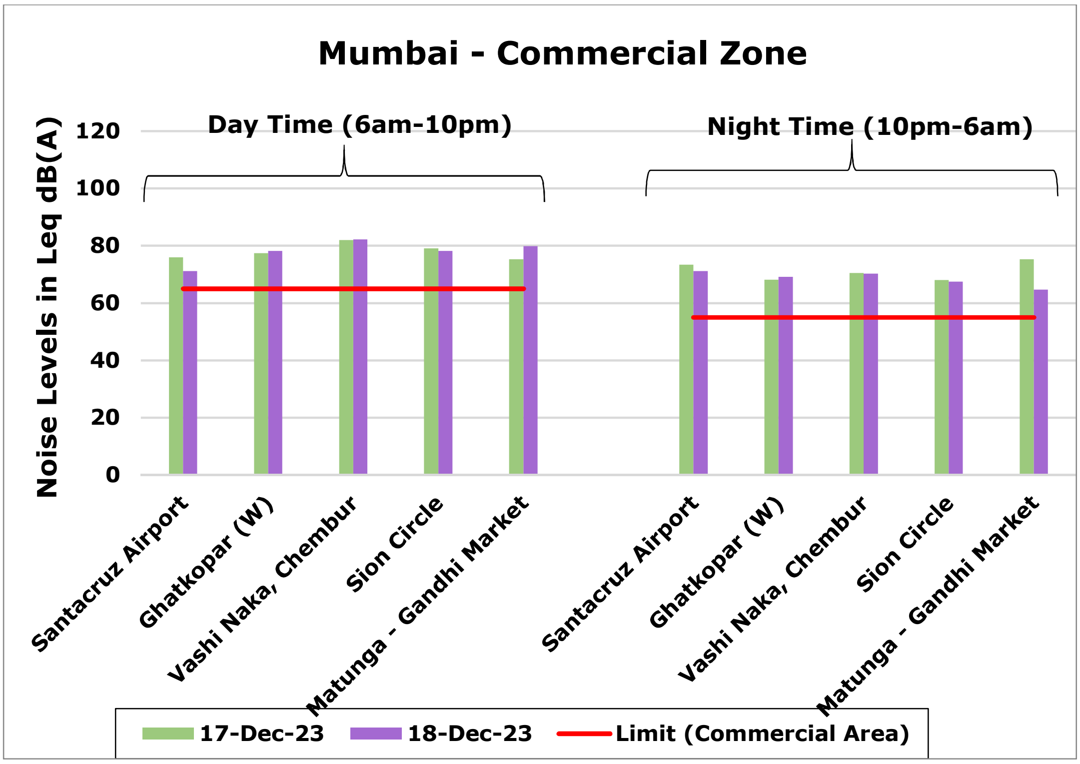
Ambient Noise Monitoring on 18th December 2023– MUMBAI												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Backside of High Court	76.9	57.3	87.7	80.3	70.1	62.0	71.6	50.5	84.6	75.5	62.4	53.3
Mumbadevi Temple	87.0	59.5	93.6	90.8	84.1	68.8	65.8	57.8	72.9	69.4	62.9	59.3
Borivali National Park	73.1	59.3	78.7	78.4	68.3	64.2	68.1	52.2	78.7	69.4	62.4	55.4

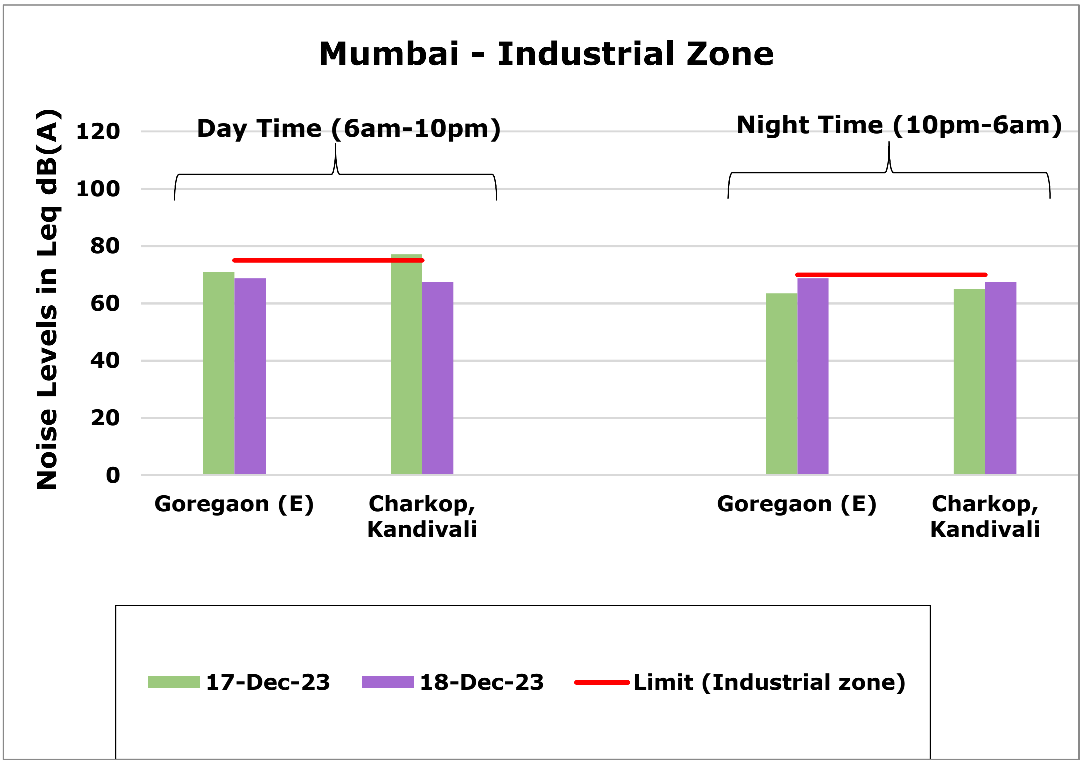
Ambient Noise Monitoring on 18th December 2023– MUMBAI												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Antop Hill	72.5	59.0	83.6	74.9	69.9	64.1	64.8	53.7	71.9	69.4	62.8	55.7
Shivaji Park, Dadar	78.0	50.2	89.2	81.9	71.7	55.8	74.5	45.6	87.5	76.7	57.6	48.3
Santacruz Airport	77.7	63.0	89.4	79.4	75.4	68.6	71.1	50.5	84.6	74.7	60.3	53.3
Ghatkopar (W)	78.2	48.7	89.1	82.6	73.5	59.6	69.1	45.8	79.0	73.4	60.2	48.3
Vashi Naka, Chembur	82.2	64.9	89.7	87.4	77.5	69.5	70.2	42.3	84.6	73.2	62.2	50.1
Goregaon (E)	69.8	56.4	76.6	72.4	68.9	66.1	68.7	64.0	72.8	71.6	67.8	64.9
Charkop, Kandivali	80.6	60.7	89.9	85.1	73.6	65.8	67.4	60.3	76.5	71.6	64.4	61.7
Sion	78.2	48.7	89.1	82.6	73.5	59.6	67.4	60.0	76.0	71.5	64.2	61.6
Hindu Colony	82.5	55.8	94.4	87.2	74.1	67.2	74.9	45.7	89.0	76.0	57.5	50.1
Matunga	79.8	45.7	89.9	84.8	74.8	58.0	64.6	43.2	73.8	69.1	59.9	48.6
Kamathipura	72.5	59.0	83.6	74.9	69.9	64.1	64.8	53.4	71.9	69.4	62.9	55.7
Malabar Hills	77.4	36.3	89.7	79.9	68.3	55.3	76.1	42.7	86.0	79.9	70.5	54.4

Chart 5.1: Ambient Noise Levels in Mumbai






Mumbai - Commercial Zone
Noise Levels in Leq dB(A)
120
100
80
60
40
20
0
Day Time (6am-10pm)
Night Time (10pm-6am)
Santacruz Airport
Ghatkopar (W)
Vashi Naka, Chembur
Sion Circle
Matunga - Gandhi Market
Santacruz Airport
Ghatkopar (W)
Vashi Naka, Chembur
Sion Circle
Matunga - Gandhi Market
17-Dec-23
18-Dec-23
Limit (Commercial Area)


Mumbai - Industrial Zone
Noise Levels in Leq dB(A)
120
100
80
60
40
20
0
Day Time (6am-10pm)
Night Time (10pm-6am)
Goregaon (E)
Charkop, Kandivali
Goregaon (E)
Charkop, Kandivali
17-Dec-23
18-Dec-23
Limit (Industrial zone)

5.2 Navi Mumbai

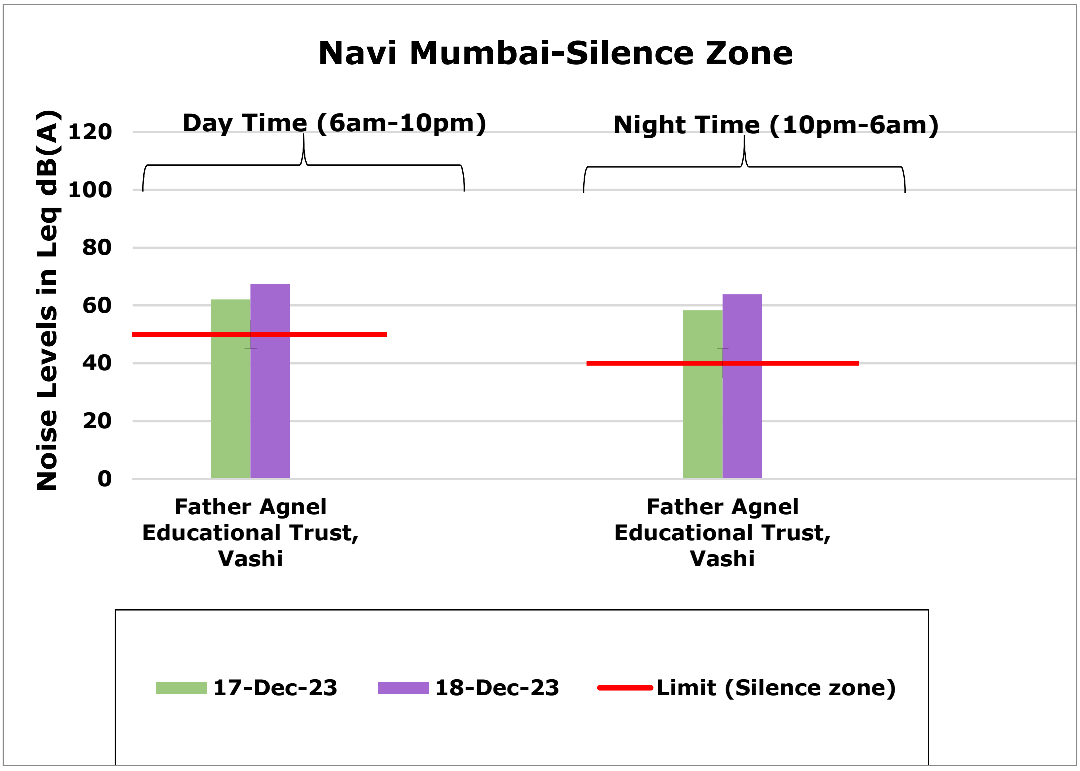
In Navi Mumbai a total of three locations were monitored. The highest noise level during day time on 17th December and 18th December 2023 was observed with 69.3dB(A) and 72.3dB(A) both at Mahape Shil Road. During night time, the highest noise level 70.9dB(A) and 72.7dB(A) respectively) on both days of monitoring was observed at APMC Market, Vashi.

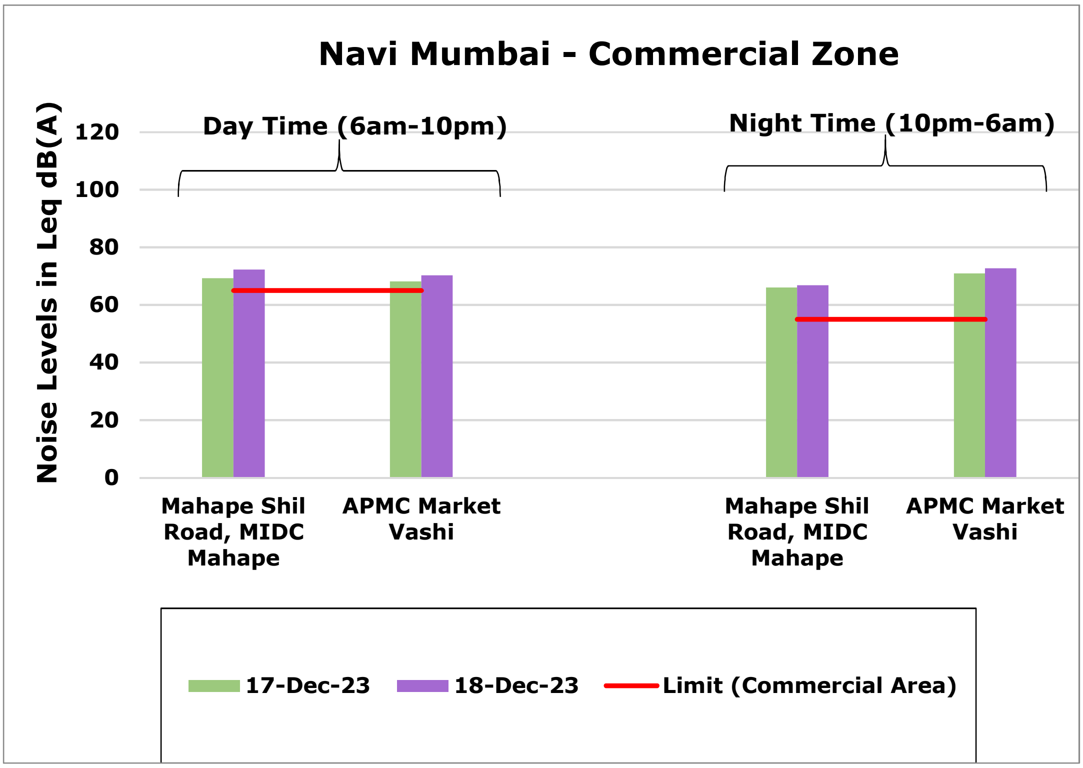
Table 5.2: Ambient Noise Levels in Navi Mumbai

Ambient Noise Monitoring on 17th December 2023 - Navi Mumbai												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	**L_{min}**	**L_{max}**	**L_{10}**	**L_{50}**	**L_{90}**	**L_{eq}**	**L_{min}**	**L_{max}**	**L_{10}**	**L_{50}**	**L_{90}**
Mahape Shil Road	69.3	53.9	77.3	73.4	66.8	59.8	66.0	58.4	74.3	69.3	63.4	58.9
APMC Market Vashi	68.1	56.7	77.6	71.3	66.6	62.3	70.9	63.2	76.9	73.1	69.7	65.9
Father Agnel Educational Trust, Vashi	62.0	44.3	68.2	65.7	60.6	49.3	58.3	41.1	65.7	62.2	55.1	48.1

Ambient Noise Monitoring on 18th December 2023 - Navi Mumbai												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	**L_{min}**	**L_{max}**	**L_{10}**	**L_{50}**	**L_{90}**	**L_{eq}**	**L_{min}**	**L_{max}**	**L_{10}**	**L_{50}**	**L_{90}**
Mahape Shil Road	72.3	54.3	82.4	76.4	69.4	61.3	66.8	58.4	73.8	70.2	64.3	60.4
APMC Market Vashi	70.2	57.6	79.1	74.1	67.8	63.5	72.7	61.9	79.6	76.2	69.8	64.6
Father Agnel Educational Trust, Vashi	67.4	49.6	74.5	70.6	66.2	58.3	63.8	48.4	74.3	67.2	61.2	52.4

Chart 5.2: Ambient Noise Levels in Navi Mumbai





5.3 Thane

In Thane a total of 5 locations were monitored. The highest noise level during day time on 17th December is observed at Pokharan road i.e. 82.0 dB(A) and on 18th December , the Gaondevi mandir, Naupada was the loudest with 78.6 dB(A). However, during night time, the highest noise level on both the days was observed at Gaondevi mandir, Naupada and Tembhi Naka with 81.5 dB(A) and 72.9 dB(A) respectively.

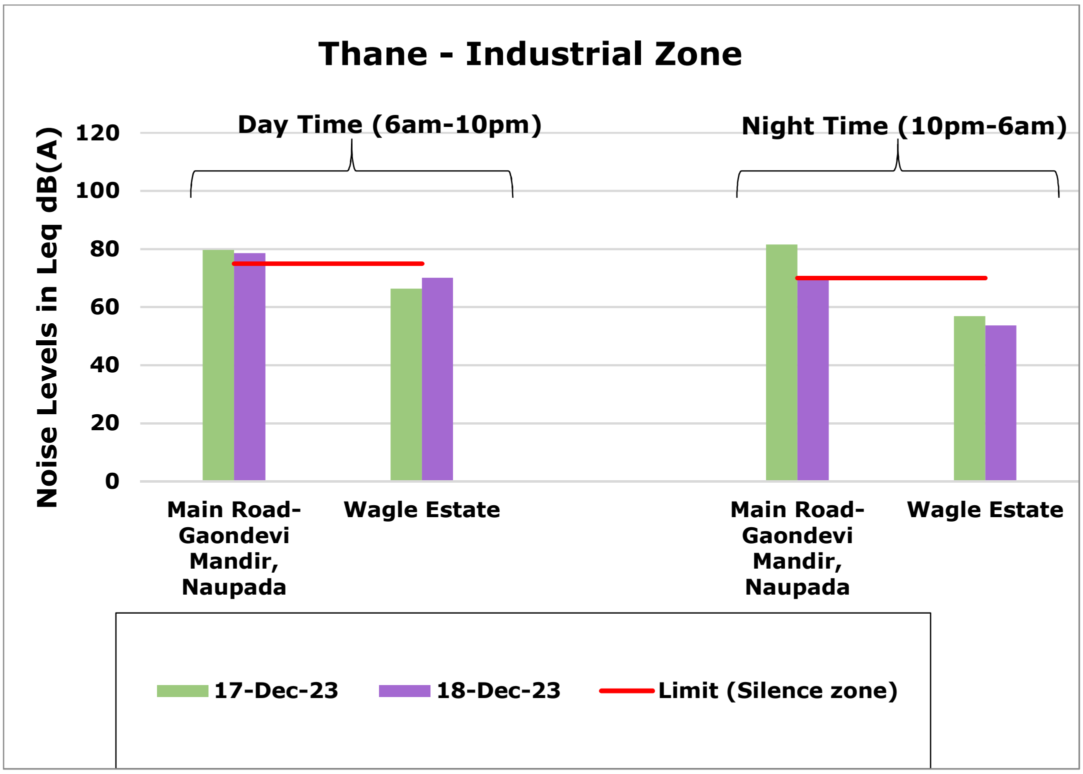
Table 5.3: Ambient Noise Levels in Thane

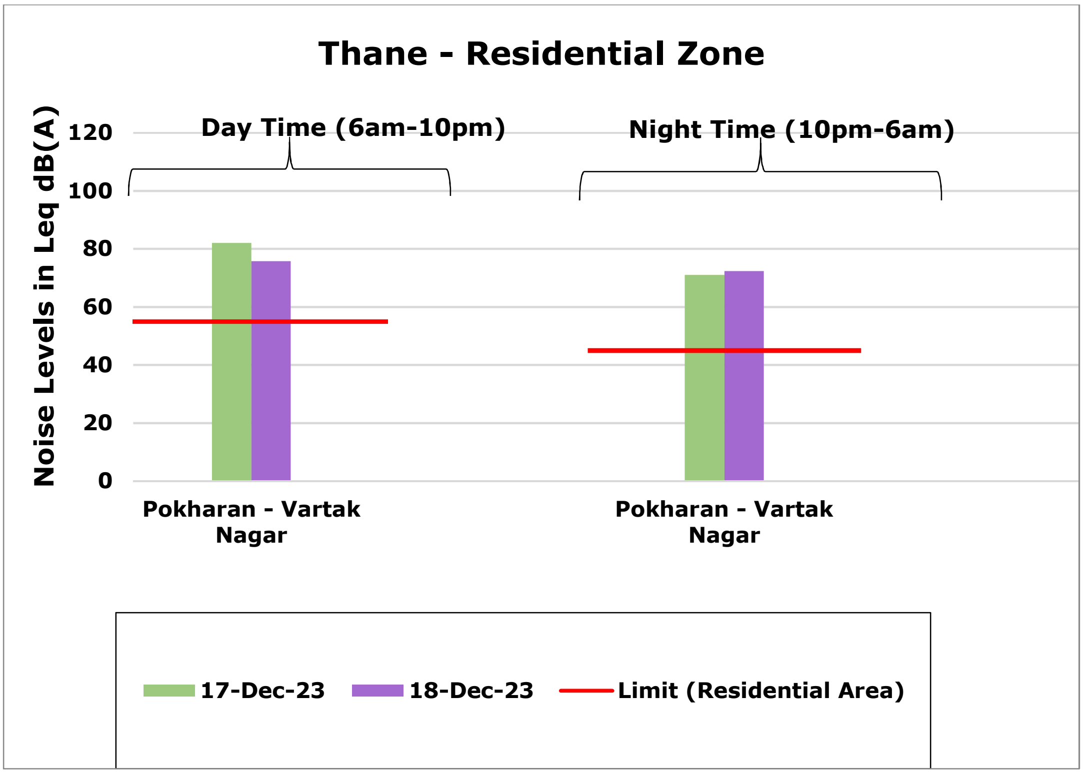
Ambient Noise Monitoring on 17th December 2023- THANE												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Main Road-Gaondevi Mandir	79.7	60.0	95.2	80.5	74.6	65.4	81.5	62.0	95.2	84.1	74.2	63.4
Tembhi Naka	67.8	49.0	79.4	70.1	64.9	57.4	62.0	49.0	69.7	66.4	57.8	51.8
Ghokhale Road	70.1	51.4	78.9	73.8	68.4	63.2	70.6	58.1	83.4	74.1	68.8	64.0
Pokharan	82.0	62.1	90.7	85.3	78.3	68.1	71.0	50.3	79.6	76.5	60.3	52.2
Wagle Estate	66.3	40.4	76.2	71.2	59.5	47.8	56.9	40.4	72.2	60.9	50.4	43.8

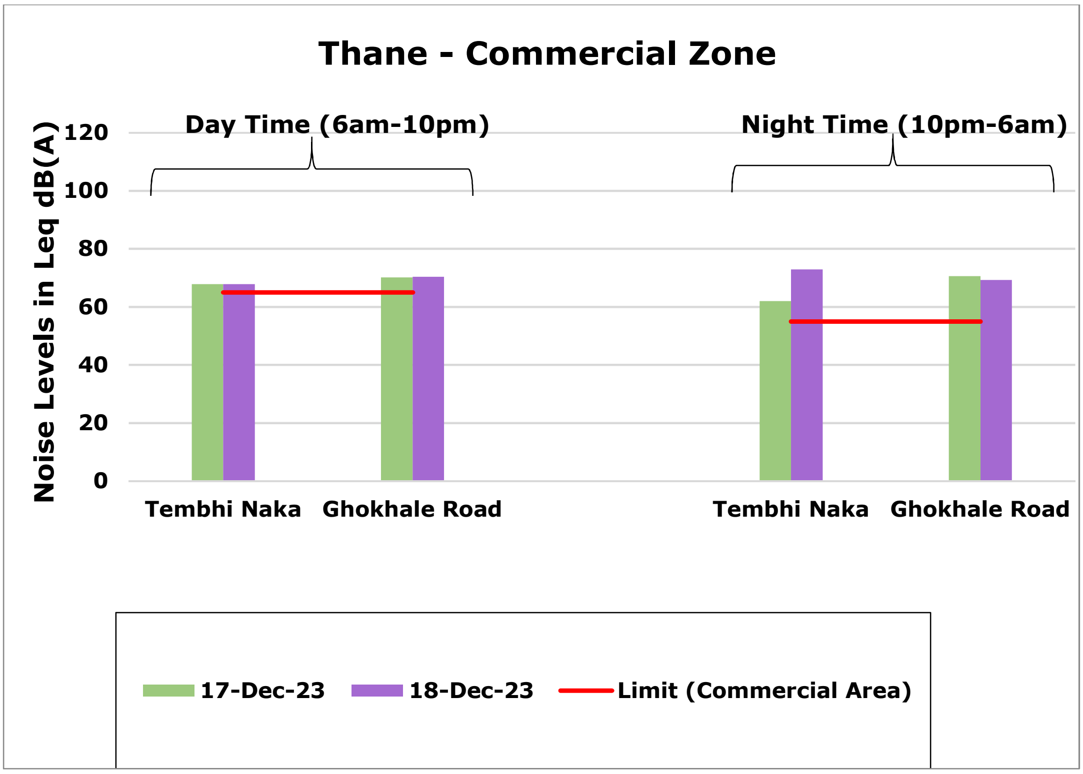
Ambient Noise Monitoring on 18th December 2023 - THANE												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Main Road-Gaondevi Mandir	78.6	43.1	89.7	80.9	76.4	62.8	70.0	41.4	79.4	75.6	59.9	47.9
Tembhi Naka	67.8	49.2	79.4	70.1	64.9	57.4	72.9	41.2	85.6	76.3	51.9	42.9
Ghokhale Road	70.3	58.9	78.9	74.5	68.4	62.9	69.2	49.0	83.4	73.1	57.4	52.9
Pokharan	75.8	55.2	87.3	79.7	71.2	65.4	72.3	51.2	86.7	75.3	58.5	52.4

Ambient Noise Monitoring on 18th December 2023 - THANE												
Location	Day Time (6am-10pm)						Night Time (10pm-6am)					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Wagle Estate	70.1	45.7	79.5	74.5	64.4	50.4	53.7	42.9	64.8	57.7	49.6	45.1

Chart 5.3: Ambient Noise Levels in Thane




Thane - Residential Zone
Day Time (6am-10pm)
Night Time (10pm-6am)
Noise Levels in Leq dB(A)
120
100
80
60
40
20
0
Pokharan - Vartak Nagar
Pokharan - Vartak Nagar
17-Dec-23
18-Dec-23
Limit (Residential Area)


Thane - Commercial Zone
Day Time (6am-10pm)
Night Time (10pm-6am)
Noise Levels in Leq dB(A)
120
100
80
60
40
20
0
Tembhi Naka
Ghokhale Road
Tembhi Naka
Ghokhale Road
17-Dec-23
18-Dec-23
Limit (Commercial Area)

5.4 Pune

Five locations were monitored in Pune region. During both days of monitoring, Pune University road was observed as noisiest with 76.0dB(A) on 17th December and 77.7dB(A) on 18th December 2023.

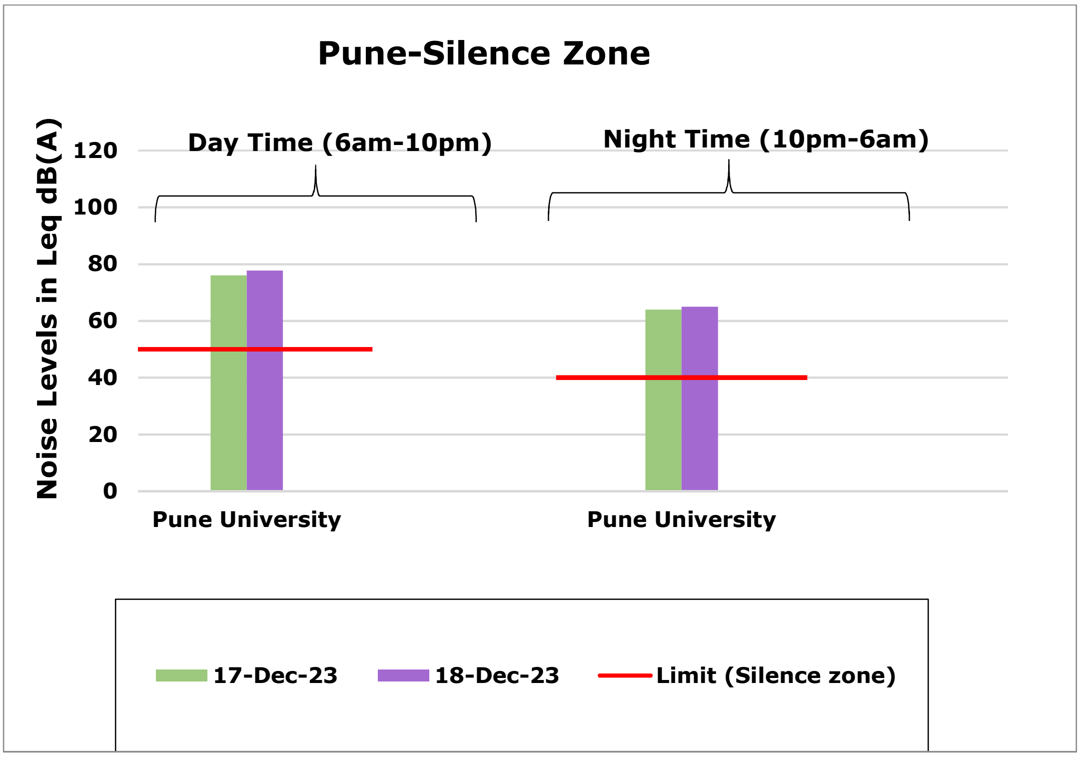
However, during night time of 17th December, the highest noise level 63.9dB(A) was recorded at Pune University and on 18th December, again Pune University was observed with the highest noise level of 65.0dB(A).

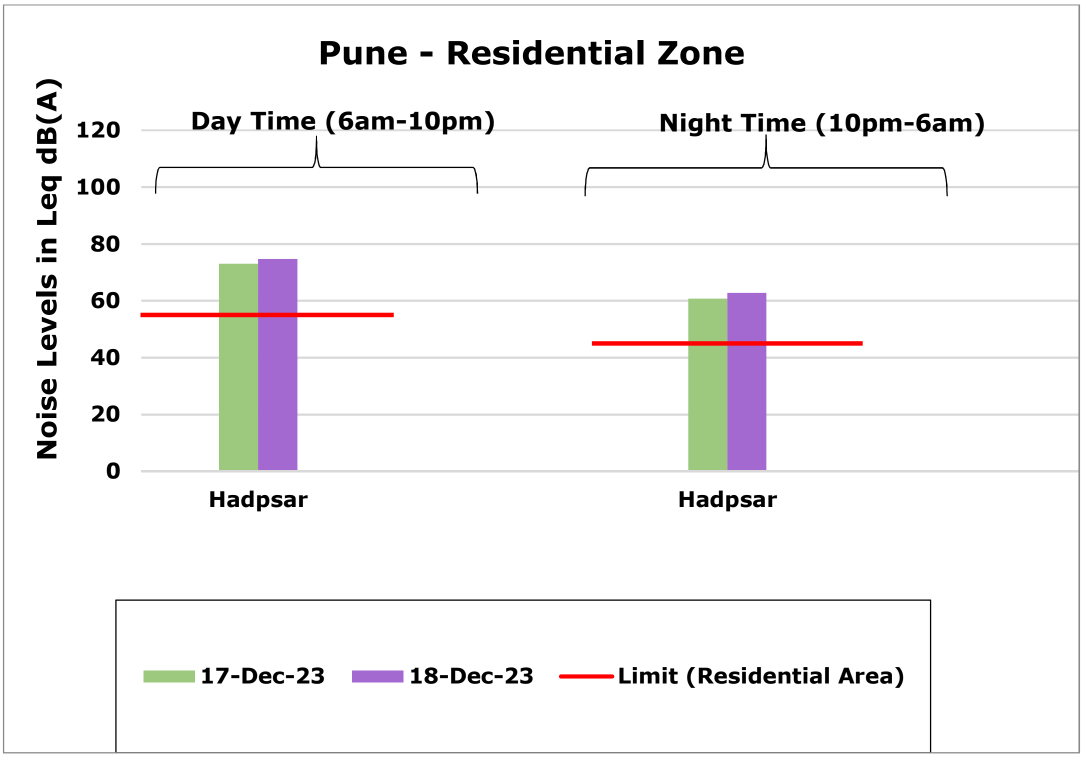
Table 5.4: Ambient Noise Levels in Pune

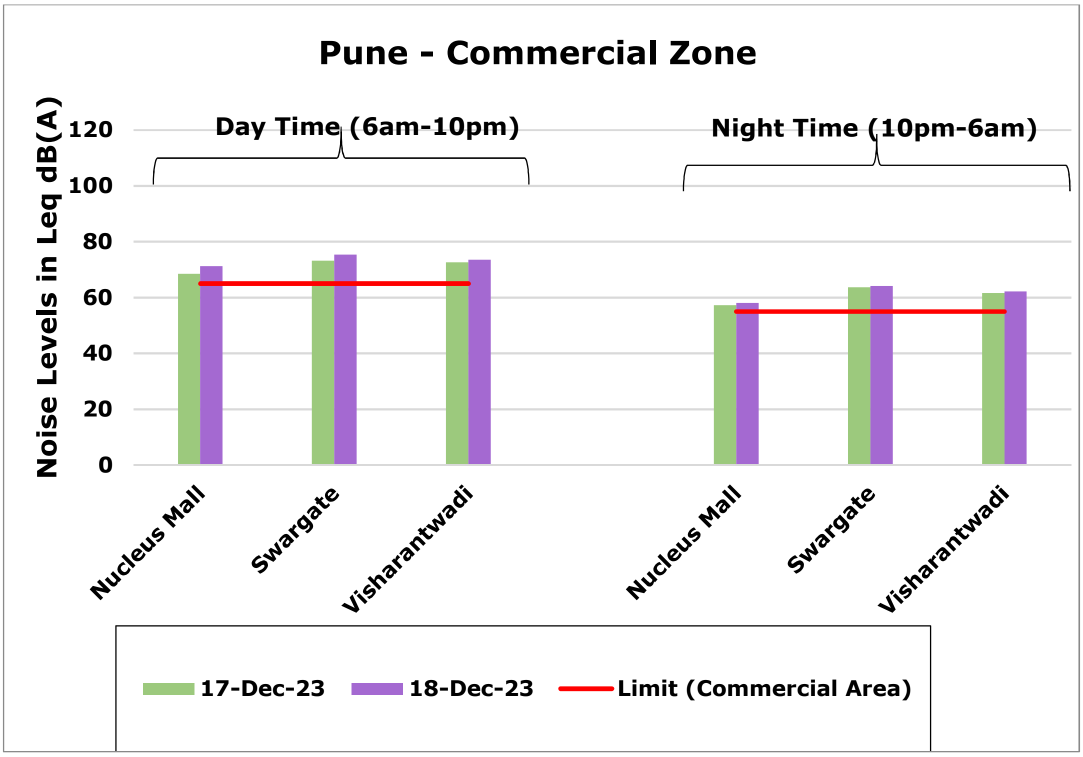
Ambient Noise Monitoring on 17th December 2023- PUNE												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Nucleus Mall	68.5	50.7	79.3	71.9	66.0	57.2	57.2	42.8	64.7	61.5	52.3	44.9
Pune University	76.0	58.4	83.4	78.9	75.2	67.1	63.9	43.3	72.1	69.8	52.0	44.7
Swargate	73.2	62.3	81.6	76.8	71.4	65.4	63.7	43.3	73.3	69.2	51.6	45.1
Hadpsar	73.0	58.4	82.4	76.3	71.1	64.2	60.7	42.9	72.1	65.5	49.8	43.3
Visharantwadi	72.6	57.6	80.6	77.2	70.0	62.8	61.6	42.3	71.6	65.4	51.8	43.8

Ambient Noise Monitoring on 18th December 2023- PUNE												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Nucleus Mall	71.2	52.8	79.6	74.6	67.5	60.9	58.0	42.2	67.8	63.3	48.0	43.6
Pune University	77.7	61.9	84.7	79.9	77.4	71.3	65.0	43.3	73.3	70.6	50.7	45.0
Swargate	75.3	64.7	81.5	78.9	74.5	68.7	64.1	43.8	72.5	70.1	51.7	44.1
Hadpsar	74.7	57.2	81.4	78.4	73.6	66.2	62.7	43.8	72.2	68.7	50.8	44.7
Visharantwadi	73.5	56.0	79.8	77.4	71.5	64.7	62.2	43.8	70.8	66.3	55.4	44.5

Chart 5.4: Ambient Noise Levels in Pune






Pune - Commercial Zone
Noise Levels in Leq dB(A)
120
100
80
60
40
20
0
Day Time (6am-10pm)
Night Time (10pm-6am)
Nucleus Mall
Swargate
Visharantwadi
Nucleus Mall
Swargate
Visharantwadi
17-Dec-23
18-Dec-23
Limit (Commercial Area)

5.5 Nashik

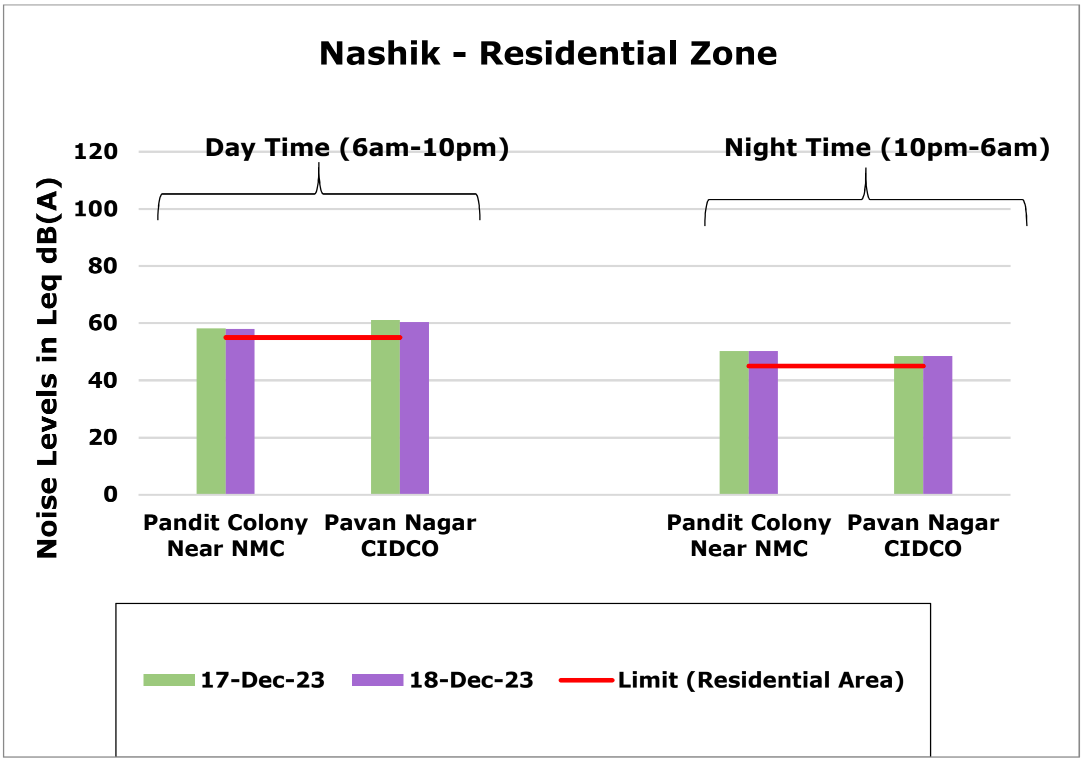
In Nashik also, we have monitored five locations. The highest noise level during day time on 17th and 18th December 2023 was observed with 76.5 dB(A) at Bytco. During night time the highest noise level on both the days was observed at Bytco, with 64.0 dB(A) and 64.4dB(A) respectively.

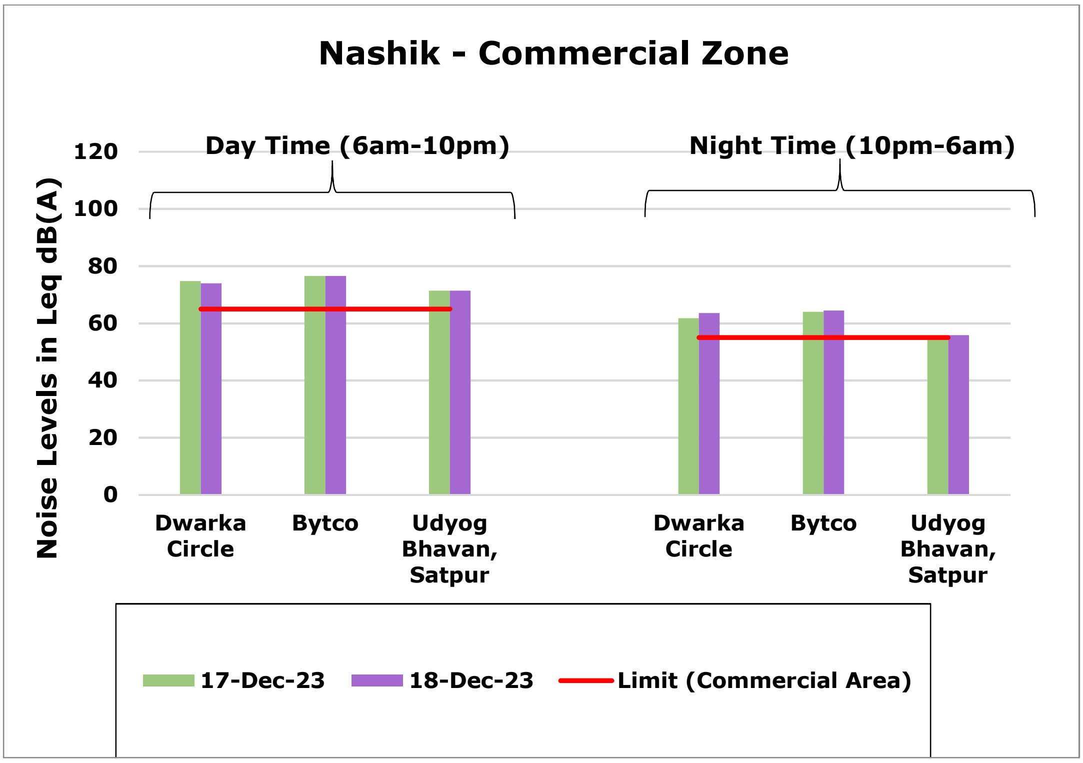
Table 5.5: Ambient Noise Levels in Nashik

Ambient Noise Monitoring on 17th December 2023- NASHIK												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Dwarka Circle	74.7	67.0	79.0	76.0	75.0	70.0	61.7	54.0	66.0	65.0	60.0	55.9
Pandit Colony Near NMC	58.1	42.0	68.0	63.0	53.0	46.0	50.2	42.0	56.0	54.0	49.0	43.0
Pavan Nagar CIDCO	61.1	42.0	68.0	65.0	60.0	48.9	48.4	41.0	53.0	51.1	48.0	42.9
Bytco	76.5	70.0	81.0	79.0	76.0	72.0	64.0	55.0	69.0	68.0	61.5	56.0
Udyog Bhavan, Satpur	71.4	63.0	76.0	74.0	71.0	68.0	55.6	48.0	62.0	58.0	54.0	49.0

Ambient Noise Monitoring on 18th December 2023- NASHIK												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Dwarka Circle	74.0	62.0	79.0	76.0	74.0	69.0	63.5	57.0	71.0	66.1	61.0	58.0
Pandit Colony Near NMC	58.0	42.0	68.0	63.0	53.0	46.0	50.2	42.0	56.0	54.0	48.0	43.0
Pavan Nagar CIDCO	60.4	42.0	66.0	64.0	58.0	49.9	48.5	41.0	53.0	52.0	47.0	43.0
Bytco	76.5	70.0	81.0	79.0	76.0	72.0	64.4	56.0	69.0	67.0	64.0	59.0
Udyog Bhavan, Satpur	71.4	65.0	76.0	74.0	70.5	68.0	55.8	48.0	62.0	60.0	54.0	48.9

Chart 5.5: Ambient Noise Levels in Nashik





5.6 Aurangabad

Five locations were monitored for Aurangabad region. The highest avergae noise level on 17th December, during day time was observed at Nirala Bazaar with 61.6dB(A). On 18th December, the highest average noise level during day time was observed at Swami Vivekanand College with 67.0 dB(A) and during night time the highest noise level was also observed at Swami Vivekanand College with 49.6 dB(A).

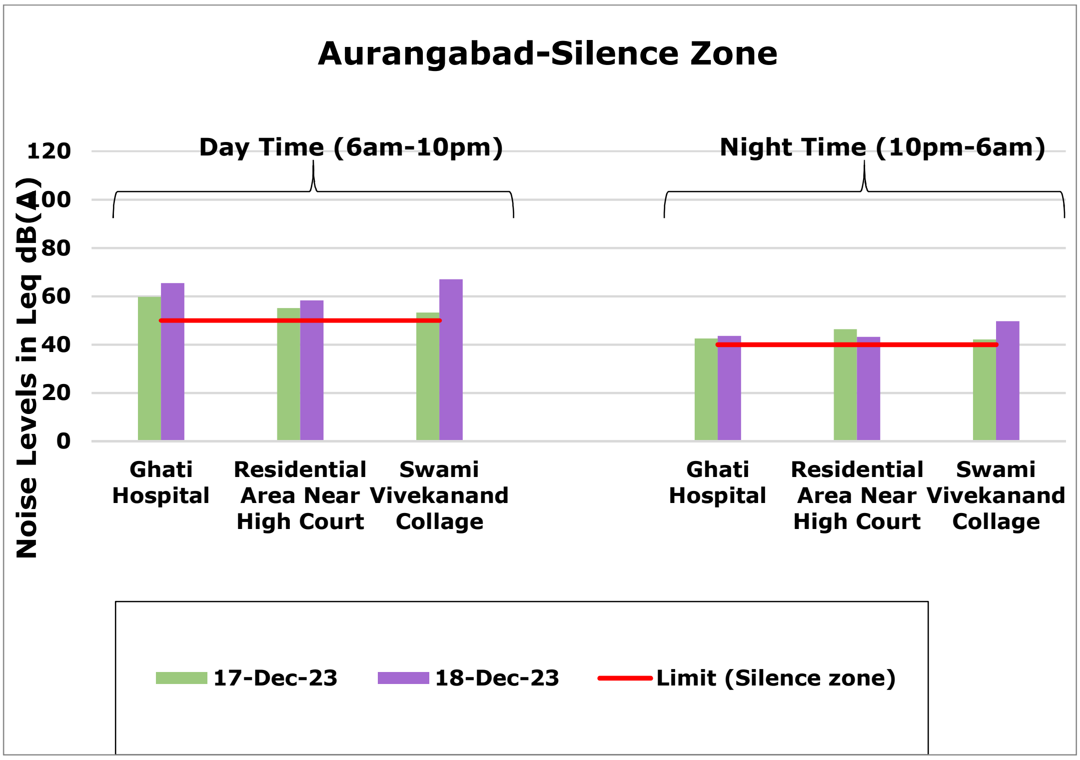
Table 5.6: Ambient Noise Levels in Aurangabad

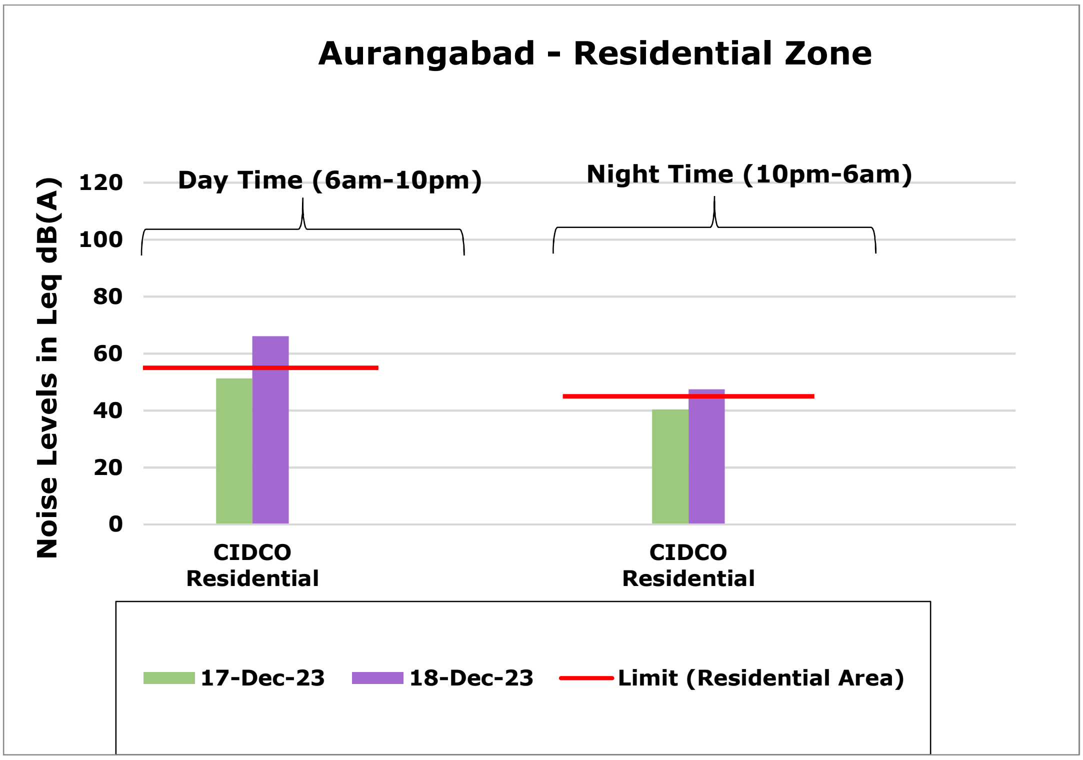
Ambient Noise Monitoring on 17th December 2023- AURANGABAD												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Ghati Hospital	59.7	40.0	68.0	63.0	59.0	45.0	42.5	34.0	49.0	45.1	41.0	37.9
Nirala Bazaar	61.6	41.0	66.0	65.0	61.0	51.0	45.6	34.0	54.0	50.1	41.0	38.9
CIDCO N-9	51.3	41.0	56.0	54.0	51.0	45.0	40.3	34.0	43.0	42.0	40.0	38.0
Residential Area near High Court	55.1	41.0	65.0	58.0	53.0	46.0	46.3	37.0	53.0	51.0	42.0	40.0
Swami Vivekanand College	53.2	39.0	61.0	58.0	51.0	41.0	42.1	37.0	48.0	45.1	41.0	38.9

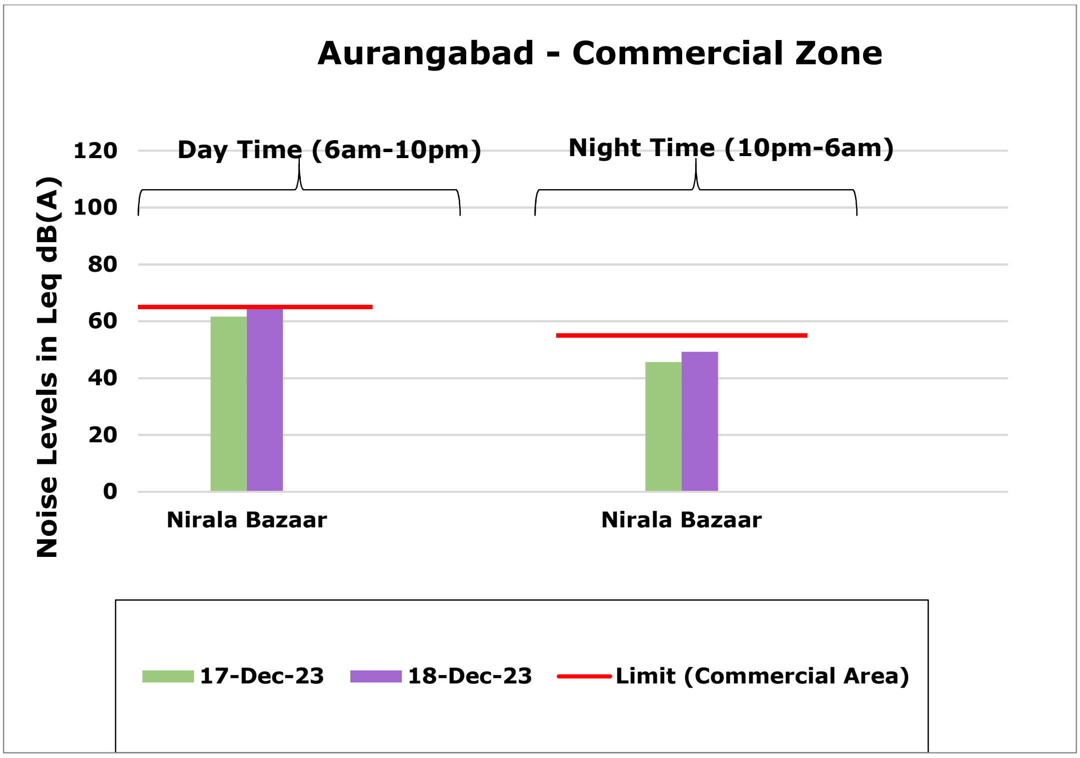
Ambient Noise Monitoring on 18th December 2023- AURANGABAD												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Ghati Hospital	65.4	40.0	70.0	69.0	65.0	45.0	43.6	37.0	49.0	47.0	42.0	40.0
Nirala Bazaar	65.0	42.0	69.0	68.0	65.0	48.9	49.2	40.0	55.0	51.0	48.0	42.0
CIDCO N-9	66.1	41.0	71.0	69.0	66.0	52.0	47.4	39.0	54.0	51.0	45.0	40.9
Residential Area near High Court	58.2	40.0	66.0	62.0	57.0	44.0	43.1	38.0	48.0	46.0	42.0	40.0

Swami Vivekanand College	67.0	41.0	72.0	70.0	67.0	50.9	49.6	40.0	55.0	54.0	46.0	41.0

Chart 5.6: Ambient Noise Levels in Aurangabad






Aurangabad - Commercial Zone
Day Time (6am-10pm)
Night Time (10pm-6am)
Noise Levels in Leq dB(A)
120
100
80
60
40
20
0
Nirala Bazaar
Nirala Bazaar
17-Dec-23
18-Dec-23
Limit (Commercial Area)

5.7 Nagpur

In Nagpur region also, noise levels were recorded at five different locations of the city. On 17th and 18th December , the highest noise level during daytime were observed at Sitabardi Police Station with 78.2 dB(A) and 74.4 dB(A) respectively. On both days during night time, the highest noise level was observed at Sitabardi Police Station.

Table 5.7: Ambient Noise Levels in Nagpur

Ambient Noise Monitoring on 17th December 2023- NAGPUR												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	**L_{min}**	**L_{max}**	**L_{10}**	**L_{50}**	**L_{90}**	**L_{eq}**	**L_{min}**	**L_{max}**	**L_{10}**	**L_{50}**	**L_{90}**
Govt. Medical College	61.4	48.9	69.7	65.6	57.3	51.9	49.3	44.3	54.6	52.6	48.2	45.7
Sitabardi Police Station	78.2	48.5	86.5	81.2	77.5	60.2	64.3	40.0	79.5	63.2	51.0	41.2
Shivaji Nagar	66.2	47.2	74.7	70.4	63.1	54.3	61.5	51.2	69.7	65.3	59.5	54.1
Mahal	69.3	41.6	79.2	72.4	64.0	51.5	60.7	43.3	71.0	63.4	57.8	48.0
Sadar	63.7	51.3	71.1	66.8	62.1	57.2	59.2	40.1	67.6	64.1	55.5	45.1

Ambient Noise Monitoring on 18th December 2023- NAGPUR												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	**L_{min}**	**L_{max}**	**L_{10}**	**L_{50}**	**L_{90}**	**L_{eq}**	**L_{min}**	**L_{max}**	**L_{10}**	**L_{50}**	**L_{90}**
Govt. Medical College	62.1	48.9	68.7	65.8	60.1	52.3	49.3	44.3	54.5	52.6	48.0	45.7
Sitabardi Police Station	74.4	50.2	83.4	77.9	72.3	67.5	66.4	50.2	75.3	70.2	63.2	51.9
Shivaji Nagar	66.8	56.3	75.1	70.4	64.5	60.1	61.4	41.2	71.2	65.4	58.6	47.5
Mahal	67.9	41.6	79.2	73.3	63.8	51.3	61.9	43.0	77.0	63.9	57.7	48.9
Sadar	63.5	49.4	69.6	67.2	61.9	56.6	52.5	41.5	60.1	56.7	50.1	45.1

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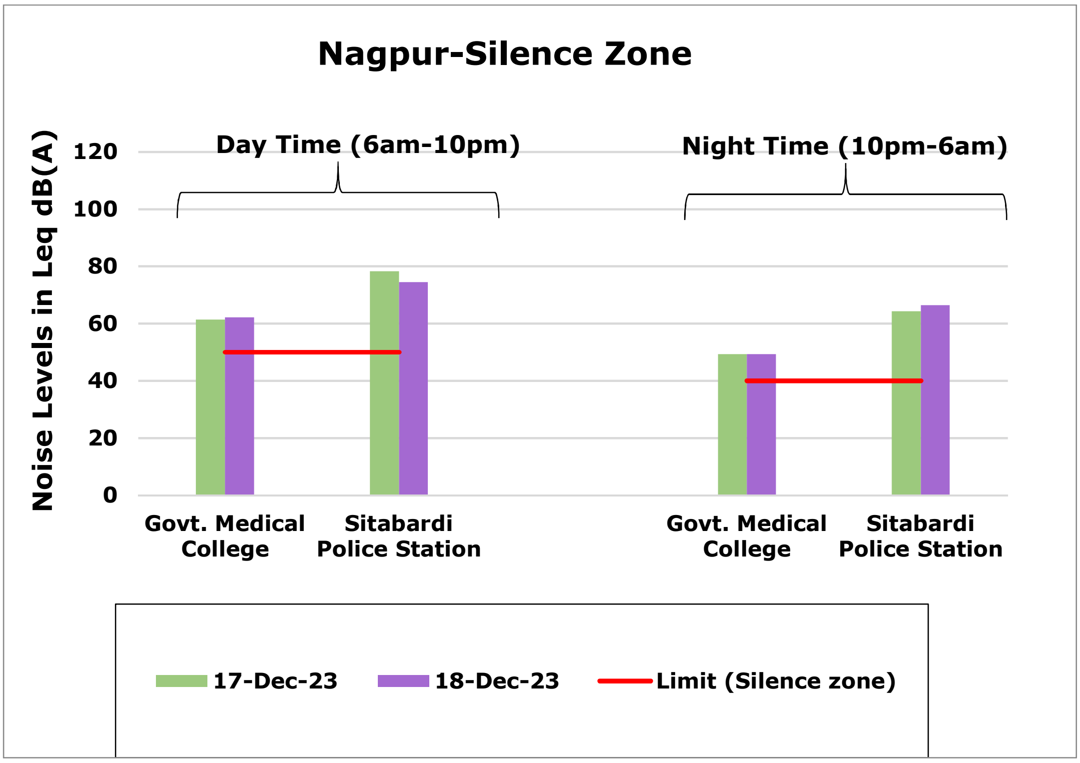
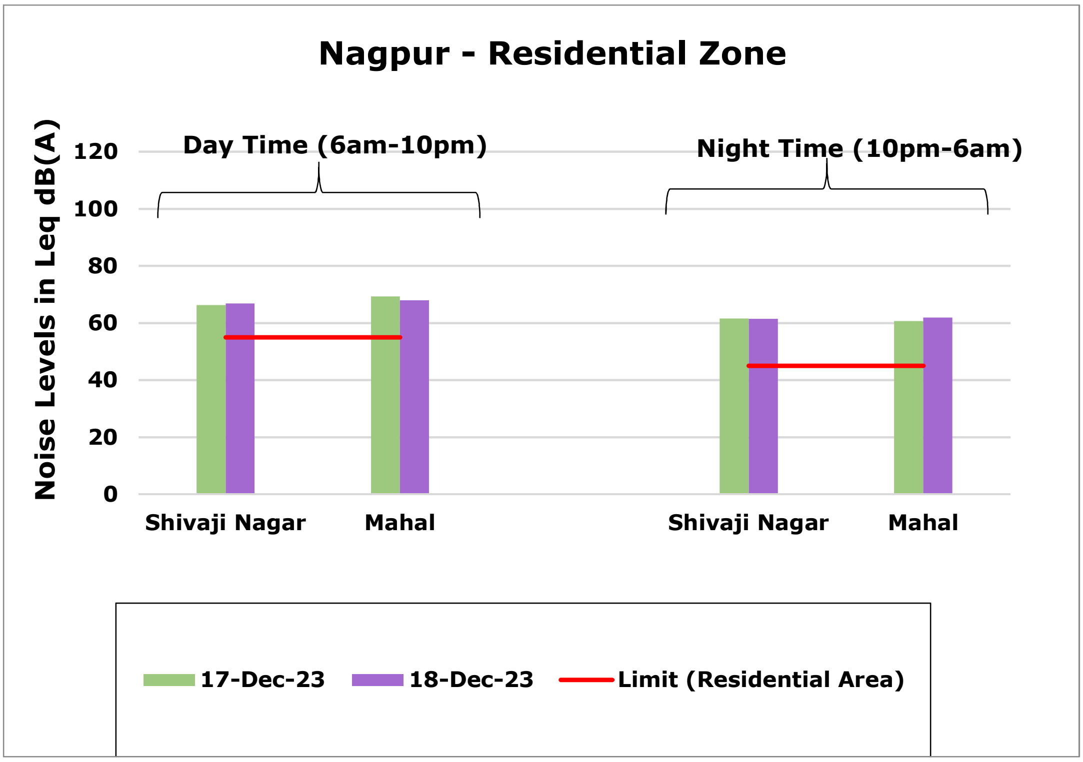
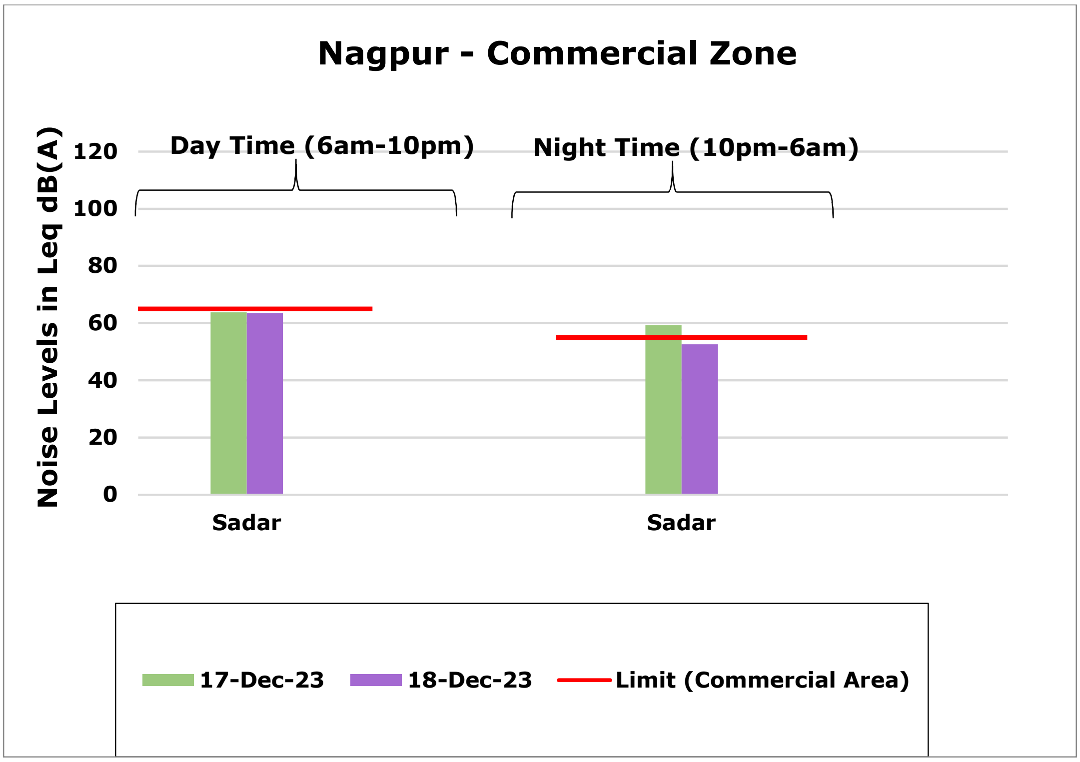
Chart 5.7: Ambient Noise Levels in Nagpur






Nagpur - Commercial Zone
Noise Levels in Leq dB(A)
120
100
80
60
40
20
0
Day Time (6am-10pm)
Night Time (10pm-6am)
Sadar
Sadar
17-Dec-23
18-Dec-23
Limit (Commercial Area)

5.8 Kalyan

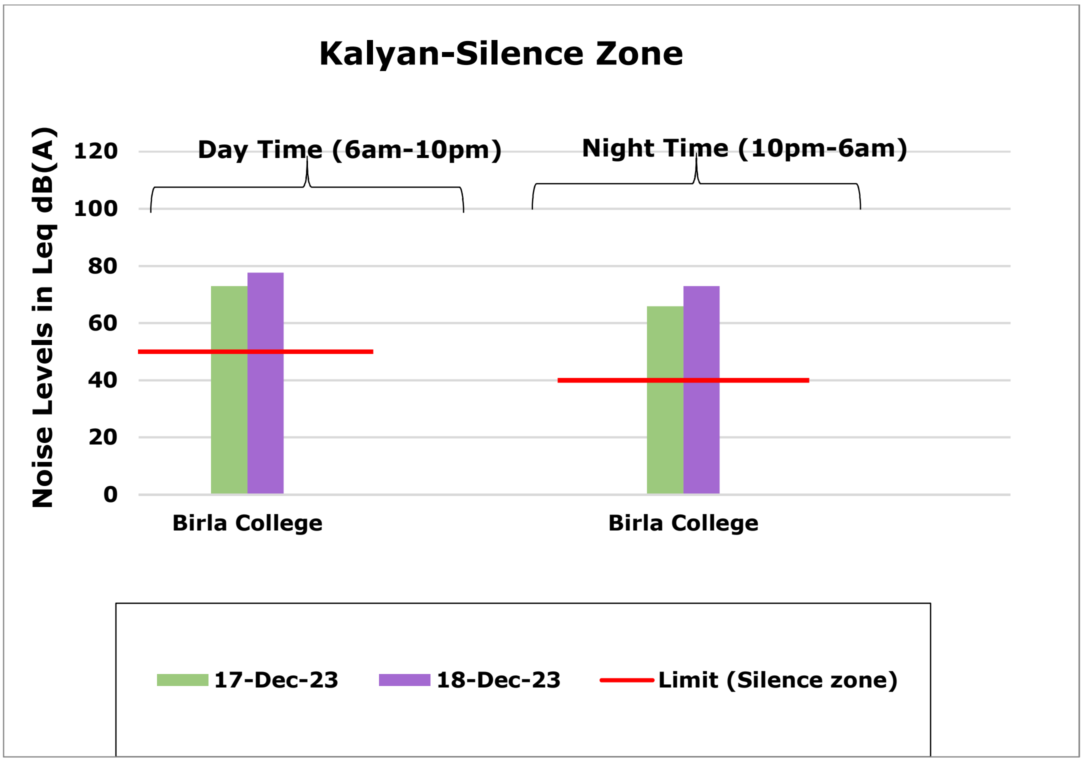
Three locations were monitored in Kalyan region. During day time on 17th December , the highest noise level 76.9dB(A) was recorded at Katemanivali and on 18th December also, Katemanivali was the noisiest with 82.9dB(A). During night time, the highest noise level was observed at Birla College on both the days of monitoring with 65.9 dB(A) and 72.9 dB(A) respectively.

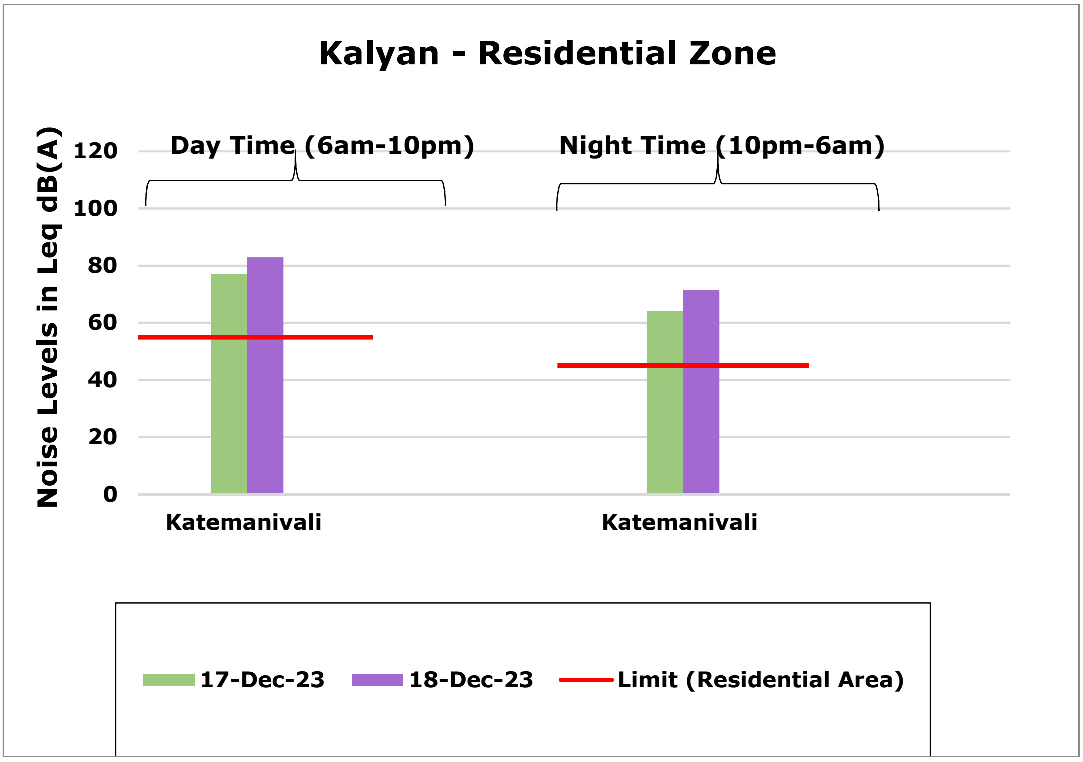
Table 5.8: Ambient Noise Levels in Kalyan

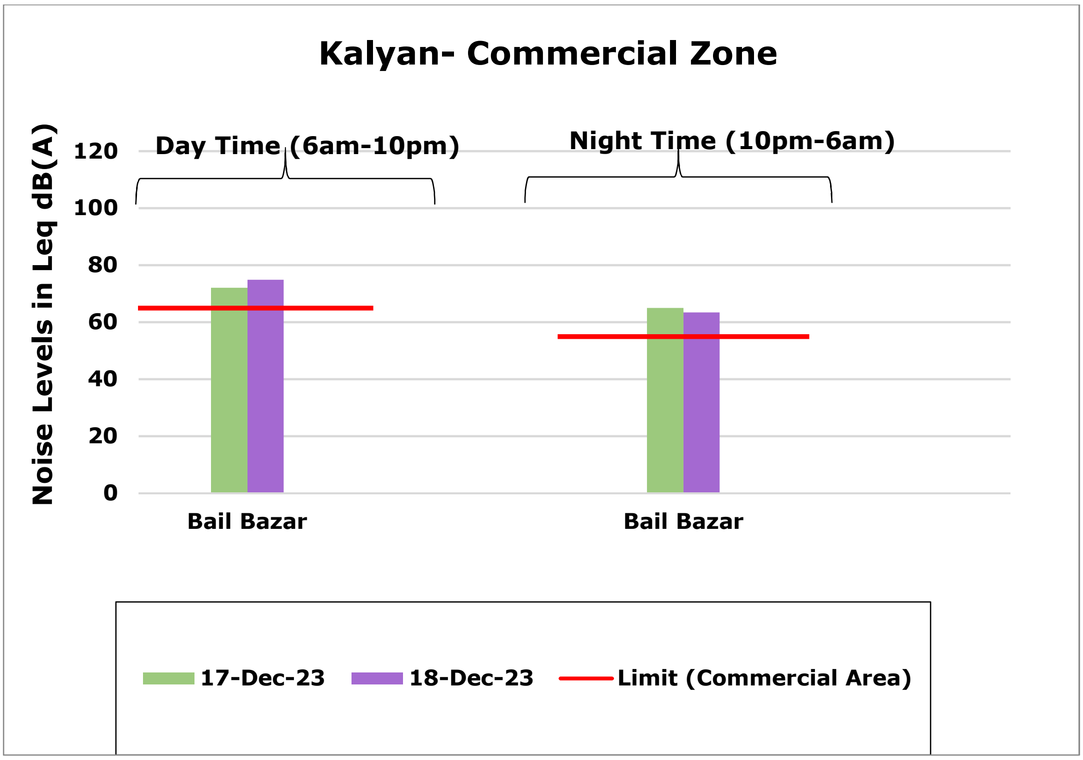
Ambient Noise Monitoring on 17th December 2023- KALYAN												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	**L_{min}**	**L_{max}**	**L_{10}**	**L_{50}**	**L_{90}**	**L_{eq}**	**L_{min}**	**L_{max}**	**L_{10}**	**L_{50}**	**L_{90}**
Katemanivali	76.9	41.5	86.2	81.0	73.2	48.3	64.1	41.5	75.8	72.2	52.6	44.8
Birla College	72.9	45.7	83.4	77.0	67.2	53.1	65.9	45.5	78.8	70.1	55.9	48.4
Bail Bazar	72.1	47.8	84.3	76.4	68.3	53.5	65.0	47.2	81.0	66.1	57.1	48.4

Ambient Noise Monitoring on 18th December 2023- KALYAN												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	**L_{min}**	**L_{max}**	**L_{10}**	**L_{50}**	**L_{90}**	**L_{eq}**	**L_{min}**	**L_{max}**	**L_{10}**	**L_{50}**	**L_{90}**
Katemanivali	82.9	46.2	90.9	86.9	81.1	58.3	71.3	41.5	82.5	76.0	57.8	46.4
Birla College	77.6	48.4	86.8	82.6	73.3	58.4	72.9	41.2	85.6	76.3	51.9	42.9
Bail Bazar	74.9	42.3	86.4	78.5	71.4	63.1	63.4	46.2	73.4	68.1	58.3	48.4

Chart 5.8: Ambient Noise Levels in Kalyan







Kalyan- Commercial Zone
Noise Levels in Leq dB(A)
120
100
80
60
40
20
0
Day Time (6am-10pm)
Night Time (10pm-6am)
Bail Bazar
Bail Bazar
17-Dec-23
18-Dec-23
Limit (Commercial Area)

5.9 Amaravati

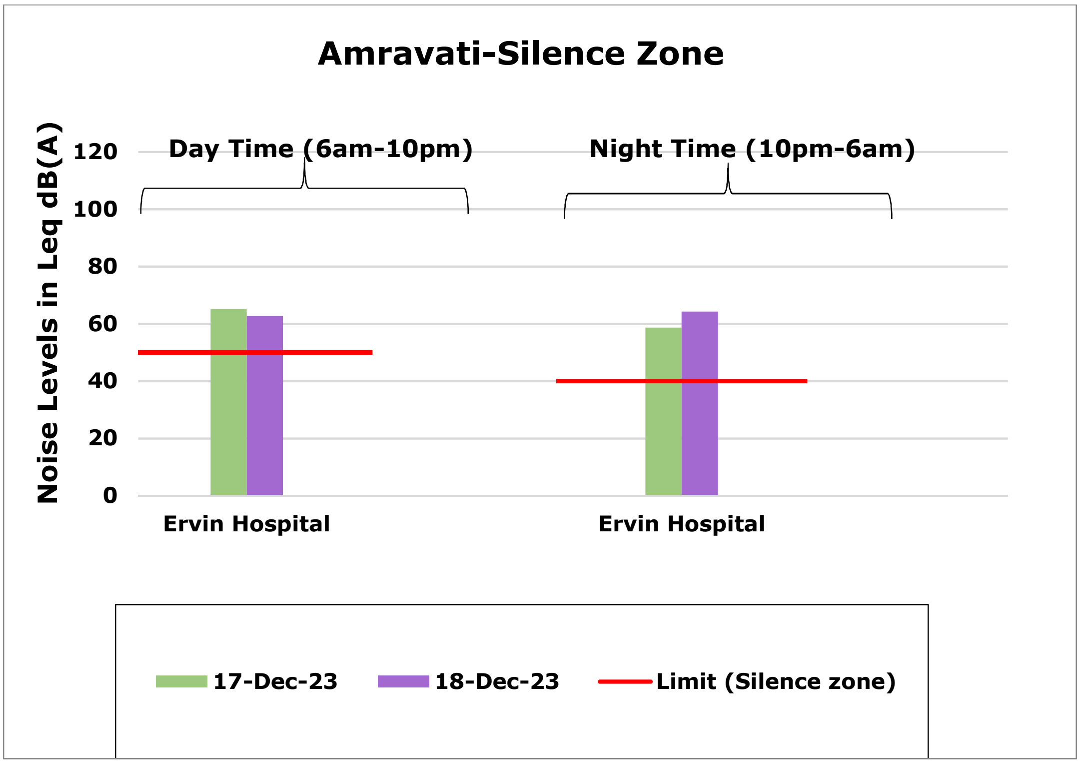
Three locations were monitored for Amravati region. It was observed that Rajkamal Chowk was the noisiest with highest noise levels on both days of monitoring both during day time with highest at 18th December 2023 with 75.1dB(A). During night time, Budhwara was the noisiest on both the days.

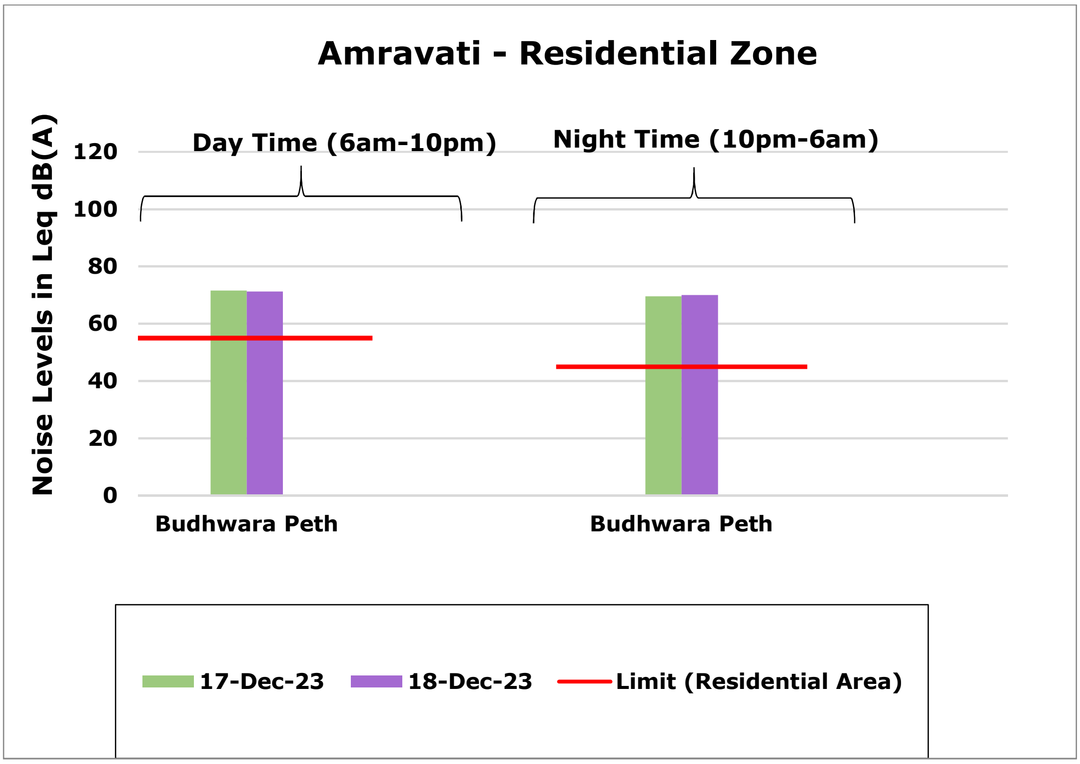
Table 5.9: Ambient Noise Levels in Amaravati

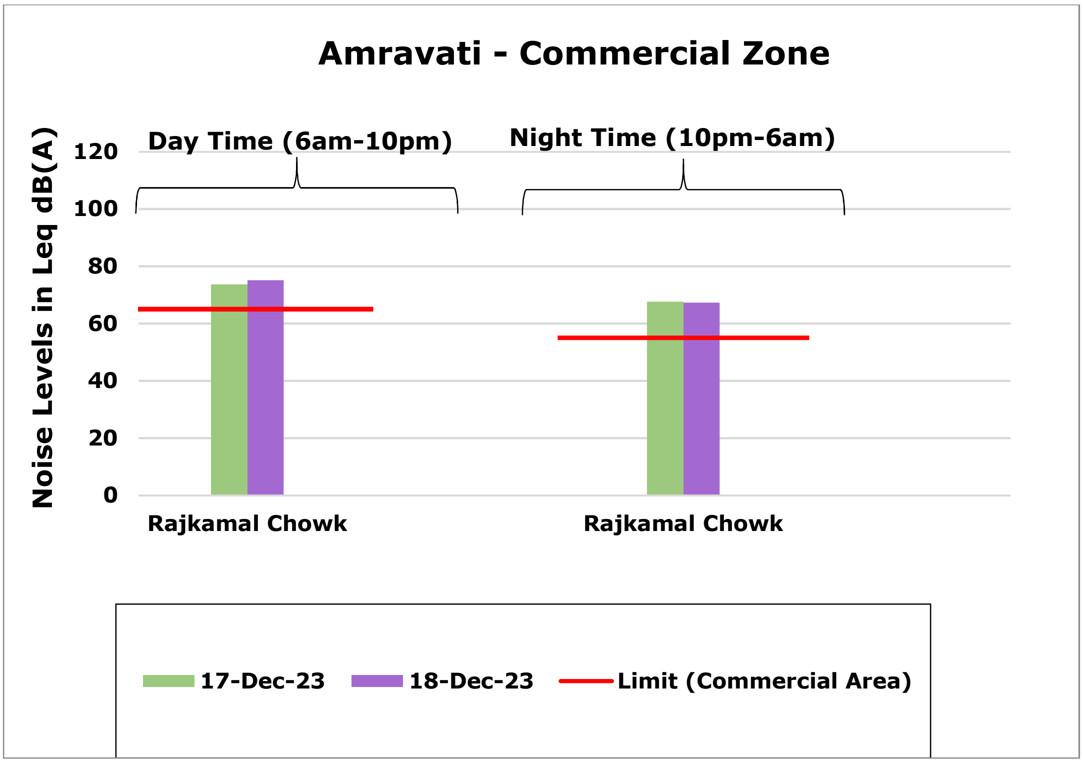
Ambient Noise Monitoring on 17th December 2023- AMRAVATI												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Ervin Hospital Square	65.1	51.6	72.8	68.8	62.9	57.7	58.6	46.4	68.8	62.8	54.8	48.4
Budhwara	71.6	48.3	81.7	76.8	65.4	58.4	69.5	45.9	78.5	74.5	60.3	49.8
Rajkamal Chowk	73.6	58.7	80.2	77.1	72.3	66.2	67.6	42.7	77.2	71.9	62.8	55.3

Ambient Noise Monitoring on 18th December 2023- AMRAVATI												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Ervin Hospital Square	62.7	43.6	77.0	66.2	59.8	49.8	64.2	55.4	69.5	67.4	63.2	58.7
Budhwara	71.2	50.2	82.7	75.9	65.3	56.2	70.0	46.9	80.4	74.5	60.0	50.1
Rajkamal Chowk	75.1	65.0	83.3	78.3	73.5	69.8	67.2	51.9	75.8	72.2	63.0	59.1

Chart 5.9: Ambient Noise Levels in Amaravati






Amravati - Commercial Zone
Noise Levels in Leq dB(A)
120
100
80
60
40
20
0
Day Time (6am-10pm)
Night Time (10pm-6am)
Rajkamal Chowk
Rajkamal Chowk
17-Dec-23
18-Dec-23
Limit (Commercial Area)

5.10 Jalgaon

In Jalgaon region also, three locations were monitored. On both the days of monitoring, the highest noise level was observed at Shashtri Tower Chowk during day time. However, during night time, near Civil hospital with 52.1dB(A) on 17th December and on 18th December 2023, Shashtri Tower Chowk was observed with the highest noise level of 71.6dB(A).

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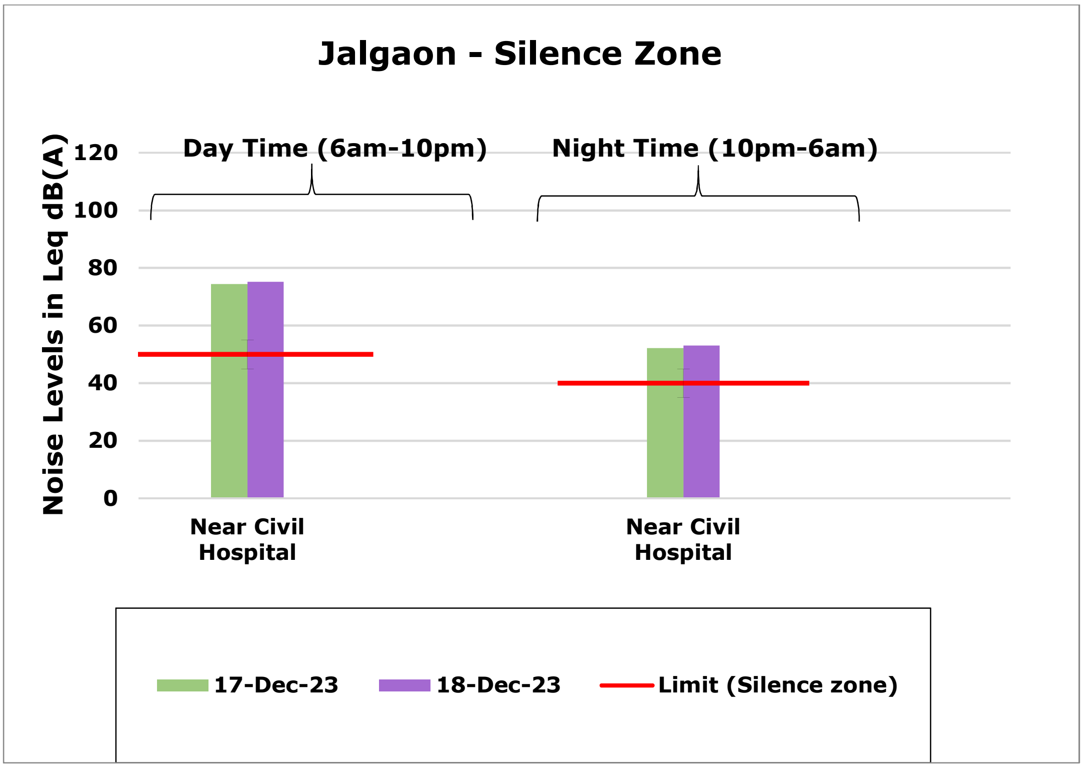
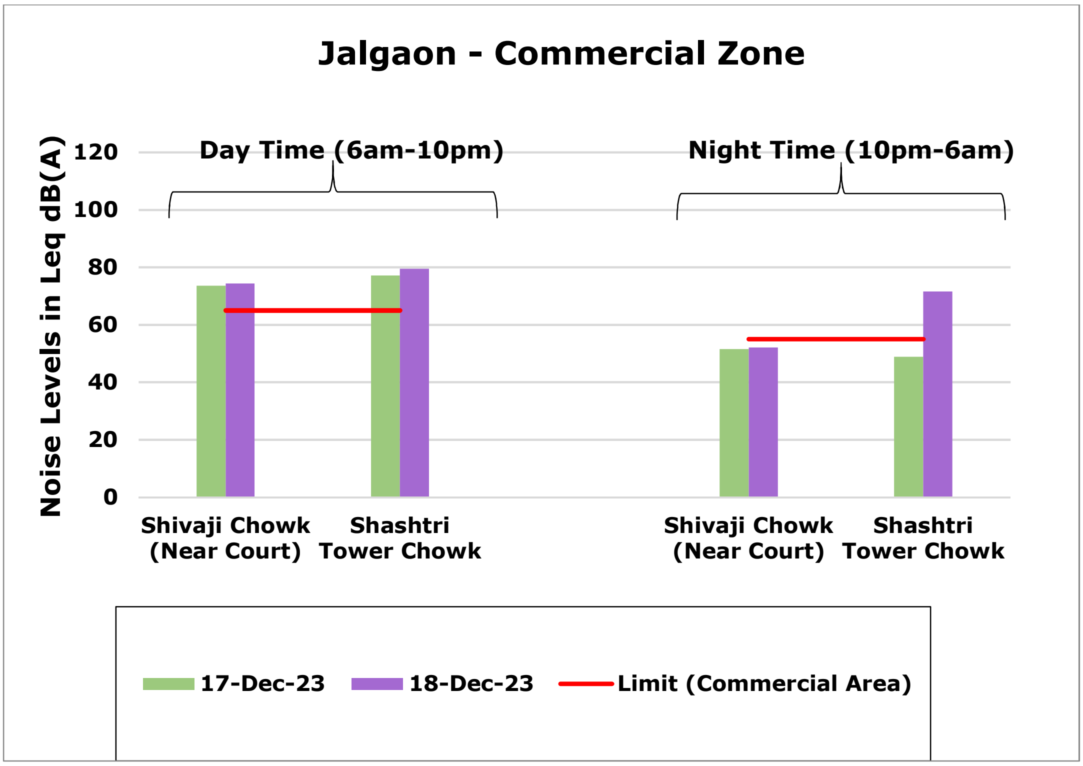
Table 5.10: Ambient Noise Levels in Jalgaon

Ambient Noise Monitoring on 17th December 2023- JALGAON												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Near Civil Hospital	74.4	58.8	81.3	78.9	70.9	60.9	52.1	34.3	61.0	58.3	41.4	36.8
Shivaji Chowk	73.6	55.3	80.3	78.3	70.3	60.7	51.5	33.2	60.9	57.2	40.7	35.7
Shashtri Tower Chowk	77.1	33.8	88.2	80.6	72.3	39.2	48.8	34.1	62.5	52.3	40.3	35.1

Ambient Noise Monitoring on 18th December 2023- JALGAON												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Near Civil Hospital	75.2	55.9	82.4	79.6	71.4	61.3	53.0	35.4	62.1	59.0	42.5	37.5
Shivaji Chowk	74.3	53.6	83.7	78.3	71.2	59.5	52.1	32.1	62.2	57.9	40.3	34.6
Shashtri Tower Chowk	79.5	37.8	88.9	84.4	75.8	45.6	71.6	30.5	82.5	77.0	40.4	34.8

Chart 5.10: Ambient Noise Levels in Jalgaon





5.11 Kolhapur

In Kolhapur region, four locations were monitored. On both the days of monitoring during daytime, the highest noise level was recorded at Gokhale College with 82.0 dB(A) and 82.1 dB(A). During night time on 17th December , Dabhorkar Corner was observed with the highest noise level i.e. 51.6dB(A) and on 18th December , Rajarampuri Chowk was recorded with the highest noise i.e. 55.1 dB(A).

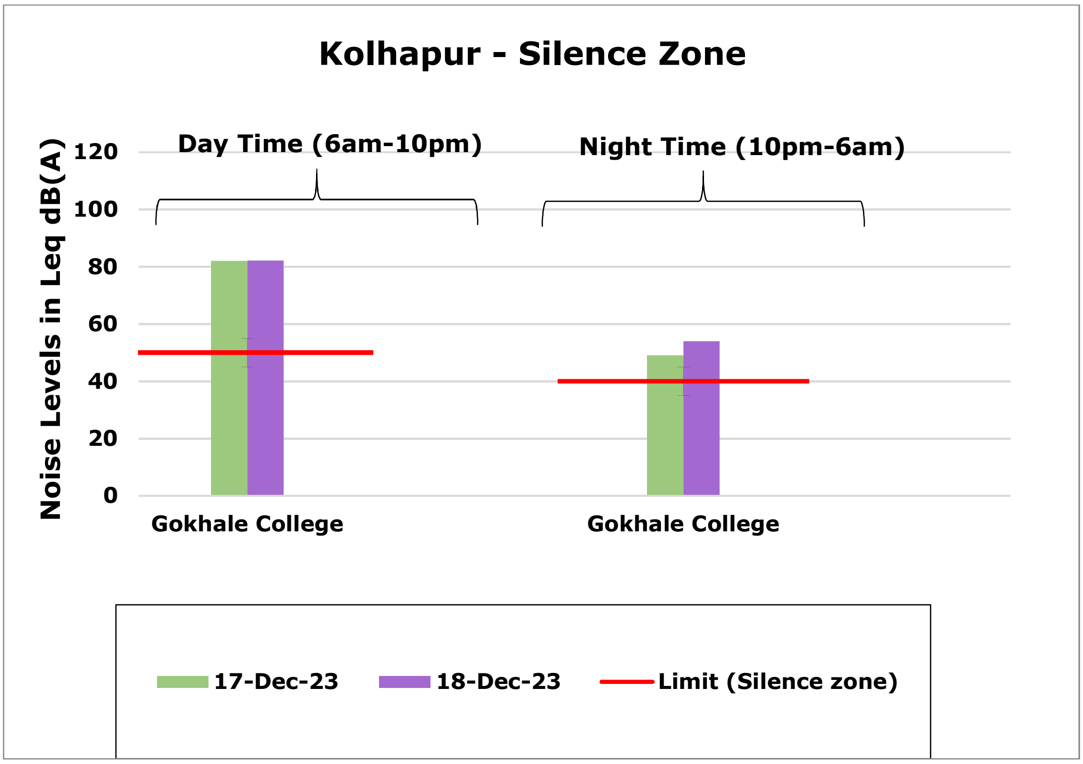
Table 5.11: Ambient Noise Levels in Kolhapur

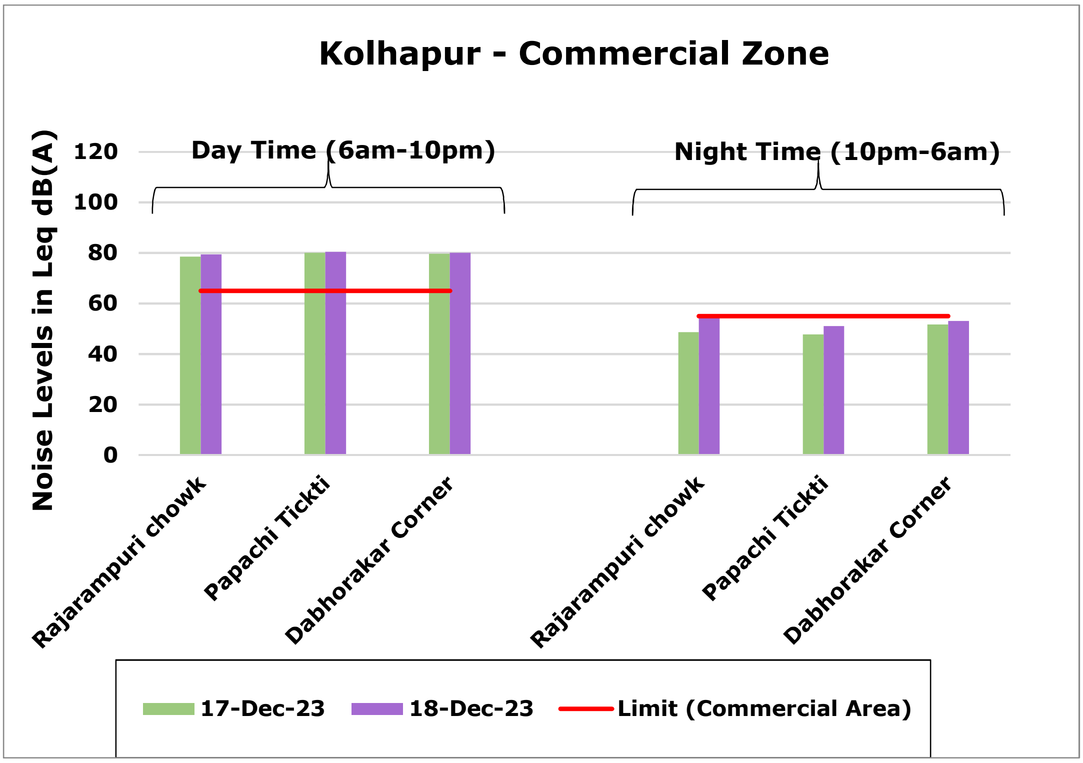
Ambient Noise Monitoring on 17th December 2023 - KOLHAPUR												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Rajarampuri chowk	78.5	47.2	92.6	82.5	70.7	54.9	48.6	37.8	56.8	52.5	46.3	40.7
Papachi Tickti	80.0	50.4	95.6	82.5	72.5	58.8	47.7	37.8	55.8	51.2	44.3	40.3
Gokhale College	82.0	52.1	95.3	84.7	73.6	61.2	49.3	38.9	58.2	52.6	46.3	40.3
Dabhorakar Corner	79.6	48.9	92.6	82.6	70.6	57.8	51.6	40.3	58.2	55.2	50.2	42.5

Ambient Noise Monitoring on 18th December 2023 - KOLHAPUR												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Rajarampuri chowk	79.4	52.4	88.5	84.5	74.5	64.0	55.1	41.8	65.7	60.1	50.0	44.6
Papachi Tickti	80.4	58.4	89.6	84.5	75.7	65.2	51.0	42.6	60.4	54.2	46.3	43.3
Gokhale College	82.1	52.5	91.2	87.0	77.4	64.8	53.9	42.8	65.1	57.7	48.7	43.9
Dabhorakar Corner	80.0	48.9	89.5	84.6	74.6	60.2	53.0	42.8	63.7	55.5	47.3	43.2

972

Chart 5.11: Ambient Noise Levels in Kolhapur





5.12 Sangli

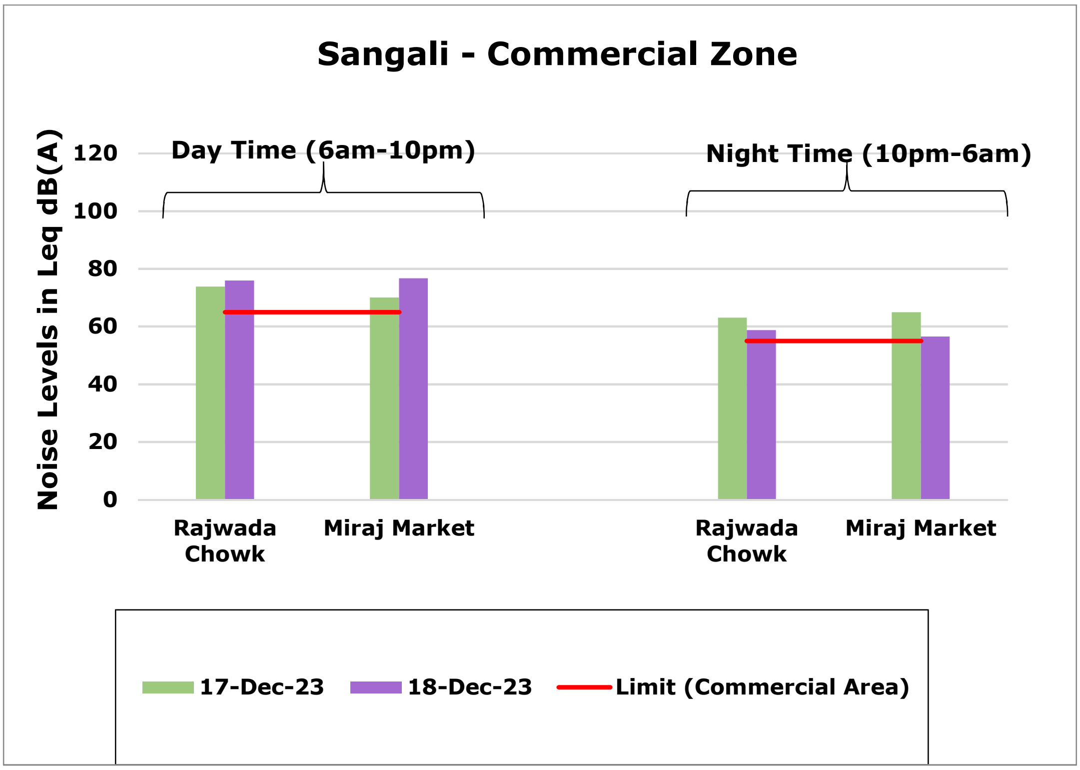
Out of the three locations monitored in Sangli region, on 17th December , Rajwada Chowk with 73.8 dB(A) was observed with the highest noise level during day time and on 18th December , the highest noise level was observed at Vishrambaug i.e. 81.6dB(A). However, during night time of both days, Miraj market was the noisiest among all three locations of monitoring.

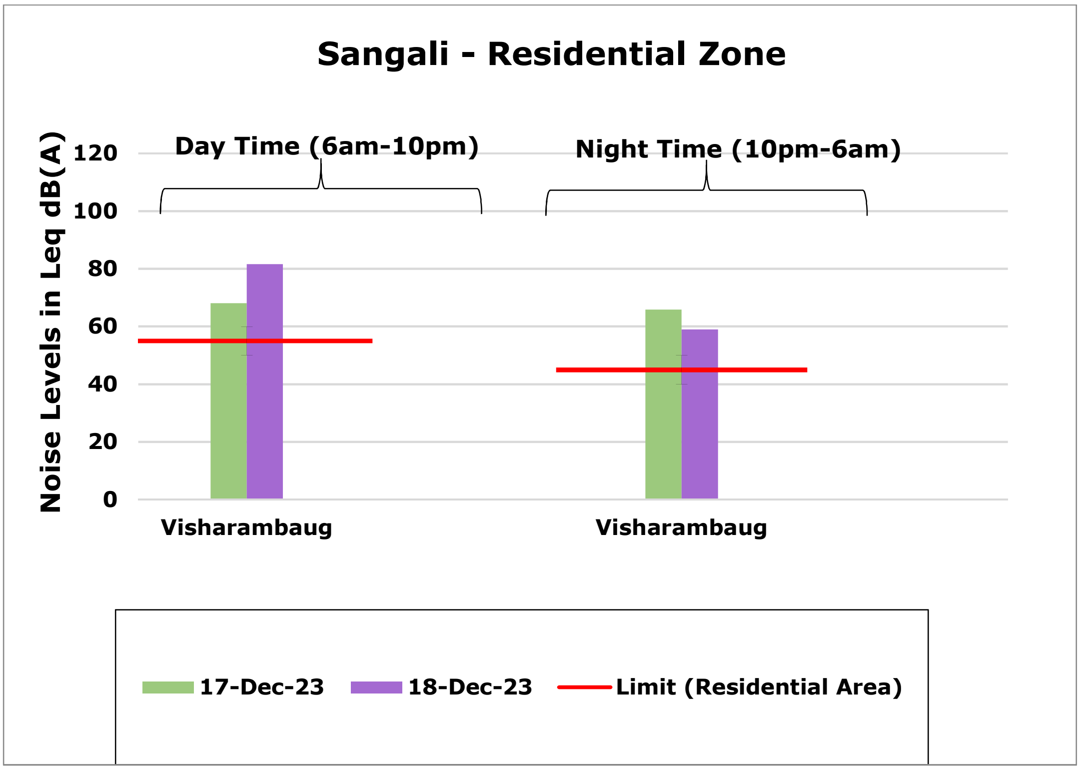
Table 5.12: Ambient Noise Levels in Sangli

Ambient Noise Monitoring on 17th December 2023- SANGLI												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	**L_{min}**	**L_{max}**	**L_{10}**	**L_{50}**	**L_{90}**	**L_{eq}**	**L_{min}**	**L_{max}**	**L_{10}**	**L_{50}**	**L_{90}**
Rajwada Chowk	73.8	40.3	88.9	77.8	64.5	52.2	63.1	44.5	73.6	66.0	57.8	52.1
Visharambaug	68.0	40.2	80.1	72.3	60.2	47.5	65.8	40.3	77.8	69.5	58.4	47.9
Miraj Market	70.0	40.2	84.5	73.9	62.7	48.9	64.9	45.6	72.5	70.4	60.2	50.1

Ambient Noise Monitoring on 18th December 2023- SANGLI												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	**L_{min}**	**L_{max}**	**L_{10}**	**L_{50}**	**L_{90}**	**L_{eq}**	**L_{min}**	**L_{max}**	**L_{10}**	**L_{50}**	**L_{90}**
Rajwada Chowk	75.9	50.3	88.5	80.2	64.9	52.3	58.7	42.3	69.2	61.4	52.6	47.9
Visharambaug	81.6	50.2	92.6	85.6	76.9	62.1	59.0	42.5	75.6	57.9	51.8	46.5
Miraj Market	76.7	51.7	85.9	81.3	71.6	60.1	56.5	41.6	68.3	60.6	50.3	42.6

Chart 5.12: Ambient Noise Levels in Sangli





5.13 Mira-Bhayander

In Mira-Bhayander also three locations were monitored. On 17th and 18th December the highest noise level during day time was observed at Bhakti Vedant Hospital with 77.9 dB(A) and 76.3 dB(A). During night, the highest noise level 71.5 dB(A) on 17th December was observed at Golden Police Chowki and on 18th December, Shivaji Chowk Kashi meera was the noisiest with 75.8 dB(A).

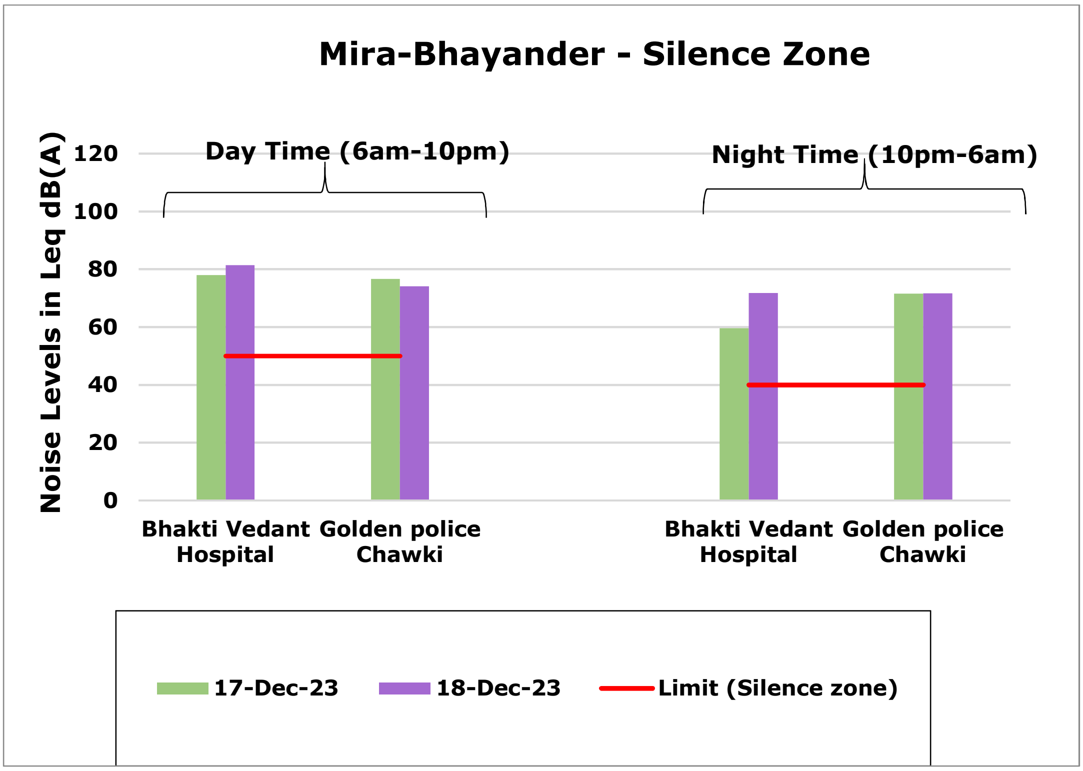
Table 5.13: Ambient Noise Levels in Mira-Bhayander

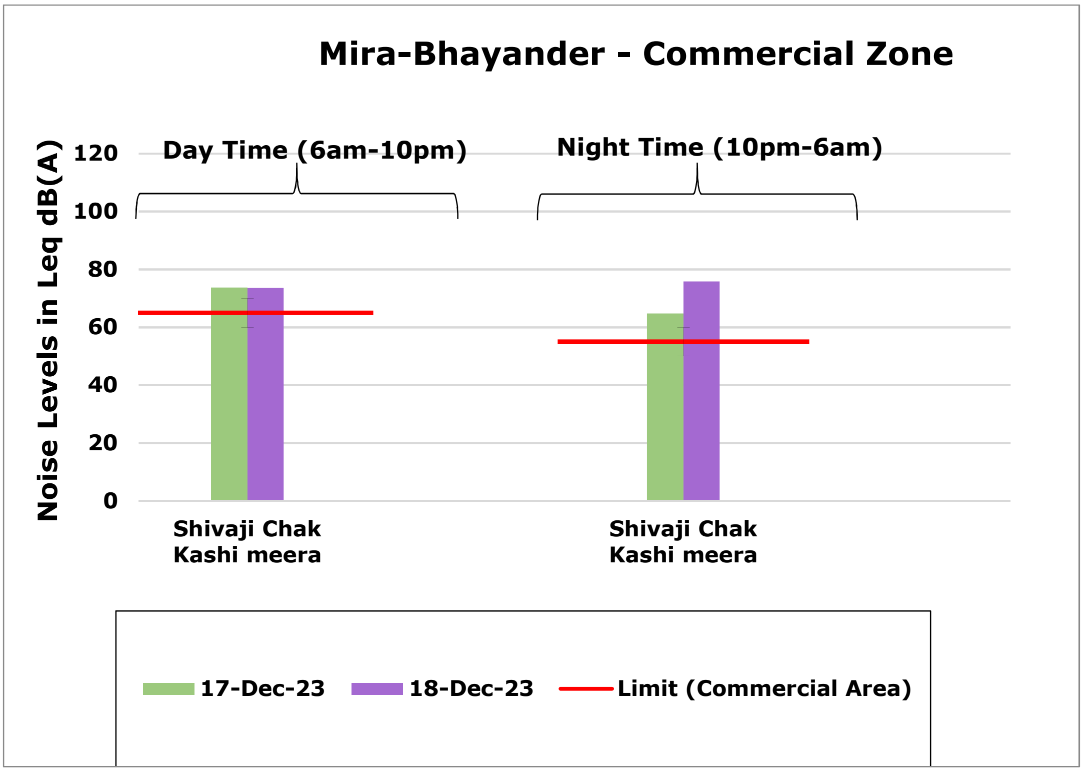
Ambient Noise Monitoring on 17th December 2023– MIRA BHAYANDER												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Bhakti Vedant Hospital	77.9	50.9	89.5	82.0	72.2	58.6	59.6	50.9	69.1	64.0	58.2	53.6
Golden police Chowki	76.6	50.7	87.7	82.9	73.7	64.1	71.5	50.5	84.6	75.6	62.0	53.4
Shivaji Chowk Kashi meera	73.7	50.8	86.0	76.6	70.2	62.1	64.7	44.5	75.3	68.0	62.6	52.8

Ambient Noise Monitoring on 18th December 2023– MIRA BHAYANDER												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Bhakti Vedant Hospital	81.4	47.3	97.2	85.5	75.5	62.5	71.7	44.5	85.4	78.2	57.2	48.5
Golden police Chowki	74.1	53.2	79.7	77.5	73.4	64.5	71.6	52.3	78.5	77.5	64.9	55.4
Shivaji Chowk Kashi meera	73.6	50.8	86.0	76.6	70.2	62.1	75.8	52.2	85.2	80.4	69.3	55.1

976

Chart 5.13: Ambient Noise Levels in Mira-Bhayander





5.14 Vasai-Virar

At Vasai-Virar also three locations were monitored for checking the noise level. During the day time the highest noise level on 17th and 18th December, was observed at Range office, Virar East with 78.0 dB(A) and 76.3 dB(A). During the night time, the highest noise level was observed at Range Office, Virar East with 71.8 dB(A) on 17th December and on 18th December, the highest noise level was recorded at N.B. Estate, Virar West with 69.8 dB(A).

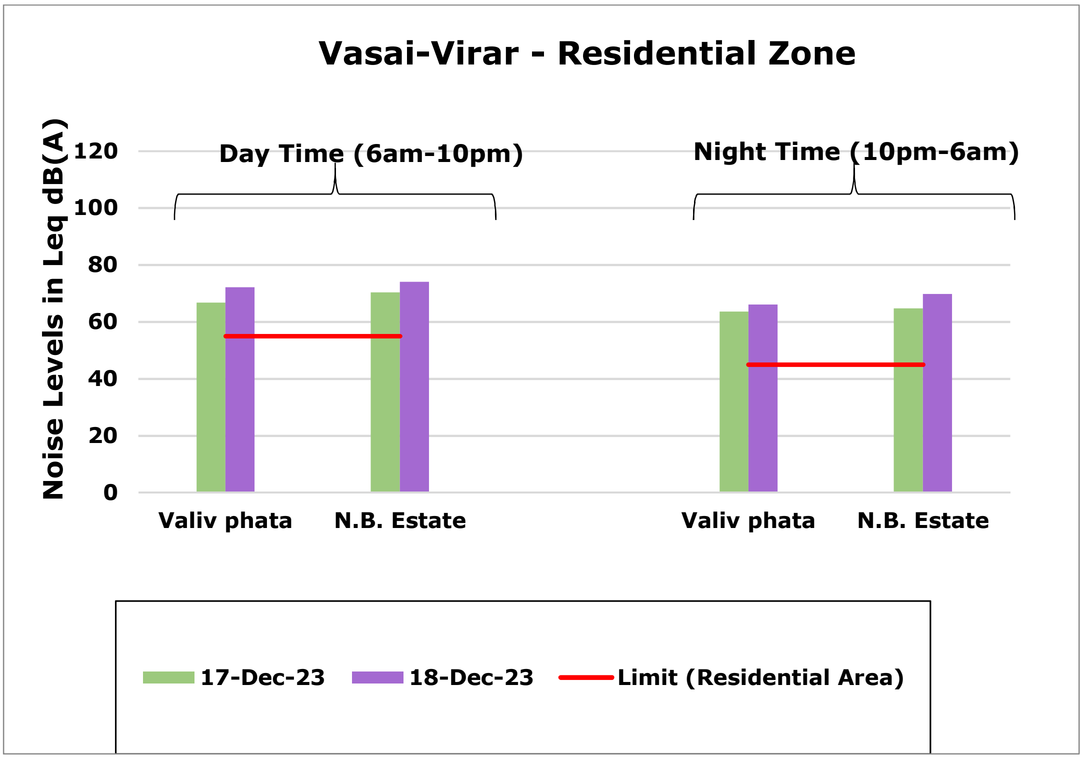
Table 5.14: Ambient Noise Levelsi n Vasai-Virar

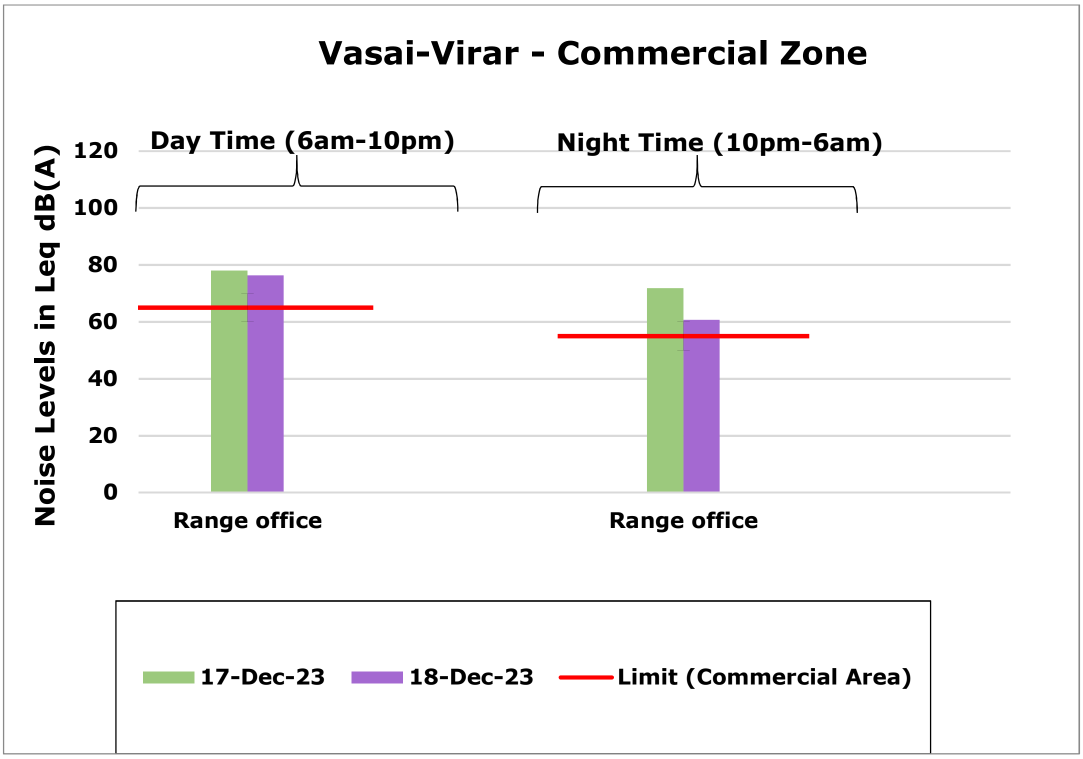
Ambient Noise Monitoring on 17th December 2023– VASAI-VIRAR												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Range office, Vasai East	78.0	54.1	87.3	82.6	72.6	62.8	71.8	56.4	85.6	75.4	68.5	60.8
Valiv phata, Vasai East	66.8	40.8	83.7	68.4	59.7	52.0	63.6	45.0	79.3	63.8	58.3	50.8
N.B. Estate, Virar West	70.3	60.0	77.6	73.9	68.6	62.3	64.7	53.8	73.0	67.7	62.3	56.8

Ambient Noise Monitoring on 18th December 2023– VASAI-VIRAR												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Range office, Vasai East	76.3	62.7	79.9	79.2	76.2	69.5	60.7	52.0	69.5	64.4	57.7	54.3
Valiv phata, Vasai East	72.2	46.3	87.4	78.4	59.6	52.6	66.1	48.3	79.3	65.4	58.5	52.5
N.B. Estate, Virar West	74.1	62.0	79.5	78.2	69.6	64.4	69.8	52.4	78.6	73.8	63.4	55.4

978

Chart 5.14: Ambient Noise Levels in Vasai-Virar





5.15 Ulhasnagar

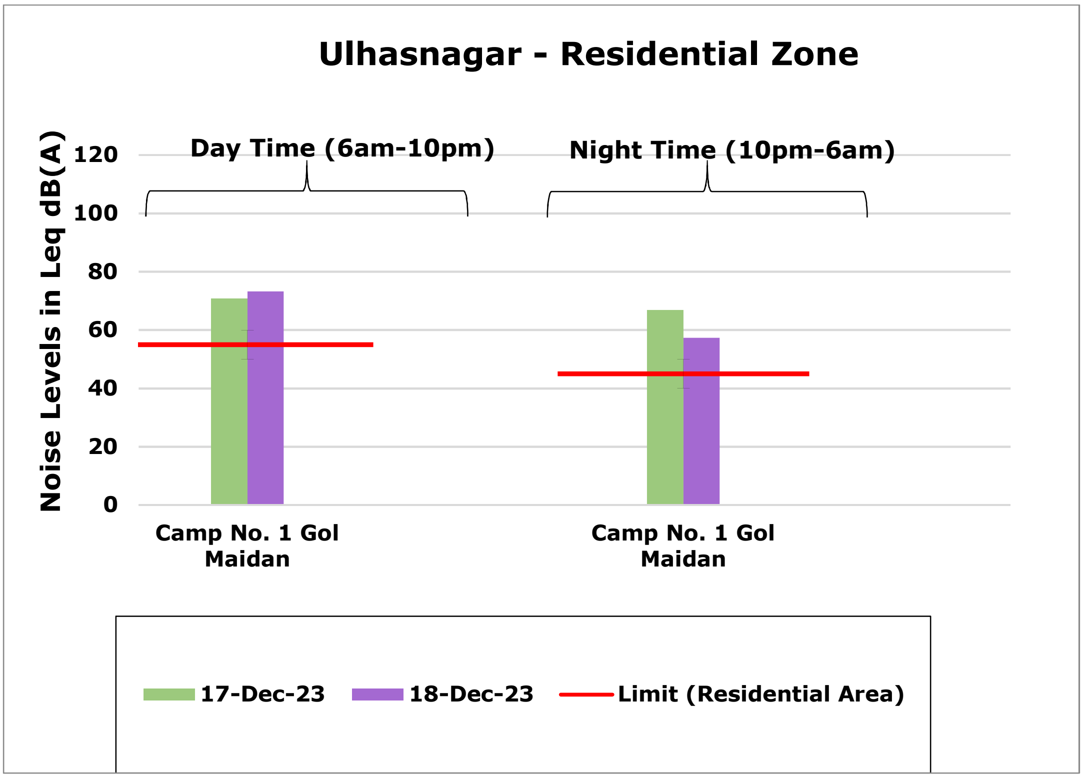
At Ulhasnagar three locations were monitored for noise levels. On 17th and 18th December , during day time, the highest noise level was observed at Camp no.5 Bus Stop with 79.6 dB(A) and 81.0dB (A) respectively. However during night time, the highest noise level of 68.1dB (A) was observed at Camp no.5 Bus Stop on 17th December . Similarly, on 18th December , the highest noise level of 71.9dB (A) was also observed at Camp no.5.

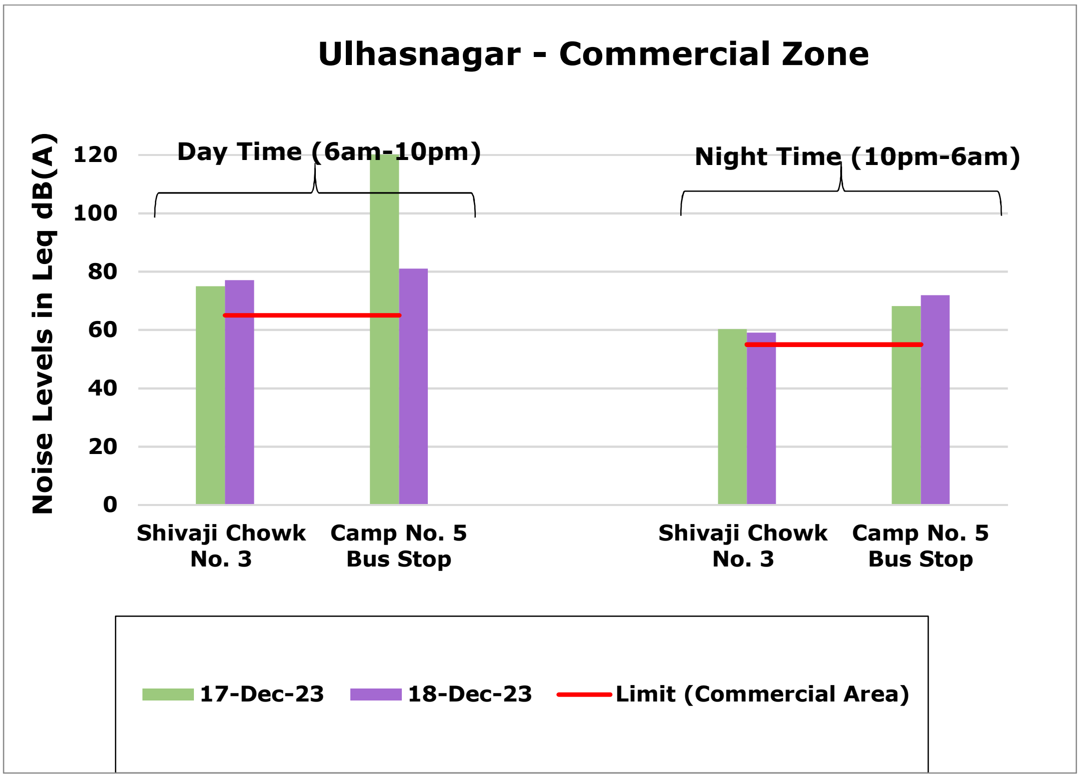
Table 5.15: Ambient Noise Levels in Ulhasnagar

Ambient Noise Monitoring on 17th December 2023- ULHASNAGAR												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Shivaji Chowk No. 3	74.9	45.3	86.4	79.2	68.5	60.2	60.2	42.1	72.8	62.8	52.9	46.2
Camp No. 5 Bus Stop	79.6	42.5	87.5	83.7	76.4	53.6	68.1	42.9	81.3	70.7	56.0	48.6
Camp No. 1 Gol Maidan	70.8	49.4	82.8	74.3	65.4	55.5	66.8	43.2	76.5	70.6	59.6	48.2

Ambient Noise Monitoring on 18th December 2023- ULHASNAGAR												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Shivaji Chowk No. 3	77.0	42.8	88.3	80.5	74.2	57.7	59.0	45.2	69.1	62.8	53.2	48.9
Camp No. 5 Bus Stop	81.0	42.2	88.9	84.9	78.4	59.4	71.9	42.7	83.9	76.5	54.0	45.9
Camp No. 1 Gol Maidan	73.2	42.2	84.3	77.4	68.8	60.4	57.3	40.4	70.2	60.4	51.0	43.2

Chart 5.15: Ambient Noise Levels in Ulhasnagar





5.16 Bhiwandi-Nizampur

In Bhiwandi-Nizampur also 3 locations were monitored. On 17th and 18th December, during day on both days, the highest noise level was observed at Dhamnkar naka, while at night, the highest noise level was observed at Shelar near Nadi naka.

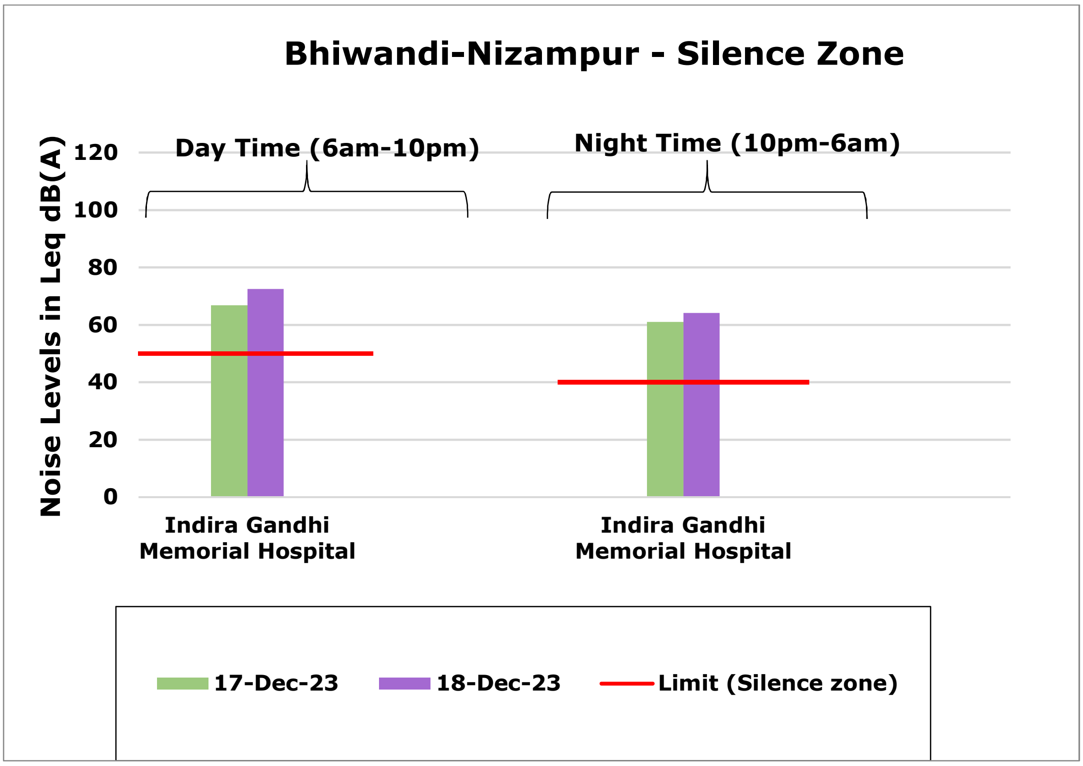
Table 4.16: Ambient Noise Levels in Bhiwandi-Nizampur

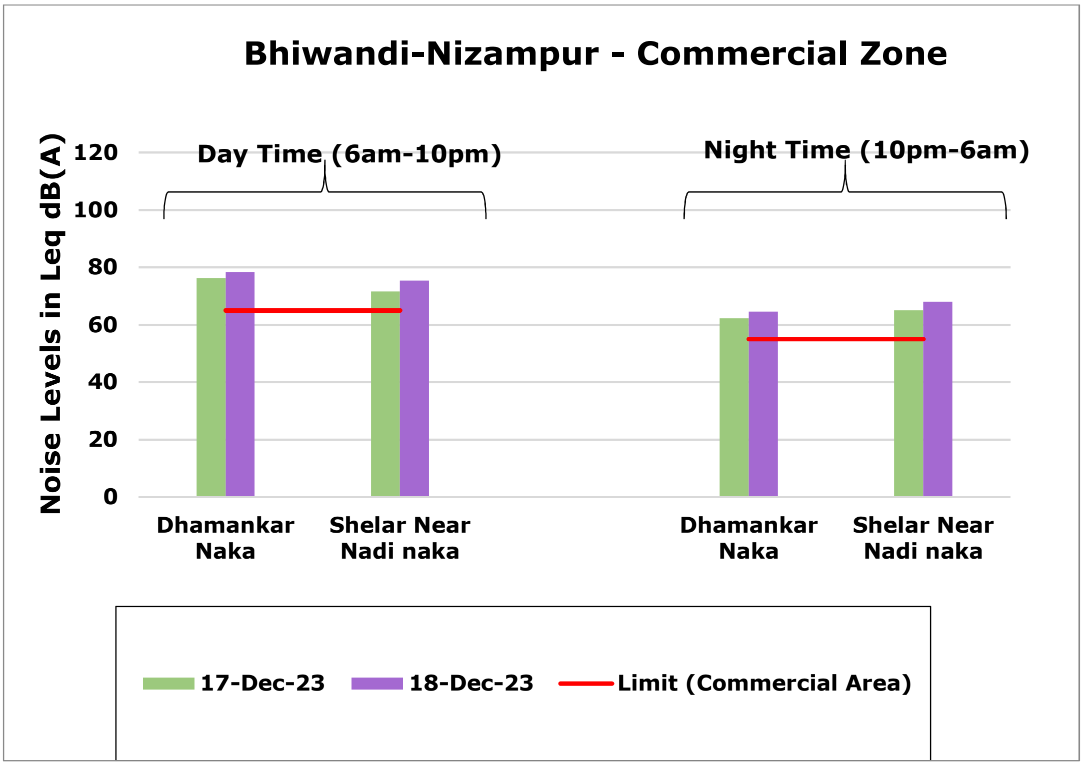
Ambient Noise Monitoring on 17th December 2023– BHIWANDI-NIZAMPUR												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Dhamankar Naka	76.2	47.4	85.6	79.9	72.6	64.3	62.2	40.2	73.8	65.2	56.6	48.2
Indira Gandhi Memorial Hospital	66.8	48.8	78.5	69.8	64.2	56.7	61.0	43.2	69.2	65.7	56.6	47.3
Shelar Near Nadi naka	71.6	45.3	82.1	75.9	68.1	57.3	65.0	44.1	78.4	68.3	56.4	49.7

Ambient Noise Monitoring on 18th December 2023– BHIWANDI-NIZAMPUR												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Dhamankar Naka	78.4	52.9	85.6	82.3	77.3	68.3	64.5	40.2	75.4	69.0	59.2	46.5
Indira Gandhi Memorial Hospital	72.4	43.2	84.4	76.4	66.4	56.7	64.1	42.3	78.2	67.3	55.0	46.1
Shelar Near Nadi naka	75.3	44.3	86.4	79.1	71.1	59.0	68.0	43.3	82.1	69.2	53.8	46.3

982

Chart 5.16: Ambient Noise Levels in Bhiwandi-Nizampur





5.17 Chandrapur

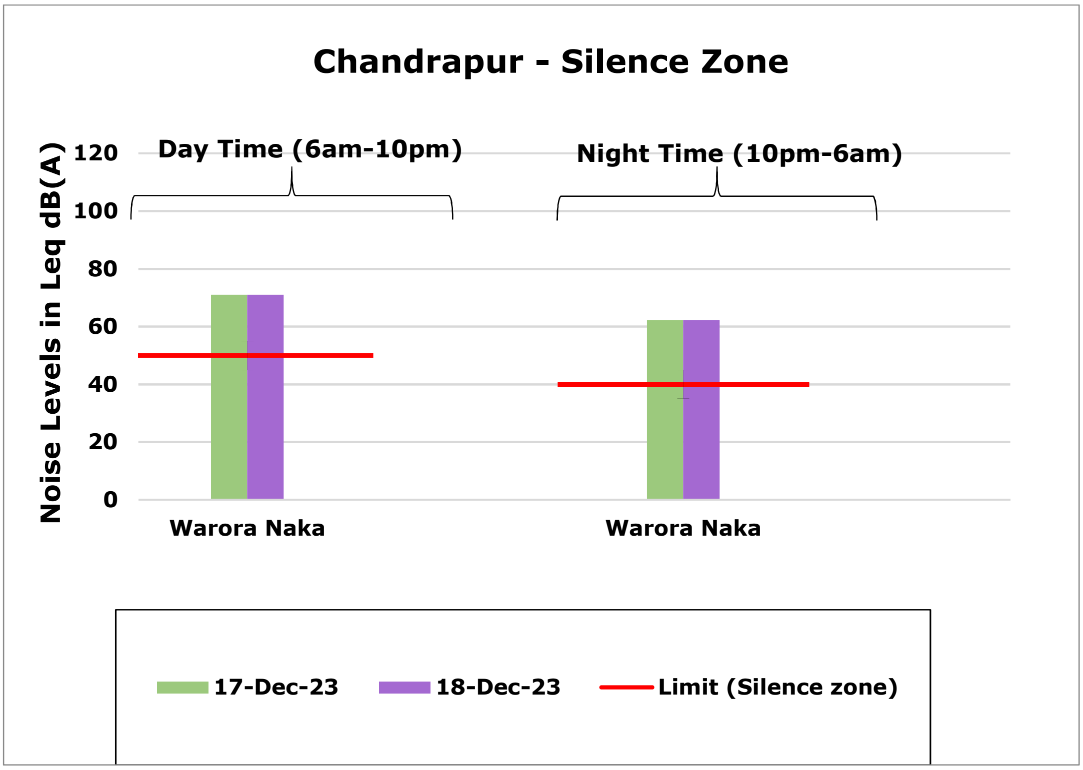
In Chandrapur region also three locations were monitored. During both 17th and 18th December, the highest noise level at day time was observed at Gandhi Chowk. However, during night on 17th December, the highest noise level was observed at Jatpura Gate with 62.2 dB(A) and on 18th December, highest noise level was observed at Warora Naka with 62.2 dB(A) as well.

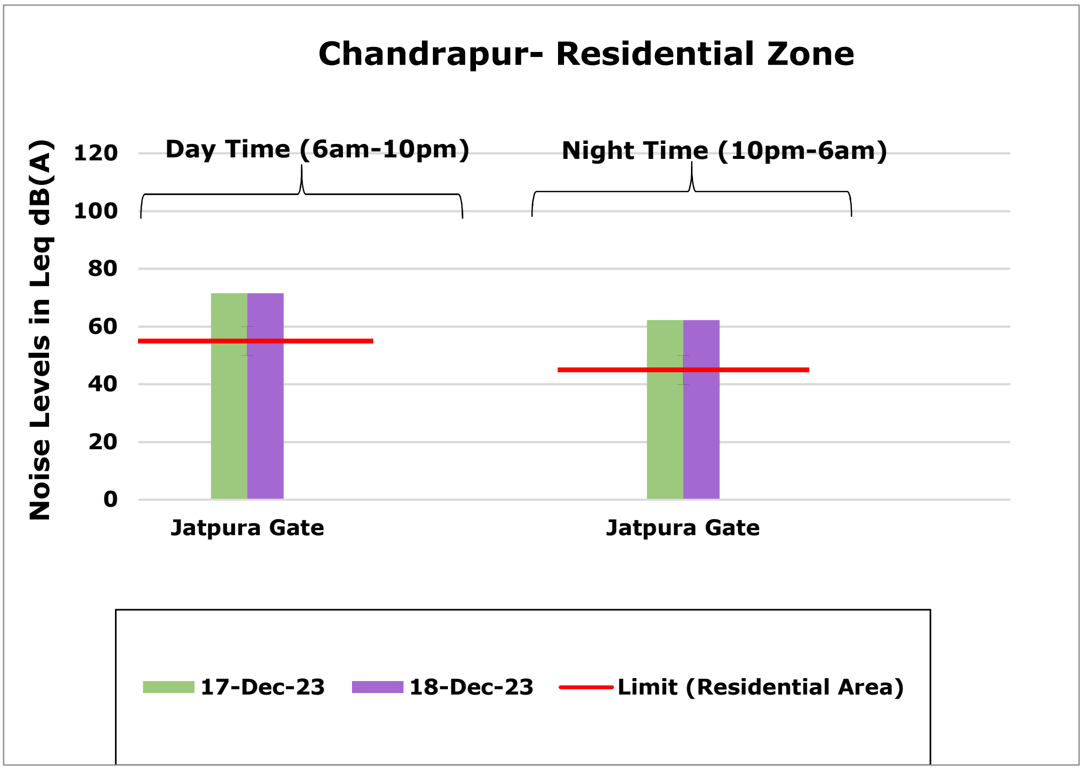
Table 5.17: Ambient Noise Levels in Chandrapur

Ambient Noise Monitoring on 17th December 2023- CHANDRAPUR												
Location	Day Time (6am-10pm)						Night Time (10pm-6am)					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Gandhi Chowk	72.6	64.3	80.3	75.5	70.9	67.6	61.5	48.3	72.9	63.8	58.0	50.6
Jatpura Gate	71.5	51.8	78.9	75.6	68.9	64.2	62.2	42.8	72.3	67.2	56.7	46.2
Warora Naka	71.0	48.4	79.9	74.8	69.4	58.3	62.2	46.3	70.1	68.5	55.6	48.6

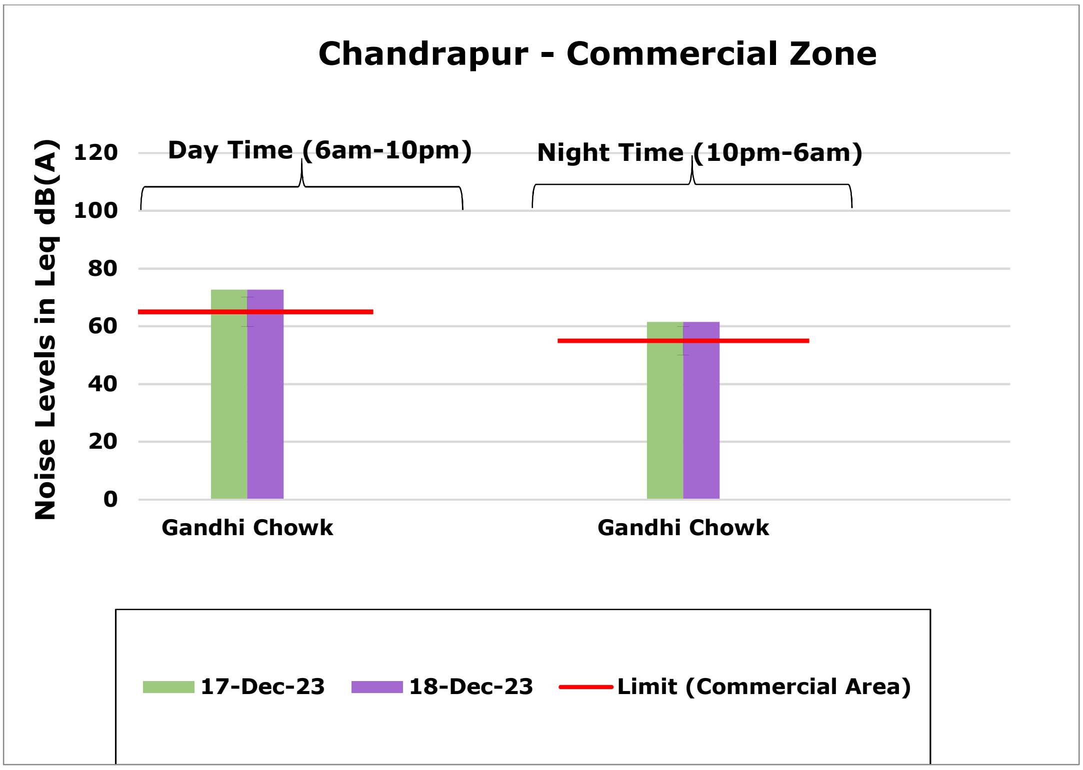
Ambient Noise Monitoring on 18th December 2023- CHANDRAPUR												
Location	Day Time (6am-10pm)						Night Time (10pm-6am)					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Gandhi Chowk	72.6	64.3	80.3	75.5	70.9	67.6	61.5	48.3	72.9	63.8	58.0	50.6
Jatpura Gate	71.5	51.8	78.9	75.6	68.9	64.2	62.2	42.8	72.3	67.2	56.7	46.2
Warora Naka	71.0	48.4	79.9	74.8	69.4	58.3	62.2	46.3	70.1	68.5	55.6	48.6

Chart 5.17: Ambient Noise Levels in Chandrapur





985


Chandrapur - Commercial Zone
Day Time (6am-10pm)
Night Time (10pm-6am)
Noise Levels in Leq dB(A)
0
20
40
60
80
100
120
Gandhi Chowk
Gandhi Chowk
17-Dec-23
18-Dec-23
Limit (Commercial Area)

5.18 Nanded-Waghala

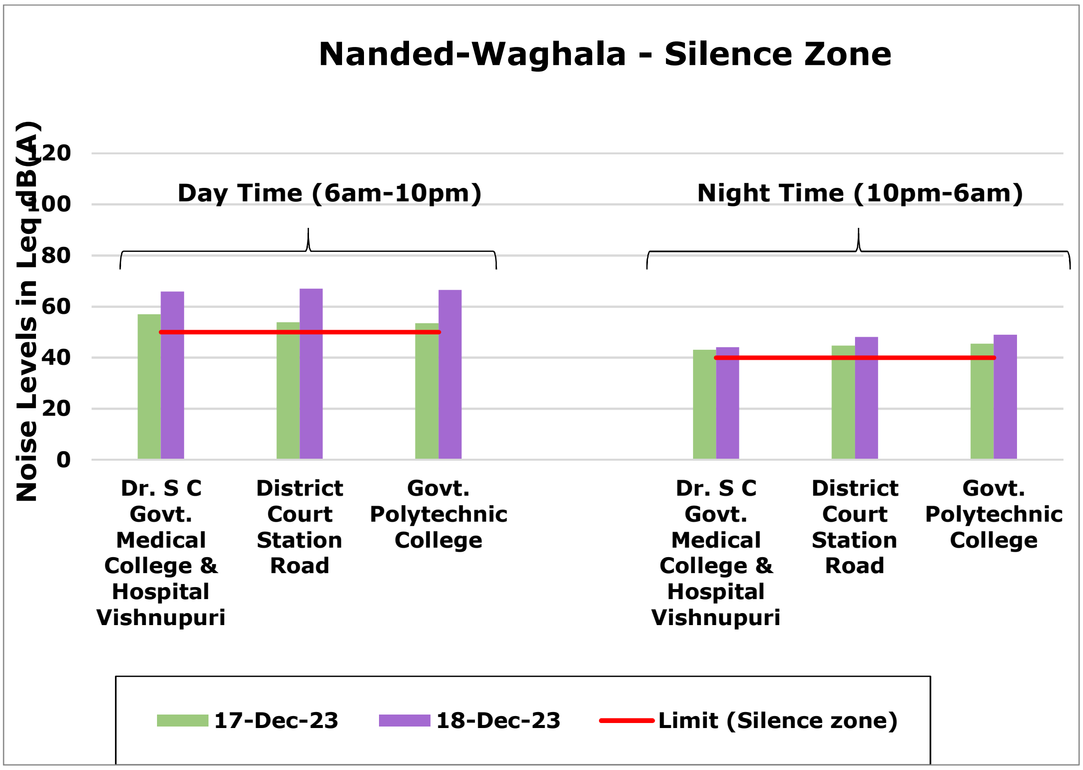
At Nanded-Waghala also 3 location were monitored. On 17th December, the highest noise level during day time was observed at Dr. Shankarao Chavan Govt. Medical College & Hospital Vishnupuri 56.9 dB(A) and during night time, Govt. Polytechnic College was the noisiest with 45.4 dB(A) respectively. On 18th December , the highest noise level during day time was observed at District Court Station Road with 67.4 dB(A) and during night time, the highest noise level was 48.9 dB(A) at Govt. Polytechnic College.

Table 5.18: Ambient Noise Levels in Nanded-Waghala

Ambient Noise Monitoring on 17th December 2023– NANDED WAGHALA												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Dr. S C Govt. Medical College & Hospital Vishnupuri	56.9	40.0	64.0	61.0	56.0	43.0	43.0	39.0	49.0	46.0	42.0	40.0
District Court Station Road	53.8	40.0	65.0	57.0	52.0	46.0	44.7	38.0	49.0	48.0	43.0	41.0
Govt. Polytechnic College	53.4	38.0	62.0	56.0	51.0	41.9	45.4	38.0	52.0	50.0	42.0	40.0

Ambient Noise Monitoring on 18th December 2023– NANDED WAGHALA												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Dr. S C Govt. Medical College & Hospital Vishnupuri	65.9	41.0	72.0	70.0	64.0	48.0	44.1	38.0	49.0	48.0	42.0	40.0
District Court Station Road	67.4	42.0	72.0	71.0	67.0	54.0	48.1	39.0	55.0	52.0	45.5	41.0
Govt. Polytechnic College	66.5	41.0	71.0	69.0	67.0	46.0	48.9	40.0	55.0	53.0	45.0	41.0

Chart 5.18: Ambient Noise Levels in Nanded-Waghala



5.19 Ahmednagar

At Ahmednagar also 3 location were monitored. On 17th December , during the day as well as night time the highest noise level was observed at old bus stand. However, on 18th December, the highest noise level was recorded at old bus stand 73.1dB(A) during day time and at the same place with 63.0 dB(A) during night time.

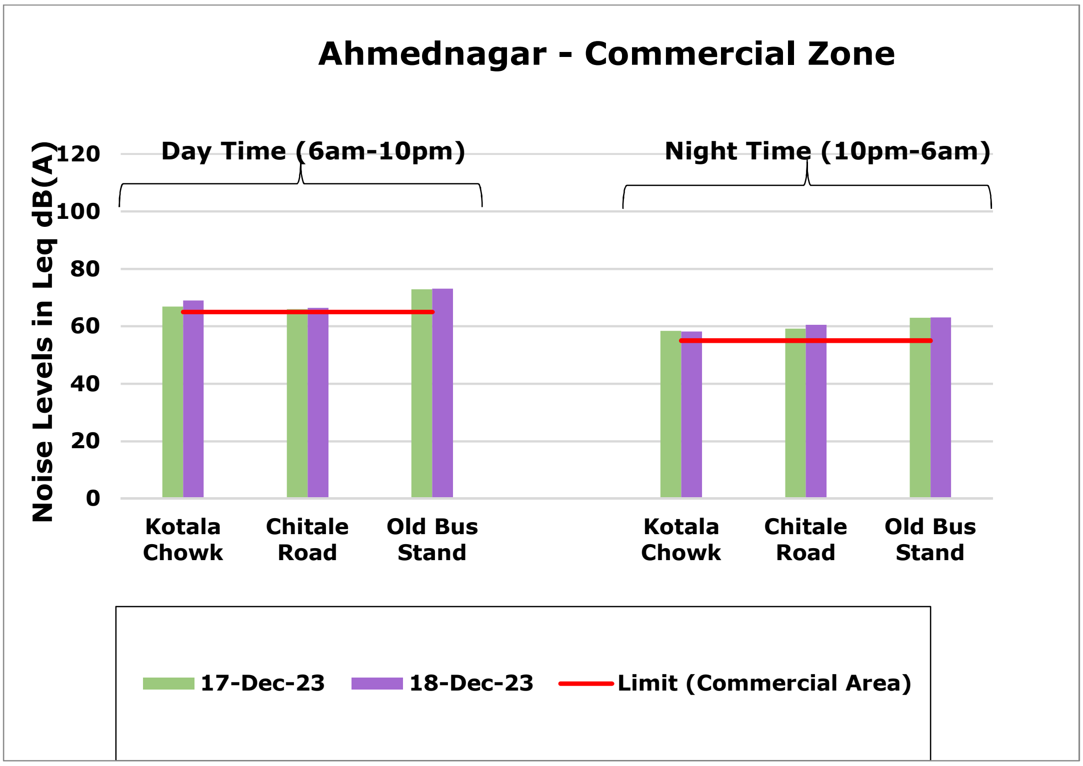
Table 5.19: Ambient Noise Levels in Ahmednagar

Ambient Noise Monitoring on 17th December 2023- AHMEDNAGAR												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Kotala Chowk	66.8	60.0	72.0	69.0	66.0	62.0	58.4	52.0	66.0	62.0	56.0	53.9
Chitale Road	65.9	56.0	72.0	68.0	65.0	62.9	59.2	50.0	66.0	63.0	57.0	52.0
Old Bus Stand	72.9	58.0	78.0	75.0	73.0	62.9	62.9	57.0	68.0	66.0	62.0	58.0

Ambient Noise Monitoring on 18th December 2023- AHMEDNAGAR												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Kotala Chowk	68.9	60.0	74.0	72.0	68.0	64.0	58.2	52.0	63.0	62.0	57.0	54.0
Chitale Road	66.4	58.0	72.0	69.0	65.5	63.0	60.5	50.0	68.0	64.1	58.0	53.9
Old Bus Stand	73.1	58.0	78.0	75.0	73.0	60.0	63.0	57.0	68.0	65.0	63.0	58.0

989

Chart 5.19: Ambient Noise Levels in Ahmednagar



5.20 Dhule

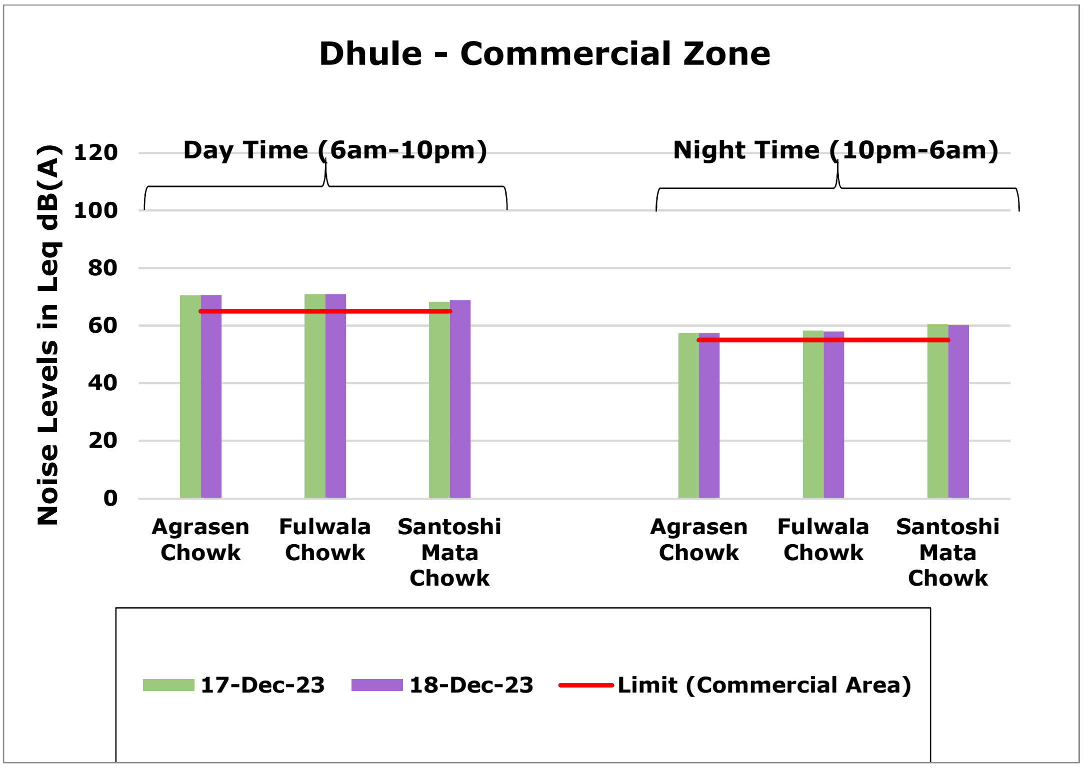
At Dhule also three locations were monitored. On 17th and 18th December, the highest noise level during day time was observed at Fulwala chowk 70.95 dB(A). However, during night time the highest noise level was observed at Santoshi Mata Chowk on both the days with 62.9dB(A) and 60.1 dB(A) respectively.

Table 5.20: Ambient Noise Levels in Dhule

Ambient Noise Monitoring on 17th December 2023- DHULE												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Agrasen Chowk	70.4	56.0	76.0	74.0	70.0	60.0	57.5	51.0	62.0	60.0	57.0	52.0
Fulwala Chowk	70.9	54.0	76.0	74.0	70.0	63.0	58.2	51.0	65.0	62.0	57.0	52.0
Santoshi Mata Chowk	68.2	54.0	75.0	72.0	67.5	61.0	60.5	52.0	66.0	64.0	59.5	55.0

Ambient Noise Monitoring on 18th December 2023- DHULE												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Agrasen Chowk	70.6	56.0	75.0	74.0	70.5	63.0	57.4	51.0	62.0	61.0	56.0	52.0
Fulwala Chowk	70.9	56.0	76.0	74.0	70.0	63.0	57.9	52.0	63.0	60.1	57.0	54.0
Santoshi Mata Chowk	68.8	55.0	75.0	72.1	67.5	62.0	60.1	52.0	66.0	63.0	59.0	55.0

Chart 5.20: Ambient Noise Levels in Dhule



5.21 Malegaon

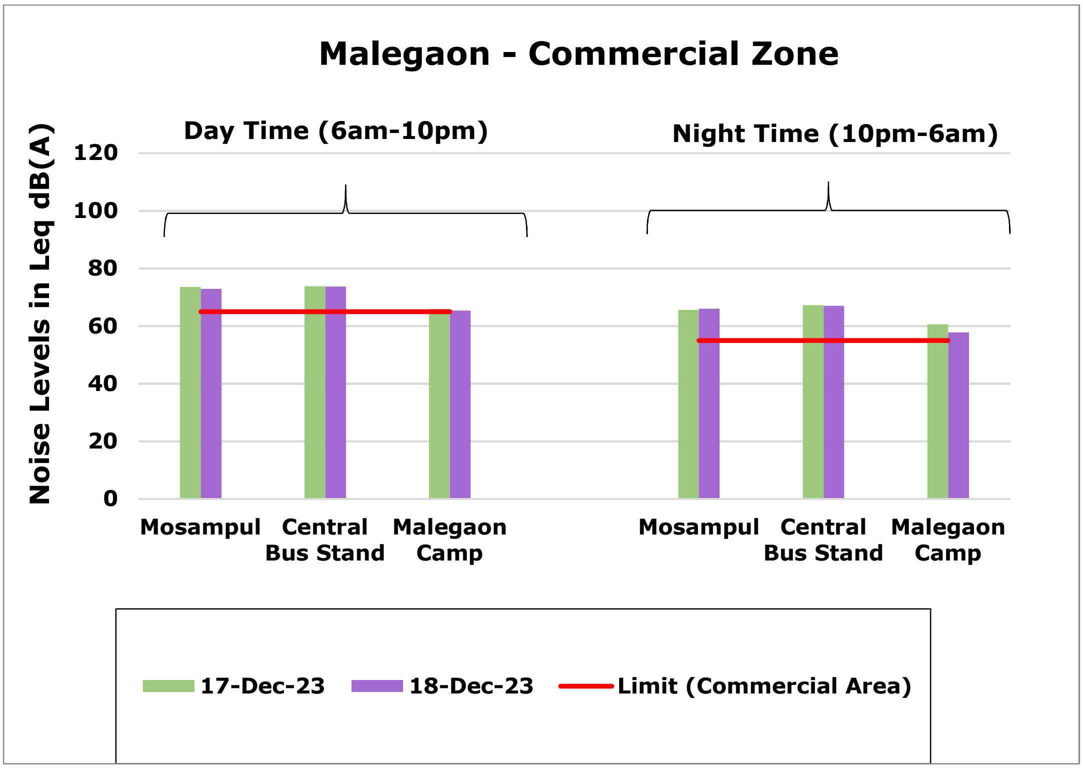
In Malegaon also, noise levels were monitored at three locations. Results show that on 17th and 18th December, the highest noise level during day time was observed at Central bus stand with 73.7 dB(A). However, the noise level was highest at Central bus stand 67.2 dB(A) on 17th December and at the same place with 67.0 dB(A) on 18th December during the night time.

Table 5.21: Ambient Noise Levels in Malegaon

Ambient Noise Monitoring on 17th December 2023- MALEGAON												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	**L_{min}**	**L_{max}**	**L_{10}**	**L_{50}**	**L_{90}**	**L_{eq}**	**L_{min}**	**L_{max}**	**L_{10}**	**L_{50}**	**L_{90}**
Mosampul	73.6	58.0	79.0	76.0	73.0	63.0	65.5	60.0	72.0	69.0	63.0	61.0
Central Bus Stand	73.7	62.0	78.0	76.0	74.0	70.0	67.2	60.0	71.0	70.0	67.0	63.0
Malegaon Camp	65.9	52.0	72.0	70.0	62.0	55.9	60.6	52.0	69.0	65.0	58.0	54.0

Ambient Noise Monitoring on 18th December 2023- MALEGAON												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	**L_{min}**	**L_{max}**	**L_{10}**	**L_{50}**	**L_{90}**	**L_{eq}**	**L_{min}**	**L_{max}**	**L_{10}**	**L_{50}**	**L_{90}**
Mosampul	72.9	58.0	79.0	76.0	72.0	63.0	66.0	60.0	72.0	69.1	63.0	61.0
Central Bus Stand	73.7	62.0	78.0	76.0	74.0	69.0	67.0	60.0	71.0	70.0	66.0	62.0
Malegaon Camp	65.3	52.0	72.0	70.0	61.0	56.9	57.7	52.0	62.0	60.0	57.0	53.9

Chart 5.21: Ambient Noise Levels in Malegaon



5.22 Pimpri-Chinchwad

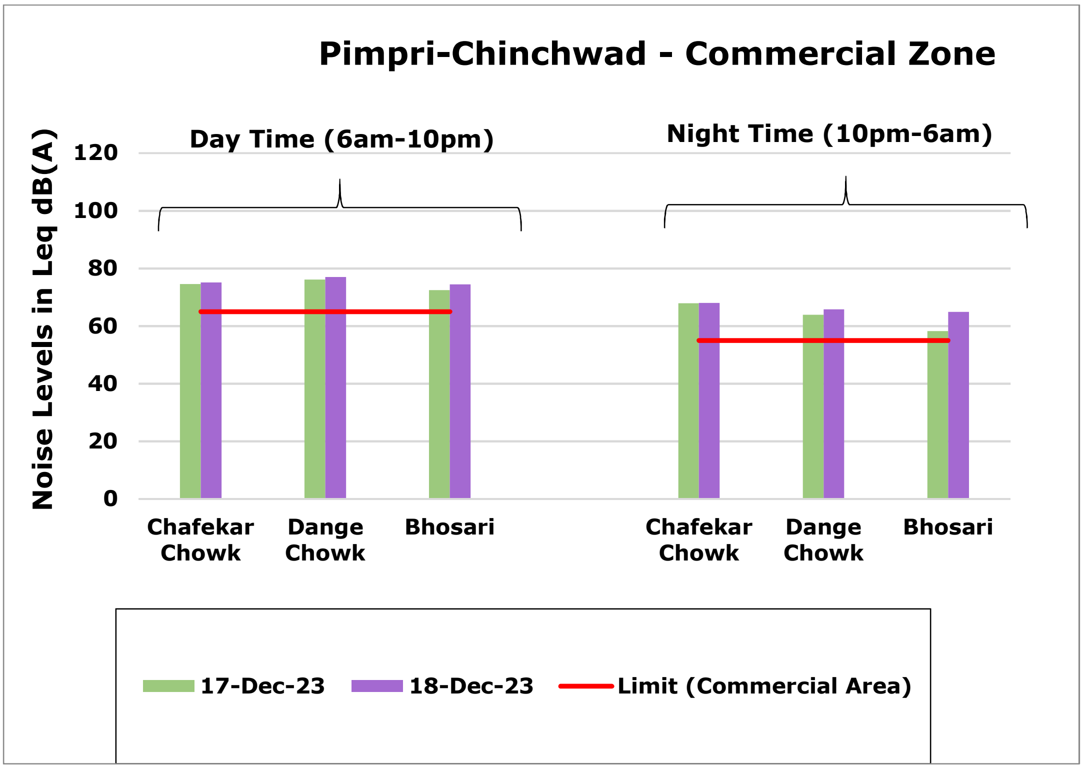
In Pimpri-Chinchwad also three locations were monitored. On 17th and 18th December , during the day time the highest noise level was observed at Dange Chowk. The highest noise level during night time was observed at Chafekar Chowk with 67.9 dB(A) and 68.0dB(A) respectively.

Table 5.22: Ambient Noise Levels in Pimpri-Chinchwad

Ambient Noise Monitoring on 17th December 2023 - PIMPRI-CHINCHWAD												
Location	Day Time (6am-10pm)						Night Time (10pm-6am)					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Chafekar Chowk	74.6	52.4	81.6	77.6	74.1	62.9	67.9	47.7	74.6	71.4	66.6	50.3
Dange Chowk	76.1	63.2	81.9	79.4	75.0	67.2	63.8	42.2	72.4	70.1	50.8	44.7
Bhosari	72.5	57.4	81.2	76.5	69.8	62.8	58.2	42.1	68.7	63.1	48.7	43.8

Ambient Noise Monitoring on 18th December 2023 - PIMPRI-CHINCHWAD												
Location	Day Time (6am-10pm)						Night Time (10pm-6am)					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Chafekar Chowk	75.1	55.2	81.3	78.9	73.6	64.7	68.0	43.2	74.6	72.0	66.8	49.1
Dange Chowk	77.0	62.3	84.6	79.6	76.1	69.7	65.8	44.0	74.9	70.8	60.4	45.7
Bhosari	74.5	55.6	85.4	78.2	72.3	62.7	64.8	41.2	73.3	70.9	49.8	43.3

Chart 5.22: Ambient Noise Levels in Pimpri-Chinchwad



5.23 Parbhani

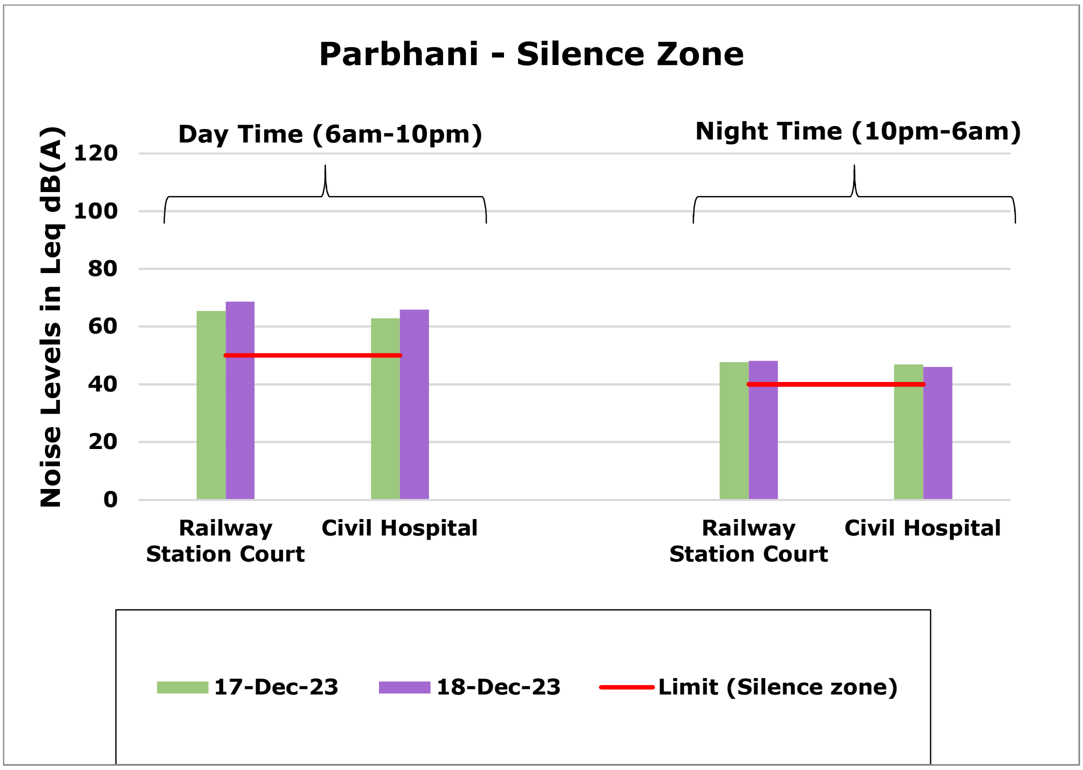
In Parbhani also, three locations were monitored for noise levels for two days i.e. on 17th December and 18th December 2023. Results demonstrates that the highest noise level on both the days during day time, Railway Station Court was the noisiest with 65.4dB(A) and 68.6dB(A) respectively. During the night time on both days, Railway Station Court was observed with the highest average noise levels among all three monitored locations.

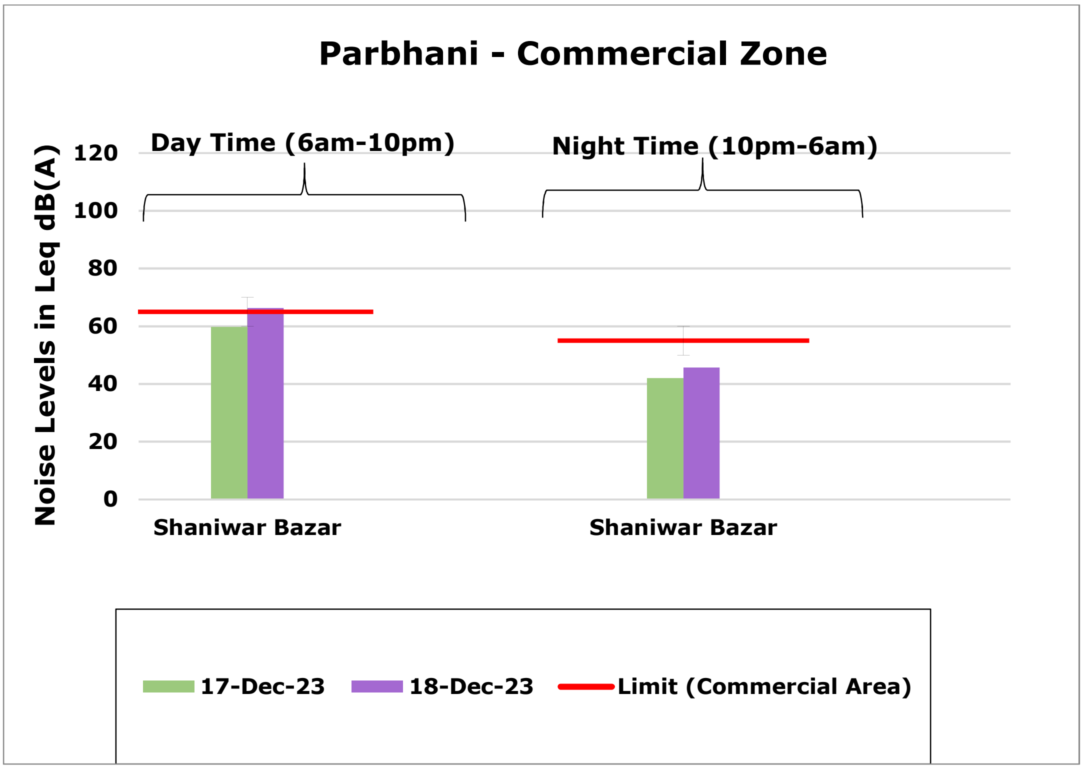
Table 5.23: Ambient Noise Levels in Parbhani

Ambient Noise Monitoring on 17th December 2023- PARBHANI												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Shaniwar Bazar	59.7	37.0	65.0	63.1	60.0	41.0	42.0	34.0	47.0	44.0	41.5	40.0
Railway Station Court	65.4	42.0	71.0	69.0	64.0	51.9	47.6	40.0	53.0	51.0	46.0	41.0
Civil Hospital	62.8	46.0	70.0	67.0	61.0	51.0	46.9	39.0	55.0	51.0	44.0	41.0

Ambient Noise Monitoring on 18th December 2023- PARBHANI												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Shaniwar Bazar	66.3	41.0	72.0	70.0	65.5	49.0	45.6	38.0	54.0	50.0	42.0	40.0
Railway Station Court	68.6	42.0	73.0	71.0	69.0	55.0	48.1	40.0	55.0	52.0	47.0	41.0
Civil Hospital	65.8	41.0	71.0	70.0	64.5	51.0	46.0	39.0	54.0	51.0	43.0	40.0

Chart 5.23: Ambient Noise Levels in Parbhani





5.24 Latur

At Latur also, 3 locations were monitored. On 17th December the highest noise level during day time and night time was observed at Shahu College 66.0dB(A) and CJM Court 49.6dB(A) respectively. On 18th December, the highest noise level both during day time and night time was observed near CJM Court.

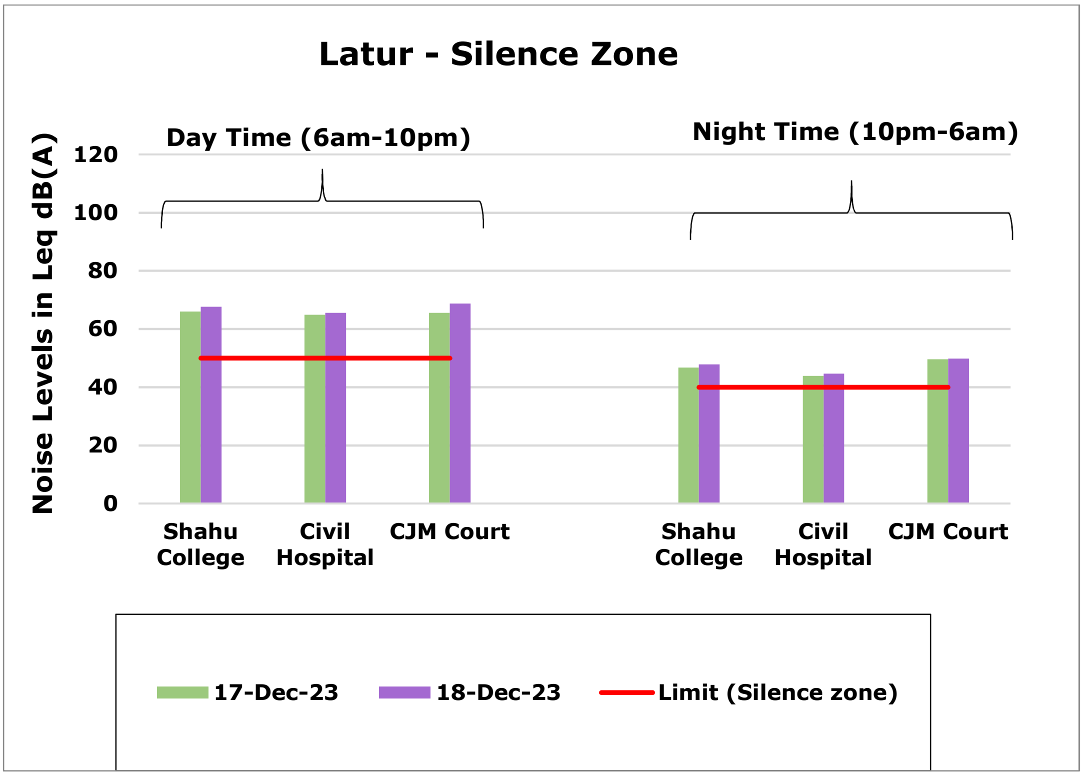
Table 5.24: Ambient Noise Levels in Latur

Ambient Noise Monitoring on 17th December 2023- LATUR												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Shahu College	66.0	39.0	72.0	70.0	64.0	43.0	46.8	36.0	54.0	51.0	43.0	39.0
Civil Hospital	64.8	41.0	70.0	68.1	64.0	50.0	43.9	38.0	49.0	48.0	42.0	41.0
CJM Court	65.5	40.0	71.0	69.0	65.0	45.0	49.6	40.0	56.0	52.2	48.0	42.0

Ambient Noise Monitoring on 18th December 2023- LATUR												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Shahu College	67.7	41.0	72.0	71.0	68.0	52.9	47.8	38.0	54.0	52.0	45.0	40.0
Civil Hospital	65.6	41.0	70.0	69.0	65.0	51.0	44.6	37.0	50.0	48.0	42.0	39.0
CJM Court	68.7	48.0	74.0	71.0	69.0	55.0	49.8	39.0	56.0	54.0	48.0	40.0

999

Chart 5.24: Ambient Noise Levels in Latur



5.25 Akola

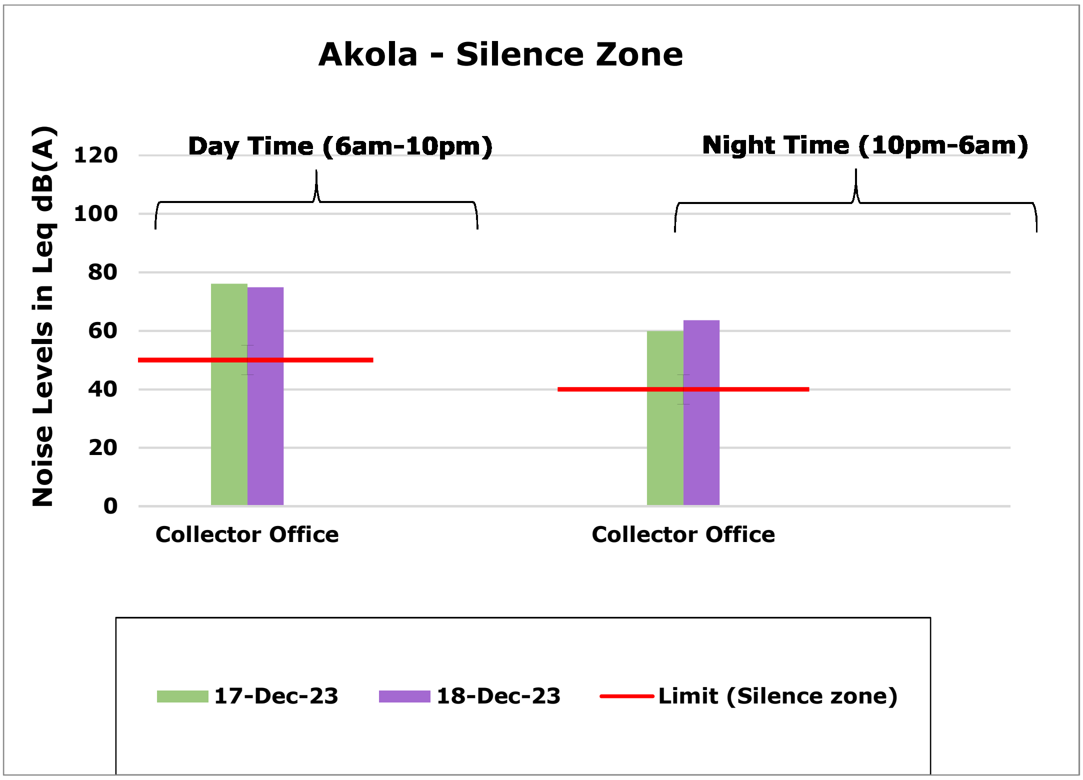
In Akola also three location was monitored. Results show that City Kotwali Chowk was the noisiest on both 17th and 18th December, during day as well as night.

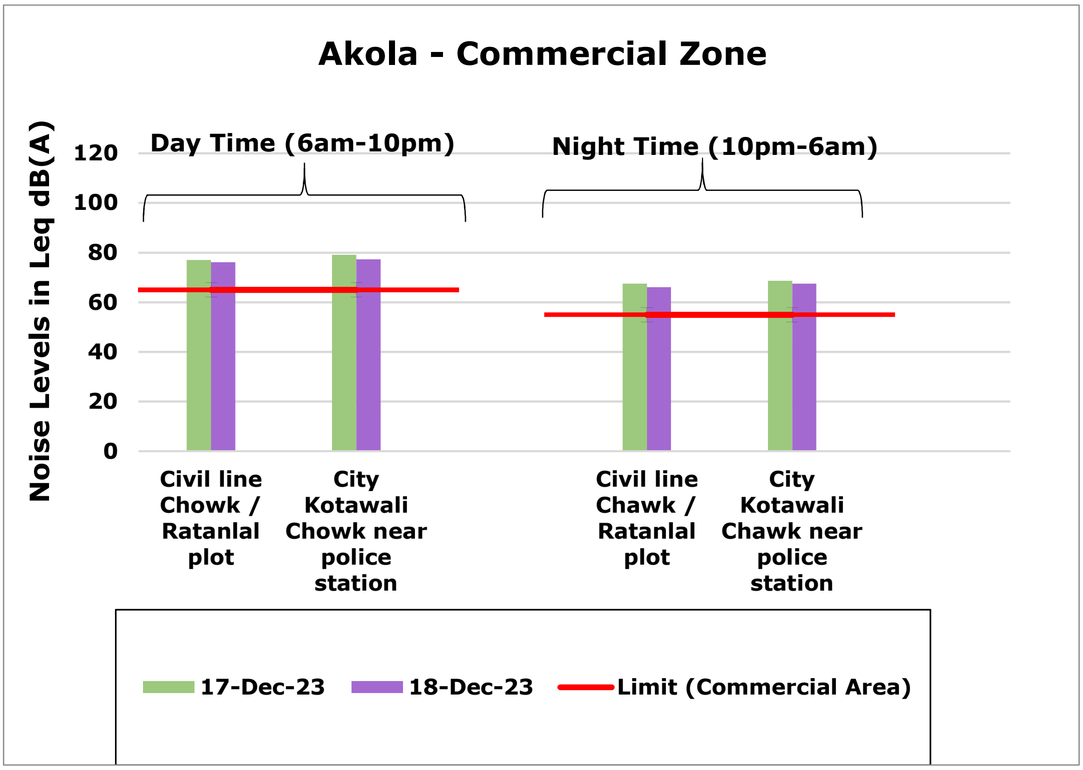
Table 5.25: Ambient Noise Levels in Akola

Ambient Noise Monitoring on 17th December 2023- AKOLA												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Collector Office	76.0	43.5	90.2	80.0	67.5	55.4	59.9	36.1	74.5	61.6	51.5	40.5
Civil line Chowk	77.0	46.4	90.5	81.3	69.1	60.8	67.5	38.0	81.9	69.3	57.9	42.0
City Kotawali Chowk	79.1	52.0	91.6	83.2	70.5	64.4	68.6	38.4	82.2	71.3	58.6	44.4

Ambient Noise Monitoring on 18th December 2023- AKOLA												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Collector Office	74.8	50.2	83.6	80.7	68.7	63.1	63.6	36.1	80.5	62.9	50.6	40.5
Civil line Chowk	76.1	51.6	85.1	81.3	70.0	64.3	66.0	36.1	80.5	68.1	55.4	41.3
City Kotawali Chowk	77.3	53.4	87.6	82.3	71.3	65.6	67.5	33.1	81.6	70.5	57.1	42.4

Chart 5.25: Ambient Noise Levels in Akola





5.26 Solapur

In Solapur, three location was monitored for noise levels. On 17th December during day and night time, the highest noise level was observed at Balives with 70.8 dB(A) and 54.1 dB(A) respectively. However, on 18th December, during day as well night time, Ashok Chowk is recorded with the highest noise levels with 73.9dB(A) and 59.5dB(A) respectively.

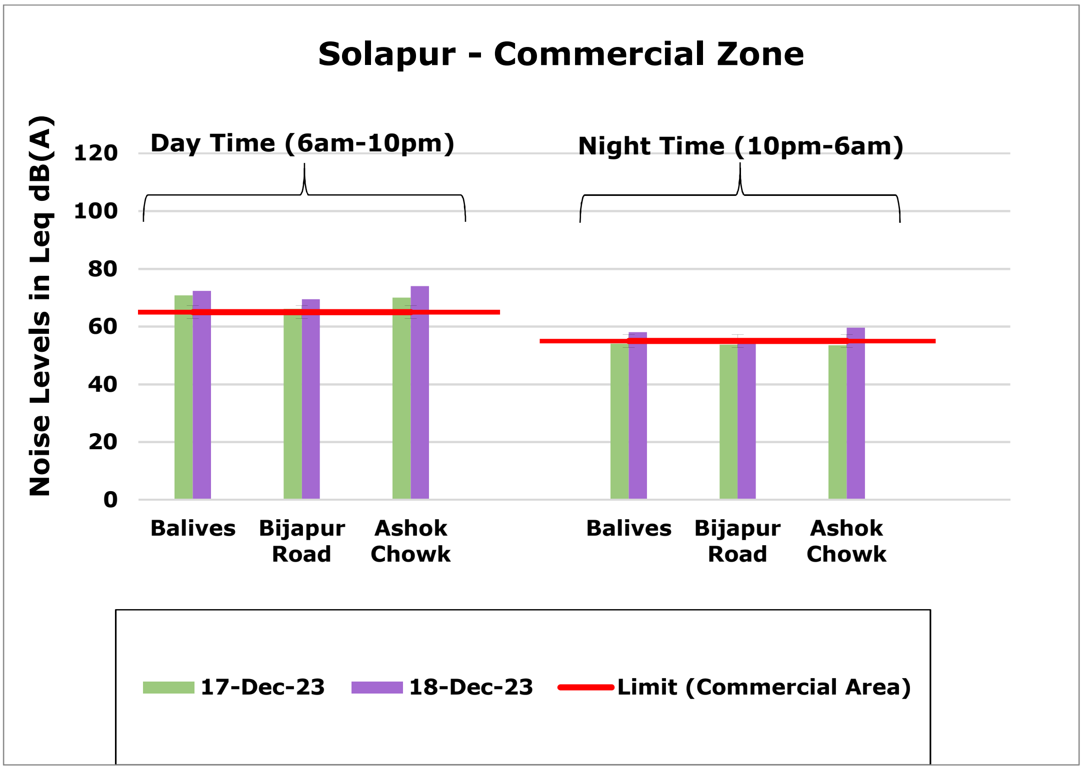
Table 5.26: Ambient Noise Levels in Solapur

Ambient Noise Monitoring on 17th December 2023- SOLAPUR												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Balives	70.8	47.8	82.5	74.9	64.6	52.8	54.1	40.5	61.0	58.2	52.5	44.7
Bijapur Road	66.1	40.3	80.3	70.9	58.9	50.7	53.8	40.2	64.3	57.0	50.5	42.5
Ashok Chowk	70.0	40.2	84.5	72.3	60.3	50.3	53.5	40.6	64.2	57.8	50.7	42.3

Ambient Noise Monitoring on 18th December 2023- SOLAPUR												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Balives	72.3	50.2	84.9	75.6	64.6	52.8	58.1	42.2	69.8	62.2	50.1	43.9
Bijapur Road	69.4	50.3	82.5	74.5	62.1	51.4	55.2	42.9	66.3	59.8	49.5	44.3
Ashok Chowk	73.9	50.2	86.9	77.5	64.3	52.8	59.5	42.8	69.7	62.3	54.7	44.3

1003

Chart 5.26: Ambient Noise Levels in Solapur



5.27 Panvel

Three locations were monitored for noise levels from Panvel Municipal Corporation. On 17th December, during day time, the highest noise level was observed at Utsav Chowk with 79.9dB(A) and during night time at Khanda Colony with 67.7 dB(A). However, on 18th December , the noise level at Utsav chowk, Kharghar was highest 73.8 dB(A) during day time and it was observed highest 67.7 dB(A) at Khanda Colony during night time.

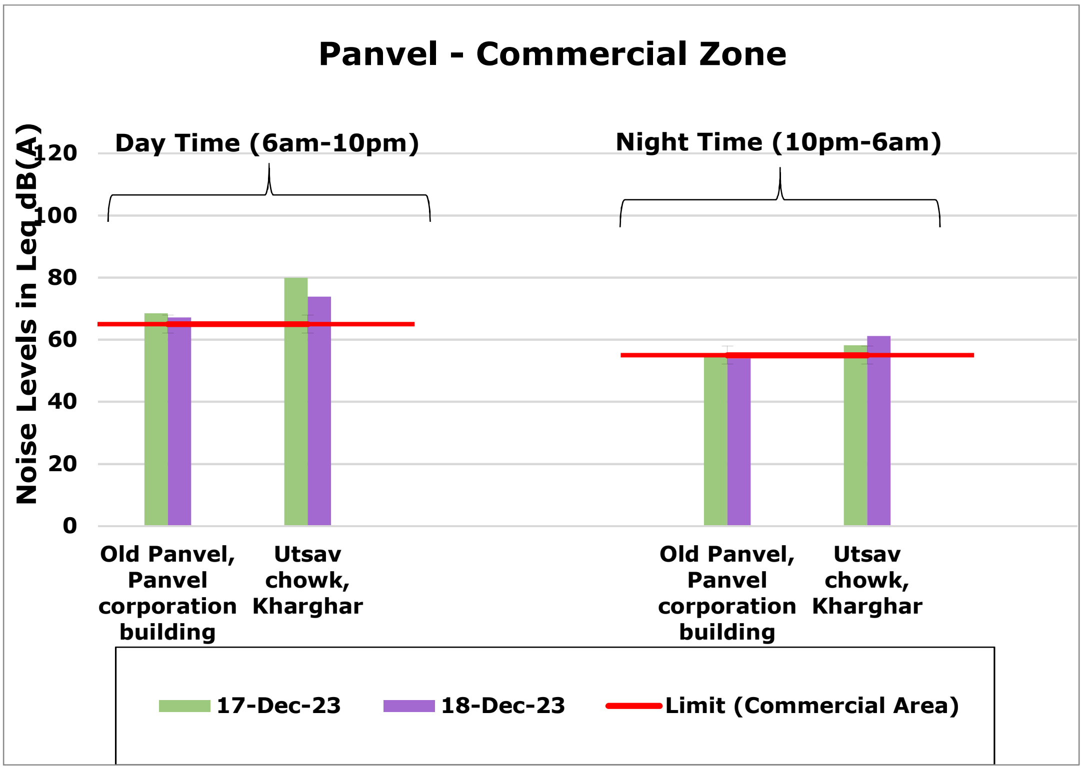
Table 5.27: Ambient Noise Levels in Panvel

Ambient Noise Monitoring on 17th December 2023 - PANVEL												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Old Panvel, Panvel corporation building	68.5	47.2	85.2	68.6	61.6	52.8	54.3	43.7	63.3	58.0	50.6	45.9
Khanda colony	74.7	57.3	79.8	78.6	73.3	63.2	67.7	58.6	75.3	72.6	63.6	60.0
Utsav chowk, Kharghar	79.9	60.1	88.3	83.4	78.3	70.4	58.2	41.1	65.7	62.0	55.1	48.1

Ambient Noise Monitoring on 18th December 2023 - PANVEL												
Location	**Day Time (6am-10pm)**						**Night Time (10pm-6am)**					
	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}
Old Panvel, Panvel corporation building	67.1	48.8	74.4	70.9	64.6	56.7	53.9	43.7	62.3	58.0	50.8	46.1
Khanda colony	73.6	58.6	79.3	76.6	72.9	63.6	67.7	58.6	75.3	72.6	63.6	60.0
Utsav chowk, Kharghar	73.8	60.5	85.5	77.1	72.1	64.1	61.1	47.9	71.5	64.8	55.6	49.5

1005

Chart 5.27: Ambient Noise Levels in Panvel



6 OBSERVATIONS

MUMBAI: The noise levels in Mumbai on December 17, 2023, varied across different locations. Hindu Colony in Dadar exhibited the highest daytime Leq at 83.3dB(A), while Goregaon (E) had the lowest at 70.8 dB(A). On December 18, Mumbadevi Temple recorded the highest daytime Leq at 87.0 dB(A), and Goregaon (E) remained the lowest at 69.8. For nighttime noise on both days, Hindu Colony had the highest Leq at 82.9 dB(A), and Goregaon (E) had the lowest at 63.5 dB(A). Overall, there were fluctuations in noise levels, with distinct maximum and minimum values across the specified locations in Mumbai.

NAVI MUMBAI: In Navi Mumbai on December 17 and 18, 2023, there were notable variations in noise levels across different locations. The highest daytime Leq was observed at Mahape Shil Road, MIDC, with a value of 72.3 dB(A), while the lowest was at Father Agnel School, Vashi, with a daytime Leq of 62.0 dB(A). For nighttime noise, APMC Market Vashi recorded the highest Leq at 72.7 dB(A), while Father Agnel School, Vashi, had the lowest at 58.3 dB(A).

THANE: In Thane on December 17 and 18, 2023, the noise levels exhibited variations across different locations. The maximum daytime Leq was recorded at Pokharan - Vartak Nagar with 82.0 dB(A), while the minimum was observed at Wagle Estate with 66.3 dB(A). For nighttime noise, Gaondevi Mandir, Naupada, reported the highest Leq at 81.5 dB(A), and Wagle Estate had the lowest at 53.7 dB(A).

PUNE: In Pune on December 17 and 18, 2023, diverse noise patterns were observed across locations. The highest daytime Leq was recorded at Pune University with 76.0 dB(A), while the lowest was at Nucleus Mall with 68.5 dB(A). For nighttime noise, Pune University reported the highest Leq at 65.0 dB(A), and Nucleus Mall had the lowest at 57.2 dB(A).

NASHIK: In Nashik during the same period, noise levels varied among different locations. Bytco reported the highest daytime Leq at 76.5 dB(A), and Pandit Colony Near NMC had the lowest at 58.0 dB(A). For nighttime noise, the highest Leq was observed at Bytco with 64.4 dB(A), and Pandit Colony Near NMC had the lowest at 48.5 dB(A).

AURANGABAD: Aurangabad exhibited diverse noise dynamics on December 17 and 18, 2023. Swami Vivekanand College reported the highest daytime Leq at 67.0 dB(A), while CIDCO N-9 had the lowest at 51.3 dB(A). For nighttime noise, the maximum Leq was observed at Swami Vivekanand College with 49.6 dB(A), and CIDCO N-9 had the lowest at 40.3 dB(A). The results suggest notable variations in noise levels across these cities and locations during the specified period.

NAGPUR: In Nagpur, on December 17 and 18, 2023, distinct noise patterns were observed across different locations. Sitabardi Police Station reported the highest daytime Leq at 78.2 dB(A), while Govt. Medical College had the lowest at 61.4 dB(A). For nighttime noise, Sitabardi Police Station again reported the maximum Leq at 66.4 dB(A), and Govt. Medical

College had the minimum at 49.3 dB(A).

KALYAN: In Kalyan during the same period, Katemanivali reported the highest daytime Leq at 82.9 dB(A), and Bail Bazar had the lowest at 72.1 dB(A). For nighttime noise, Katemanivali again reported the highest Leq at 71.3 dB(A), and Birla College had the lowest at 63.4 dB(A).

AMRAVATI: Amravati exhibited varied noise dynamics on December 17 and 18, 2023. Rajkamal Chowk reported the highest daytime Leq at 75.1 dB(A), and Ervin Hospital Square had the lowest at 65.1 dB(A). For nighttime noise, Rajkamal Chowk again reported the maximum Leq at 70.0 dB(A), and Ervin Hospital Square had the minimum at 58.6 dB(A).

JALGAON: In Jalgaon during the specified period, Shashtri Tower Chowk reported the highest daytime Leq at 79.5 dB(A), and Near Civil Hospital had the lowest at 74.4 dB(A). For nighttime noise, Shashtri Tower Chowk again reported the maximum Leq at 71.6 dB(A), and Near Civil Hospital had the minimum at 48.8 dB(A).

KOLHAPUR: Kolhapur exhibited diverse noise patterns on December 17 and 18, 2023. Gokhale College reported the highest daytime Leq at 82.1 dB(A), and Dabhorakar Corner had the lowest at 79.6 dB(A). For nighttime noise, Rajarampuri Chowk reported the highest Leq at 55.1 dB(A), and Gokhale College had the minimum at 47.7 dB(A).

SANGLI: In Sangli, diverse noise levels were observed on December 17 and 18, 2023. Visharambaug reported the highest daytime Leq at 81.6 dB(A), and Miraj Market had the lowest at 70.0 dB(A). For nighttime noise, Visharambaug again reported the maximum Leq at 65.8 dB(A), and Miraj Market had the minimum at 56.5 dB(A).

MIRA BHAYANDER: Mira-Bhayander exhibited varying noise patterns during the specified period. Bhakti Vedant Hospital reported the highest daytime Leq at 81.4 dB(A), and Shivaji Chak Kashi Meera had the lowest at 73.7 dB(A). For nighttime noise, Golden Police Chawki reported the maximum Leq at 71.6 dB(A), and Bhakti Vedant Hospital had the minimum at 59.6 dB(A).

VASAI – VIRAR: Vasai-Virar displayed diverse noise dynamics on December 17 and 18, 2023. Range Office, Satwali, Vasai East, reported the highest daytime Leq at 78.0 dB(A), and Valiv Phata, Vasai East, had the lowest at 66.8 dB(A). For nighttime noise, Range Office again reported the maximum Leq at 71.8 dB(A), and Valiv Phata had the minimum at 60.7 dB(A).

ULHASNAGAR: Ulhasnagar showed varied noise patterns during the specified period. Camp No. 5 Bus Stop reported the highest daytime Leq at 81.0 dB(A), and Camp No. 1 Gol Maidan had the lowest at 70.8 dB(A). For nighttime noise, Camp No. 5 Bus Stop again reported the maximum Leq at 71.9 dB(A), and Shivaji Chowk No. 3 had the minimum at 59.0 dB(A).

BHIWANDI-NIZAMPUR: Bhiwandi-Nizampur exhibited diverse noise levels on December 17 and 18, 2023. Indira Gandhi Memorial Hospital reported the highest daytime Leq at 78.4 dB(A), and Shelar Near Nadi Naka had the lowest at 66.8 dB(A). For nighttime noise, Indira Gandhi Memorial Hospital again reported the maximum Leq at 64.1 dB(A), and Dhamankar Naka had the minimum at 61.0 dB(A).

CHANDRAPUR: Chandrapur displayed consistent noise levels during the specified period. Gandhi Chowk reported the highest daytime and nighttime Leq at 72.6 dB(A) and 62.2 dB(A), respectively, while Jatpura Gate had the lowest at 71.0 dB(A) for both.

NANDED-WAGHALA: Nanded-Waghala exhibited varied noise patterns during the specified period. District Court Station Road reported the highest daytime and nighttime Leq at 67.4 dB(A) and 48.1 dB(A), respectively, while Govt. Polytechnic College had the lowest at 53.4 dB(A) for both.

AHMEDNAGAR: Ahmednagar showed diverse noise dynamics on December 17 and 18, 2023. Old Bus Stand reported the highest daytime Leq at 73.1 dB(A), and Chitale Road had the lowest at 66.4 dB(A). For nighttime noise, Old Bus Stand again reported the maximum Leq at 63.0 dB(A), and Kotala Chawk had the minimum at 58.2 dB(A).

DHULE: Dhule exhibited varying noise patterns during the specified period. Fulwala Chawk reported the highest daytime Leq at 70.9 dB(A), and Santoshi Mata Chawk had the lowest at 68.2 dB(A). For nighttime noise, Fulwala Chawk again reported the maximum Leq at 67.9 dB(A), and Santoshi Mata Chawk had the minimum at 57.4 dB(A).

MALEGAON: Malegaon displayed diverse noise dynamics on December 17 and 18, 2023. Central Bus Stand reported the highest daytime Leq at 73.7 dB(A), and Malegaon Camp had the lowest at 65.3 dB(A). For nighttime noise, Central Bus Stand again reported the maximum Leq at 67.0 dB(A), and Malegaon Camp had the minimum at 57.7 dB(A).

PIMPRI-CHINCHWAD: In Pimpri-Chinchwad, the noise levels varied across locations. Chafekar Chowk reported the highest daytime Leq at 76.1 dB(A), while Bhosari had the lowest at 72.5 dB(A). For nighttime noise, Chafekar Chowk again reported the maximum Leq at 68.0 dB(A), and Bhosari had the minimum at 58.2 dB(A).

PARBHANI: Parbhani displayed diverse noise patterns on December 17 and 18, 2023. Shaniwar Bazar reported the highest daytime and nighttime Leq at 65.4 dB(A) and 48.1 dB(A), respectively, while Civil Hospital had the lowest at 59.7 dB(A) for daytime and 42.0 dB(A) for nighttime.

LATUR: Latur exhibited varying noise dynamics during the specified period. Shahu College reported the highest daytime Leq at 66.0 dB(A), and CJM Court had the lowest at 64.8 dB(A).

For nighttime noise, CJM Court again reported the maximum Leq at 49.8 dB(A), and Civil Hospital had the minimum at 43.9 dB(A).

AKOLA: Akola showed diverse noise levels on December 17 and 18, 2023. City Kotawali Chawk near the police station reported the highest daytime Leq at 79.1 dB(A), while Collector Office had the lowest at 76.0 dB(A). For nighttime noise, City Kotawali Chawk again reported the maximum Leq at 68.6 dB(A), and Collector Office had the minimum at 59.9 dB(A).

SOLAPUR: Solapur exhibited varied noise patterns during the specified period. Balives reported the highest daytime Leq at 70.8 dB(A), and Ashok Chowk had the lowest at 66.1 dB(A). For nighttime noise, Balives again reported the maximum Leq at 54.1 dB(A), and Ashok Chowk had the minimum at 53.5 dB(A).

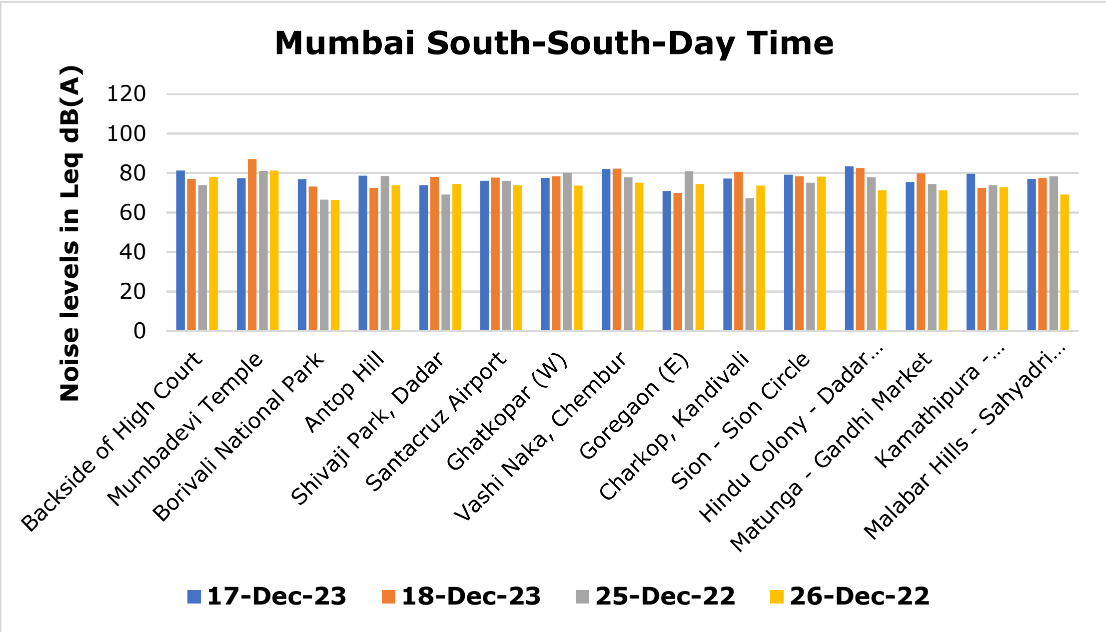
PANVEL: In Panvel, diverse noise levels were observed on December 17 and 18, 2023. Utsav Chowk, Kharghar, reported the highest daytime Leq at 79.9dB(A), and Old Panvel had the lowest at 68.5 dB(A). For nighttime noise, Utsav Chowk again reported the maximum Leq at 67.7 dB(A), and Old Panvel had the minimum at 54.3 dB(A).

7 COMPARATIVE STUDY OF NOISE LEVELS

To know the cumulative effect of noise levels in the proximity areas and the effect of mitigation measures taken by the authorities, this year's (2023) noise levels were compared with the noise levels of the last year 2022. The detailed results of each location, obtained by the study are explained and presented graphically as below:

7.1 Mumbai

In Mumbai, the maximum percentage increase in noise levels during the monitoring period in 2023 compared to 2022 occurred at Hindu Colony-Dadar, with a significant surge of 48.2%, particularly during nighttime. The maximum percentage decrease was observed in Mumba devi temple, with a substantial nighttime reduction of -13.9%. On the second day of monitoring, overall, variations ranged from a minimum decrease of -13.3% at Mumbadevi Temple to a maximum increase of 31.5% at Malabar Hills-Sahyadri Guest House during nighttime monitoring.



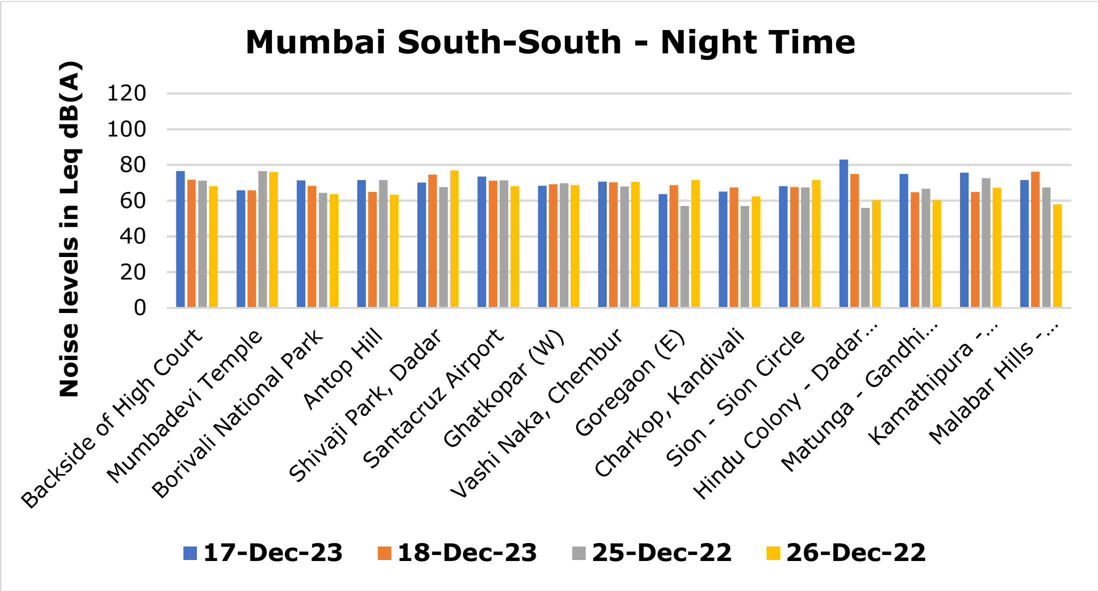
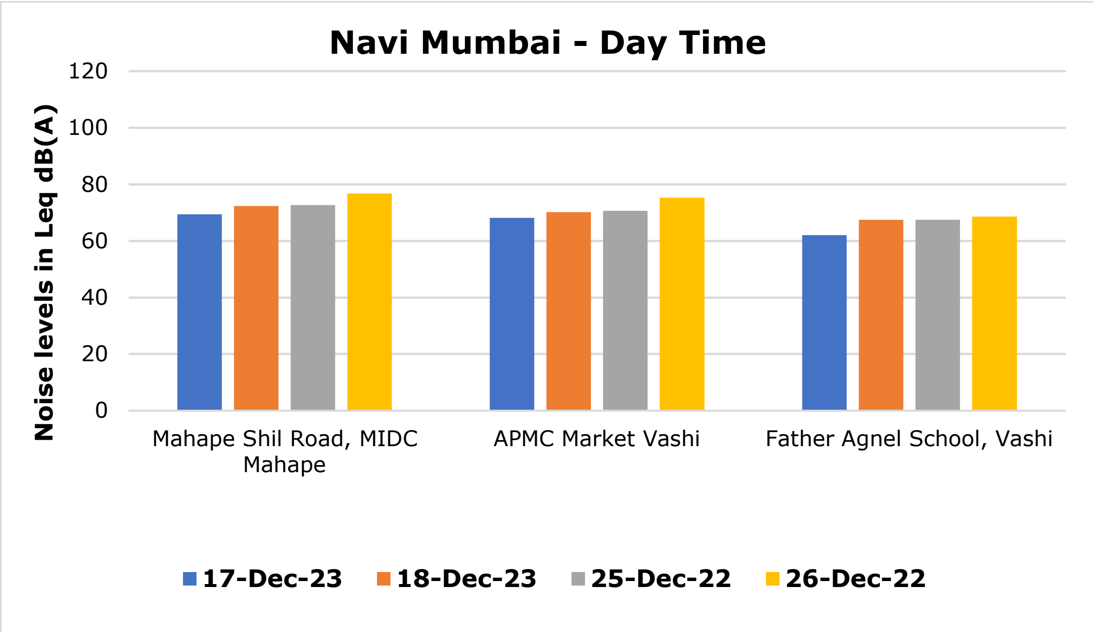


Chart 7.1: Comparison of Noise Levels for the years 2023 and 2022 in Mumbai

7.2 Navi Mumbai

In Navi Mumbai, the maximum percentage decrease in noise levels during the monitoring period in 2023 compared to 2022 occurred at Father Agnel School, Vashi, with a substantial decrease of 8.1%. The maximum percentage increase was observed at Mahape Shil Road, MIDC Mahape, with a significant nighttime rise of 8.5%.

On December 18, 2023, in Navi Mumbai, Mahape Shil Road, MIDC Mahape experienced a 5.8% decrease in daytime noise levels. Father Agnel School, Vashi, showed the minimum changes both during the day (decrease of 1.7%) and at night (increase of 0.9%).



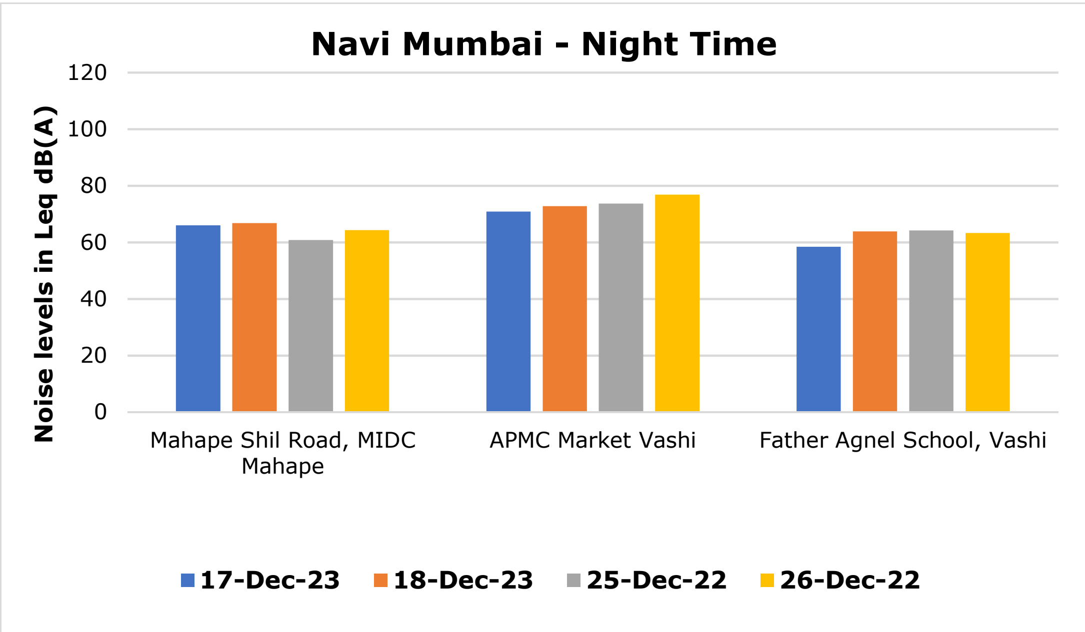
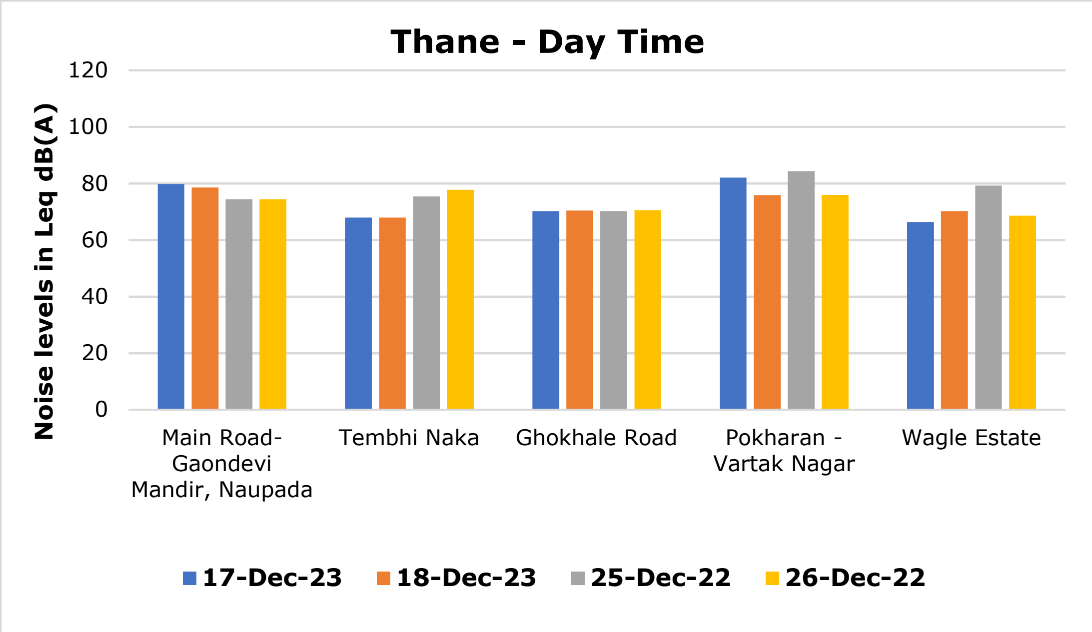


Chart 7.2: Comparison of Noise Levels for the years 2023 and 2022 in Mumbai

7.3 Thane

In Thane, Main Road-Gaondevi Mandir witnessed a 7.3% daytime noise increase to 79.7 dB on December 17, 2023, with a substantial 27.3% nighttime escalation. Conversely, Tembhi Naka experienced a notable 9.9% daytime noise reduction to 67.8 dB, along with a -7.0% nighttime decrease on the same date.



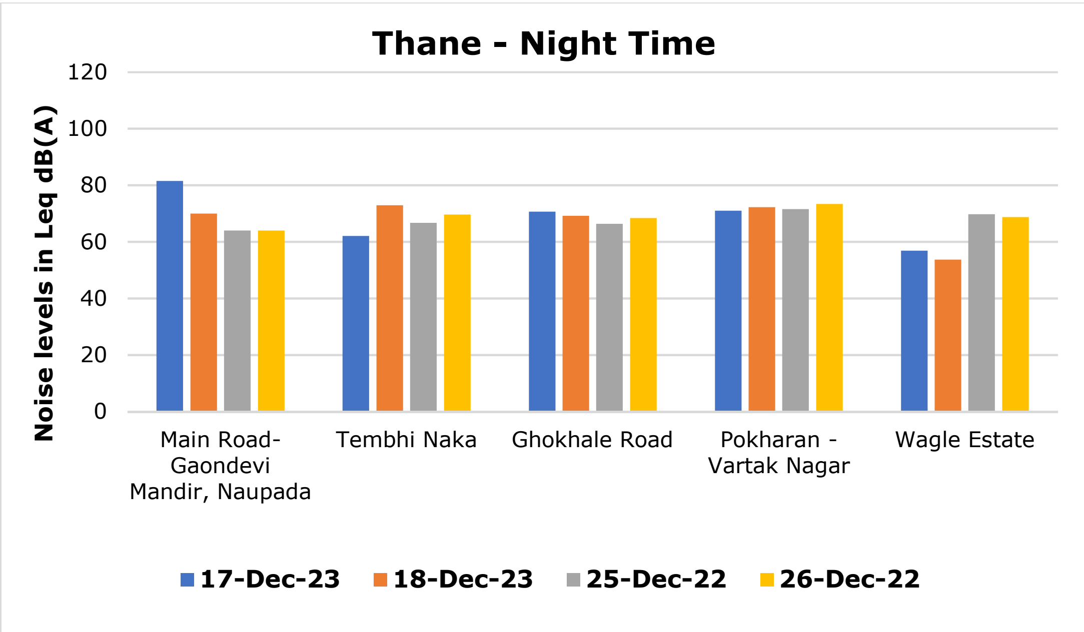
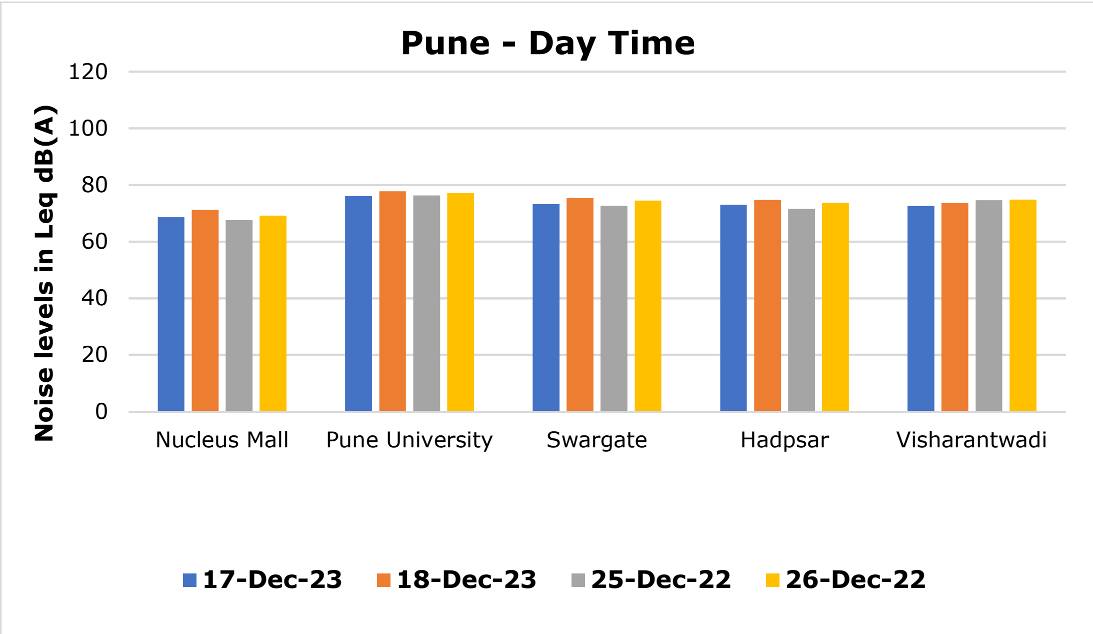


Chart 7.3: Comparison of Noise Levels for the years 2023 and 2022 in Thane

7.4 Pune

In Pune on December 17, 2023, Nucleus Mall had a 1.5% daytime increase and a 1.8% nighttime decrease, Pune University showed marginal changes during the day but a significant 7.1% increase at night, and Swargate, Hadapsar, and Visharantwadi had varying noise level changes. On December 18, 2023, Nucleus Mall recorded a 2.9% daytime increase and a 2.8% increase at night, while Pune University had a 0.9% daytime increase and a substantial 11.2% increase at night. Swargate, Hadapsar, and Visharantwadi also showed different noise level changes. The maximum changes occurred at Pune University during the night (11.2%), while the minimum changes were at Visharantwadi during the day (a decrease of 1.7%).



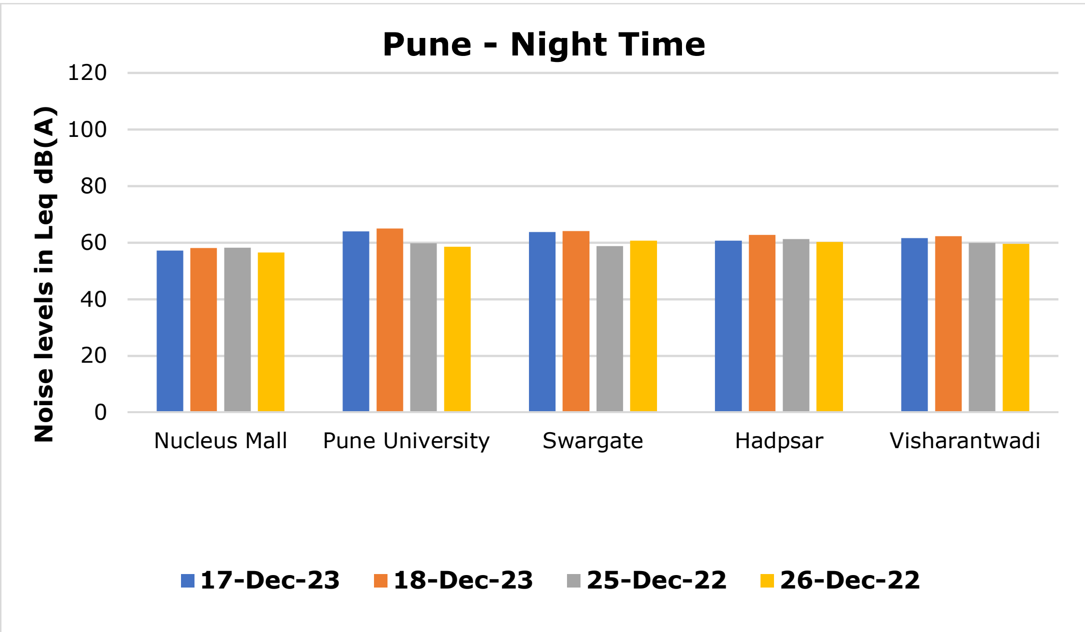
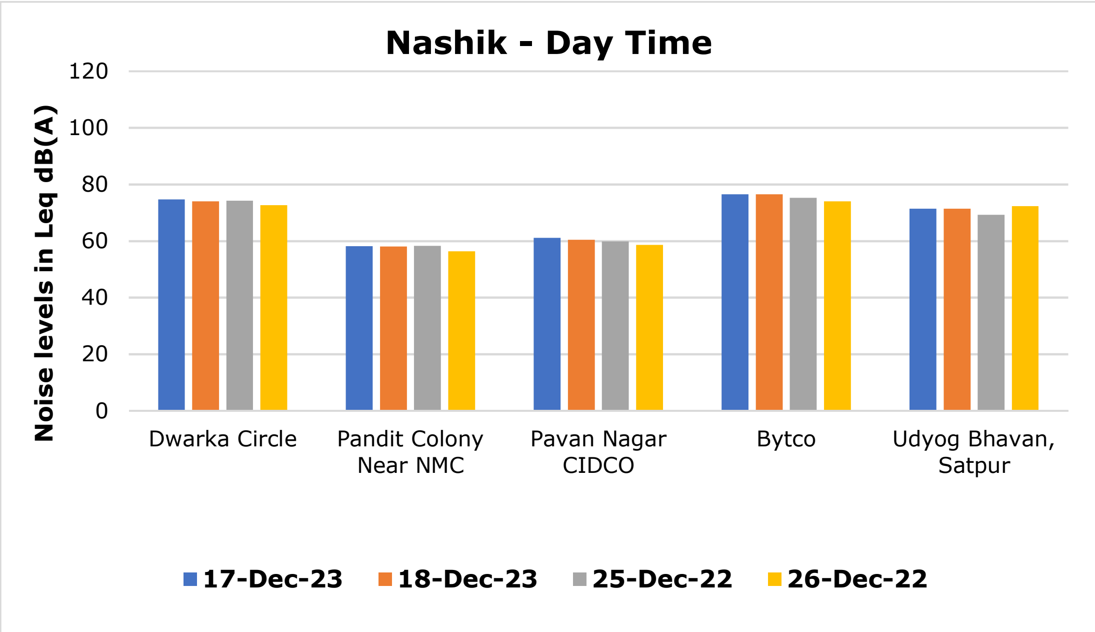


Chart 7.4: Comparison of Noise Levels for the years 2023 and 2022 in Pune

7.5 Nashik

In Nashik, Dwarka Circle experienced a marginal 0.6% increase in daytime noise and a notable 6.0% decrease at night on December 17, 2023. Pandit Colony Near NMC showed a slight 0.3% decrease during the day and a 1.2% decrease at night. Pavan Nagar CIDCO had a 2.0% increase during the day but a 4.7% decrease at night. Bytco witnessed a 1.8% increase during the day and a 0.7% increase at night, while Udyog Bhavan, Satpur, exhibited a 3.1% increase during the day and a 2.8% decrease at night. On December 18, 2023, the maximum change occurred at Pandit Colony Near NMC at night (11.8%), while the minimum change was at Udyog Bhavan, Satpur, during the night (-11.8%).



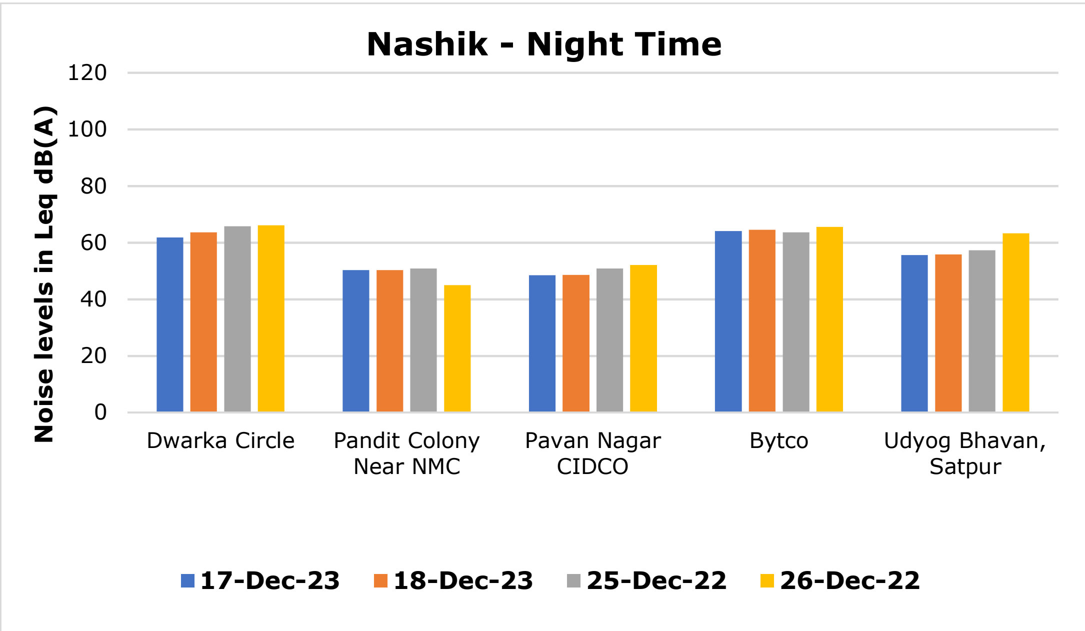
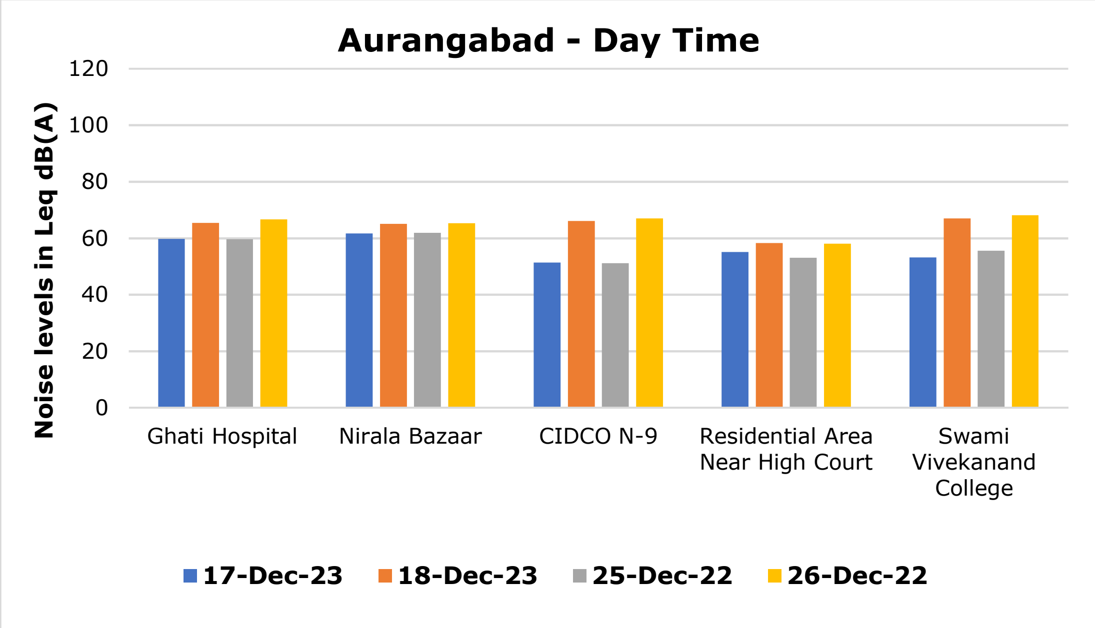


Chart 7.5: Comparison of Noise Levels for the years 2023 and 2022 in Nashik

7.6 Aurangabad

In Aurangabad, Ghati Hospital and Nirala Bazaar showed minimal changes in noise levels on December 17, 2023. CIDCO N-9 experienced a slight increase during the day and a decrease at night. Residential Area Near High Court exhibited significant daytime and nighttime increases, while Swami Vivekanand College showed noticeable decreases. On December 18, the maximum change occurred at Residential Area Near High Court at night (8.5%), with the minimum change at Nirala Bazaar during the day (-0.4%).



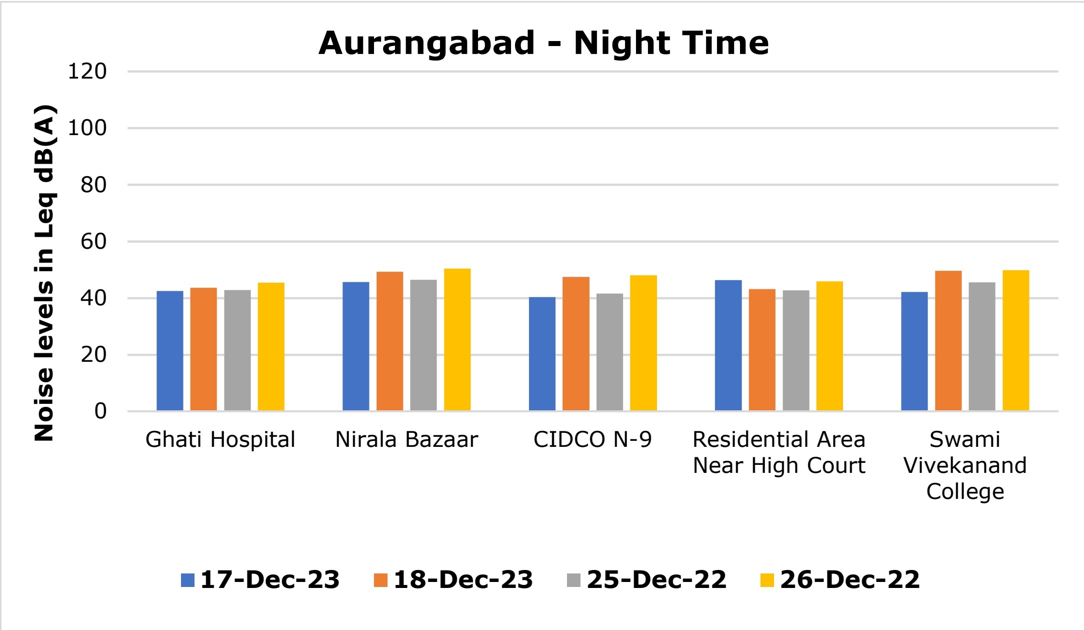
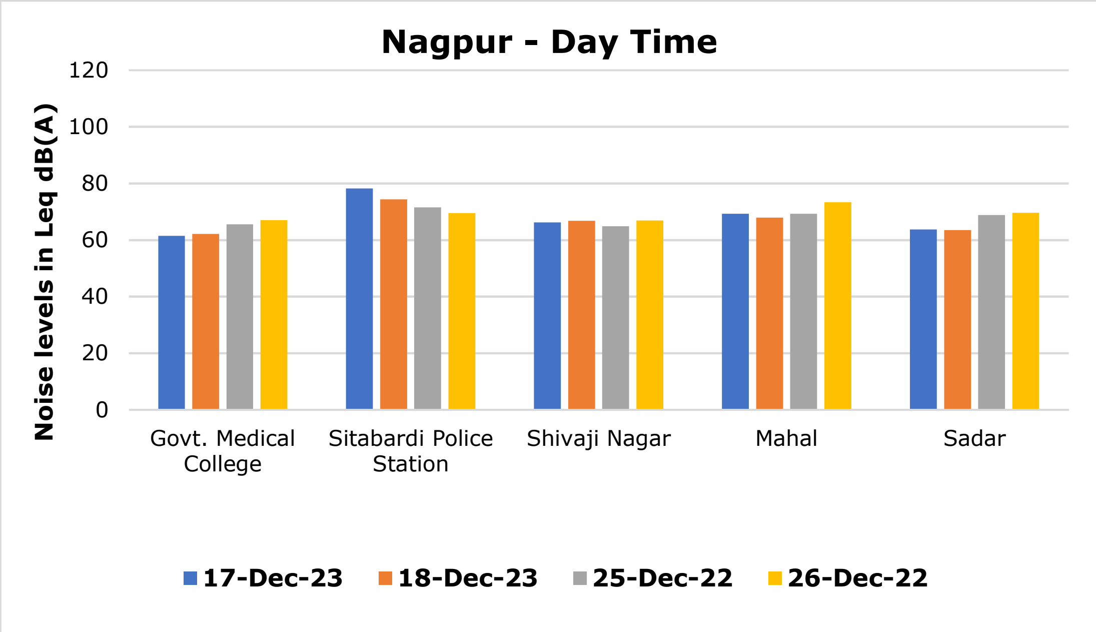


Chart 7.6: Comparison of Noise Levels for the years 2023 and 2022 in Aurangabad

7.7 Nagpur

On December 17, 2023, Nagpur saw diverse noise dynamics. While Govt. Medical College experienced a 6.3% daytime decrease, Sitabardi Police Station had a substantial 9.4% increase during the day. On December 18, Shivaji Nagar showed a maximum 18.3% increase at night. The varied patterns suggest significant noise level shifts.



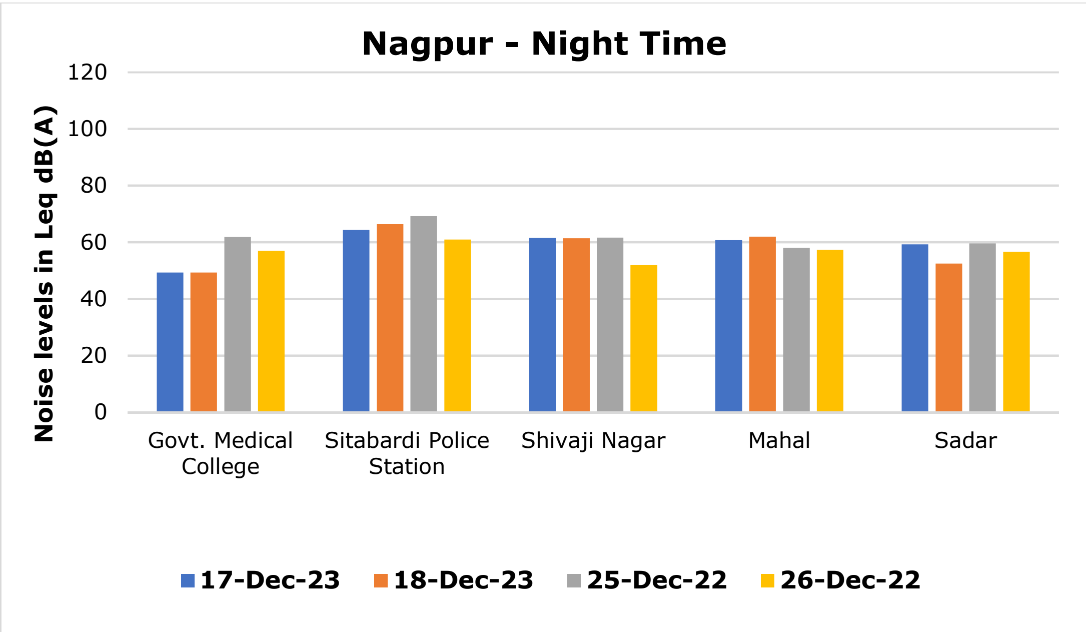
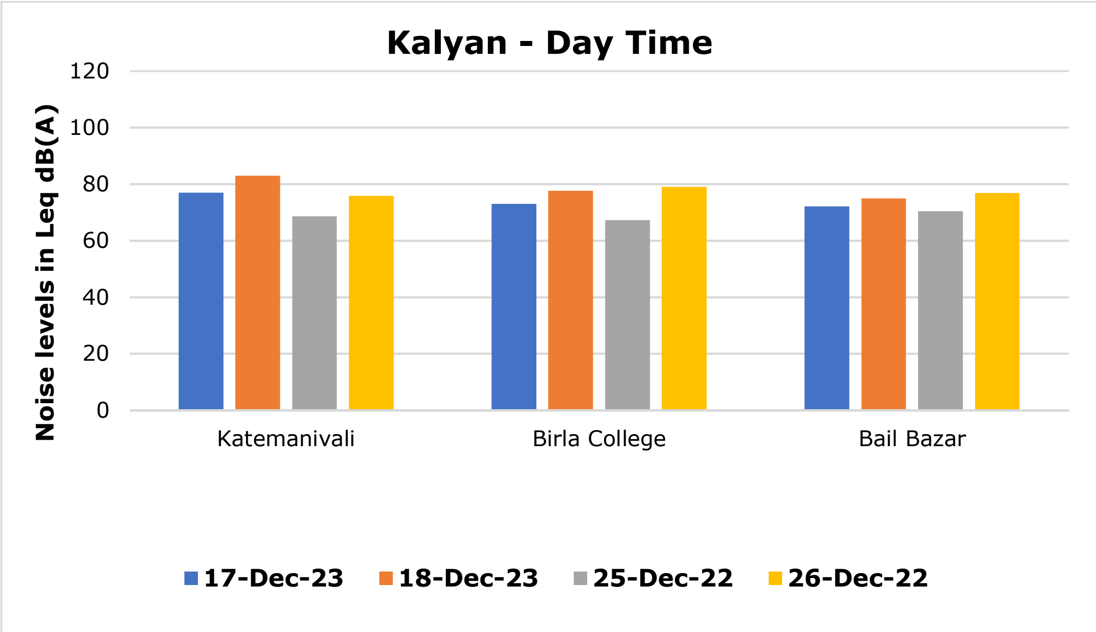


Chart 7.7: Comparison of Noise Levels for the years 2023 and 2022 in Nagpur

7.8 Kalyan

Kalyan exhibited diverse noise variations on December 17 and 18, 2023. Katemanivali had a notable 12.1% daytime increase but a 10.2% nighttime decrease. Bail Bazar showed a moderate 2.4% increase during the day and a significant 4.4% decrease at night. The data reflects complex noise dynamics in different areas.



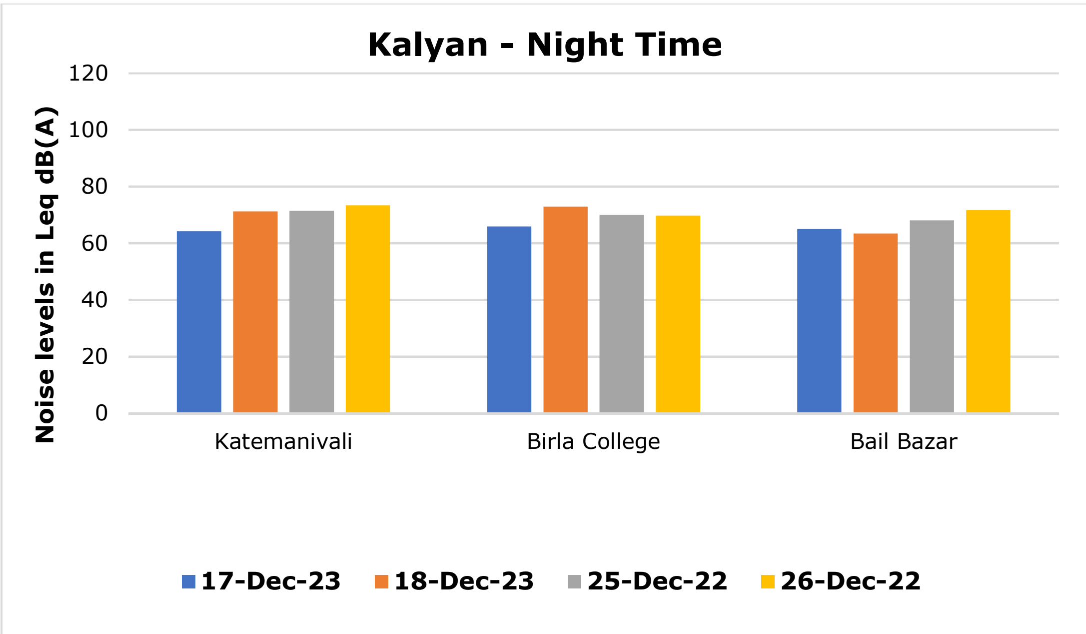
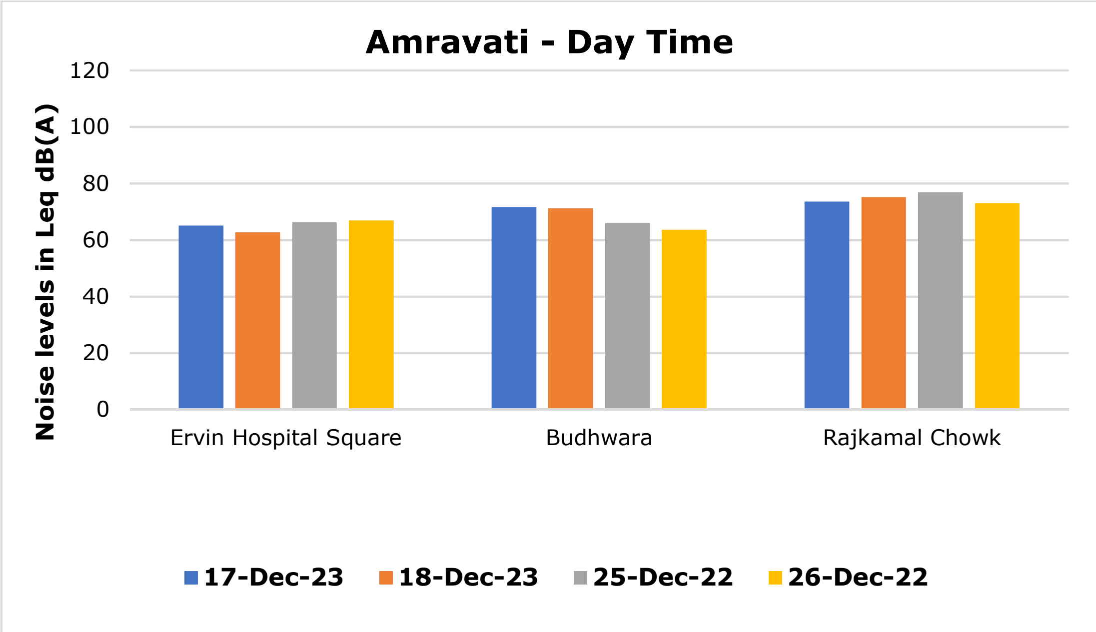


Chart 7.8: Comparison of Noise Levels for the years 2023 and 2022 in Kalyan

7.9 Amravati

Distinctive noise fluctuations were observed in Amravati on December 17 and 18, 2023. Budhwara displayed a remarkable 8.5% daytime increase and a significant 36.0% nighttime increase. On December 18, 2023, Budhwara's nighttime increase reached 37.9%. These trends underscore diverse noise patterns in Amravati.



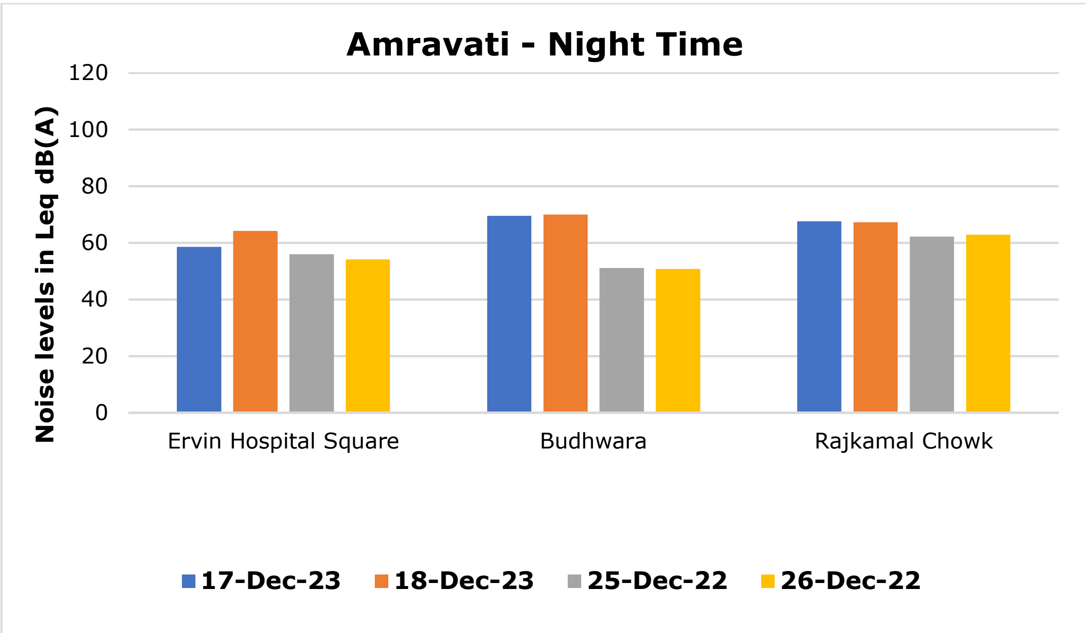
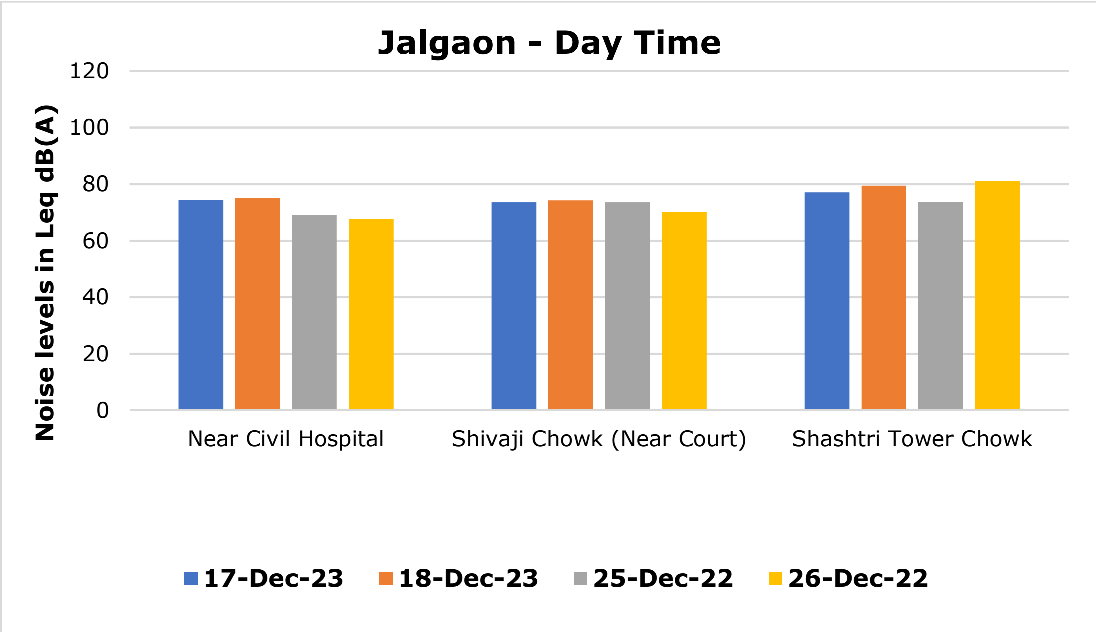


Chart 7.9: Comparison of Noise Levels for the years 2023 and 2022 in Amravati

7.10 Jalgaon

Jalgaon displayed varied noise trends on December 17 and 18, 2023. Near Civil Hospital had a significant 7.6% daytime increase but a notable 5.9% nighttime decrease. Shivaji Chowk showed a minimal 0.1% daytime increase but a substantial 12.3% nighttime decrease. Shashtri Tower Chowk exhibited a 4.6% daytime increase but a notable 9.3% nighttime decrease.



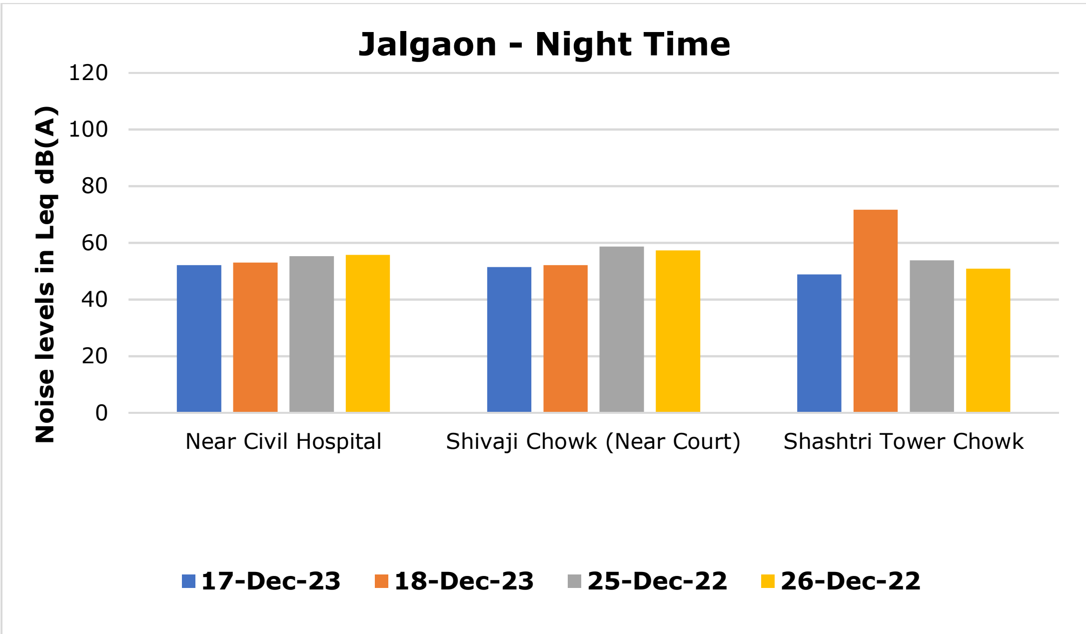
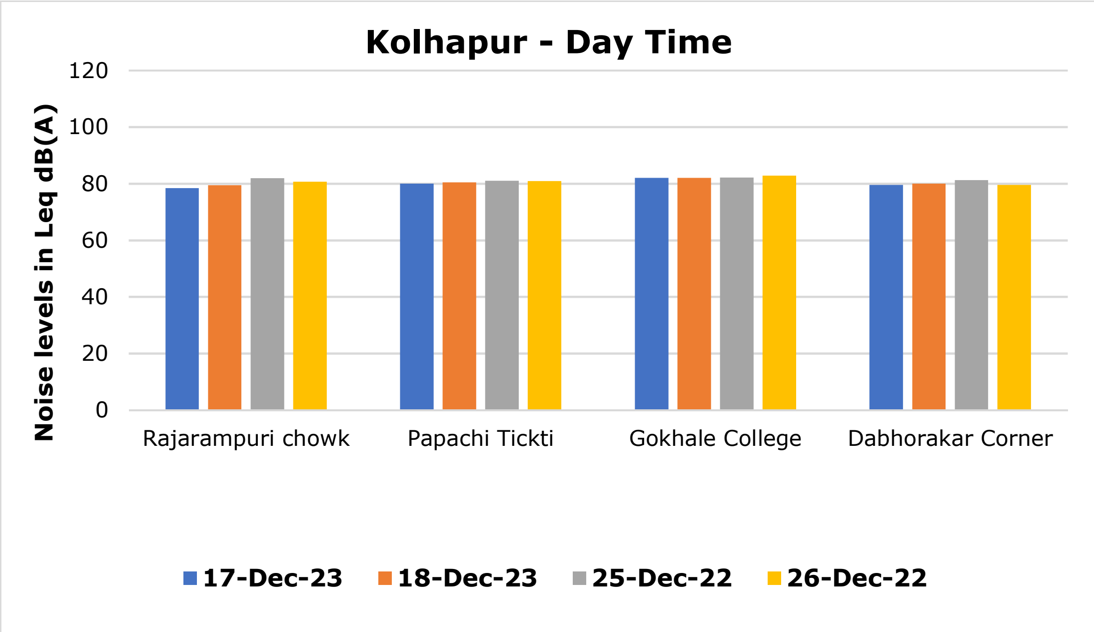


Chart 7.10: Comparison of Noise Levels for the years 2023 and 2022 in Jalgaon

7.11 Kolhapur

Kolhapur showcased relatively stable noise levels on December 17 and 18, 2023. Rajarampuri Chowk had a marginal 4.2% daytime decrease and a nighttime increase of 1.6%. Gokhale College exhibited a negligible 0.2% daytime decrease and a moderate 4.2% nighttime decrease. The data indicates consistent noise levels with minor variations in Kolhapur.



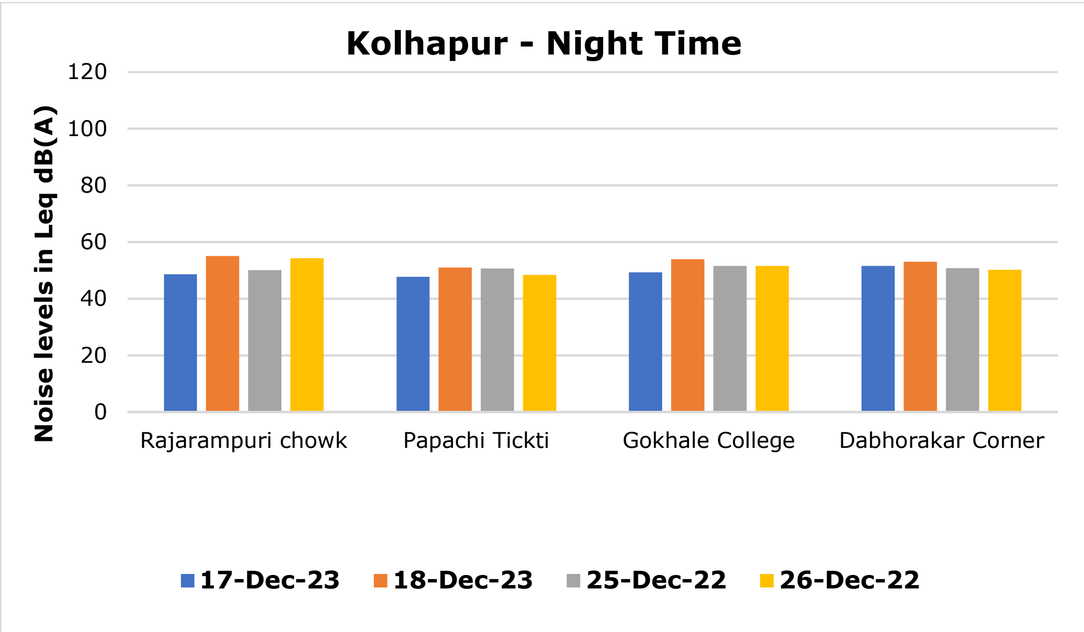
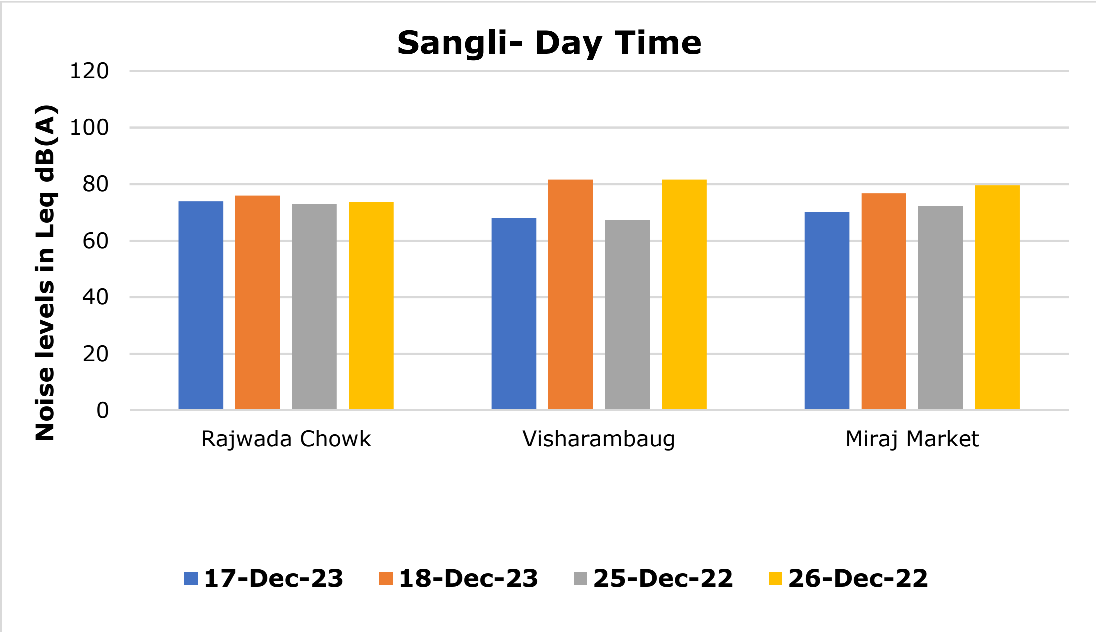


Chart 7.11: Comparison of Noise Levels for the years 2023 and 2022 in Kolhapur

7.12 Sangli

On December 17, 2023, Sangli displayed mixed noise level changes. While Rajwada Chowk experienced a slight 1.3% increase during the day, Miraj Market saw a notable 3.6% decrease in nighttime noise. Bhakti Vedant Hospital in Mira-Bhayander witnessed a substantial 12.2% decrease in nighttime noise on December 18. The varied patterns indicate diverse noise dynamics in Sangli.



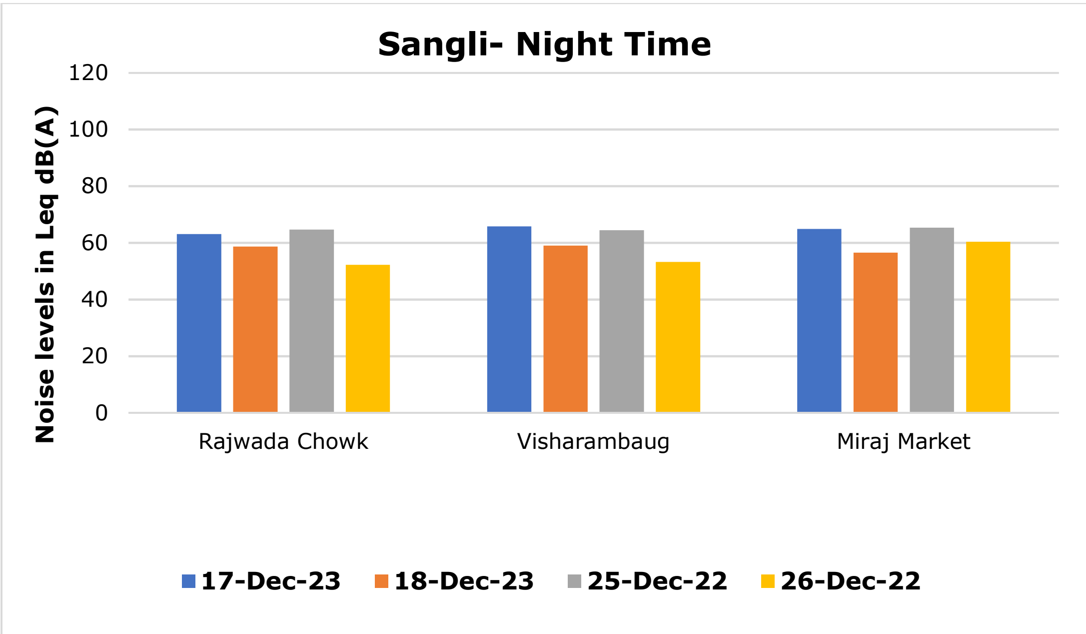
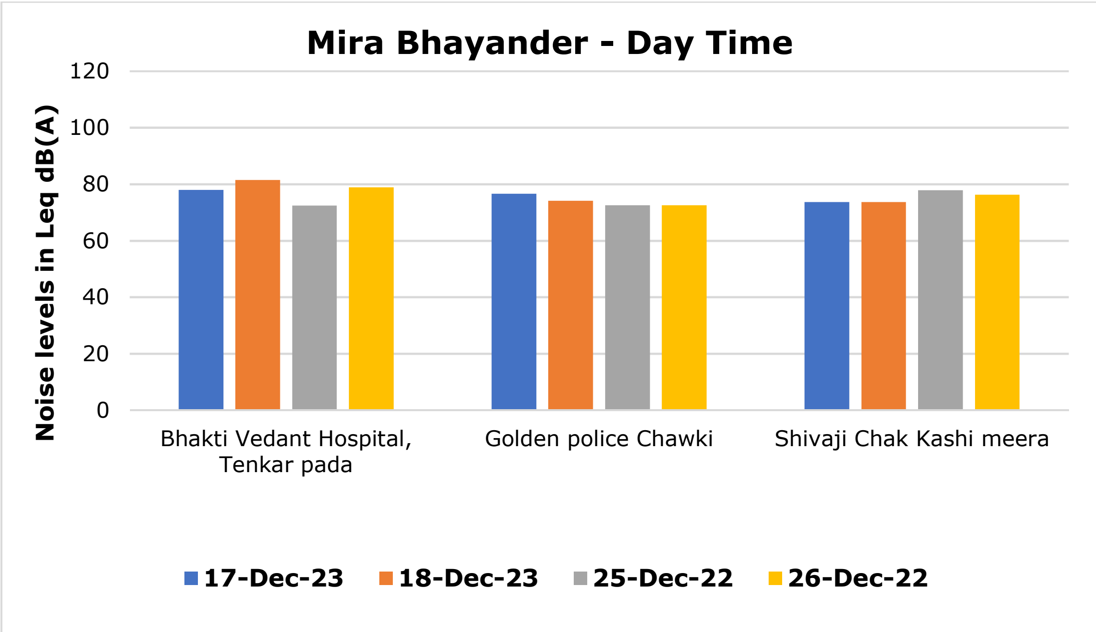


Chart 7.12: Comparison of Noise Levels for the years 2023 and 2022 in Sangli

7.13 Mira-Bhayander

The noise dynamics in Mira-Bhayander on December 17, 2023, were diverse. Bhakti Vedant Hospital exhibited a significant 7.7% increase in daytime noise, contrasting with Golden Police Chawki, which had a 12.2% decrease at night. On December 18, Shivaji Chak Kashi Meera showed a substantial 5.4% decrease in daytime noise. These variations suggest distinct noise level shifts across different locations in Mira-Bhayander.



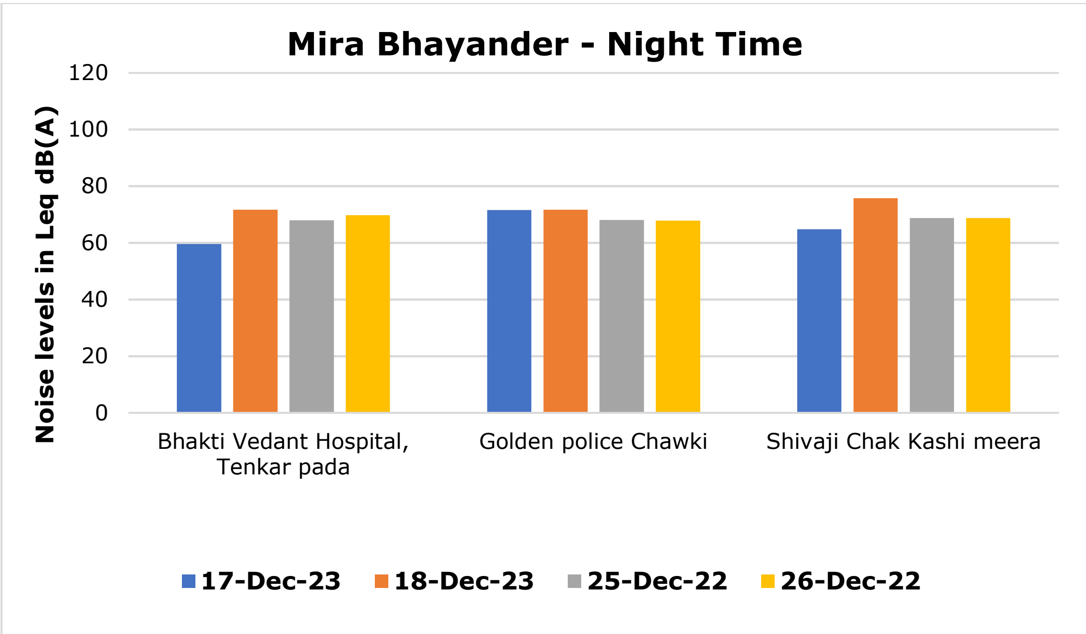
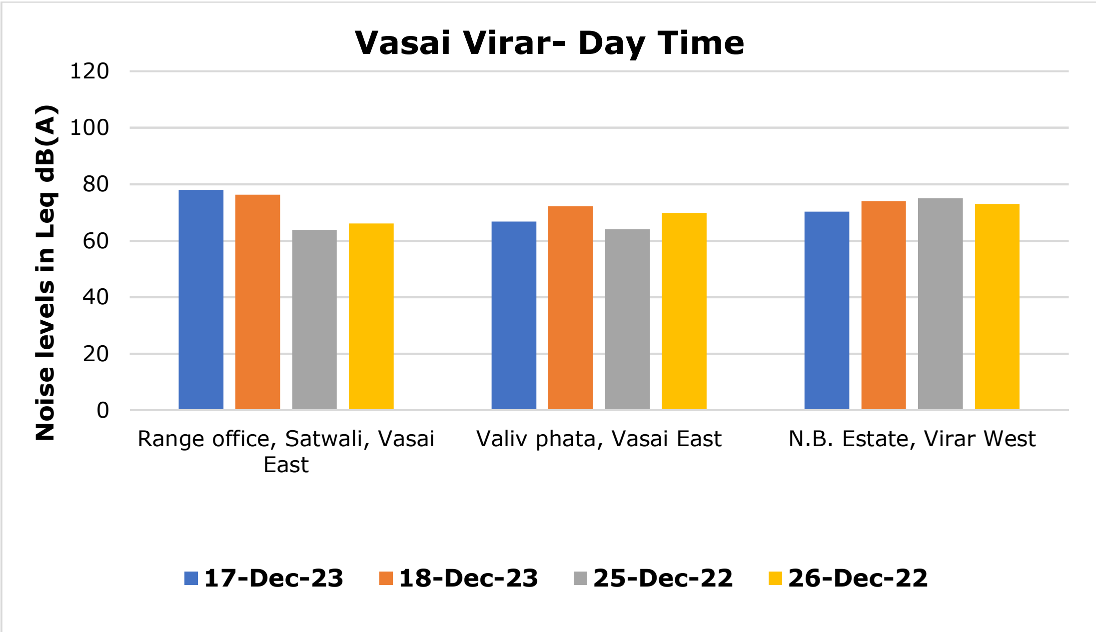


Chart 7.13: Comparison of Noise Levels for the years 2023 and 2022 in Mira-Bhayander

7.14 Vasai-Virar

Vasai-Virar witnessed varied noise level changes on December 17, 2023. Range office, Satwali, Vasai East, had a substantial 22.2% increase in daytime noise, while N.B. Estate, Virar West, experienced a 6.3% decrease. On December 18, Valiv Phata, Vasai East, showed a notable 15.7% increase in nighttime noise. These diverse patterns indicate significant fluctuations in noise levels across Vasai-Virar.



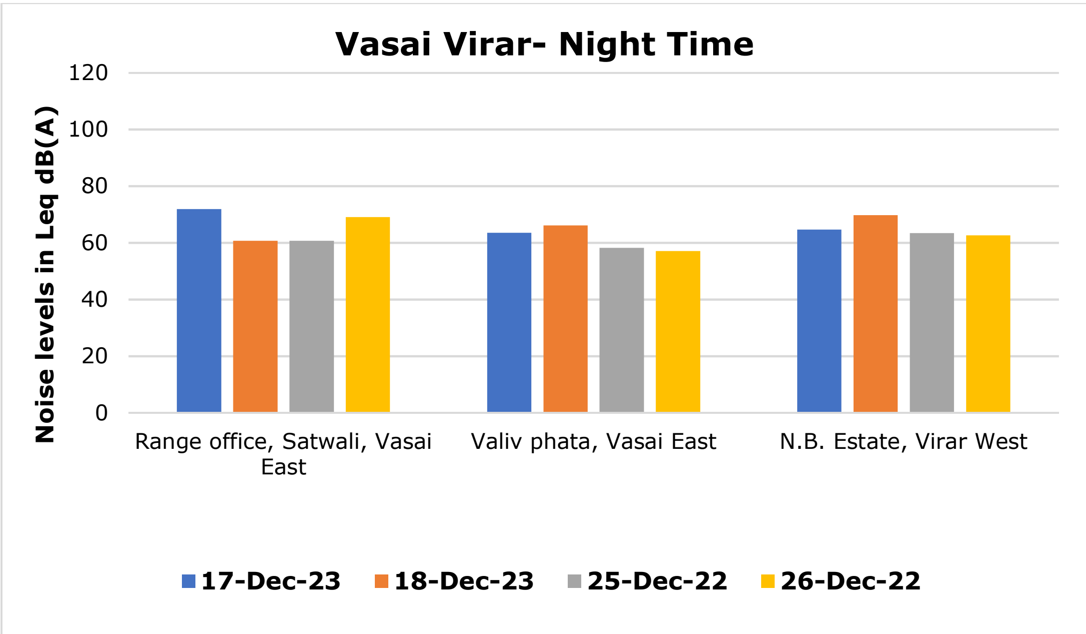
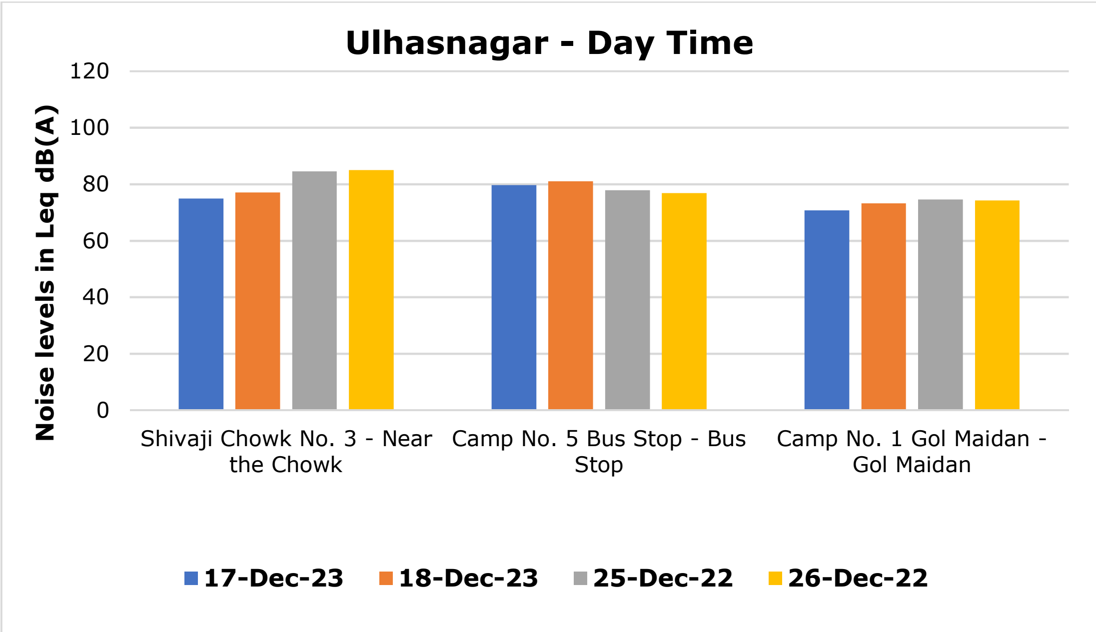


Chart 7.14: Comparison of Noise Levels for the years 2023 and 2022 in Vasai-Virar

7.15 Ulhasnagar

Ulhasnagar displayed diverse noise dynamics on December 17, 2023. Shivaji Chowk No. 3 witnessed a substantial 11.4% decrease in daytime noise, while Camp No. 1 Gol Maidan had a notable 20.0% decrease at night. Camp No. 5 Bus Stop showed a 2.4% increase during the day. These variations suggest significant shifts in noise levels across different locations in Ulhasnagar.



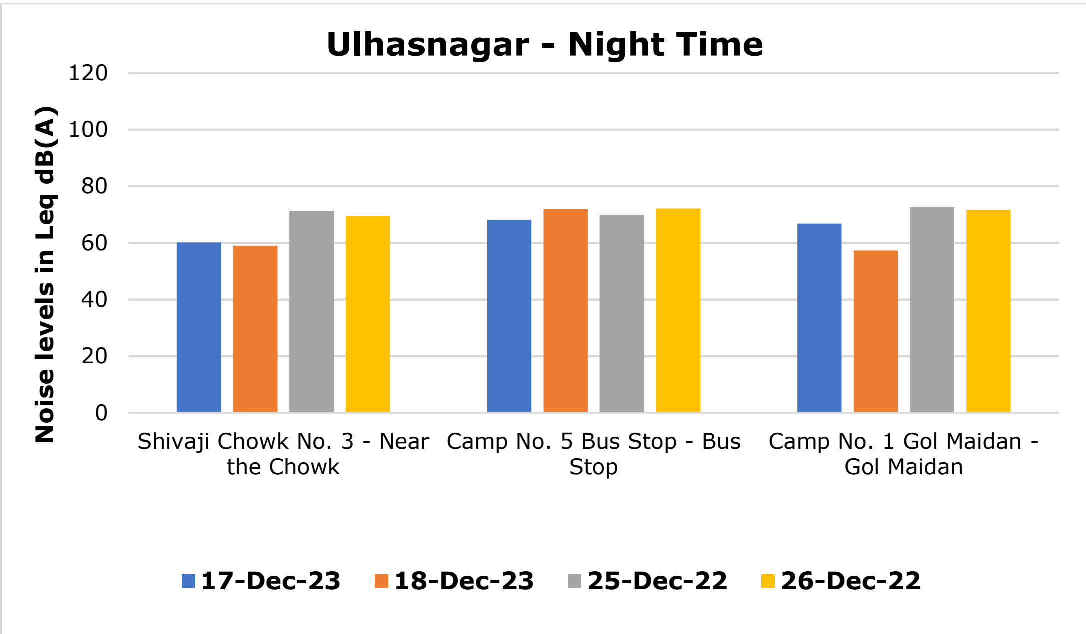
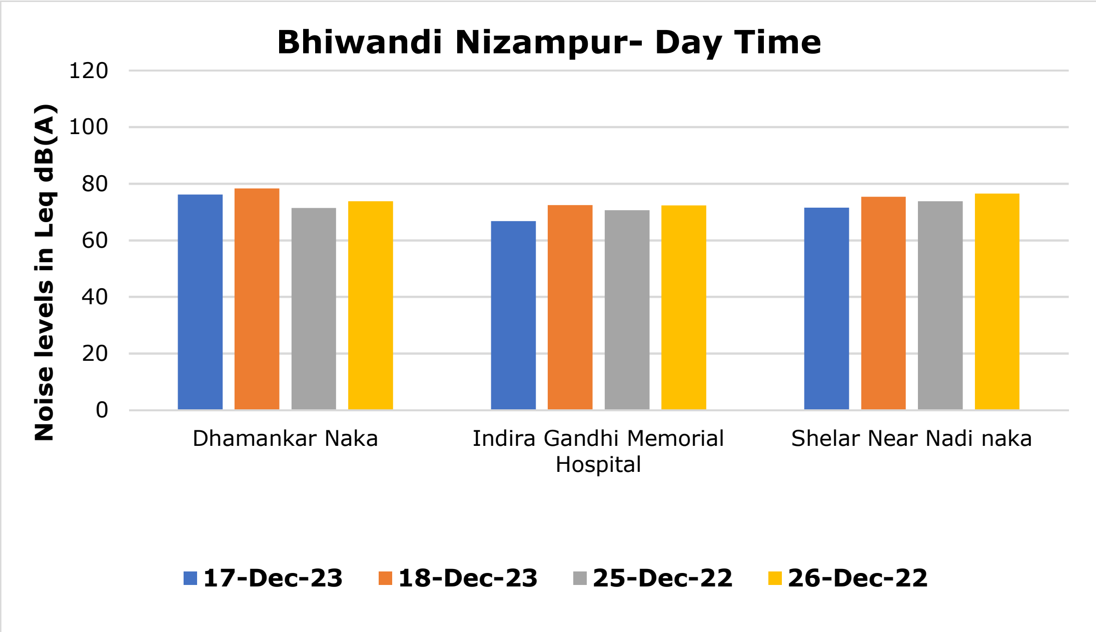


Chart 7.15: Comparison of Noise Levels for the years 2023 and 2022 in Ulhasnagar

7.16 Bhiwandi

On December 17, 2023, Bhiwandi witnessed varied noise dynamics. Dhamankar Naka experienced a significant 6.7% increase in daytime noise, while Indira Gandhi Memorial Hospital showed a notable 5.4% decrease during the day. On December 18, Dhamankar Naka exhibited a 6.2% increase in daytime noise, indicating fluctuating noise patterns in Bhiwandi.



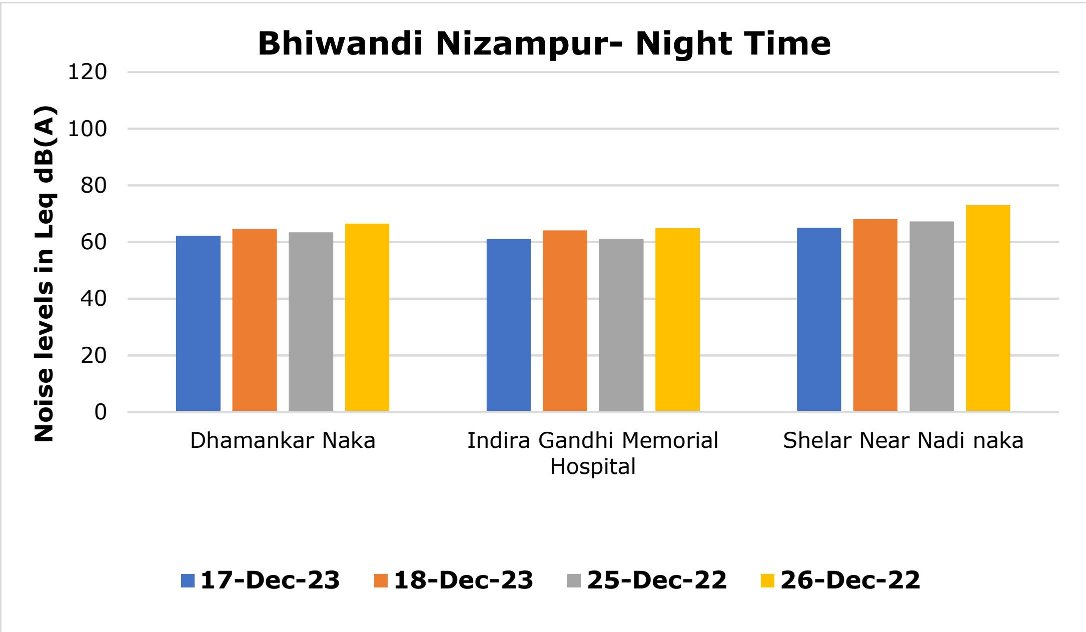
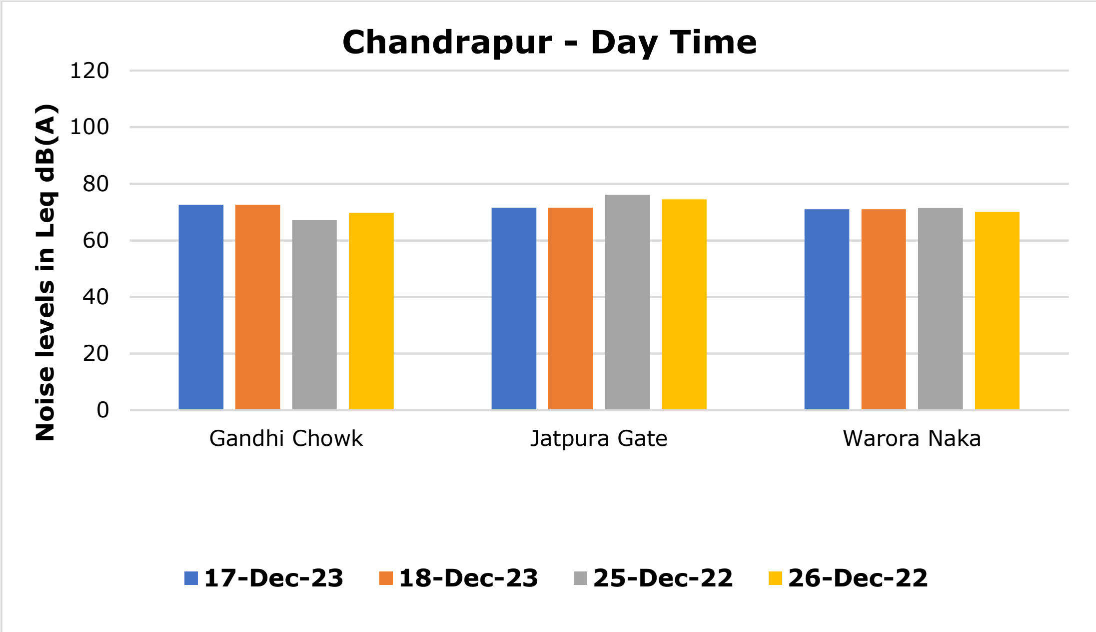


Chart 7.16: Comparison of Noise Levels for the years 2023 and 2022 in Bhiwandi-Nizampur

7.17 Chandrapur

Chandrapur displayed diverse noise trends on December 17, 2023. While Gandhi Chowk witnessed an 8.2% increase in daytime noise, Jatpura Gate had a substantial 5.9% decrease during the day. On December 18, Warora Naka showed a 1.4% increase in daytime noise, suggesting varying noise levels across different locations in Chandrapur.



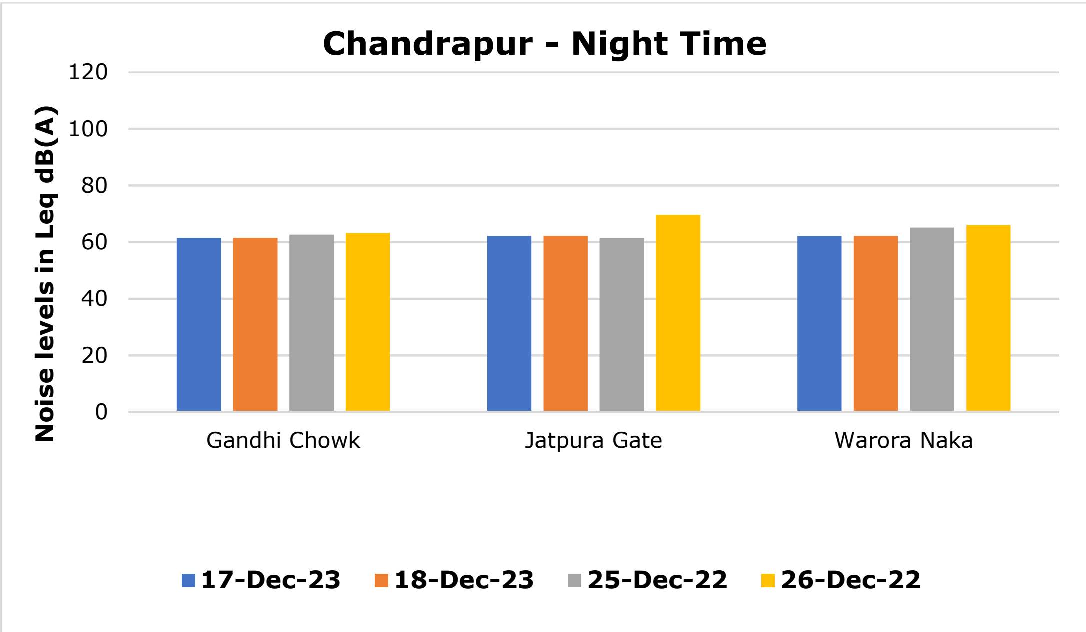
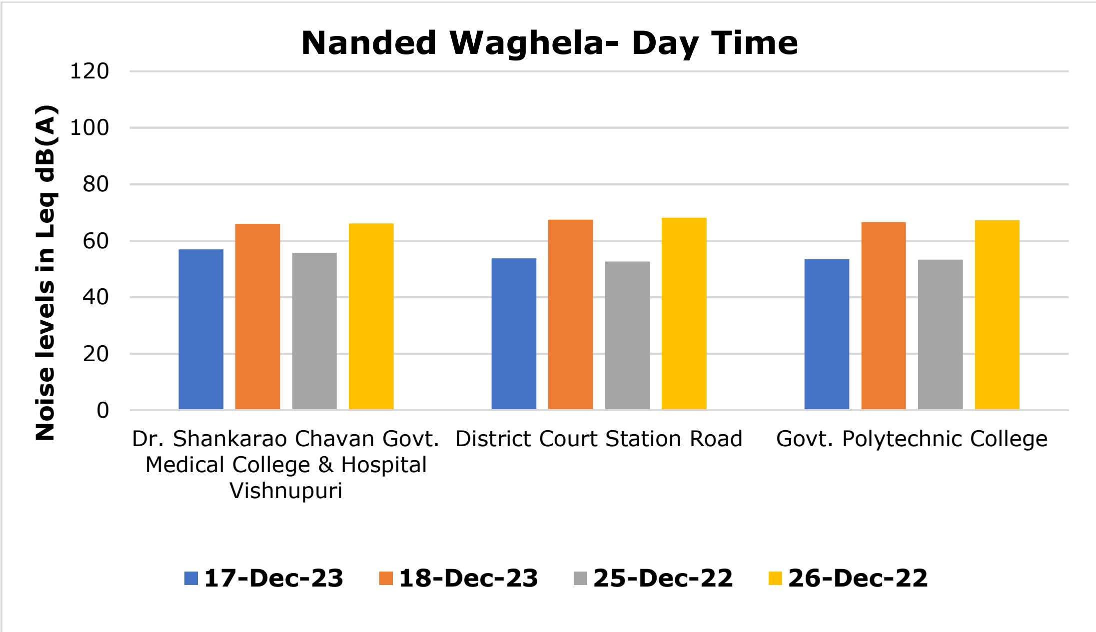


Chart 7.17: Comparison of Noise Levels for the years 2023 and 2022 in Chandrapur

7.18 Nanded-Waghela

Nanded-Waghala demonstrated nuanced noise dynamics on December 17, 2023. Dr. Shankarao Chavan GMCH Vishnupuri experienced a 2.1% increase in daytime noise, while Govt. Polytechnic College showed a marginal 0.1% change during the day. On December 18, Vishnupuri displayed a slight decrease (-0.3%) in nighttime noise, highlighting diverse noise patterns in Nanded-Waghala.



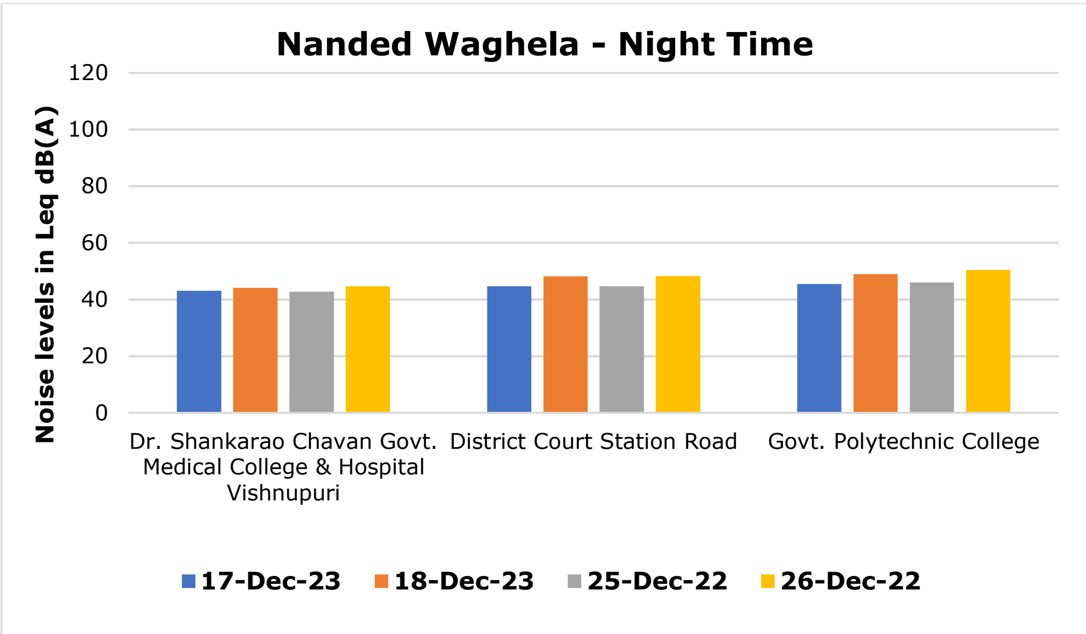
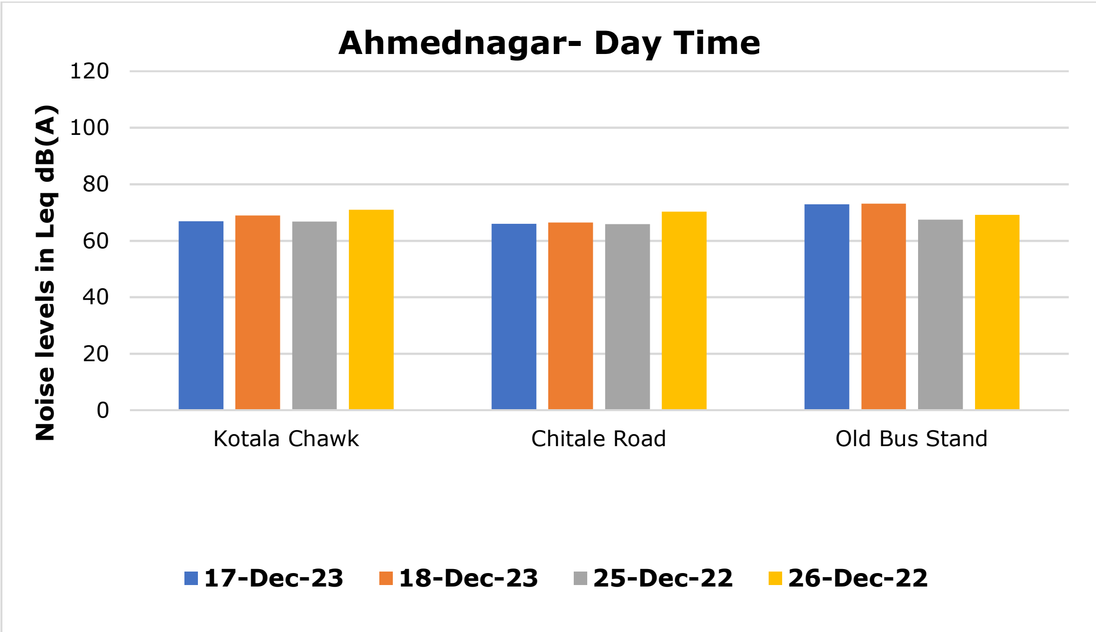


Chart 7.18: Comparison of Noise Levels for the years 2023 and 2022 in Nanded-Waghela

7.19 Ahmednagar

Ahmednagar exhibited diverse noise trends on December 17, 2023. Kotala Chawk and Chitale Road showed minimal changes in daytime noise, while Old Bus Stand experienced a notable 8.2% increase during the day in comparison to the last year noise levels. On December 18, Kotala Chawk and Old Bus Stand displayed a decrease in nighttime noise, emphasizing the varied noise levels across different locations in Ahmednagar.



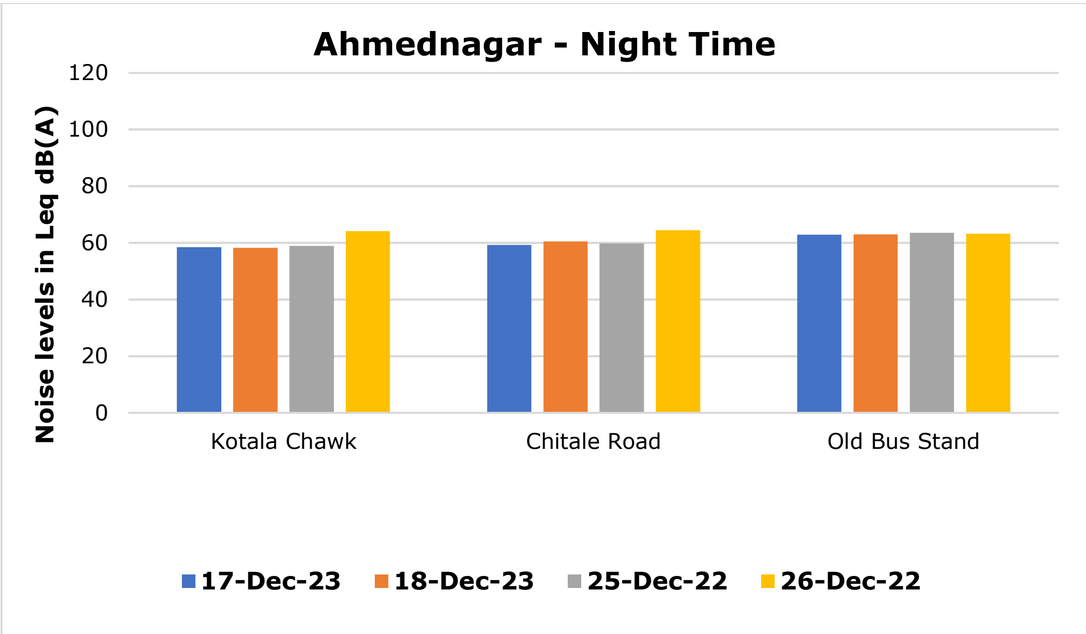
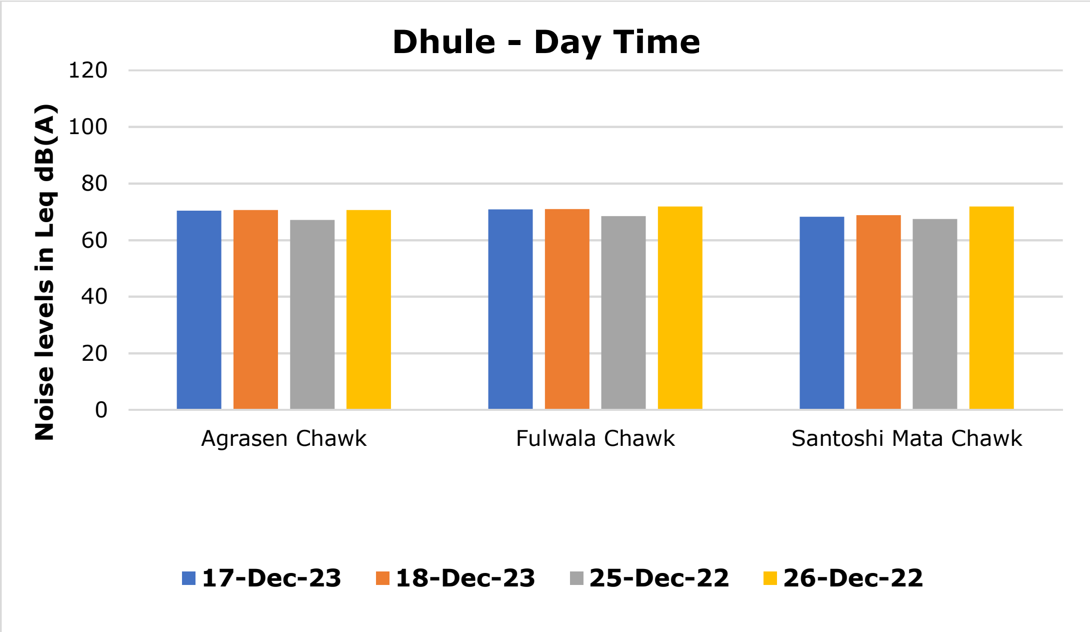


Chart 7.19: Comparison of Noise Levels for the years 2023 and 2022 in Ahmednagar

7.20 Dhule

On December 17, 2023, Dhule displayed diverse noise dynamics. Agrasen Chawk showed a 4.9% increase in daytime noise, while Fulwala Chawk experienced a 5.5% decrease during the day. On December 18, Santoshi Mata Chawk exhibited a notable 4.2% decrease in daytime noise in comparison to the last year noise levels, indicating varied noise levels in Dhule.



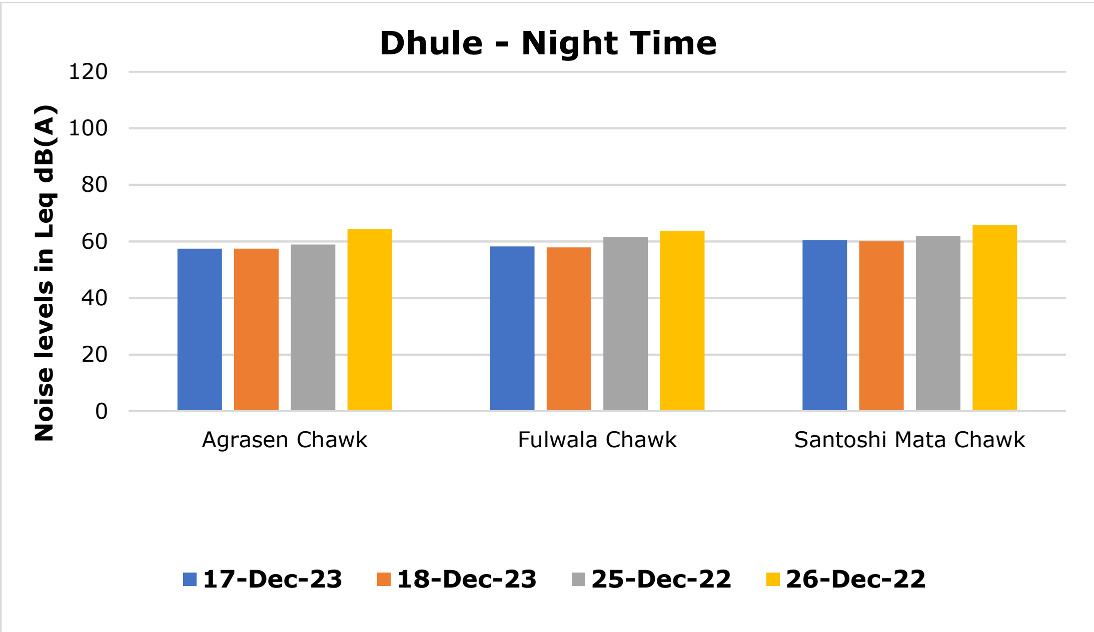
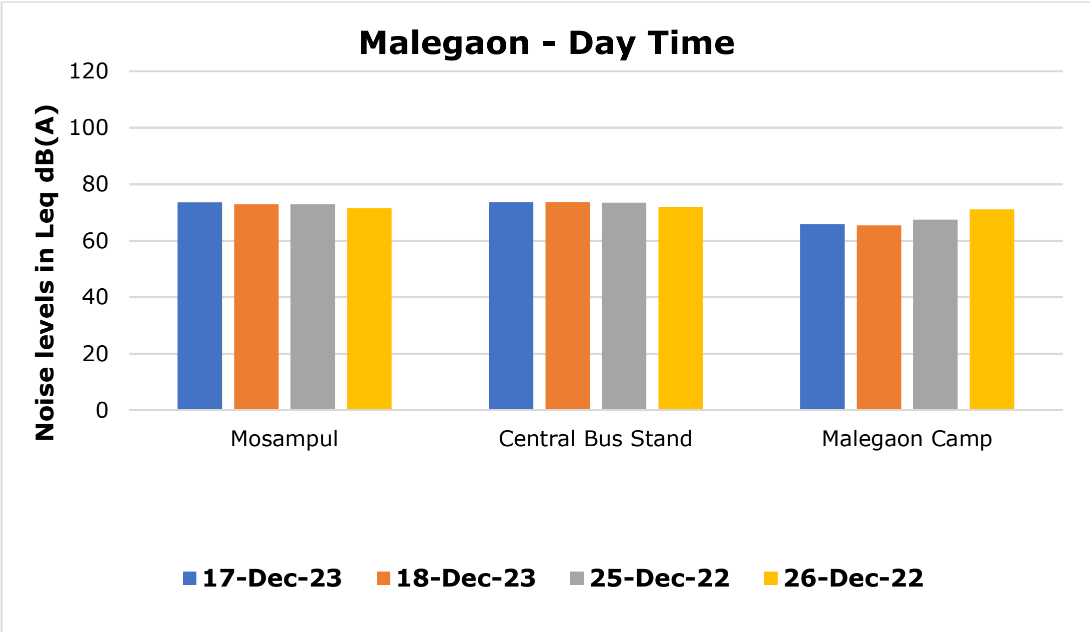


Chart 7.20: Comparison of Noise Levels for the years 2023 and 2022 in Dhule

7.21 Malegaon

Malegaon demonstrated nuanced noise dynamics on December 17, 2023 in comparison the last year's noise levels. Mosampul and Central Bus Stand experienced marginal changes in daytime noise, while Malegaon Camp showed an 8.3% decrease during the day. On December 18, Mosampul displayed a 1.9% increase in nighttime noise, highlighting varied noise patterns in Malegaon.



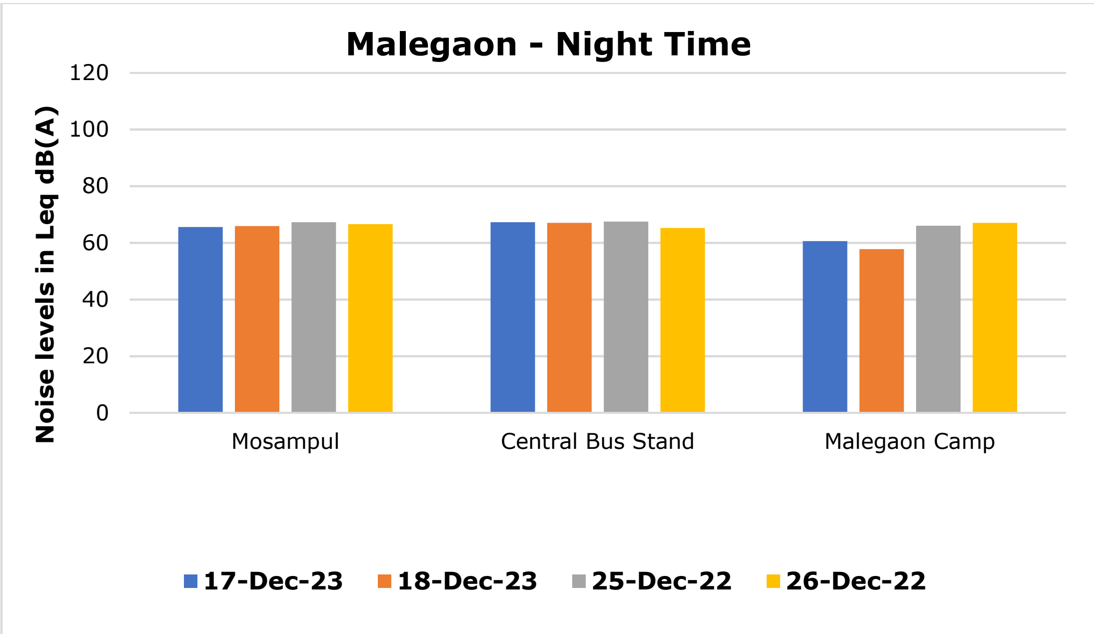
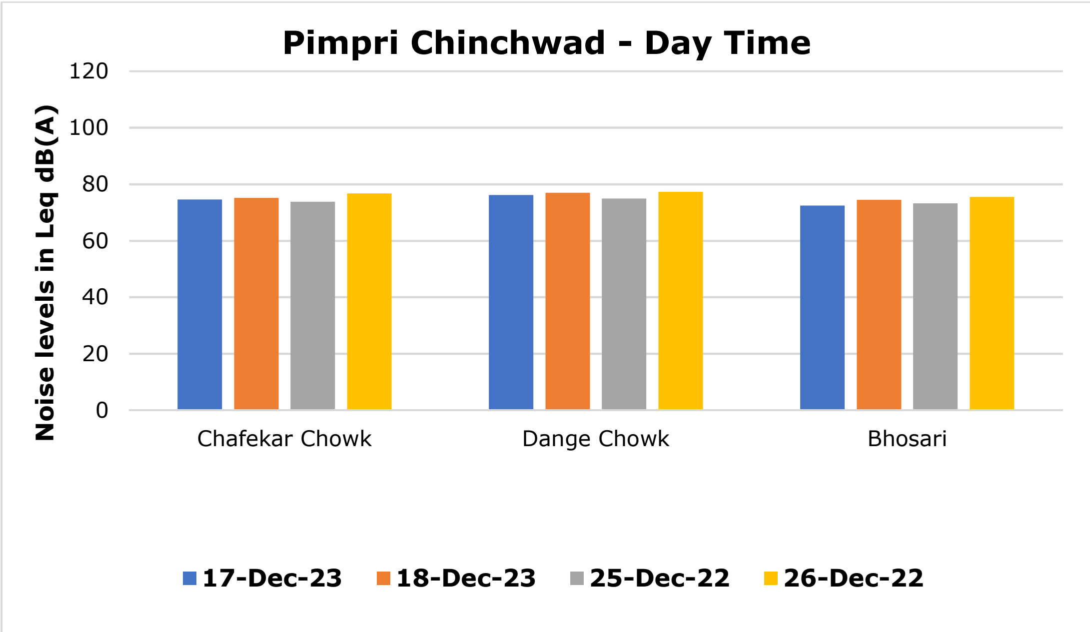


Chart 7.21: Comparison of Noise Levels for the years 2023 and 2022 in Malegaon

7.22 Pimpri-Chinchwad

Pimpri-Chinchwad exhibited diverse noise trends on December 17, 2023. Chafekar Chowk and Dange Chowk showed marginal changes in daytime noise, while Bhosari had a 3.3% increase during the day in comparison the last year's noise levels. On December 18, Bhosari exhibited a 1.8% increase in nighttime noise, emphasizing varied noise levels across different locations in Pimpri-Chinchwad.



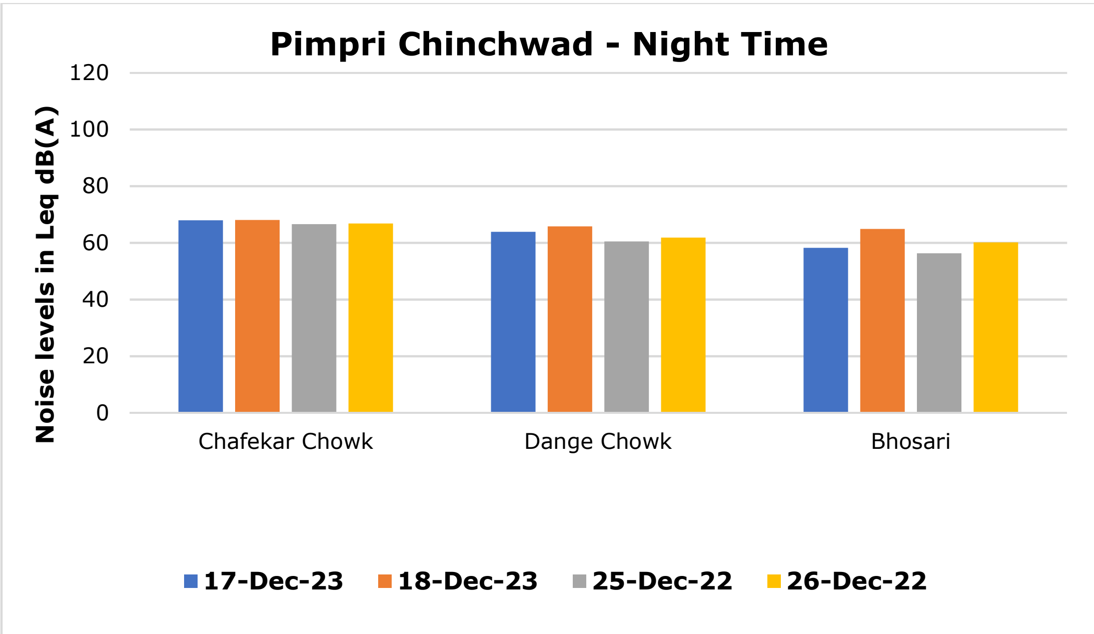
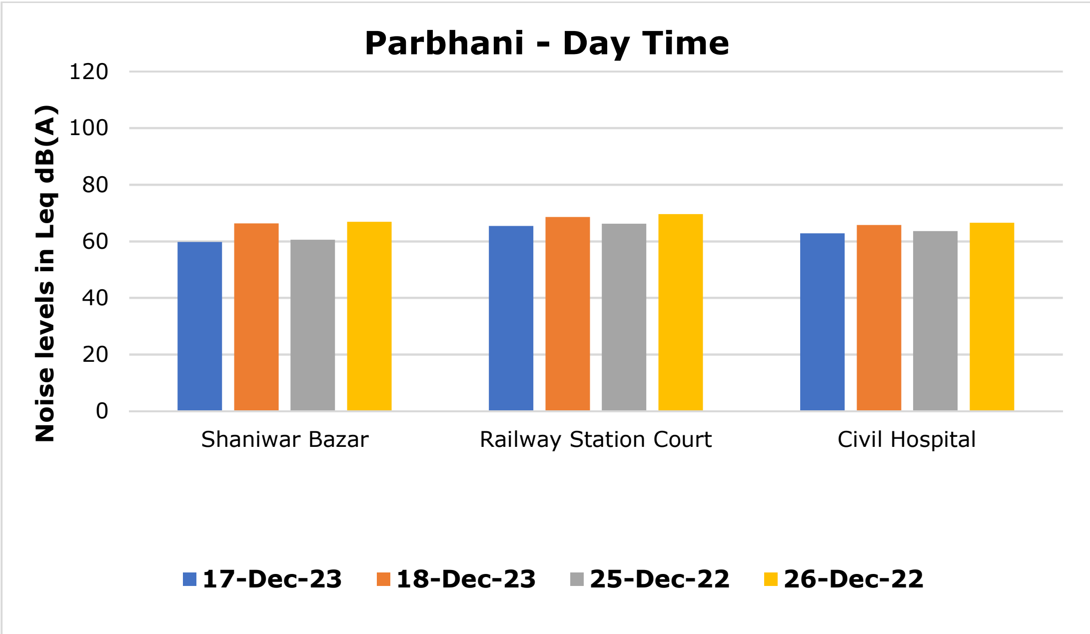


Chart 7.22: Comparison of Noise Levels for the years 2023 and 2022 in Pimpri-Chinchwad

7.23 Parbhani

In Parbhani, Shaniwar Bazar experienced a 1.3% decrease in daytime noise, while Railway Station Court showed a marginal 0.8% increase in comparison the last year's noise levels . On December 18, Civil Hospital displayed a slight decrease (0.9%) in nighttime noise, indicating nuanced noise patterns in Parbhani.



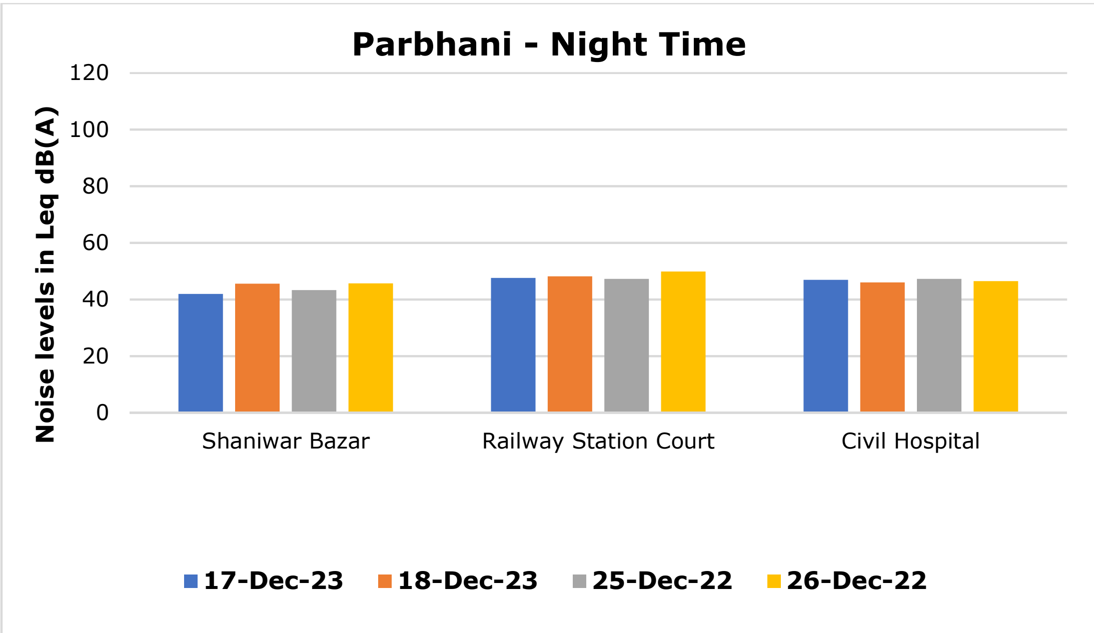
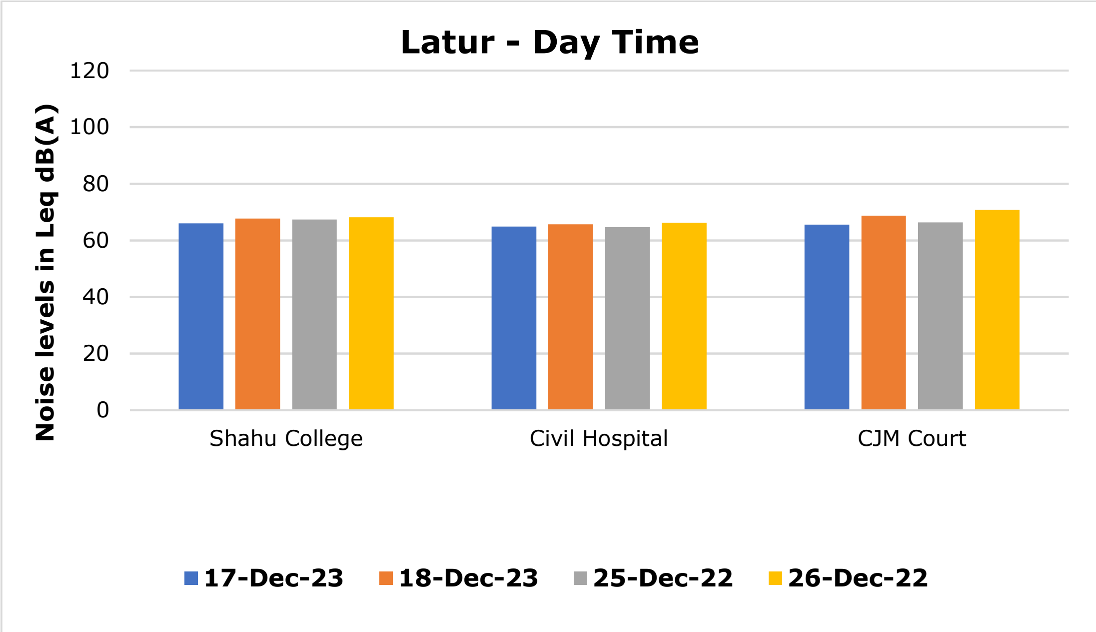


Chart 7.23: Comparison of Noise Levels for the years 2023 and 2022 in Parbhani

7.24 Latur

In Latur, Shahu College and Civil Hospital showed marginal changes in daytime noise, while CJM Court had a slight 0.7% increase during the day. On December 18, Shahu College displayed a negligible decrease (0.6%) in nighttime noise, highlighting stable noise levels in Latur.



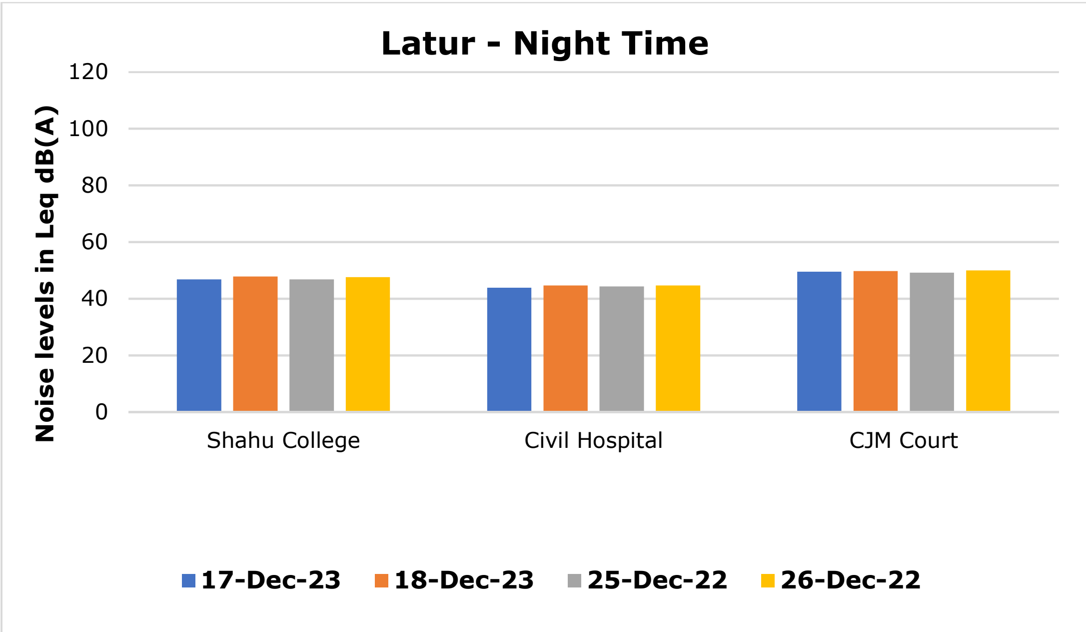
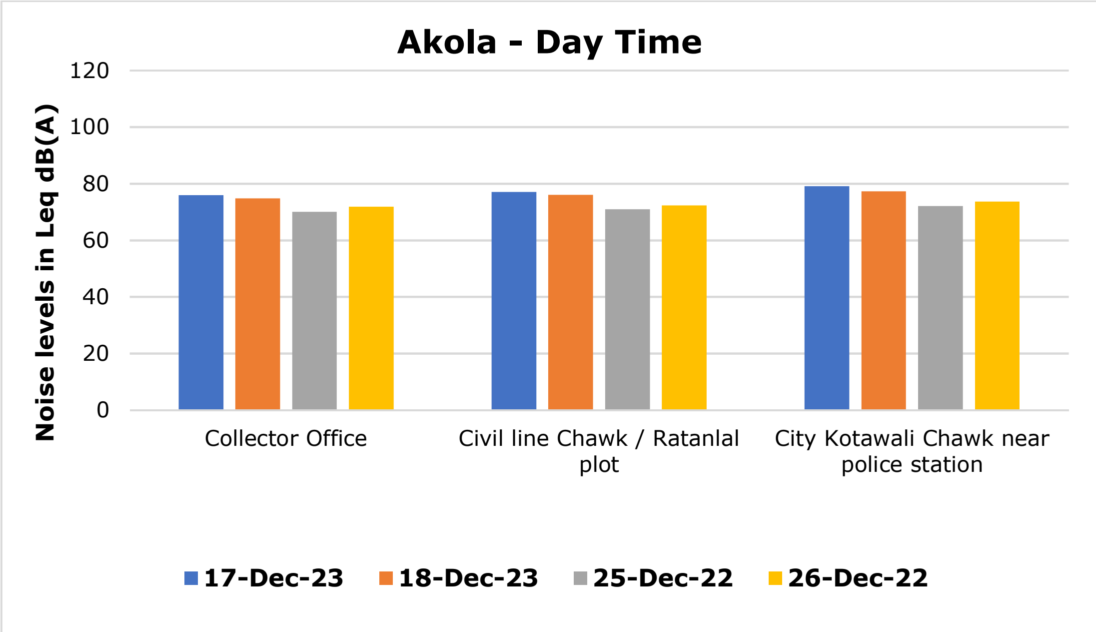


Chart 7.24: Comparison of Noise Levels for the years 2023 and 2022 in Latur

7.25 Akola

In Akola, Collector Office and Civil line Chawk showed substantial 8.4% and 8.6% increases, respectively, in daytime noise. On December 18, City Kotawali Chawk near the police station exhibited a 5.3% decrease in daytime noise, indicating diverse noise patterns in Akola.



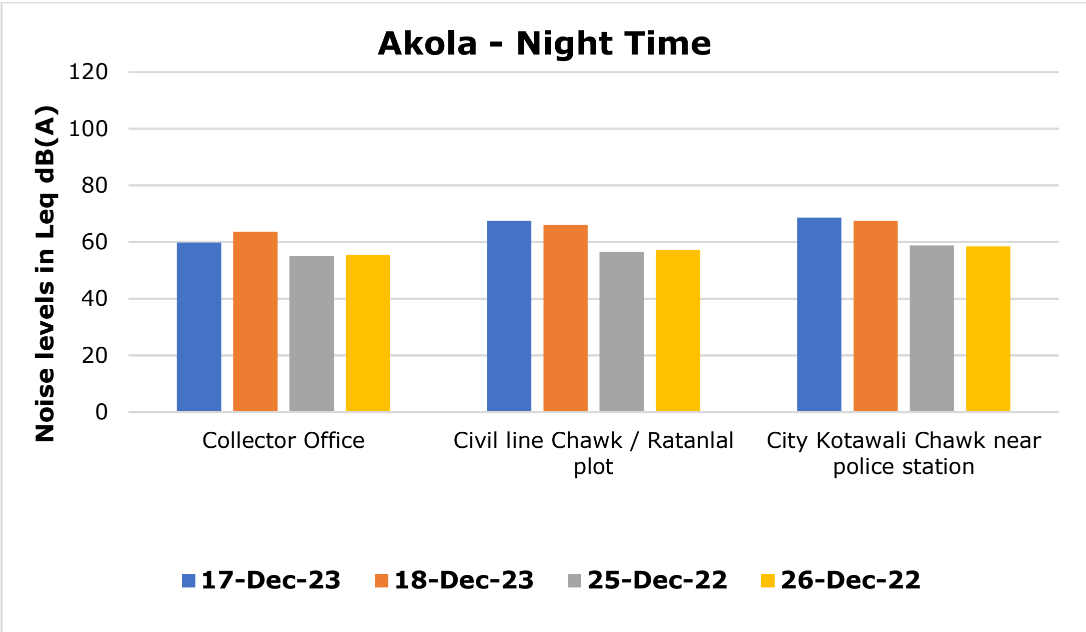
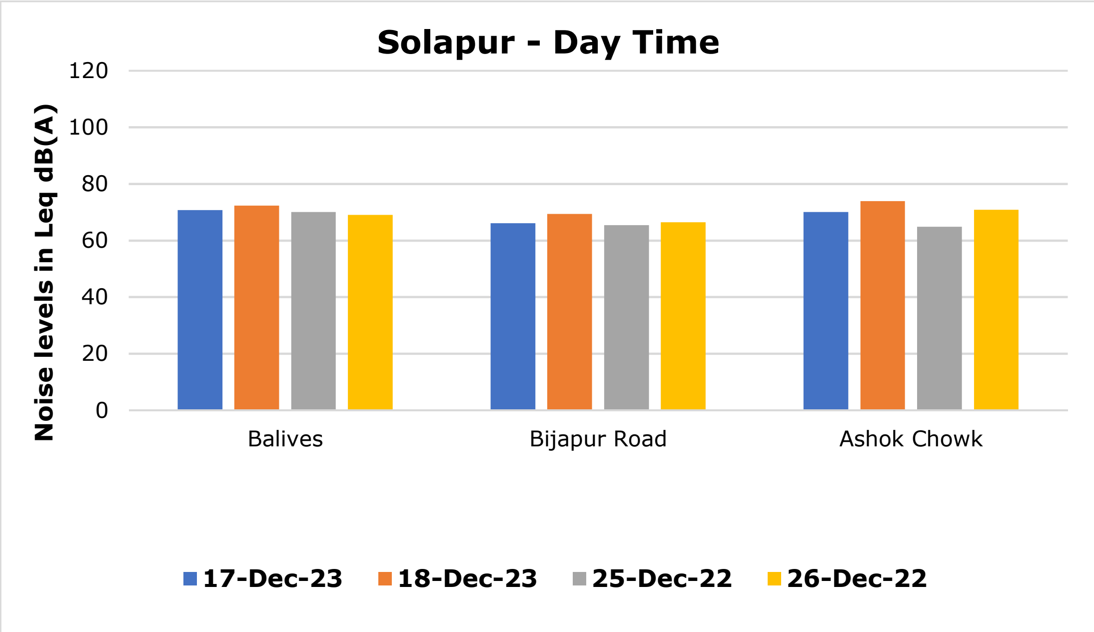


Chart 7.25: Comparison of Noise Levels for the years 2023 and 2022 in Akola

7.26 Solapur

Balives and Bijapur Road in Solapur experienced marginal changes in daytime noise, while Ashok Chowk had an 8.1% increase during the day. On December 18, Ashok Chowk displayed a 4.4% decrease in daytime noise, indicating nuanced noise patterns in Solapur.



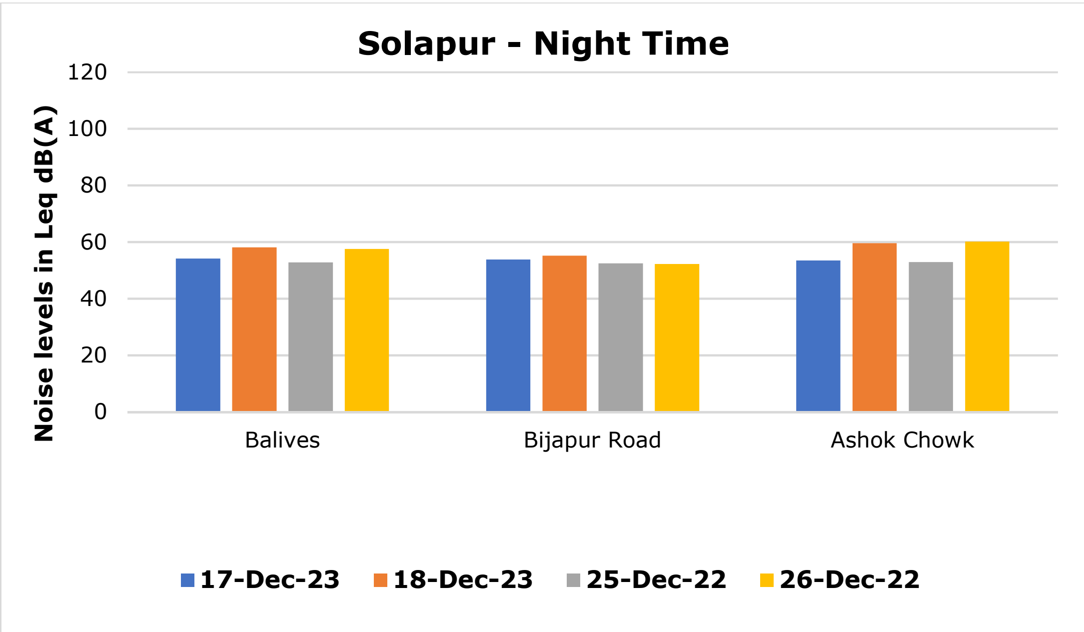
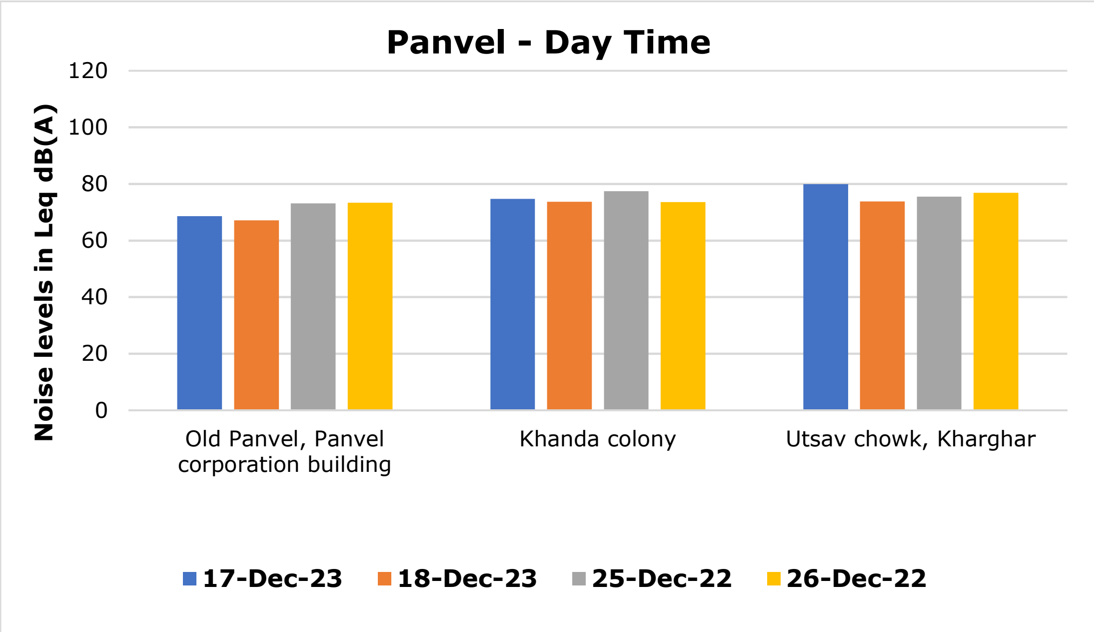


Chart 7.26: Comparison of Noise Levels for the years 2023 and 2022 in Solapur

7.27 Panvel

In Panvel on December 17, 2023, Old Panvel and Khanda colony exhibited substantial -6.3% and -3.5% decreases, respectively, in daytime noise. On December 18, Utsav chowk, Kharghar, showed a 4.0% decrease in daytime noise, indicating varied noise levels in Panvel.



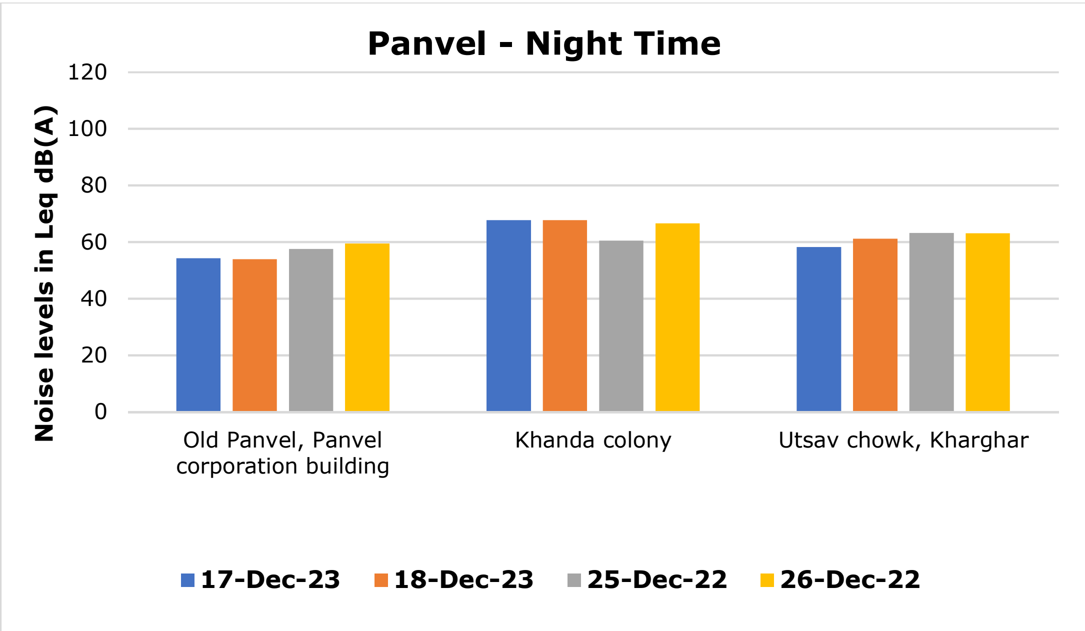


Chart 7.27: Comparison of Noise Levels for the years 2023 and 2022 in Panvel

Additionally, the percentage contribution signifies the ratio of each region's noise level to the total noise level, highlighting the relative influence of noise from individual locations within the broader noise environment of the entire region. The pie charts below visually represent the percentage contribution of each region, offering insights into the distribution of noise pollution across various locations within the specified region during day as well as night time.

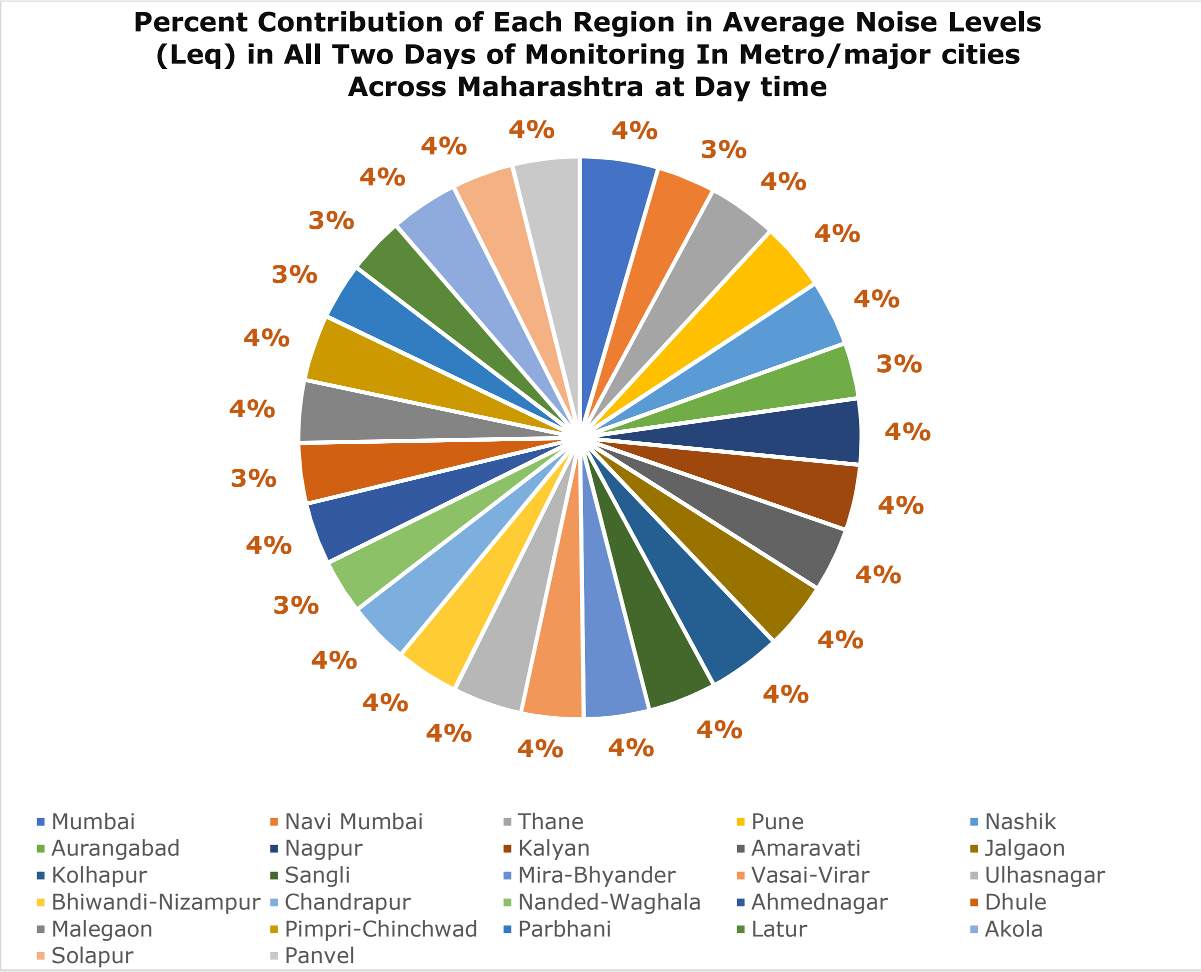


Chart 7.28: Percent Contribution of each Region in Average Noise Levels (Leq) in All Two Days of Monitoring in metro/major Cities Across Maharashtra during Day Time

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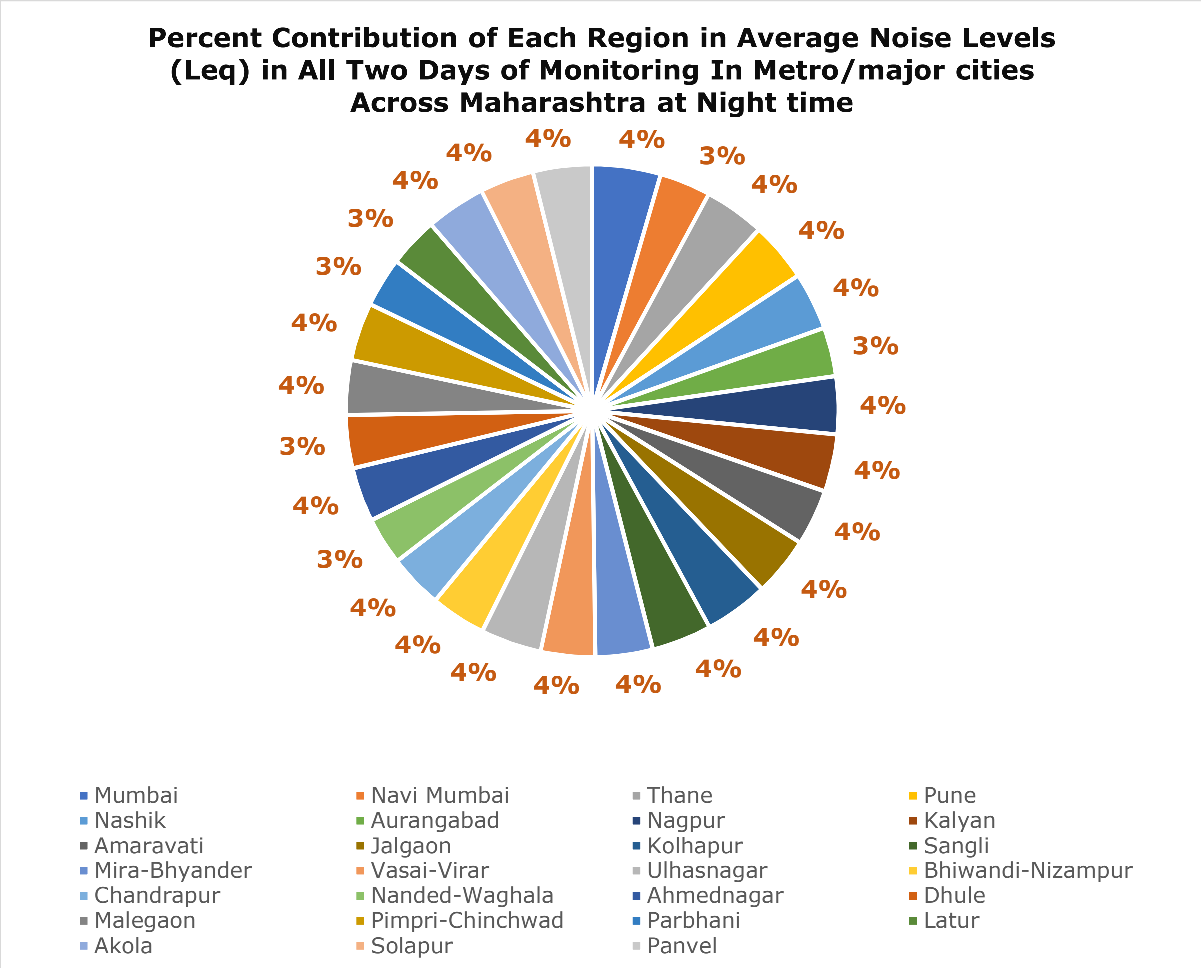

Chart 7.29: Percent Contribution of each Region in Average Noise Levels (Leq) in All Two Days of Monitoring in metro/major Cities Across Maharashtra during Night Time

8 CONCLUSION

The annual noise monitoring study conducted by the Maharashtra Pollution Control Board (MPCB) in major cities of the state aimed to evaluate noise intensity. The study involved continuous monitoring at 104 locations over a 24-hour period, encompassing both day time (from 06:00 am to 10:00 pm) and night time (from 10:00 pm to 06:00 am) in 27 Municipal Corporations across Maharashtra. The monitoring spanned two days, covering both a non-working day (Sunday, December 17) and a working day (Monday, December 18).

Results from the study revealed that the average noise levels during both day and night exceeded the permissible limits in certain zones (Industrial, Commercial, Residential, or Silence) at some locations. However, these levels were lower than those recorded in the previous year (2022) in most of the studied areas. The primary contributors to noise pollution in urban areas were identified as large public gatherings, persistent honking, and increased vehicular activity.

The results showed that in Mumbai, the Hindu Colony in Dadar stands out as the noisiest location, with an alarming maximum Leq of 83.3 dB(A) during the day and 82.9 dB(A) at night, underscoring the persistent high noise levels in this area. Navi Mumbai, Mahape Shil Road witnesses elevated noise levels during the daytime, reaching a maximum Leq of 72.3 dB(A). In Thane, the Main Road-Gaondevi Mandir experiences a substantial noise surge, with a maximum Leq of 81.5 dB(A) during the day. in Pune, Nucleus Mall records a maximum Leq of 76.0 dB(A) during the day, while in Nashik, Dwarka Circle hits 74.7 dB(A) during the day. cities like Jalgaon, Kolhapur, Sangli, and Solapur, certain locations exhibit higher noise levels compared to others. In Jalgaon, Shashtri Tower Chowk records the highest Leq of 79.5 dB(A) during the day.

The dataset highlights significant variations in noise levels in specific locations such as Mira-Bhayander, Vasai-Virar, Ulhasnagar, Bhiwandi-Nizampur, and Chandrapur. Notably, Mira-Bhayander's Bhakti Vedant Hospital and Vasai-Virar's Range Office in Satwali recorded the highest daytime noise levels, reaching 81.4 dB(A) and 78.0 dB(A), respectively. Ulhasnagar's Shivaji Chowk No. 3 registered the highest daytime noise at 77.0 dB(A). Bhiwandi-Nizampur displayed fluctuations, with Dhamankar Naka reaching 78.4 dB(A). Chandrapur's Gandhi Chowk peaked at 72.6 dB(A).

In recent years, the Government of Maharashtra, MPCB (Maharashtra Pollution Control Board), and the state Traffic Police have implemented a range of methods and initiatives to address noise pollution and its adverse impact on the health of the state's residents. Extensive awareness campaigns, involving educational institutions, club coordination committees, non-profit organizations, and more, have been conducted statewide to disseminate information about the harmful effects of noise pollution and promote mitigation measures.

To mitigate noise levels near residential areas, acoustic barriers have been strategically installed on major flyovers. Additionally, the planting of diverse trees and shrubs along roadsides, near hospitals, and educational institutes aims to reduce urban sound levels. The Transport Department and Traffic Police have been actively enforcing strict measures against reckless driving, the use of pressure horns, and vehicles operating without mufflers or silencers.

On an individual level, residents are encouraged to contribute to noise pollution reduction by planting more trees, ensuring regular maintenance of vehicles and machinery, and opting for public transport to decrease the overall number of vehicles on the road. This collective effort not only helps reduce traffic congestion and noise pollution from unnecessary honking but also contributes to mitigating air pollution.

9 INITIATIVES TAKEN BY MPCB AND GOVERNMENT OF MAHARASHTRA TO REDUCE NOISE POLLUTION DURING DIWALI

The Maharashtra government's initiative to curb noise pollution in metro/major cities of the state in past few years includes:

a) The government, as per Circular No. TPB 4308/4011/CR-343/08/UD-11 dated 3rd December 2008, issued guidelines to reduce noise pollution from elevated roads and rail corridors, emphasizing the need for clarity on exposure limits, acoustic design, barrier materials, dimensions, and international standards for effective noise abatement.

b) Encouraging sustainable and clean transport measures such as:
   - Electrification of BMC vehicles and provision of charging infrastructure
   - Procurement of 3000 electric BEST buses
   - Conversion of old BMC diesel/ petrol vehicles into CNG vehicles
   - Fully Adaptive Traffic Control systems are installed at 258 junctions. They are to be upgraded to latest technologies and impact on the traffic flow and pollution would be studied and to be further expanded for balance 395 junctions.

c) Ecologically sustainable urban greening projects
   - More than one lakh trees to be planted through ecologically sustainable planting practices.
   - Avenue planting on high pollution roads to create green buffers.
   - Adopting sustainable micro-greening guidelines to educate citizens about native species and planting methods.

d) Declaring Silence zone in 100meters are near hospitals, schools, courts etc.

e) Regular Noise monitoring in various areas of the state.

10 RECOMMENDATIONS

Recommendations for Noise Abatement in the state of Maharashtra:

a) **Increase Greenery Along Roads and in Building Campuses**: Enhance the number of trees along roads and within building campuses. Greenery serves as a natural barrier that absorbs sound, contributing to a quieter and more pleasant urban environment.

b) **Incorporate Soundproofing in Construction Materials**: Integrate soundproofing elements into construction materials to mitigate noise transmission. This can be especially crucial in densely populated areas and near busy roadways.

c) **Installation of Decibel Meters at Major Junctions**: Implement the installation of decibel meters at key junctions to continuously monitor noise levels. This proactive measure enables timely interventions to manage and reduce excessive noise.

d) **Promote Soundproof Rooms in Industrial Settings**: Encourage the construction of soundproof rooms for noisy machinery in industrial and manufacturing facilities. For residential buildings, noisy equipment should be situated away from living areas to minimize disruptions.

e) **Ban Jarring Horns and Noisy Vehicles**: Prohibit the use of horns with jarring sounds, and enforce regulations against noisy motorcycles with damaged exhaust pipes and loud trucks. This contributes to reducing unnecessary noise on the streets.

f) **Strategic Planning of Noisy Facilities**: Plan the location of noise-producing industries, airports, bus and transport terminals, and railway stations away from residential areas. This minimizes the impact of their operations on the quality of life for nearby residents.

g) **Monitoring and Regulation of Public Gatherings**: Empower community law enforcers to monitor and regulate the use of loudspeakers, public announcements systems, and outdoor events such as parties and discos. This ensures that public spaces remain conducive to peaceful living.

h) **Establish Silence Zones Near Sensitive Areas**: Enforce community laws designating silence zones near educational institutions, hospitals, and other sensitive areas. This safeguards the tranquility of spaces where minimal noise is essential.

i) **Encourage Vegetation Along Roads and in Residential Areas**: Promote the planting of trees along roads and in residential areas, as vegetation acts as a natural sound absorber. This eco-friendly approach contributes to reducing overall noise pollution.

j) **Comprehensive Urban Planning for Noise Pollution Prevention**: Implement thorough urban planning that considers noise pollution prevention. This involves thoughtful zoning, green spaces, and infrastructure design to create a harmonious and quieter urban environment.

These recommendations, coupled with public education, enlightened legislation, and active enforcement of noise ordinances, can collectively contribute to a significant reduction in noise pollution in Indian cities, particularly in the state of Maharashtra.

11 DEFINITIONS

A-Weighting

A-weighting" is the frequency weighting characteristic as specified in IEC 123 or IEC 179 and is intended to approximate the relative sensitivity of the normal human ear to different frequencies (pitches) of sound.

A-weighted Sound Pressure Level

The "A-weighted sound pressure level" is the sound pressure level modified by the application of the A-weighting. It is measured in dBA and denoted as dBA.

Decibel

The "decibel" is a dimensionless measure of sound level or sound pressure level; see sound pressure level. It is denoted as dB.

Equivalent Continuous Sound Level

Equivalent continuous sound level, denoted as Leq, is defined as the steady sound pressure level that, over a given period of time, has the same total energy as the actual fluctuating noise.

Fast Response

"Fast response" is a dynamic characteristic setting of a sound level meter meeting the applicable specifications.

Sound

"Sound" is an oscillation in pressure, stress, particle displacement, or particle velocity, in a medium with internal forces (e.g. elastic, viscous), or the superposition of such propagated oscillations, which may cause an auditory sensation.

Sound Level Meter

A "Sound Level Meter" is an instrument that is sensitive to and calibrated for the measurement of sound.

Sound Pressure Level

The "Sound Pressure Level" is twenty times the logarithm to the base 10 of the ratio of the effective pressure (p) of a sound to the reference pressure (Pr) of 20 µPa. Thus, the sound pressure level in dB = 20 log10 P/Pr.

12 GLIMPSE OF THE EVENT

Day 1: 17th December 2023	
	Father Angel School – Vashi, Navi Mumbai
	Civil Hospital-Latur

Day 1: 17th December 2023

Old Bus Stand - Malegaon

Irwin Square- Amravati

<table>
<tr><th colspan="2">Day 1: 17th December 2023</th></tr>
<tr><td>


</td><td>Jatpura Gate-Chandrapur</td></tr>
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</td><td>Hadapsad – Pune</td></tr>
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Day 1: 17th December 2023	
	Visharambaug - Sangli
	Tembhi naka-Thane West

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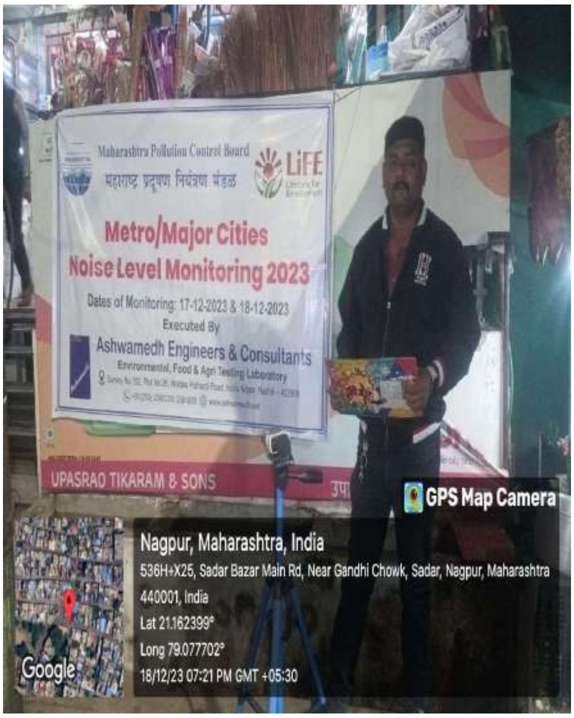

</td><td>Sadar Bazar-Nagpur</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td>


</td><td>Civil lines - Akola</td></tr>
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Day 2: 18th December 2023

Udyog Bhavan - Nashik

High court N-3 - Aurangabad

Day 2: 18th December 2023	
	Bail Bazar -Kalyan (West)
	Malabar Hill - Mumbai

Day 2: 18th December 2023	
	Old bus stand - Malegaon
	Ghati hospital - Aurangabad

13 COMPARATIVE AMBIENT NOISE LEVELS DURING THE YEAR 2022 & 2023

	Day Time			Night Time			Day Time			Night Time		
	25-Dec-22			17-Dec-23			26-Dec-22			18-Dec-23		
Location	L_{eq}	Lmin	Lmax	L_{eq}	Lmin	Lmax	L_{eq}	Lmin	Lmax	L_{eq}	Lmin	Lmax
MUMBAI												
Backside of High Court	73.8	51.6	85.2	81.1	50.4	89.6	71.1	51.1	82.4	76.4	36.1	88.4
Mumbadevi Temple	81.0	60.8	89.9	77.3	58.2	84.7	76.4	62.3	85.1	65.8	57.8	72.9
Borivali National Park	66.5	56.2	69.8	76.7	59.5	87.7	64.2	54.1	70.6	71.4	50.3	84.6
Antop Hill	78.5	61.3	88.8	78.7	44.3	94.8	71.5	50.5	84.6	71.5	50.5	84.6
Shivaji Park, Dadar	69.0	51.0	80.9	73.8	52.2	87.9	67.5	44.5	81.1	69.9	59.5	79.8
Santacruz Airport	76.0	60.1	87.4	75.9	58.2	87.3	71.3	49.6	83.6	73.4	56.4	86.7
Ghatkopar (W)	80.0	50.4	92.1	77.4	48.0	88.0	69.7	40.3	81.6	68.1	43.4	78.7
Vashi Naka, Chembur	77.8	60.9	87.2	82.0	62.9	89.9	67.8	45.0	79.0	70.5	42.8	82.7
Goregaon (E)	80.8	65.1	90.7	70.8	56.4	79.6	57.0	50.4	65.4	63.5	54.9	71.7
Charkop, Kandivali	67.3	50.4	77.4	77.1	56.9	86.2	57.0	50.4	65.4	65.0	44.1	75.4
Sion - Sion Circle	75.0	63.7	85.3	79.0	58.2	88.3	67.4	48.7	75.4	68.0	41.4	78.7

Hindu Colony - Dadar Hindu Colony	77.8	39.1	89.0	83.3	61.5	94.4	55.9	45.1	61.0	82.9	53.1	92.9
Matunga - Gandhi Market	74.3	38.3	87.8	75.3	35.5	85.8	66.6	41.6	79.3	74.9	45.0	88.9
Kamathipura - Kamathipura	73.8	51.6	89.3	79.5	54.8	89.9	72.5	53.0	82.5	75.5	47.5	86.6
Malabar Hills - Sahyadri Guest House	78.3	53.3	89.1	76.9	30.4	88.5	67.4	48.7	75.4	71.5	50.5	84.6
NAVI MUMBAI												
Mahape Shil Road, MIDC Mahape	72.6	56.7	82.3	69.3	53.9	77.3	60.8	52.3	68.5	66.0	58.4	74.3
APMC Market Vashi	70.6	63.2	79.7	68.1	56.7	77.6	73.7	61.2	84.2	70.9	63.2	76.9
Father Agnel School, Vashi	67.4	41.3	74.5	62.0	44.3	68.2	64.1	46.3	71.3	58.3	41.1	65.7
THANE												
Main Road-Gaondevi Mandir, Naupada	74.3	46.7	86.2	79.7	60.0	95.2	64.0	50.2	72.3	81.5	62.0	95.2
Tembhi Naka	75.3	44.6	83.7	67.8	49.0	79.4	66.7	43.1	77.2	62.0	49.0	69.7
Ghokhale Road	70.1	51.4	78.9	70.1	51.4	78.9	66.4	49.0	77.0	70.6	58.1	83.4
Pokharan - Vartak Nagar	84.3	64.0	90.8	82.0	62.1	90.7	71.5	50.5	84.6	71.0	50.3	79.6

Wagle Estate	79.2	47.3	90.2	66.3	40.4	76.2	69.7	44.5	82.5	56.9	40.4	72.2
PUNE												
Nucleus Mall	67.5	51.2	74.0	68.5	50.7	79.3	58.2	41.3	72.6	57.2	42.8	64.7
Pune University	76.2	58.9	84.0	76.0	58.4	83.4	59.7	41.9	72.6	63.9	43.3	72.1
Swargate	72.6	63.2	81.2	73.2	62.3	81.6	58.7	42.5	71.2	63.7	43.3	73.3
Hadpsar	71.5	54.2	79.2	73.0	58.4	82.4	61.2	41.0	73.5	60.7	42.9	72.1
Visharantwadi	74.5	55.2	82.4	72.6	57.6	80.6	59.8	40.9	69.1	61.6	42.3	71.6
NASHIK												
Dwarka Circle	74.2	64.0	80.0	74.7	67.0	79.0	65.7	61.0	69.0	61.7	54.0	66.0
Pandit Colony Near NMC	58.3	45.0	65.0	58.1	42.0	68.0	50.8	41.0	56.0	50.2	42.0	56.0
Pavan Nagar CIDCO	59.9	48.0	65.0	61.1	42.0	68.0	50.8	41.0	56.0	48.4	41.0	53.0
Bytco	75.2	68.0	80.0	76.5	70.0	81.0	63.6	54.0	68.0	64.0	55.0	69.0
Udyog Bhavan, Satpur	69.3	62.0	75.0	71.4	63.0	76.0	57.2	50.0	64.0	55.6	48.0	62.0
AURANGABAD												
Ghati Hospital	59.6	40.0	65.0	59.7	40.0	68.0	42.8	37.0	49.0	42.5	34.0	49.0
Nirala Bazaar	61.9	41.0	68.0	61.6	41.0	66.0	46.4	35.0	54.0	45.6	34.0	54.0
CIDCO N-9	51.1	39.0	57.0	51.3	41.0	56.0	41.5	37.0	47.0	40.3	34.0	43.0

Residential Area Near High Court	53.1	38.0	61.0	55.1	41.0	65.0	42.7	36.0	48.0	46.3	37.0	53.0
Swami Vivekanand College	55.5	41.0	62.0	53.2	39.0	61.0	45.5	38.0	53.0	42.1	37.0	48.0
NAGPUR												
Govt. Medical College	65.5	47.9	78.1	61.4	48.9	69.7	61.8	47.9	72.1	49.3	44.3	54.6
Sitabardi Police Station	71.5	50.7	80.4	78.2	48.5	86.5	69.2	50.1	78.1	64.3	40.0	79.5
Shivaji Nagar	64.8	40.6	74.7	66.2	47.2	74.7	61.6	47.9	72.1	61.5	51.2	69.7
Mahal	69.2	40.2	77.1	69.3	41.6	79.2	58.0	44.2	64.5	60.7	43.3	71.0
Sadar	68.8	35.1	80.1	63.7	51.3	71.1	59.6	45.7	68.7	59.2	40.1	67.6
KALYAN												
Katemanivali	68.6	54.7	75.1	76.9	41.5	86.2	71.4	50.5	84.6	64.1	41.5	75.8
Birla College	67.2	41.3	74.5	72.9	45.7	83.4	70.0	49.0	79.7	65.9	45.5	78.8
Bail Bazar	70.4	51.4	78.9	72.1	47.8	84.3	68.0	44.9	80.0	65.0	47.2	81.0
AMRAVATI												
Ervin Hospital Square	66.2	48.3	73.2	65.1	51.6	72.8	55.9	39.3	62.4	58.6	46.4	68.8
Budhwara	66.0	48.6	74.6	71.6	48.3	81.7	51.1	38.5	63.2	69.5	45.9	78.5
Rajkamal Chowk	76.8	63.9	86.1	73.6	58.7	80.2	62.2	46.0	69.6	67.6	42.7	77.2

JALGAON												
Near Civil Hospital	69.1	56.6	77.2	74.4	58.8	81.3	55.3	50.3	67.3	52.1	34.3	61.0
Shivaji Chowk (Near Court)	73.5	59.1	83.5	73.6	55.3	80.3	58.7	46.6	73.2	51.5	33.2	60.9
Shashtri Tower Chowk	73.7	60.2	81.0	77.1	33.8	88.2	53.8	43.8	74.1	48.8	34.1	62.5
KOLHAPUR												
Rajarampuri chowk	81.9	50.2	92.6	78.5	47.2	92.6	50.1	40.6	58.4	48.6	37.8	56.8
Papachi Tickti	81.0	50.4	92.8	80.0	50.4	95.6	50.6	40.2	62.1	47.7	37.8	55.8
Gokhale College	82.2	50.4	94.6	82.0	52.1	95.3	51.5	40.8	61.4	49.3	38.9	58.2
Dabhorakar Corner	81.3	50.6	91.7	79.6	48.9	92.6	50.8	40.6	56.6	51.6	40.3	58.2
SANGLI												
Rajwada Chowk	72.9	48.5	84.3	73.8	40.3	88.9	64.7	41.2	75.3	63.1	44.5	73.6
Visharambaug	67.2	42.6	79.5	68.0	40.2	80.1	64.4	40.9	72.2	65.8	40.3	77.8
Miraj Market	72.2	42.5	84.6	70.0	40.2	84.5	65.3	42.2	72.5	64.9	45.6	72.5
MIRA-BHAYANDER												
Bhakti Vedant Hospital, Tenkar pada	72.4	50.2	78.6	77.9	50.9	89.5	67.9	51.3	79.0	59.6	50.9	69.1
Golden police Chawki	72.5	50.4	79.3	76.6	50.7	87.7	68.0	50.1	76.4	71.5	50.5	84.6

Shivaji Chak Kashi meera	77.9	53.2	98.7	73.7	50.8	86.0	68.7	50.2	74.8	64.7	44.5	75.3
VASAI-VIRAR												
Range office, Satwali, Vasai East	63.8	52.2	70.8	78.0	54.1	87.3	60.7	50.2	66.9	71.8	56.4	85.6
Valiv phata, Vasai East	64.1	50.0	72.2	66.8	40.8	83.7	58.2	50.0	67.4	63.6	45.0	79.3
N.B. Estate, Virar West	75.0	60.0	79.9	70.3	60.0	77.6	63.4	55.6	69.0	64.7	53.8	73.0
ULHASNAGAR												
Shivaji Chowk No. 3 - Near the Chowk	84.5	42.3	95.6	74.9	45.3	86.4	71.3	49.6	83.6	60.2	42.1	72.8
Camp No. 5 Bus Stop - Bus Stop	77.8	47.3	88.6	79.6	42.5	87.5	69.7	44.5	82.5	68.1	42.9	81.3
Camp No. 1 Gol Maidan - Gol Maidan	74.6	58.8	79.7	70.8	49.4	82.8	72.6	55.1	87.5	66.8	43.2	76.5
BHIWANDI-NIZAMPUR												
Dhamankar Naka	71.4	50.4	79.4	76.2	47.4	85.6	63.4	50.1	74.3	62.2	40.2	73.8
Indira Gandhi Memorial Hospital	70.6	45.2	79.5	66.8	48.8	78.5	61.2	45.5	69.4	61.0	43.2	69.2
Shelar Near Nadi naka	73.8	48.7	80.5	71.6	45.3	82.1	67.3	44.1	79.6	65.0	44.1	78.4

CHANDRAPUR												
Gandhi Chowk	67.1	54.6	74.9	72.6	64.3	80.3	62.6	51.8	72.8	61.5	48.3	72.9
Jatpura Gate	76.0	52.8	88.5	71.5	51.8	78.9	61.4	48.4	70.7	62.2	42.8	72.3
Warora Naka	71.4	53.1	82.6	71.0	48.4	79.9	65.1	50.3	74.7	62.2	46.3	70.1
NANDED-WAGHALA												
Dr. Shankarao Chavan Govt. Medical College & Hospital Vishnupuri	55.7	38.0	64.0	56.9	40.0	64.0	42.7	37.0	49.0	43.0	39.0	49.0
District Court Station Road	52.6	37.0	62.0	53.8	40.0	65.0	44.7	40.0	49.0	44.7	38.0	49.0
Govt. Polytechnic College	53.3	37.0	62.0	53.4	38.0	62.0	46.0	41.0	53.0	45.4	38.0	52.0
AHMEDNAGAR												
Kotala Chawk	66.8	60.0	72.0	66.8	60.0	72.0	58.9	52.0	65.0	58.4	52.0	66.0
Chitale Road	65.9	56.0	72.0	65.9	56.0	72.0	59.8	52.0	66.0	59.2	50.0	66.0
Old Bus Stand	67.4	56.0	73.0	72.9	58.0	78.0	63.5	57.0	68.0	62.9	57.0	68.0
DHULE												
Agrasen Chawk	67.1	56.0	72.0	70.4	56.0	76.0	58.9	53.0	64.0	57.5	51.0	62.0
Fulwala Chawk	68.5	55.0	75.0	70.9	54.0	76.0	61.6	55.0	67.0	58.2	51.0	65.0

Santoshi Mata Chawk	67.4	57.0	74.0	68.2	54.0	75.0	61.9	54.0	68.0	60.5	52.0	66.0
MALEGAON												
Mosampul	72.9	57.0	79.0	73.6	58.0	79.0	67.2	62.0	72.0	65.5	60.0	72.0
Central Bus Stand	73.4	63.0	78.0	73.7	62.0	78.0	67.5	60.0	72.0	67.2	60.0	71.0
Malegaon Camp	67.4	54.0	75.0	65.9	52.0	72.0	66.0	61.0	70.0	60.6	52.0	69.0
PIMPRI-CHINCHWAD												
Chafekar Chowk	73.8	53.3	80.2	74.6	52.4	81.6	66.6	41.2	74.5	67.9	47.7	74.6
Dange Chowk	74.9	60.2	82.5	76.1	63.2	81.9	60.5	42.2	70.8	63.8	42.2	72.4
Bhosari	73.2	55.6	81.2	72.5	57.4	81.2	56.3	40.8	65.5	58.2	42.1	68.7
PARBHANI												
Shaniwar Bazar	60.5	37.0	68.0	59.7	37.0	65.0	43.3	40.0	48.0	42.0	34.0	47.0
Railway Station Court	66.2	41.0	72.0	65.4	42.0	71.0	47.2	41.0	53.0	47.6	40.0	53.0
Civil Hospital	63.6	48.0	71.0	62.8	46.0	70.0	47.2	40.0	54.0	46.9	39.0	55.0
LATUR												
Shahu College	67.3	39.0	75.0	66.0	39.0	72.0	46.8	38.0	55.0	46.8	36.0	54.0
Civil Hospital	64.6	41.0	71.0	64.8	41.0	70.0	44.3	40.0	51.0	43.9	38.0	49.0
CJM Court	66.3	40.0	72.0	65.5	40.0	71.0	49.2	40.0	57.0	49.6	40.0	56.0

AKOLA												
Collector Office	70.1	57.6	77.9	76.0	43.5	90.2	55.0	49.6	62.8	59.9	36.1	74.5
Civil line Chawk / Ratanlal plot	70.9	60.1	74.6	77.0	46.4	90.5	56.5	50.1	68.0	67.5	38.0	81.9
City Kotawali Chawk near police station	72.1	61.5	76.6	79.1	52.0	91.6	58.8	50.5	68.6	68.6	38.4	82.2
SOLAPUR												
Balives	70.1	47.2	78.2	70.8	47.8	82.5	52.8	43.8	60.8	54.1	40.5	61.0
Bijapur Road	65.4	45.3	75.0	66.1	40.3	80.3	52.4	41.2	60.0	53.8	40.2	64.3
Ashok Chowk	64.8	44.6	73.0	70.0	40.2	84.5	52.9	43.8	60.0	53.5	40.6	64.2
PANVEL												
Old Panvel, Panvel corporation building	73.1	54.6	81.8	68.5	47.2	85.2	57.5	50.4	63.5	54.3	43.7	63.3
Khanda colony	77.4	56.2	86.9	74.7	57.3	79.8	60.5	52.5	66.2	67.7	58.6	75.3
Utsav chowk, Kharghar	75.5	55.5	83.9	79.9	60.1	88.3	63.2	51.9	72.1	58.2	41.1	65.7

14 ANNEXURES

14.1 ANNEXURE I: Detailed list of Studied locations

Sr. No.	City	Location name (details)
1.	Mumbai	Backside of High Court
		Mumbadevi Temple
		Borivali National Park
		Antop Hill
		Shivaji Park, Dadar
		Santacruz Airport
		Ghatkopar (W)
		Vashi Naka, Chembur
		Goregaon (E)
		Charkop, Kandivali
		Sion - Sion Circle
		Hindu Colony - Dadar Hindu Colony
		Matunga - Gandhi Market
		Kamathipura - Kamathipura
		Malabar Hills - Sahyadri Guest House/ 3 Batti/ Bangauga
2.	Navi Mumbai	Mahape Shil Road, MIDC Mahape
		APMC Market Vashi
		Father Agnel Educational Trust, Vashi
3.	Thane	Main Road- Gaondevi Mandir, Naupada
		Tembhi Naka
		Ghokhale Road
		Pokharan - Vartak Nagar
		Wagle Estate
4.	Pune	Nucleus Mall
		Pune University
		Swargate
		Hadpsar
		Visharantwadi
5.	Nashik	Dwarka Circle
		Pandit Colony Near NMC
		Pavan Nagar CIDCO
		Bytco
		Udyog Bhavan, Satpur
6.	Aurangabad	Ghati Hospital
		Nirala Bazaar
		CIDCO N-9
		Residential Area Near High Court
		Swami Vivekanand Collage
7.	Nagpur	Govt. Medical College
		Sitabardi Police Station
		Shivaji Nagar
		Mahal
		Sadar

Sr. No.	City	Location name (details)
8.	Kalyan	Katemanivali
		Birla College
		Bail Bazar
9.	Amravati	Ervin Hospital Square
		Budhwara
		Rajkamal Chowk
10.	Jalgaon	Near Civil Hospital
		Shivaji Chowk (Near Court)
		Shashtri Tower Chowk
11.	Kolhapur	Rajarampuri chowk
		Papachi Tikati
		Gokhale College
		Dabhorakar Corner
12.	Sangli	Rajwada Chowk
		Visharambaug
		Miraj Market
13.	Mira-Bhayander	Bhakti Vedant Hospital, Tenkar pada
		Golden police Chawki
		Shivaji Chawk Kashi meera
14.	Vasai-Virar	Range office, Satwali, Vasai East
		Valiv Phata, Vasai East
		N.B. Estate, Virar West
15.	Ulhasnagar	Shivaji Chowk No. 3 - Near the Chowk
		Camp No. 5 Bus Stop - Bus Stop
		Camp No. 1 Gol Maidan - Gol Maidan
16.	Bhiwandi-Nizampur	Dhamankar Naka
		Indira Gandhi Memorial Hospital
		Shelar Near Nadi Naka
17.	Chandrapur	Gandhi Chowk
		Jatpura Gate
		Warora Naka
18.	Nanded-Waghala	Dr. Shankarao Chavan Govt. Medical College & Hospital Vishnupuri
		District Court Station Road
		Govt. Polytechnic College
19.	Ahmednagar	Kotala Chawk
		Chitale Road
		Old Bus Stand
20.	Dhule	Agrasen Chawk
		Fulwala Chawk
		Santoshi Mata Chawk
21.	Malegaon	Mosampul
		Central Bus Stand
		Malegaon Camp
22.	Pimpri-Chinchwad	Chafekar Chowk
		Dange Chowk
		Bhosari

Sr. No.	City	Location name (details)
23.	**Parbhani**	Shaniwar Bazar
		Railway Station Court
		Civil Hospital
24.	**Latur**	Shahu College
		Civil Hospital
		CJM Court
25.	**Akola**	Collector Office
		Civil line Chawk / Ratanlal plot
		City Kotawali Chawk near police station
26.	**Solapur**	Balives
		Bijapur Road
		Ashok Chowk
27.	**Panvel**	Old Panvel, Panvel corporation building
		Khanda colony
		Utsav chowk, Kharghar

14.2 ANNEXURE II: Noise Pollution (Regulation & Control) Rules, 2000 amendment dated 21st April, 2009

SCHEDULE

(see rule 3 (1) and 4 (1)

Ambient Air Quality Standards in respect of Noise

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

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 defined as an area comprising not less than 100 meters 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-abovementioned categories by the competent authority.

*dB (A) Leq denotes the time-weighted average of the level of sound in dB(A) on scale A which is relatable to human hearing.

A "decibel" is a unit in which noise is measured.

"A" in dB (A) Leq, denotes the frequency weighting in the measurement of noise and corresponds to frequency response characteristics of the human ear.

Leq: It is an energy mean of the noise level over a specified period

ध्वनी प्रदूषण (नियंत्रण व नियमन) नियम, २००० ची प्रभावीपणे अंमलबजावणी करण्यासाठी प्राधिकरणाची नियुक्ती करण्याबाबत

महाराष्ट्र शासन
पर्यावरण विभाग, मंत्रालय,
शासन निर्णय क्रमांक : ध्वनीप्र-२००९/प्र.क्र.९५/तांक-१
नविन प्रशासन भवन, १५ वा मजला, मादाम कामा रोड, मुंबई - ४०० ०३२
दिनांक: २१ एप्रिल, २००९

वाचा - १) शासन निर्णय क्रमांक : ध्वनीप्र-२०००/प्र.क्र.२४/तांक ३, दिनांक १६ ऑगस्ट, २००० आणि दिनांक १५ जून, २००१
२) मे. उच्च न्यायालयाच्या मुंबई खंडपीठामध्ये दाखल करण्यात आलेल्या सार्वजनिक हिताच्या याचिका क्र. (१) २०५३/२००३, (२) ७४/२००७, (३) ८५/२००७ आणि (४) १/२००९ मधील दिनांक २६/२/२००९ चे आदेश

प्रस्तावना :-

पर्यावरण विभाग, शासन निर्णय क्र. एन.पी./२०००/२४/क्र.३, दिनांक १६/८/२००० व दिनांक १५/०६/२००१ रोजी ध्वनी प्रदूषण (नियंत्रण व नियमन) नियम, २००० च्या २ (क) नुसार, राज्यातील पोलीस आयुक्त असलेल्या शहरामध्ये पोलीस उप आयुक्त व इतर ठिकाणी जिल्हा पोलीस अधिक्षक यांना एक सदस्य प्राधिकरण म्हणून ध्वनी प्रदूषण नियमाची अंमलबजावणी करण्यासाठी नियुक्ती करण्यात आली आहे.

मा. उच्च न्यायालय, मुंबई खंडपीठाने वरील याचिकांमध्ये महाराष्ट्र शासन व इतर विभागांनी ध्वनी प्रदूषण (नियंत्रण व नियमन) नियम, २००० ची प्रभावी अंमलबजावणी करण्याकरीता दिनांक २६/२/२००९ रोजी ठराविक निर्देश दिलेले आहेत. त्यानुसार स्थानिक स्वराज्य संस्थांनी शहरी भागात शांतता झोन जाहीर करणे आवश्यक आहे.

शासन निर्णय :-

१) मा. उच्च न्यायालयाच्या आदेशानुसार तसेच ध्वनी प्रदूषण (नियंत्रण व नियमन) नियम, २००० च्या कलम ३ (५) नुसार स्थानिक स्वराज्य संस्थांनी शहरी भागात शांतता झोन त्वरीत जाहिर करुन योग्य ते आदेश काढावेत. तसेच शहरात शांतता झोनचे फलक लावून आदेशाची प्रभावी अंमलबजावणी करण्यासाठी योग्य ती प्रसिध्दी करावी.

१) शैक्षणिक संस्थांच्या सभोवताली १०० मीटर क्षेत्र
२) सर्व न्यायालयाच्या सभोवतीली १०० मीटर क्षेत्र
३) रुग्णालयाच्या सभोवताली १०० मीटर क्षेत्र

२) ध्वनी प्रदूषणाची वाढती पातळी व निरनिराळे प्रदूषण स्त्रोत विचारात घेता, शासनाच्या निरनिराळ्या विभागांनी सद्यःस्थितीत ते राबवीत असलेल्या नियमाद्वारे ध्वनी प्रदूषण नियंत्रण व नियमनाची अंमलबजावणी करावी. त्याकरिता परिशिष्ट १ मध्ये नमूद केल्याप्रमाणे, शासनाच्या संबंधित विभागांच्या अधिपत्याखालील संस्थांच्या अधिकाऱ्यांना पदनाम प्राधिकरण म्हणून जाहीर करण्यात येत आहे. याबाबत संबंधीत

रोटा/इच-०१००[४न०-४-२००९]-१

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विभागांनी स्वतंत्र आदेश निर्गमित करावेत. सदर प्राधिकरण, ते राबवित असलेल्या नियमाच्या तरतुदीनुसार तसेच ध्वनी प्रदूषण (नियंत्रण व नियमन) नियम, २००० च्या तरतूदीनुसार ध्वनी प्रदूषण नियंत्रण व नियमनार्थ कार्यवाही करण्यास सक्षम असेल.

A.

३) ध्वनी प्रदूषण करणारे उपकरणे / स्त्रोत जसे D.G. Sets (15-500 KVA); Coal Washeries ; Fire Crackers Generator Sets with Diesel (upto 1000 KVA) manufactured on or after 1st July, 2003 ; Vehicles at manufacturing stage from the year, 2003 and 1st April, 2005 respectively as well as Noise Limits for Automobiles and Domestic appliances and construction equipments at the manufacturing stage laid down under the provisions of the Environment (Protection) Act, 1986 and Rules made there under इत्यादींची, सभोवतालच्या हवेतील ध्वनी प्रदूषण गुणवत्तेच्या विहित मर्यादा परिशिष्ट २ मध्ये नमूद केल्याप्रमाणे असेल.

४) या शासन निर्णयान्वये, पर्यावरण विभागाने यापूर्वी दिनांक १६ ऑगस्ट, २००० आणि दिनांक १५ जून, २००१ रोजी या विषयाबाबत निर्गमित केलेला शासन निर्णय खारीज करण्यात येत आहे. हा शासन निर्णय निर्गमित झाल्याच्या दिनांकापासून लागू राहील.

महाराष्ट्राचे राज्यपाल यांच्या आदेशानुसार व नावाने.

B.

(ग.नि.बराडे)
संचालक (पर्यावरण)

प्रत माहितीसाठी :-
मा.मुख्यमंत्र्यांचे प्रधान सचिव
मा.उपमुख्यमंत्र्यांचे प्रधान सचिव
मा. मुख्यसचिव
अतिरिक्त मुख्यसचिव, गृह विभाग, मंत्रालय
अतिरिक्त मुख्यसचिव, सार्वजनिक आरोग्य विभाग, मंत्रालय
प्रधान सचिव (अ. व सु.), गृह विभाग
प्रधान सचिव, नगर विकास विभाग (१), मंत्रालय
प्रधान सचिव, नगर विकास विभाग (२), मंत्रालय
प्रधान सचिव, महसूल विभाग, मंत्रालय
प्रधान सचिव, उच्च व तंत्रशिक्षण विभाग, मंत्रालय,
प्रधान सचिव, शालेय शिक्षण विभाग, मंत्रालय
सचिव , गृह विभाग (परिवहन),
सचिव, पर्यावरण
मा. मंत्री (पर्यावरण), यांचे खाजगी सचिव,
मा. राज्यमंत्री (पर्यावरण), यांचे खाजगी सचिव,
सर्व मा. मंत्री / राज्यमंत्री यांचे खाजगी सचिव
सर्व जिल्हाधिकारी
सर्व पोलीस आयुक्त / उप आयुक्त
सर्व जिल्हा पोलीस अधिक्षक / उप अधिक्षक
पर्यावरण विभाग सर्व अधिकारी / कार्यासन /निवडनस्ती - तांक १

परिशिष्ट - १

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ध्वनी प्रदूषण व नियमन व नियंत्रणाची अंमलबजावणी करण्यासाठी शासनाच्या अधिपत्याखाली असलेल्या संस्थांमधील संबंधीत अधिका-याची पदनाम प्राधिकरण म्हणून नियुक्ती

Sr. No	Officer /Agency	Concerned Department	Duties
1.	District Magistrate, Sub-Divisional Magistrate,	Revenue	Corresponding Rules for the enforcement of the Noise Pollution Control measures within their respective jurisdiction.
2.	Police Commissioner or any other officer not below the rank of the Deputy Superintendent of Police designated for the maintenance of Ambient Air Quality Standards, as mentioned in the Rule 2(c) of Noise Pollution(Regulation and Control) Rules, 2000.	Home	The Police Authorities will be responsible for initiating further legal actions in respect of the violations..
3.	Municipal Commissioner, Additional/Deputy Municipal Commissioner/ Chief Officer of Municipal Council/Committee Govt. of Maharashtra not below the rank of the Deputy Superintendent of Police.	Urban Developement	Corresponding Rules for the enforcement of noise standards laid down under the Environment (Protection) Rules, 1986 at source for construction projects, utilities for buildings (ACs, DG sets etc.), domestic appliances, development and other activities in their jurisdiction. The urban local bodies shall be responsible for demarcation of the silent zones as per the Noise Rules, 2000 and displaying the same adequately. The urban local bodies shall include an Action Plan for noise control in the Environmental Status Report submitted by them annually, including noise monitoring and noise mapping studies. The Local Body and Urban Development Deptt., Govt. of Maharashtra will not grant any permissions for development activities in consistent with or in conflict with the categorization of zone. In case of overlapping zones, stringent standards will prevail over in that particular area.
4.	Registrar /Head Master of the Educational Institutions duly approved by the concerned Government not below the rank of the Deputy Superintendent of Police	Higher & Technical Education/ School Education	Corresponding Rules for the enforcement and maintenance of the Ambient Noise Standards laid down for domestic appliances, automobiles etc. in respect of any activity in its jurisdiction.
5.	Dean/Superintendent of the Government Hospitals not below the rank of the Deputy Superintendent of Police	Public Health	Corresponding Rules for the enforcement and maintenance of the Ambient Noise Standards laid down for domestic appliances, automobiles etc. in respect of any activity in its

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			jurisdiction.
6.	Head of M.M.R.D.A., M.S.R.D.C., C.I.D.C.O., having local jurisdiction constituted under various Laws and Public Works Department.	Urban Developement	Corresponding Rules for the enforcement and maintenance of Noise Standards laid down under the Environment (Protection) Rules, 1986 at source for construction projects, utilities for buildings (ACs, DG sets etc.), domestic appliances, development and other activities in their jurisdiction These Developmental Authorities should include adequate noise abatement measures in their project activities such as noise barriers to the bridges and flyovers, tree plantation for roads etc.
7.	Member Secretary and any officer Maharashtra Pollution Control Board not below the rank of the Deputy Superintendent of Police	Environment Department	(i) Monitoring of Ambient Noise Levels in case of specific requests from other authorities referred in the table and communicating the results to the respective Authorities for further necessary action at their end. (ii) For the enforcement of Noise Pollution Control Measures and Standards in industrial areas.
8.	(i) Any officer from the State Transport Department / Deputy Regional Transport Officer in their respective jurisdiction not below the rank of the Deputy Superintendent of Police (ii) Head of Maharashtra State Road Transport Corporation or any officer/ Depot Manager not below the rank of the Deputy Superintendent of Police. (iii) Traffic Police Authorities not below the rank of the Deputy Superintendent of Police	Home Department (Transport)	Enforcement and maintenance of the Noise Standards laid down under Environment (Protection) Rules, 1986 and Motor Vehicles Act, 1939 for the new and operating vehicles within their respective jurisdiction. The noise levels generated by the in-use vehicles should be monitored while grant of Pollution Under Control Certificate.

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Schedule

(Under rule 3(1) and 4(1)) of Noise Pollution (Control and Regulation) Rules, 1999

Ambient Air Quality Standards in respect of Noise

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

i. Day time shall mean from 6.00 a.m. to 10.00 p.m.

ii. Night time shall mean from 10.00 p.m. to 6.00 a.m.

iii. Silence Zone is defined as an area comprising not less than 100 meters around hospitals, educational institutions and courts. The silence zones are zones which are declared as such by the competent authority.

iv. Mixed categories of areas may be declared as one of the four above mentioned categories by the competent authority.

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

A "decibel" is a unit in which noise is measured.

"A" , in dB(A) Leq, denotes the frequency weighting in the measurement of noise and corresponds to frequency response characteristics of the human ear.

Leq : it is an energy mean of the noise level, over a specified period.

2. Standards / Guidelines for control of Noise Pollution from Stationary Diesel Generator (DG) Sets.

(A) Noise Standards for DG sets (15-500 KVA)

The total sound power level, Lw of a DG set should be less than, $94+10 \log_{10}$ (KVA), dB(A), at the manufacturing stage, where, KVA is the nominal power rating of a DG set. This level should fall by 5 dB(A) every five years, till 2007, i.e. in 2002 and then in 2007

(B) Mandatory acoustic enclosure/acoustic treatment of room for stationary DG sets (5KVA and above).

Noise from the D.G. Set should be controlled by providing an acoustic enclosure or by treating the room acoustically.

The acoustic enclosure / acoustic treatment of the room should be designed for minimum 25 dB (A) Insertion Loss or for meeting the ambient noise standards, whichever is on the higher side (if the actual ambient noise is on the higher side, it may not be possible to check the performance of the acoustic enclosure/acoustic treatment. Under such circumstances, the performance may be checked for noise reduction upto actual ambient noise level, preferably in the night time). The measurement for Insertion Loss may be done at different points at 0.5 m from the acoustic enclosure/room, and then averaged.

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The DG set should also be provided with proper exhaust muffler with insertion loss of minimum 25dB (A).

A. **(C) Guidelines for the manufacturers/users of DG sets (5 KVA and above).**

01. The manufacturer should offer to the user a standard acoustic enclosure of 25 dB(A) insertion Loss and also a suitable exhaust muffler, with Insertion Loss of 25 dB(A).

02. The user should make efforts to bring down the noise levels due to the D.G. set, outside his premises, within the ambient noise requirements by proper siting and control measures.

03. The manufacturer should furnish noise power levels of the unsilenced DG sets as per standards prescribed under (A).

04. The total sound power level of a D.G. set, at the user's end, shall be within 2 dB(A) of the total sound power level of the DG set, at the manufacturing stage as prescribed under (A).

05. Installation of a DG set must be strictly in compliance with the recommendations of the DG set manufacturer.

06. A proper routine and preventive maintenance procedure for the DG set should be set and followed in consultation with the DG set manufacturer, which would help to prevent noise levels of the DG set from deteriorating with use.

3. Noise Level Standards for Coal Washeries

Operational / Working Zone – not to exceed 85 dB(A) Leq for 8 hours exposure.

The Ambient Air Quality Standards in respect of noise as notified under Environment (Protection) Rules, 1986 shall be followed at the boundary line of the coal washery.

Code of Practice of Coal Washery

Water or Water mixed chemical shall be sprayed at all strategic coal transfer points such as conveyors, loading/unloading points etc. As far as practically possible conveyors, transfer points etc. shall be provided with enclosures.

* The crushers/pulverizers of the coal washeries shall be provided with enclosures, fitted with suitable air pollution control measures and finally emitted through a stack of minimum height of 30m, conforming particulate matter emission standards of 150 mg/Nm^3 or provided with adequate water sprinkling arrangement.

* Water sprinkling by using fine atomizer nozzeles arrangement shall be provided on the coal heaps and on land around the crushers/pulverisers.

* Area, in and around the coal washery shall be pucca either asphalted or concreted.

* Water consumption in the coal washery shall not exceed 1.5 cubic meter per tonne of coal.

* The efficiency of the settling ponds of the waste water treatment system of the coal washery shall not be less than 90%.

* Green belt shall be developed along the road side, coal handling plants, residential complex, office building and all around the boundary line of the coal washery.

* Storage bunkers, hoppers, rubber decks in chutes and centrifugal chutes shall be provided with proper rubber linings.

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* Vehicles movement in the coal washery area shall be regulated effectively to avoid traffic congestion. High pressure horn shall be prohibited. Smoke emission from heavy duty vehicle operating in the coal washeries should conform the standards prescribed under Motor Vehicle Rules, 1989.

4. Noise Standards for fire-crackers

A.(i) The manufacturer, sale or use of fire-crackers generating noise level exceeding 125 dB(AI) or 145 dB(C)$_{pk}$ at 4 meters distance from the point of bursting shall be prohibited.

(ii) For individual fire-cracker constituting the series (joined fire crackers), the above mentioned limit be reduced by 5 $\log_{10}$ (N) dB, where N=Number of crackers joined together.

B. The broad requirements for measurement of noise from fire-crackers shall be-

(i) The measurements shall be made on a hard concrete surface of minimum 5 meter diameter or equivalent.

(ii) The measurement shall be made in free field conditions i.e., there shall not be any reflecting surface upto 15 meter distance from the point of bursting.

(iii) The measurement shall be made with an approved sound level meter.

C. The Department of Explosives shall ensure implementation of these standards.

5. Noise Limits for Generator Sets run with diesel

Noise limit for diesel generator sets (upto 1000 KVA) manufactured on or after 1st July, 2003

The maximum permissible sound pressure level for new diesel generator (DG) sets with rated capacity upto 1000 KVA, manufactured on or after the 1st July, 2003 shall be 75 dB(A) at 1 meter from the enclosure surface.

The diesel generator sets should be provided with integral acoustic enclosure at the manufacturing stage itself.

The implementation of noise limit for these diesel generator sets shall be regulated as given in below mentioned paragraph.

Requirement of certification

Every manufacturer of engine or every importer of engine or product must have valid certificates of Type. Approval and certificates of Conformity of Production for each year, for all engine models being manufactured or for all engines or product models being imported, after the effective date with the emission limit as specified in earlier paragraph.

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6. (1) Noise limits for vehicles applicable at manufacturing stage from the year, 2003.

Sr.No.	Type of Vehicle	Noise Limits dB(A)	Date of Implementation
(1)	(2)	(3)	(4)
1.	Two Wheeler		1st January, 2003
	Displacement upto 80 cm^3	75	
	Displacement more than 80 cm^3 but upto 175 cm^3	77	
	Displacement more than 175 cm^3	89	
2.	Three Wheeler		1st January, 2003
	Displacement upto 175 cm^3	77	
	Displacement more than 175 cm^3	80	
3.	Passenger Car	75	1st January, 2003
4.	Passenger or Commercial Vehicles		1st July, 2003
	Gross vehicle weight upto 4 tonnes	80	
	Gross vehicle weight more than 4 tonnes but upto 12 tonnes	83	
	Gross vehicle weight more than 12 tonnes	85	

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(2) **Noise Limits for vehicles at manufacturing stage applicable on and from 1st April, 2005**

Sr.No.	Type of vehicles	Noise Limits
1.0	Two Wheelers	
1.1	Displacement upto 80 cc	75
1.2	Displacement more than 80 cc but upto 175 cc	77
1.3	Displacement more than 175 cc	80
2.1	Three Wheelers	
2.1	Displacement upto 175 cc	77
2.2	Displacement more than 175 cc	80
3.0	Vehicles used for the carriage of passengers and capable of having not more than nine seats, including the driver's seat	74
4.0	Vehicles used for the carriage of passengers having more than nine seats including the driver's seat and a maximum Gross Vehicle Weight (GVW) of more than tonnes	
4.1	With an engine power less than 150KW	78
4.2	With an engine power of 150 KW or above	80
5.0	Vehicles used for the carriage of passengers having more than nine seats including the driver's seat: Vehicle used for the carriage of goods.	
5.1	With a maximum GVW not exceeding 2 tonnes	76
5.2	With a maximum GVW greater than 3 tonnes but not exceeding 3.5 tonnes	77
6.0	Vehicles used for the transport of goods with a maximum GVW exceeding 3.5 tonnes	
6.1	With an engine power less than 75 KW	77
6.2	With an engine power of 75 KW or above but less than 150KW	78
6.3	With an engine power of 150 KW or above	80

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7. Noise Standards Part E:-

A. **Noise limits for Automobiles (Free Field Distance at 7.5 meter in dB(A) at the manufacturing stage.**

(a)	Motorcycle, Scooters and Three Wheelers	80
(b)	Passenger Cars	82
(c)	Passenger or Commercial vehicles upto 4 MT	85
(d)	Passenger or Commercial vehicles above 4 MT and Upto 12 MT	89
(e)	Passenger or Commercial vehicles exceeding 12 MT	91

B. **Domestic appliances and construction equipments at the manufacturing stage to be achieved by 31st December, 1993.**

(a)	Window Air Conditioners of 1 ton to 1.5 ton	68
(b)	Air Coolers	60
(c)	Refrigerators	46
(d)	Diesel generator of domestic purposes	85-90
(e)	Compactors (rollers), Front Loaders, Concrete Mixers, Cranes (moveable), Vibrators and Saws	75

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Annexure-2

Draft Report On

AIR QUALITY MONITORING, EMISSION INVENTORY AND SOURCE APPORTIONMENT STUDIES FOR TEN CITIES IN THE STATE OF MAHARASHTRA

(NAVI MUMBAI CITY)

for

Maharashtra pollution Control Board

By

&

Indian Institute of Technology Bombay
&
CSIR- National Environmental Engineering Research Institute

November, 2021

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Chapter 1

Introduction

1.1 Preamble

Navi Mumbai is a part of Konkan coast line and is located in center of MMR (Mumbai Metropolitan Region) with Thane creek on west side, while the Parsik hill ranges surrounded on east side, whereas region of Thane and Panvel region covers the North and South zone. The total area of Navi Mumbai Municipal Corporation (NMMC) is around 110 square Km. As per MRSAC (Maharashtra Remote Sensing Application Centre), area under NMMC's jurisdiction is broadly distributed under Built Up area (56%), Forests (24%) and Wetlands (12%) and the remaining area is covered under water bodies and agriculture. There are a total of 163 gardens and 80 open spaces which support the biodiversity of the city. Navi Mumbai's coastline has rich mangrove coverage, which spread over approximately 50 square Km.

In 1970, CIDCO (City & Industrial Development Corporation), a state public sector undertaking, was incorporated with purpose to plan, develop and maintain the city of Navi Mumbai under 'Companies Act' of 1956. CIDCO prepared development plan for Navi Mumbai covering 95 villages from Thane to Raigad district with an estimated area of 345 square Km. CIDCO has planned to develop 14 nodes in Navi Mumbai out of which 8 nodes were handed over to NMMC (Navi Mumbai Municipal Corporation) in 1991 for its maintenance.

The development of industrial belt in Navi Mumbai attracted a large population as it gave rise to employment opportunities. Further given the ease of connectivity to Mumbai, the city witnessed quick progress in term of urbanization. Navi Mumbai, in true terms has lived to its expectations of absorbing the population shock from the mega city of Mumbai which is evident from the fact that Navi Mumbai recorded a decadal population growth by more than 51% between 2001 and 2011.

This increase in population coupled with growth in industrial, educational hub, economic activities and infrastructure are the major driving forces for the growth of a city which exert pressure on the resources of the city like water, air and land. Some renowned facts of Navi Mumbai's are :

- Mahape's (Millennium Business Park) and Airoli Knowledge Park are the modern state of the art Software Park ideally located for many IT and BPO companies due to its vicinity near and are well connected road to other major metropolis like Thane and Mumbai.

- CBD Belapur is a chief business district of Mumbai after Vashi, Bandra-Kurla Complex, Nariman Point and Worli. CBD Belapur locations having several economic and government administrative and private companies' offices.
- Vashi is the leading node having big and famous malls like Centre One, Raghuleela mall and Inorbit mall, while some Hypermalls are also located at Koparkhairne and Nerul.
- The APMC market established at Vashi node of NMMC, spread across almost 8 hectares, is one of the biggest agricultural markets in Asia and has given a unique identity to the city. Agricultural produce from various parts of the country arrives at APMC which attracts a lot of wholesalers as well as retailers as it gets distributed to various suburbs of the city. The APMC has an estimated annual trade turnover of INR. 6000 crores, and generates employment for about 1 lakh people. APMC comprises of four markets divided into two phases - Phase-I has Market I for wholesale dealing of onion & potato and Market –II for fruit & vegetable, whereas Phase-II has Market-I as commodity market and Market-II is the grain, rice and oilseed market. The market has influx of major vehicles along with hustle and bustle of traders and floating population.
- The Trans Thane creek (TTC) Industrial area lies within the NMMC limits while the Taloja MIDC area lies in close proximity of NMMC area. The TTC industrial area accounts for more than 3000 industries while the Taloja industrial area consists of large, medium and small industrial units. Various types of processing industries including chemical, paper, and plastic and so on are located in these industrial areas.
- About 16% of total area in Navi Mumbai falls under MIDC (Maharashtra Industrial Development Corporation) zone. Various MNC's (Multi-National Companies) have their offices/branches in the city which makes this city an attractive business destination. It has various recreational and public places which makes it an ideal city for living.
- One of the well-known Jawaharlal Nehru Port Trust residence nearby the city have largest container port that handles around 60% of the country's containerized cargo.
- In terms of rail connectivity, Navi Mumbai has six rail corridors, 157 Km railway system and an independent mainline rail terminal connecting the city directly to Chhatrapati Shivaji Maharaj Terminus (town side) as well as western parts of Mumbai. The city also has good accessibility to Pune and Pimpri regions through road as well as rail transport. The NMMC area is served by 4 bus transport agencies operation between Mumbai-NMMC area, within NMMC area, Thane-NMMC area and surrounding areas. The road transport wing of Navi Mumbai includes connectivity from bus operators of BEST (BrihanMumbai Electric Supply and Transport),

NMMT (Navi Mumbai Municipal Transport), KDMT (Kalyan- Dombivli Municipal Transport) and KMT (Khopoli Municipal Transport) which provide bus services to entire Navi Mumbai city as well as to certain parts of Mumbai, Thane, Kalyan, Dombivli, Badlapur, Taloja, Panvel and Uran.

- Many projects, like the Navi Mumbai Metro, trans-harbour link between Mumbai (Wadala) and Navi Mumbai (Ulwe), elevated corridor on Palm Beach road, as well as the ambitious international airport proposed near Panvel, are expected to enhance the connectivity as well as the status of the city.

The Navi Mumbai Municipal Corporation (NMMC) secured the first rank in the Cleanest Big City in the 10 to 40 lakh population category, but it slipped to the fourth position from the third last year in the overall ranking in the annual survey of cleanliness, Swachh Survekshan 2021. As per the annual Environment Status Report of Navi Mumbai Municipal Corporation, 2021 the EQI (Environmental Quality Index) improved by 0.63 percent, the QOLI (Quality of Life) by 0.64 percent, and the UII (Urban Infrastructure Index) by 0.65 percent in 2018-19.The overall improvement in EQI can be attributed to better air quality, particularly at traffic intersections, better solid waste management, a decrease in vector-borne diseases, the completion of road work in MIDC, enhanced public awareness of noise and solid wastes, and so on. The development of sanitary facilities, improved waste segregation at the source, improved operating efficiency of solid waste processing plants, and finished construction activities of roads and bridges inside Navi Mumbai city are all contributing to an increase in UII. In the current year, NMMC has calculated the EPI (Environment Performance Index), endorsed by MPCB for the sixth consecutive year. The calculator takes into consideration 65 data variables which are compared against the state level and national level benchmarks or averages as may be applicable. The EPI score for the NMMC area was determined to be 698.0 out of 944 and has registered an improvement of 0.64% as compared to the previous year owing to major initiatives undertaken to increase awareness related to environmental issues, public transport, effective segregation and management of solid waste, and development of roads.

The study area covers Navi Mumbai Municipal Corporation city limits. Jurisdiction of Navi Mumbai Municipal Corporation is spread over eight zones starting with Digha in north, Airoli, Ghansoli, Koparkhairane, Vashi, Turbhe, Nerul and Belapur in south. Each ward has its corresponding Ward Office to facilitate the civic amenities to the general population. The study area of Navi Mumbai Municipal Corporation city limits with zoning structure is presented in **Figure 1.1.**

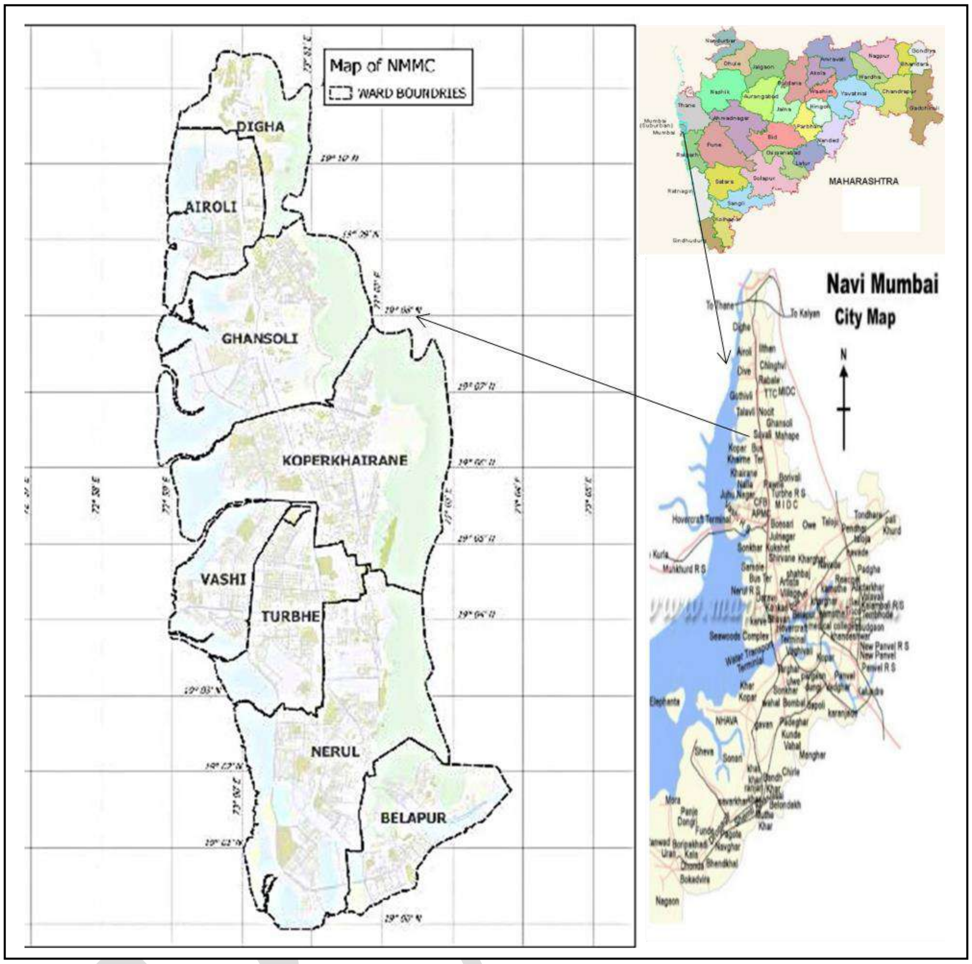


Figure 1.1: Ward wise Jurisdiction of Navi Mumbai Municipal Corporation

Population

As per the Census of India 2011, the population in NMMC is 11,20,547, with population density of 10,315 persons per sq. km., and according to NMMC UHP Survey, 2018-19 the population of NMMC was estimated to be about 15,52,980. Population density is estimated to be 14,171 persons /sq. Km. The development of industrial belt with job opportunities, higher income, civic lifestyle, and

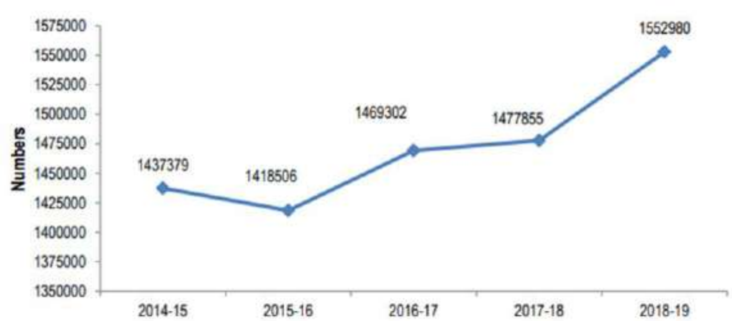


Figure 1.2 : Population Growth in Navi Mumbai *Source: UHP Survey, NMMC*

other facilities has led to migration of people into the city. The population growth for last 5 years for Navi Mumbai has been represented in **Figure 1.2**. Total number of 48,577 Slums in Navi Mumbai city has population of 207,645 residents. This is around 18.53% of total population of Navi Mumbai city *(census2011.co.in)*. Since last 9 years, the city has witnessed over 21% rise in properties. In 2018-19, total number of properties rose to 3,10,222 from 3,09,841 in 2017-18. Residential sector holds major share of the properties (~82%) followed by commercial (~17%) and then MIDC commercial with least of 1% share.

Climate

In terms of weather, temperature of the region varies from 22°C to 36°C. The area receives average annual rainfall of 2500-3000 mm and humidity is about 60-75 %. Navi Mumbai lies in the tropical climatic zone and has three seasons' summer, monsoon and winter. The annual temperature in Navi Mumbai varies from 22°C to 36°C while in summers the maximum temperature ranges between 36°C to 41°C and the minimum temperatures in winter ranges between 17°C to 20°C. Based on IMD's (Indian Meteorology Department) observations recorded at TBIA's (Thane Belapur Industry Association's) premises, the predominant wind direction in Navi Mumbai is southwest in monsoon and north-east during rest of the year.

1.2 Air Quality of Navi Mumbai City

Ambient air quality is being monitored under National Ambient Air Monitoring Program (NAMP), coordinated by Central Pollution Control Board (CPCB) or SAMP (State Ambient Air Monitoring Program) stations. Presently 5 stations are operated under NAMP programme at Rabale, Nerul-DY Patil, Mahape, MPCB-Nirmal Bhavan, Kharghar-CIDCO Nodal Office and at Taloja-MIDC Building. The need for continuous ambient monitoring led to the establishment of CAAQMS (Continuous Ambient Air Quality Monitoring Stations) networks and is also being expanded throughout the country. At present there are 4 CAAQMS (Continuous Ambient Air Monitoring Stations) installed at Airoli, Koparkhairane, Turbhe, and Nerul taken care by NMMC. NMMC has also proposed installation of a CAAQMS at CBD-Belapur. The Municipal Corporation operates a mobile monitoring van which is deputed at various locations on the nodes of Navi Mumbai to monitor the air quality. The annual averages of criteria pollutants with respect to NAAQM Standards are presented in **Figure 1.3 a to d**.

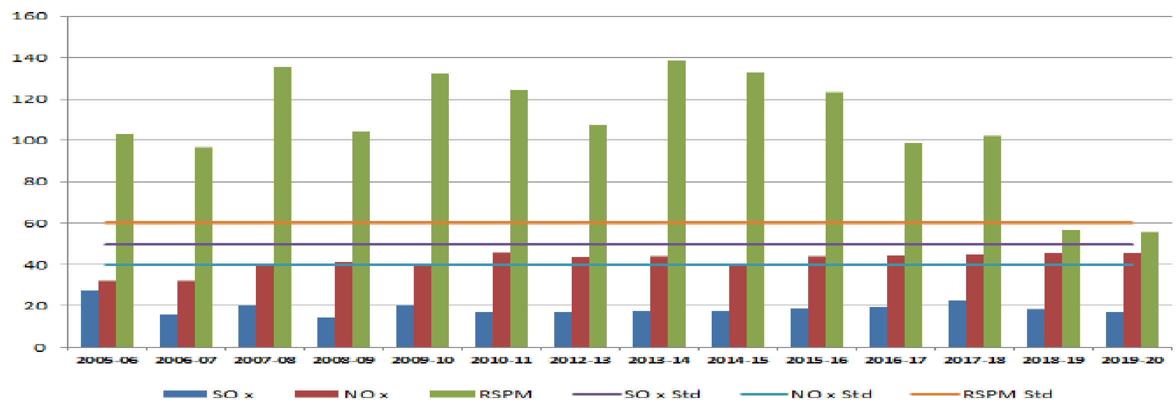


Figure 1.3a : Trend of Annual Concentrations of Criteria Pollutant in Navi Mumbai City

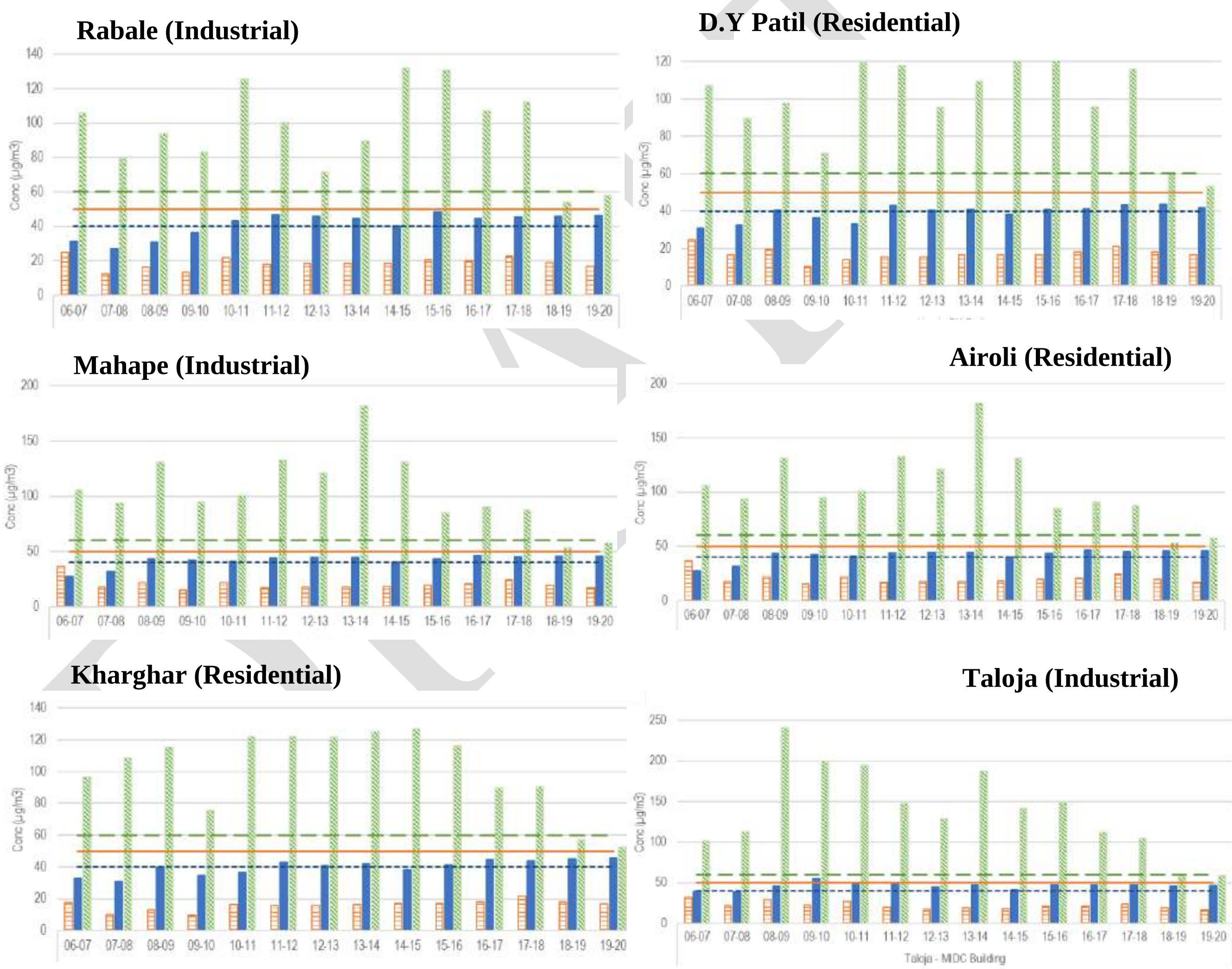


Figure 1.3b (Contd..) : Trend of Annual Concentrations at Different Monitoring Locations in Navi Mumbai City (MPCB Sites) (2006-07 to 2019-20)

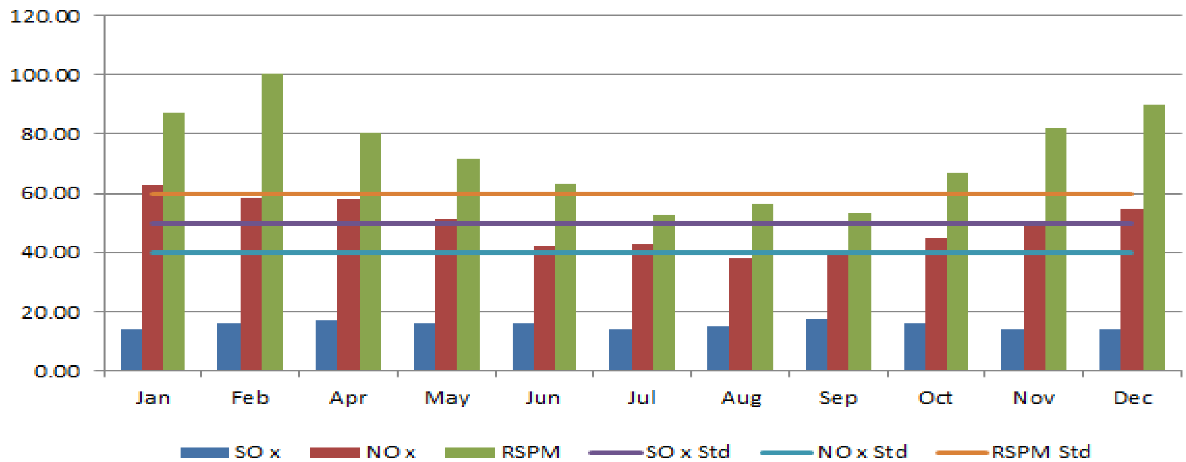


Figure 1.3c (Contd..) : Monthly Variation Trends for PM10, SOx, and NOx (2019-20)

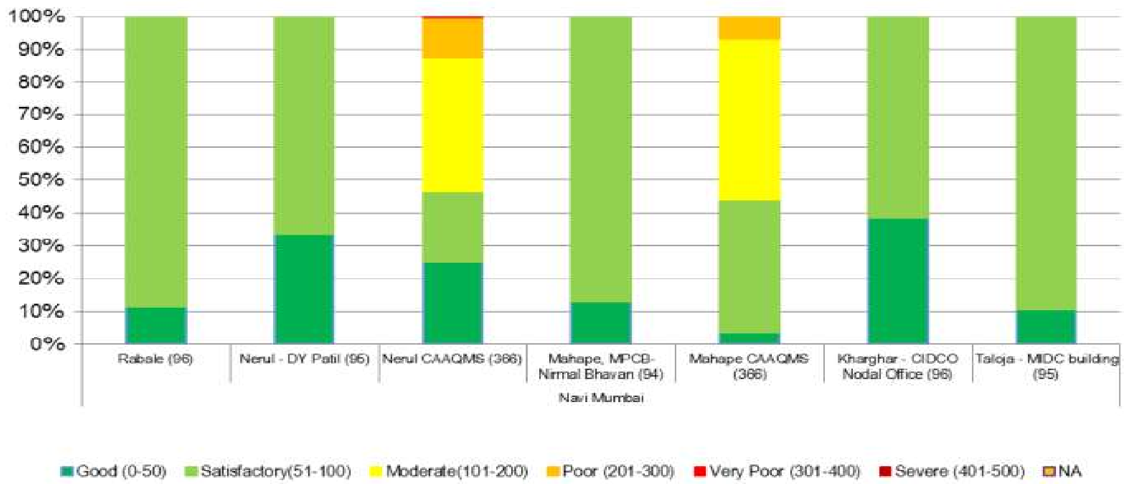


Figure 1.3d (Contd..) : Percentage Occurrence of Composite AQI of AQQMS in Navi Mumbai (2019-20)

From recent report of MPCB prepared by TERI -'Air Quality Status of Maharashtra' during 2019-2020, the decadal analysis shows that the Annual PM concentration of Navi Mumbai City is around 71 to 136 µg/m^3, which is mostly higher than the CPCB standards of 100 µg/m^3, as construction, vehicular and industrial impacts were observed to be more. In the recent years considerable increase in annual average NOx Concentrations from 43 µg/m^3 to 55 µg/m^3 were noticed, which are higher than the prescribed annual average limit of 40 µg/m^3. The concentration of SO_2 observed at Navi Mumbai city ranges from 15 to 37 µg/m^3.

The decadal annual averages from 2007 to 2019 at residential (D.Y.Patil and Kharghar) sites has the concentration range from 75 to 130 µg/m^3 for RSPM, whereas for NOx it was 31-45 µg/m^3 and for SO_2 was 10-25 µg/m^3. The industrial site at Mahape recorded highest annual PM concentration of 182 µg/m^3. The Rabale industrial site also exceeds the CPCB standard limit with concentration of

PM ranging from 70 to 132 µg/m^3. NOx concentration at industrial monitoring location was observed at around 31-45 µg/m^3 and SOx at 12-37 µg/m^3.

In Navi Mumbai region 5 locations- Rabale, Nerul D.Y. Patil, Mahape MPCB Nirmal Bhawan Kharghar CIDCO Nodal Office and Taloja MIDC Building recorded all observations in the Good and Satisfactory categories. Moderate and Poor AQI was observed at Nerul CAAQMS (41% and 12%) and Mahape CAAQMS (49% and 7%). The AQI at Airoli (residential) represented as Good, whereas for Kharghar (residential) it was moderate to satisfactory. The downward trend of emission concentration was observed in monsoon.

1.3 Objective of the Study

CPCB has listed cities in India in which the RSPM levels are non-complaint with the NAAQS and has directed SPCBs to develop action plans and implement these to control air pollution in these cities; Navi Mumbai is one of them. There is a strong need for city-scale emission inventories to assess the types and sources of emission loads and to develop control measure as well for the development of pollution control strategies and policies.

The main objectives of the projects are :

- To measure baseline air pollutants (Particulate Matter) in different parts of the city which include "hot spots" and kerbside locations.
- To develop emissions inventory of various air pollutants in the city.
- To conduct source apportionment study of PM.
- Suggest action plan based on various options delineated in the Six City Study of MoEF-CC or any relevant workable options. To prioritize the source categories for evolving city-specific air pollution management strategies/plan.
- To assess the impact of sources on ambient air quality under different management/ interventions/control options and draw a roadmap of short and long term measures as a part of action plan suggested

Among all the criteria air pollutants, particulate matter has emerged as the most critical pollutant in almost all urban areas of the country. Thus the main focus of this study was on characterization and source apportionment of particulate matter.

Chapter 2

Air Quality Monitoring

2.1 Monitoring Sites (Navi Mumbai)

Population density, climatology, topography, and other factors all have a role in air quality monitoring design and assessment. The monitoring stations were chosen on the basis of region demography, consideration of activities and standard sampling procedure. Six sampling sites were finalized as representative of the Navi Mumbai metropolitan area. Of these, one site was selected as control site (Maritime University), and two for Kerbside (Vashi Toll Naka and Vashi Plaza Traffic Intersection), others are Nerul (Residential), APMC-Kanda Batata Market (Commercial) and industrial site at Thane Belapur Road, Juinagar. The study area is presented in **Figure 2.1** and site characteristics are presented below.

Maritime University (Background) : Located at Seawoods, on further end of Palm Beach Road, the sampling instrument was installed in the premises of Maritime University at a height of about 1.5 m above the ground level. The location is on western boundary side of Navi Mumbai region and secluded in terms of activities as compared to other monitoring locations, hence selected as background location. The area around these locations is a well-planned neighborhood, with Nerul on the north, Panvel Creek on the south, Belapur CBD on the east, and Thane Creek on west. The NMMC Corporation building is across the street from the site, and there is seasonal sighting of flamingo’s congregation in the nearby stream area of the location.

Nerul- Sahakar Bazar (Residential Site) : Nerul is a well-planned neighborhood that acts as a residential and business center in Navi Mumbai. As the city is accessible in terms of road connectivity, local market in Sector 1 of Nerul is visited by people from the vicinity as well as from Palm Beach Road, Vashi, Thane, and Belapur. The various activities at market, hotels, restaurants and, open eateries along with buzzing neighbourhood contribute in local emission load. The sampling instrument was installed on the terrace (first floor) of Sahakar Bazar building, about 3 m above the ground level.

APMC Market (Commercial Site): The Agricultural Produce Market Committee (APMC) in Vashi was selected as commercial site location for monitoring. The samplers were installed at a height of about 1.5 m above the ground level near the security guard cabin of the market. At peak hours, the market area has heavy duty vehicles movement for loading-unloading of the goods. The monitoring station was installed near Kanda Batata Market. The market is at the interjection of

Thane Belapur Road, Vashi Bridge, and Turbhe Road. The surrounding region has residential buildings, small and medium hotels; open eateries, and frequent movement of public transportation as well as commercial and private vehicles along the route.

Vashi Toll Plaza (Kerbside) : This was a kerbside location and the samplers were installed on an elevated platform at a height of about 1.5 m from the ground level. The majority of NMMC's private as well as public transportation buses arrive at this intersection. The key routes in the area include Vashi Sanpada Road, APMC Market Road, Palm Beach Road, and others. Along the route are major commercial buildings like malls, restaurant, hotel and shops, institutions like hospitals and schools and so on. The traffic at this interjection is high as compared to other part of the city, as it serves link between Mumbai, Thane, Panvel and Pune.

Vashi Toll Naka (Kerbside) : The Vashi toll naka is located on the Vashi end of the Vashi creek bridge, which is 1837 meters long. This was a kerbside and the samplers were installed on an elevated foothpath at a height of about 2 m from the ground level, near Vashi Traffic Office. It is a key entry point toll in Navi Mumbai. The kerbside location was chosen due to the huge volume of vehicles entering and exiting the city premises, particularly during peak hours. During idle and acceleration situations, which are common at toll plazas and traffic junctions, engine will release greater particle exhaust emissions.

Juinagar, Thane-Belapur Road (Industrial): Industrial units of various categories which includes manufacturing units of chemicals, dyes, pharmaceuticals, petrochemicals, textile and engineering, are the main category of industries in NMMC. Besides this, the city is having well established Information Technology (IT) sector especially in Airoli, Ghansoli and Vashi node. Thane-Belapur is congested majorly with heavy duty and private vehicles at peak hours because it connects Navi Mumbai to Thane District. The monitoring station was installed in industrial premises near Juinagar on Thane-Belapur Road, on the top of a single story building at about 3 m height.

Figure 2.1 : Air Quality Monitoring Locations at New Mumbai City

Maritime University (Background Site)

Nerul (Sahakar Bazar Area) Residential Site)

APMC Market (Kanda Batata Market) Commercial

Vashi Plaza Junction (Traffic Kerb)

Vashi Toll Naka (Traffic Kerb)

TBIA Area (Juinagar) (Industrial Site)

2.2 Measurement and Frequencies

Air quality was monitored as per the CPCB guidelines and chemical speciation methodologies adopted are given in **Table 2.1.** Portable air samplers (Airmetric) were used to sample $PM_{2.5}$ and PM_{10}. Four samplers were collocated at every monitoring site to collect samples for $PM_{2.5}$ and PM_{10}, each on two filter substrates (Teflon and Quartz). The mass of samples collected over a specified duration includes two main considerations: i) adequate mass collection for gravimetric as well as chemical analysis, and ii) prevention of overloading of the filter that could lead to excessive pressure drop across the filter. The sampling instrument has a constant flow control system, and an elapsed time totalizer. The flow rate of 5.0 lpm was found to be suitable as it would collect about 7.2 m^3 of air in 24 hours, and the total mass of sample would be under 1500 µg (based on the average ambient concentration of PM_{10} and $PM_{2.5}$ is 203 and 80 µg/m^3 respectively reported for Navi Mumbai). 24-hour air quality was monitored at each site for 10 days during winter 2018-19.

Table 2.1 : Target Physical and Chemical Components (groups) for Characterization of Particulate Matter for Source Apportionment

	PM_{10}	$PM_{2.5}$	OC/EC	Element /Ions
Sampling Instrument	Air Metric MiniVol Portable Sampler		Particulate collected on Quartz filter paper	Particulate collected on PTFE Filter paper
Sampling Principle	Inertial impaction			
Flow Rate	5 LPM			
Sampling Period	24-Hour			
Sampling Frequency	Total 10 days; using Quartz and PTFE Filter Simultaneously			
Analytical Instrument	Electronic Microbalance	Electronic Microbalance	OC/EC Analyzer	Ion Chromatography (Ions) and ED-XRF (Elements)
Minimum Reportable Value	5 µg/m^3	5 µg/m^3	0.2 µg/ 0.5 cm^2 Punch	NA

Components	Required Filter Matrix	Analytical Methods
PM_{10} / $PM_{2.5}$	Teflon (PTFE) filter paper. Pre and post exposure conditioning of filter paper is mandatory	Gravimetric
Elements (Na, Mg, Al, Si, P, S, Cl, Ca, Br, V, Mn, Fe, Co, Ni, Cu, Zn, As, Ti, Ga, Rb, Y, Zr, Pd, Ag, In, Sn, La Se, Sr, Mo, Cr, Cd, Sb, Ba, Hg, and Pb)	Teflon (PTFE) filter paper	ED-XRF
Ions (Na^+, NH_4^+, K^+, Mg_2^+, Ca_2^+, F^-, Cl^-, NO_2^-, NO_3^-, SO_4^{2-})	Teflon (PTFE) filter paper (Same teflon filter paper can be utilized if ED-XRF is used for elements analysis)	Ion chromatography with conductivity detector
Carbon Analysis (OC, EC and Carbonate Carbon)	Quartz filter. Prebaking of quartz filter paper at 600 ºC is essential	TOR/TOT method

2.3 Monitoring Results

The particulate matter concentration compared with NAAQM Standard of $PM_{2.5}$ and PM_{10} is presented in of **Figure 2.2.**

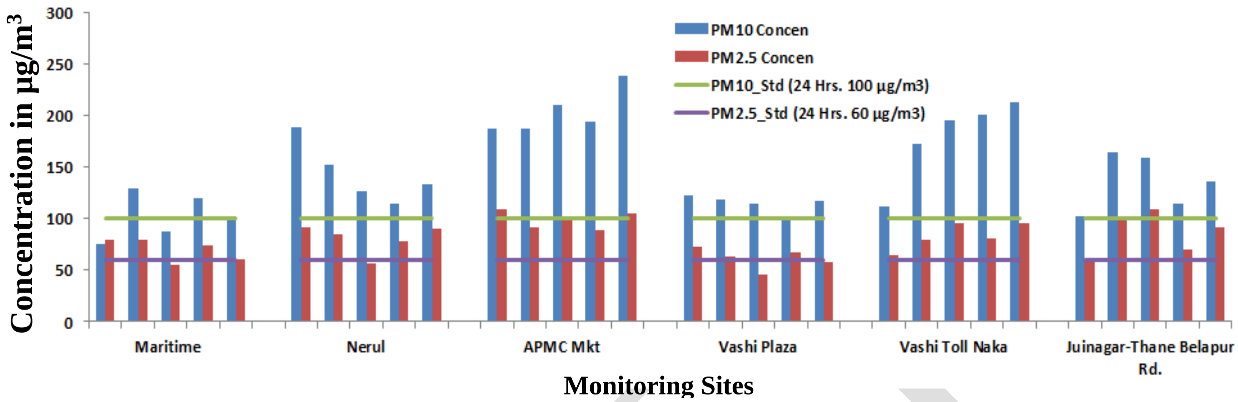


Figure 2.2 : PM_{10} and $PM_{2.5}$ Concentrations with respect to NAAQM Std

The PM_{10} concentration at Maritime Board (Background site) ranges from 75.5 to 129.0 µg/m^3 (Avg. 103 µg/m^3), whereas for $PM_{2.5}$ it was 55 to 80.1 (Avg. 69.8 µg/m^3) for same location. $PM_{2.5}$/PM_{10} ratio is in the range of 0.5 to 0.7. The concentration range at Nerul (residential site) for PM_{10} was from 114.2 to 189.5 µg/m^3 (Avg. 143.3 µg/m^3), whereas $PM_{2.5}$ ranged from 56.6 to 91.5 µg/m^3 (Avg. 80.4 µg/m^3). $PM_{2.5}$/PM_{10} ratio is in the range of 0.4 to 0.6 for the location. The concentrations at APMC Market (Commercial site) were in the range of 187.2 to 239.4 µg/m^3 (Avg. 203.9 µg/m^3) and 89 to 108.7 µg/m^3 (Avg. 98.7 µg/m^3) for PM_{10} and $PM_{2.5}$ respectively, with $PM_{2.5}$/PM_{10} ratio of 0.4 to 0.5. At kerbside location Vashi Plaza, PM_{10} concentration was found to be between 98.3 to 122.7 µg/m^3 (Avg. 114.3 µg/m^3) and 46 to 72.5 µg/m^3 (Avg. 61.4 µg/m^3) for $PM_{2.5}$. Another kerbside at Vashi Toll Naka reported PM_{10} concentration at the range of112.5 to 213.2 µg/m^3 (Avg. 178.9 µg/m^3) and for $PM_{2.5}$ concentration at range 65.1 to 95.9 µg/m^3 (Avg. 83.2 µg/m^3). At both the sites $PM_{2.5}$/PM_{10} ratio is around 0.4. At Juinagar-Thane Belapur Rd. vicinity, PM_{10} concentration at Industrial monitoring location was observed to be 103.2 to 164.5 µg/m^3 (Avg. 135.8 µg/m^3) and 58.1 to 108.9 µg/m^3 (Avg. 85.4 µg/m^3) for $PM_{2.5}$ with ratio of 0.6. The 24 hourly average concentrations of PM_{10} and $PM_{2.5}$ exceeded at all the sites of the NAAQM CPCB Standards of 100 µg/m^3 for PM_{10} and 60 µg/m^3 for $PM_{2.5}$. The highest particulate matter concentrations were observed at APMC Mkt; followed by Vashi Toll Naka and Thane Belapur industrial area. Overall average PM /PM ratio was in the range of 0.4 to 0.7 indicating the predominance of coarse particulate matter. The correlation between PM_{10} and $PM_{2.5}$ showed on R^2 value of 0.3 indicating merely similar sources for PM_{10} and $PM_{2.5}$. The graphical compositional comparison of $PM_{2.5}$ Vs PM_{10} for all species are shown in **Figure 2.3**

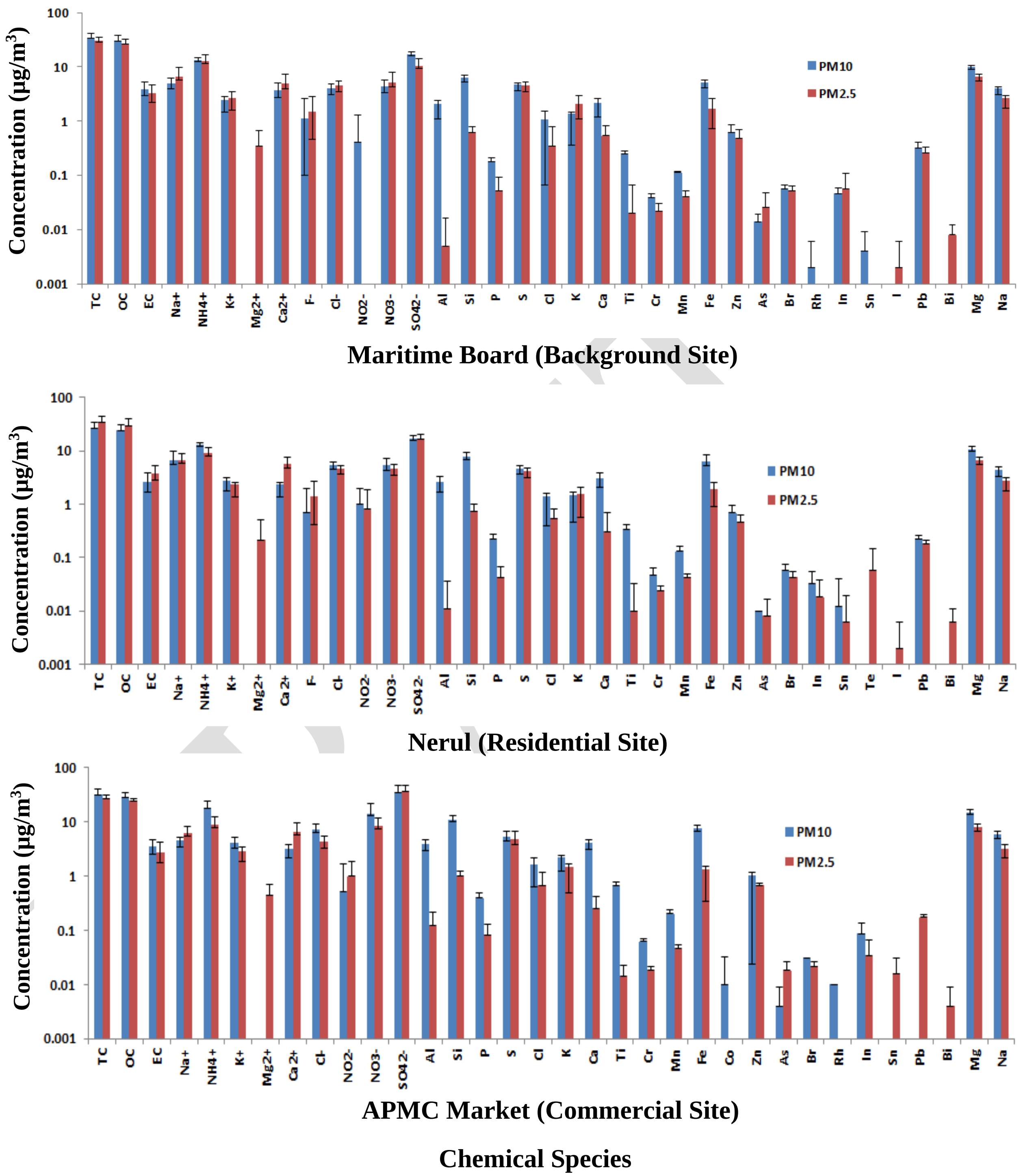
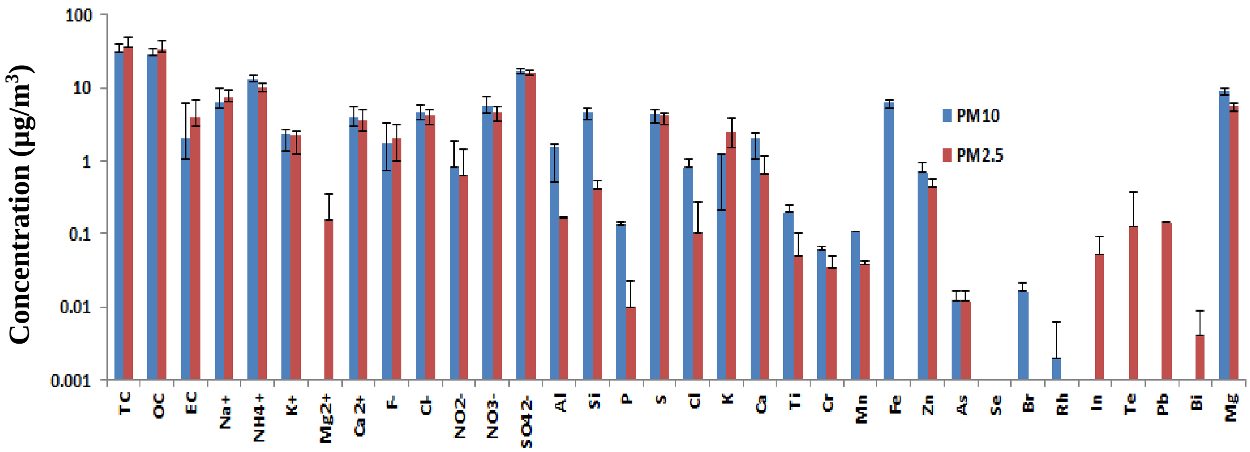
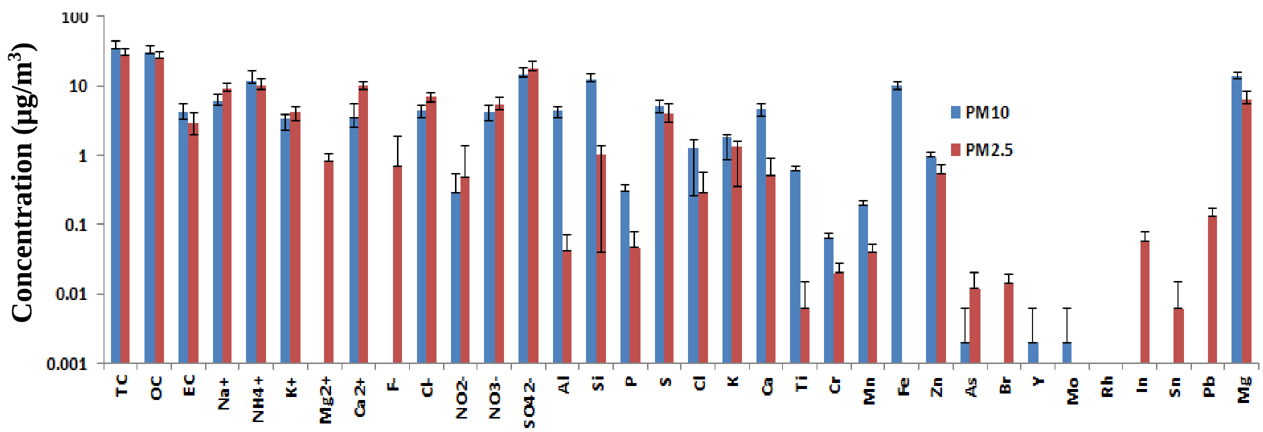


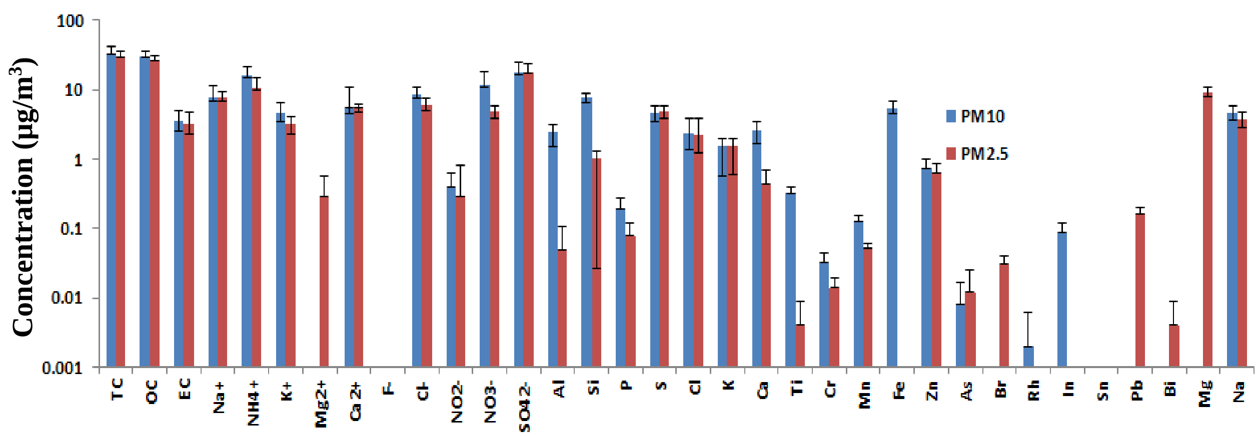
Figure 2.3 : Compositional Comparison of Species Concentrations in PM_{10} and $PM_{2.5}$



Vashi Plaza (Kerbside)



Vashi Toll Naka (Kerbside)



Juinagar-Thane Belapur Road (Industrial Site)

Chemical Species

Figure 2.3 (Contd..) : Compositional Comparison of Species Concentrations in PM_{10} and $PM_{2.5}$

2.3.1 Mass Closure of PM_{10} and $PM_{2.5}$

The PM_{10} and $PM_{2.5}$ samples were analyzed for 46 elements and 12 ions species for a total of 60 samples. The mass reconstruction procedure used in the present study was based on PM Data Analysis Workbook, USA.

Material Balance Equation

Geographical [(1.89 x Al) + (2.14 x Si) + (1.4 x Ca) + (1.43 x Fe)]

Organic Carbon (1.4 x OC) + Elemental Carbon

+ Anions (Cl^-, SO_4^{2-}, NO_3^-,…) + Cations (Na^+, K^+, $NH4^+$,…)

+ Trace Elements (Excluding geological + Unidentified

Maritime Board (Background): The major chemical component of PM_{10} is of Crustal and Non-crustal elements that account for 27.7% and 18.1%, respectively at this site. Anions account for 26.9% of the total coarse particulate mass. Amongst the anions, contribution from sulfate is maximum (17.1%), followed by nitrate and chloride (4%), which is probably due to secondary aerosol, road dust etc. Cations make up 24.9% of the total PM_{10} concentration. Composition of Ammonia (13.5%), calcium and sodium (4 to 5%) are higher in Cation. The 25.8% organic matter and 3.9% of elemental carbon is probably due to anthropogenic activities near the monitoring site. The negative unidentified portion in PM_{10} was -24.3% indicates that the sum of identified species exceeded the measured mass. This is due to particle bound water and other analytical uncertainties *(Rees et al., 2004)*. **(Figure 2.4)**

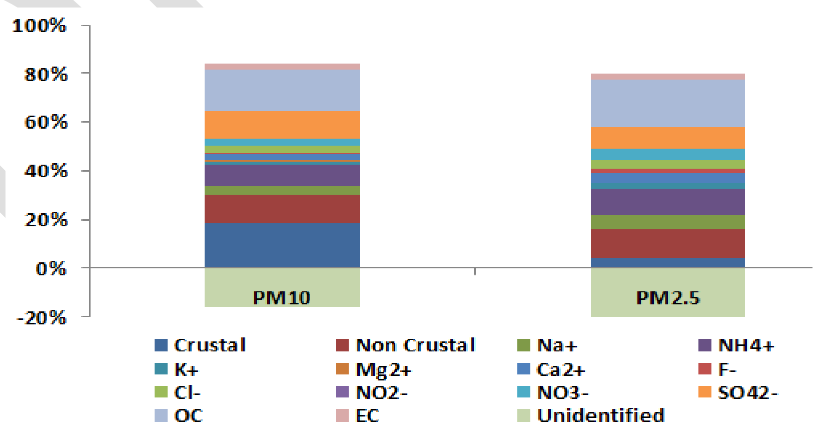


Figure 2.4 : Percent Contribution to Mass in PM_{10} and $PM_{2.5}$ at Maritime Board (Background Site)

Percent contribution of Crustal and Non-crustal elements in $PM_{2.5}$ is around 4.5% and 13.8%, respectively. Anions and cations contribute 21.6% and 27.2% of the total $PM_{2.5}$. Contribution of Sulfate (10.4%), nitrate and chlorides (4 to 5%) are high in Anions, whereas that of ammonia (12.6%), calcium (4.9%) and sodium (6.7%) are higher in Cation. The organic matter accounts for 22.5% and elemental carbon is 3.2% of the total concentration. Negative percent -23.1% in $PM_{2.5}$ indicates that water bound particle exceeded the sum of identified species in measured mass.

Nerul (Residential Site) : The Crustal and Non-crustal elements accounts for 35.2% and 19.4%, respectively in PM_{10}. Anions account for 29.3% of the total coarse particulate mass (sulphate 16.9%, nitrate 5.3% and chloride 5.4%); whereas, Cations constitutes of up 25.2% (ammonia 13% and sodium 6.7%) of the total PM_{10}. Out of the total concentration, 20.9% accounts for OC and 2.7% for elemental carbon. The impact of highly commercial and residential is visible in the results and maximum contribution is probably due to secondary aerosol, road dust etc. Unidentified portion in PM_{10} was 10.7% which may due to volatilization of organic matter and nitrates.

$PM_{2.5}$ is found to be in Crustal and Non-crustal elements i.e. 4.8% and 13.2%, respectively. Anions and cations contribute 28.5% and 23.9% of the total $PM_{2.5}$ concentration. In anion, 17.1% sulfate and 4% chlorides & nitrate and 5.7% calcium and 8.9% ammonia in Cation, are of the highest composition. The organic matter accounts for 25.8%, and elemental carbon is around 3.8% of the total concentration. The unidentified negative contribution -19.4% of $PM_{2.5}$ indicates that the sum of identified species exceeded the measured mass. This is due to particle bound water and other analytical uncertainties **(Figure 2.5)**.

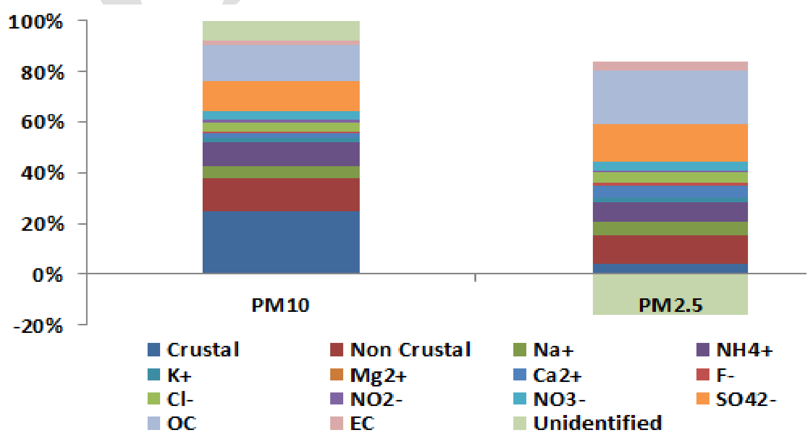


Figure 2.5 : Percent Contribution to Mass in PM_{10} and $PM_{2.5}$ at Nerul (Residential Site)

APMC Mkt Yard: The monitoring location being commercial market area and also because of heavy duty vehicle movements, the resuspension of dust is contributing 48% for Crustal and 26.2% of Non-crustal elements in PM_{10} mass. Anions account for 57.6% of the total coarse particulate mass (sulphate 35.3%, nitrate 14.3% and chloride 7.5%); whereas Cations make up 31.4% (ammonia 18.8%, calcium 7.5% and sodium 4.5%) of the total PM_{10}. The organic matter, accounting for 24.3% and elemental carbon is around 3.5%. The high contribution is probably due to secondary aerosol, road dust and extensive vehicular movement. Unidentified portion in PM_{10} was 13% which may due to volatilization of organic matter and nitrates **(Figure 2.6)**.

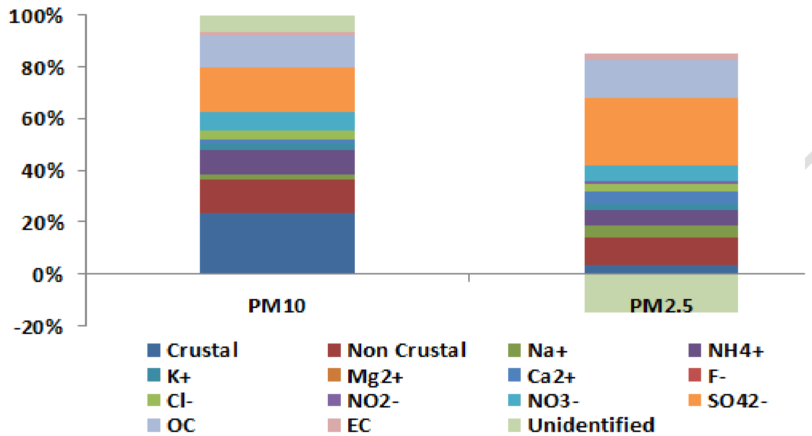


Figure 2.6 : Percent Contribution to Mass in PM_{10} and $PM_{2.5}$ at APMC Mkt (Commercial Site)

$PM_{2.5}$ in Crustal and Non-crustal elements i.e. 4.6% and 15.4%, respectively. Anions and cations contribute 50.7% and 25.2% of the total $PM_{2.5}$. Sulfate 37%; nitrate 8.5% and chlorides 4.3% are the major portion in Anions, whereas calcium 6.7% and ammonia 8.8% are highest in Cation. The organic matter accounts for 21.3%, and elemental carbon is around 2.8%. The unidentified negative contribution -21.3% of $PM_{2.5}$ indicates that the sum of identified species exceeded the measured mass.

Vashi Plaza (Kerbside): The major source identified at this location was heavy duty vehicle movement, idling of the vehicles at toll and traffic, and commercial activities. The 24.8% and 16.5% is contributed by Crustal and Non-crustal elements in PM_{10} mass, respectively. Anions account for 29.7% of the total coarse particulate mass (sulphate 17%, nitrate and chloride 4 to 5%); whereas, Cations make up 25.7% of the total PM_{10} (ammonia 13%, sodium 6.4% and calcium 3.9%). The organic matter accounts for 24.3% and elemental carbon is around 2%. The highly commercial activities and vehicular movement reflected the area for maximum contribution. Negative percent -8.8% in PM_{10} indicates that the sum of identified species exceeded the measured mass **(Figure 2.7)**.

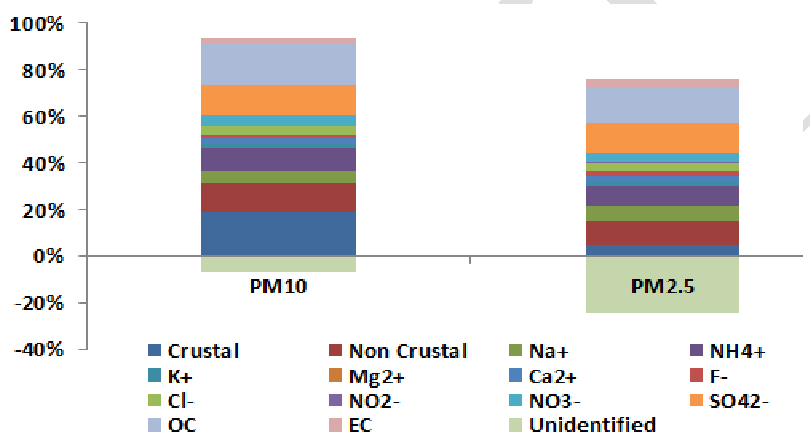


Figure 2.7 : Percent Contribution to Mass in PM_{10} and $PM_{2.5}$ at Vashi Plaza (Kerbside)

The Crustal (5.9%) and Non-crustal elements (12.5%) contributes for $PM_{2.5}$. Anions and cations contribute 26.9% and 23.2% of the total $PM_{2.5}$. Sulfate 15.7%, chlorides and nitrate 4% are highest in Anions, whereas, ammonia 10% and sodium 7% and calcium 4% are highest in Cation. The organic matter accounts for 18.2% and elemental carbon is around 3.9%. The negative discrepancy unidentified portion in PM_{10} was -29.1% indicates that the sum of identified species exceeded the measured mass. This is due to particle bound water and other analytical uncertainties.

Vashi Toll Naka (Kerbside): This monitoring site is another major hotspot for traffic, heavy vehicular movement which results in resuspension of road dust. The 56% and 23.7% is contribution of Crustal and Non-crustal elements in PM_{10} mass. Anions account for 23.1% of the total coarse particulate mass (sulphate 14.6%, nitrate and chloride 4%); whereas, Cations make up 27.1% of the total PM_{10} (ammonia 12%, sodium 6% and calcium 3.5%). The organic matter accounts for 25.3% and elemental carbon is around 4.2%. The highly vehicular movement reflected the area for maximum contribution. Unidentified portion in PM_{10} was 19.5% which may due to volatilization of organic matter and nitrates **(Figure 2.8)**.

The Crustal (5.6%) and Non-crustal elements (12.4%) contributes for $PM_{2.5}$. Anions and cations contribute 31.4% and 33.9% of the total $PM_{2.5}$. Sulfate 17.8%, chlorides 7% and nitrate 5.4% are high in Anions, whereas, ammonia, sodium and calcium are around 9%, and are higher in Cation. The organic matter accounts for 21.4% and elemental carbon is around 2.9%. The negative discrepancy unidentified portion in PM_{10} was -24.4% indicates that the sum of identified species exceeded the measured mass. This is due to particle bound water and other analytical uncertainties.

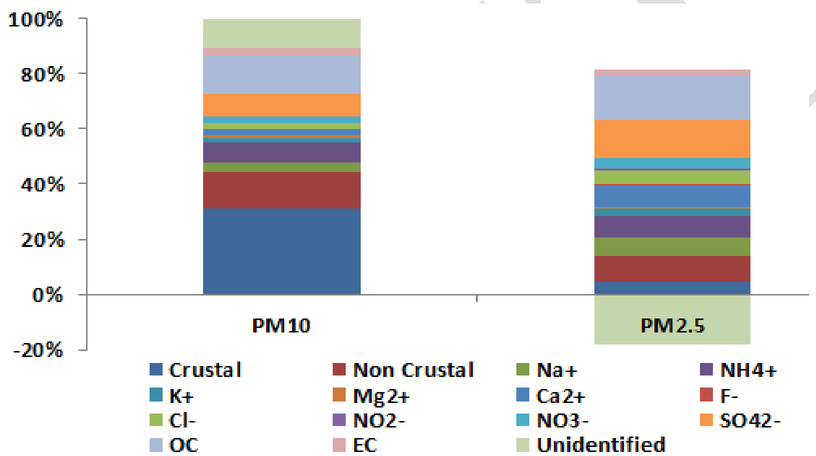


Figure 2.8 : Percent Contribution to Mass in PM_{10} and $PM_{2.5}$ at Vashi Toll Naka (Kerbside)

Juinagar-Thane Belapur Rd. (Industrial Site) : In TBIA belt, resuspension of dust due to anthropogenic activities and natural wind effect is the major cause. The Crustal and Non-crustal elements contribution is around 32.6% and 21% respectively to the PM_{10} mass. Anions account for 38.1% of the total coarse particulate mass, whereas Cations make up 34% of the total PM_{10}. The sulphate 17.9%, nitrate 11.7% and chloride 8.5% in anions, and ammonia 15.9%, calcium and potassium 4% sodium 7.8% in cations are the major contributors; as also the organic matter, accounting for 20.9%. The high contribution is probably due to secondary aerosol and road dust. Unidentified negative portion in PM_{10} was -14.4% indicates that the sum of identified species exceeded the measured mass **(Figure 2.9).**

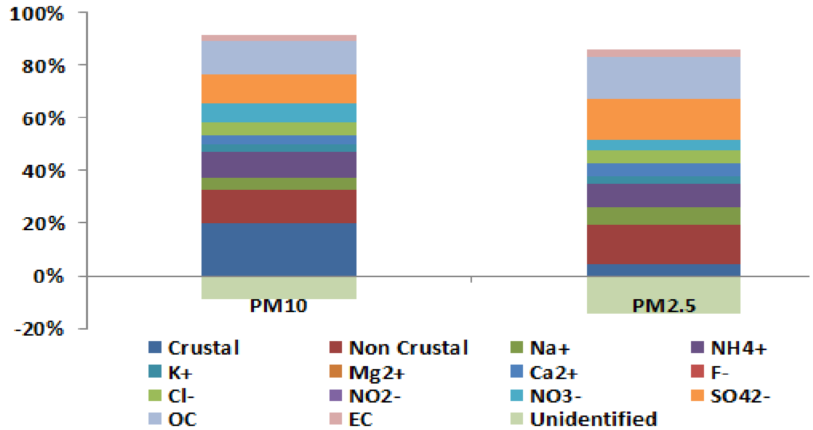


Figure 2.9 : Percent Contribution to PM_{10} and $PM_{2.5}$ at TBIA (Industrial Site)

Crustal and Non-crustal elements influence in $PM_{2.5}$ is around 5.2% and 18%. Anions and cations contribute 29% and 27.7% of the total $PM_{2.5}$. Sulfate 18.3%, nitrate and chlorides 4 to 6% are high in Anions, whereas ammonia 10.6%, sodium 7.9% and calcium 5.7% are higher in Cation, as also organic matter, accounting for 19.2%. Negative unidentified portion -16.9% in $PM_{2.5}$ is identified due to particle bound water and other analytical uncertainties.

Chapter 3

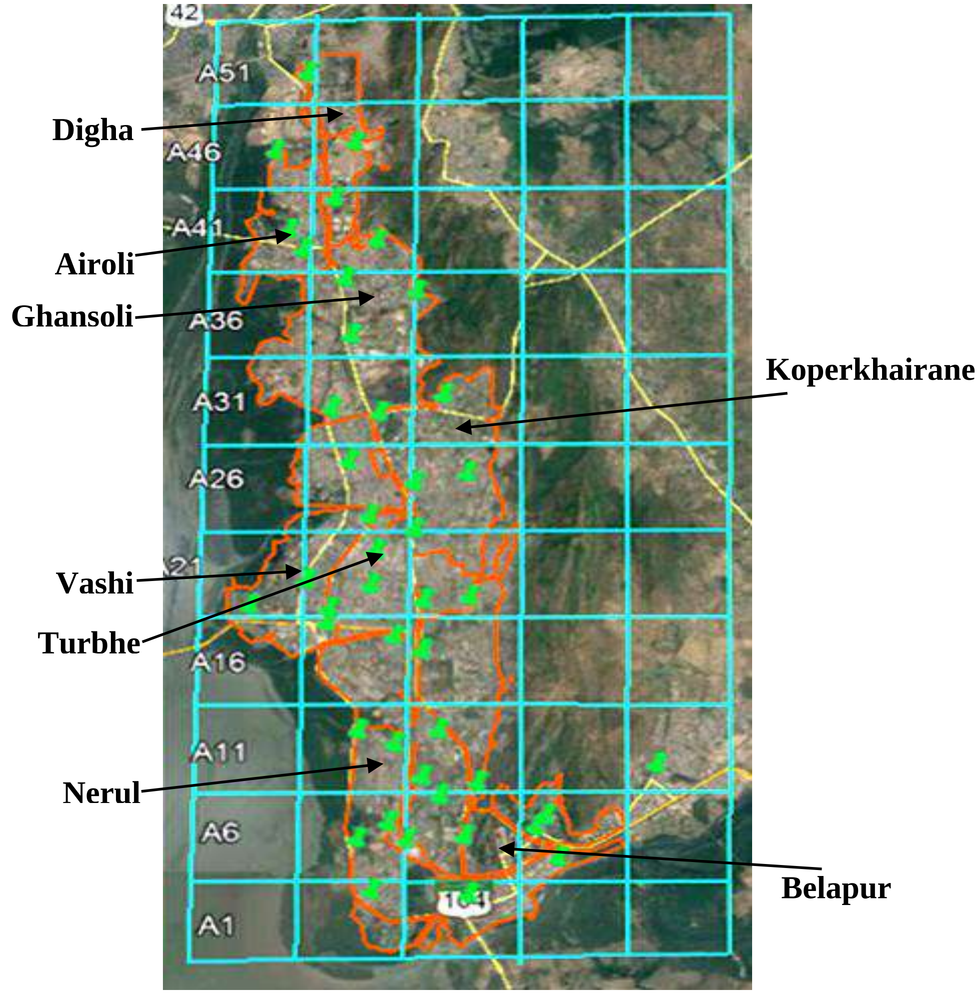
Emission Inventory

3.1 Preamble

As the city is expanding in terms of commerce and infrastructure development, there is increase in the rate of population and vehicular growth in the city. With this, there is increase in the level of anthropogenic activities in the region which contribute to overall emission load of the city. The unchecked increasing emission load of the region might lead to several health complexions in the general population. The identification of pollutant loads and to prepare the strategic action plan for controlling them is the need of the hour. Quantitative emissions estimates supplied by an inventory enable policymakers and the general public gains a better knowledge of actual emissions and raise awareness. Emission inventories are increasingly considered essential tools for a wide range of environmental measures, management of chemicals as well as the prevention of air pollution.

An emissions factor is a representative variable that attempts to link the amount of a pollutant emitted to the level of activity associated with that pollutant's emission. Emissions data when geographically and temporally distributed can be utilized as input data for atmospheric transport and dispersion models. After verification using ground monitoring data and/or data from satellite observations, the resulting air concentration and dispersion estimations derived by modeling will be critical information for air quality management decision-making. The key emission sources can be identified, emission reduction priorities can be established, and any data gaps that need to be filled can be discovered through this approach. An emission inventory can be used to forecast future emissions based on expected socio-economic indicators (e.g. population increase, economic growth, changes in energy usage per unit activity), lower emission factors (e.g. better control methods), fuel switching, and so on. Future emissions projections are crucial for determining emissions targets. One of the most important dimensions that characterize emission inventories is the spatial resolution of emission data. Inventory with high spatial resolution is required for micro scale or local scale assessments. Low spatial resolution inventories are sufficient for estimating background concentration.

Air pollution sources are broadly categorized as area (domestic and fugitive combustion type emission sources viz. domestic, bakeries, crematoria etc), industrial (point) sources and vehicular (line) sources. Emission inventory of different sources of air pollution has been prepared for 2 Km x 2 Km sizes for whole of Navi Mumbai for accurately identify and quantify emissions from different sources **(Figure 3.1)**. mission inventory has been prepared in terms of five major pollutants, viz. PM_{10}, SO_2, NOx, CO and HC.



Area Source : Navi Mumbai Municipal Corporation Ward Boundary
(A) Belapur, (B) Nerul, (C) Vashi, (D) Turbhe, (E) Koparkhairane,
(F) Ghansoli, (G) Airoli and (H) Digha
31 Vehicular Monitoring Locations and Red, Orange, Green Industries (LSI,MSI,SSI)
Study Area : 22 Kms (Vertical) x 10 Kms (Horizontal)

Figure 3.1: 2 Km X 2 Km Grid Distribution Map of Navi Mumbai City

3.2 Area Sources

Area sources are sources with relatively dispersed emissions over large areas and lead to proportionately constant source contributions over space but can have very large temporal changes in emissions. They are often collection of similar units within a geographic area. Though emissions from individual area sources are relatively small, collectively their emissions can be of concern - particularly where large numbers of sources are located in heavily populated areas. The emission load for volatile organic compound (VOC) emissions and particulate matter (PM) from area source accounts more proportion as compared to point and line sources. VOC significantly contribute towards the formation of ground level ozone. Area sources include the following groups, viz. bakeries, hotels/restaurants, crematories, construction activity, garages, domestic cooking, open eat outs, paved/unpaved road dust, solid waste dumping ground and refuse burning. Area source emissions are calculated by multiplying an established emissions factor (emissions per unit of activity) by the appropriate activity or activity surrogate responsible for generating emissions. Population is one of the more commonly used activity surrogates for area sources. In subsequent sections, these sources have been described along with the methodologies delineated for load estimation.

3.2.1 Bakery

About 60% of bakery industry in India is unorganized, being an essential item in urban areas, bakeries mainly operate from the midst of a city. According to NMMC, there are 8 bakeries in Navi Mumbai region, spread across 5 wards. To suffice the demands of Navi Mumbai's population for bakery products, the number of bakeries is few. There have been reported cases of unorganized bakeries comprising small bakery units, cottage and household type manufacturing, characterized by low levels of packing and distribution mainly in neighboring areas. These small time bakeries use outdated technologies and traditional methods of manufacturing baked goods that utilize solid fuels in large quantity. Wood burning is the main source of pollution from bakeries. Mostly bakeries operate for 16 hours in a day and the peak season of business is December and January. An initial survey with baker association pointed out that on average bakeries has 2 wood based operating ovens and the average amount of wood consumed per oven is 250 kg/day. Diesel consumption for oven operating is about 60 liters/day. Data regarding bakeries in each ward was obtained from NMMC, Public Health Department. The study area was divided into array of 2 Km x 2 Km grid to quantify the average fuel consumption and their subsequent emission across regions **(Table 3.1)**. Based on the local survey and estimates it was found that most of the bakeries use about 90% firewood and remaining 10% diesel. However, it was found only wood is being used as the fuel for ovens in these regions. Some of the bakeries also use electric ovens and PNG, however to a very limited extent. But the data for the same is not being inventoried to maintain such records. In our study, emission from wood consumption of these bakeries is taken into account.

Emission Estimations:

Emissions (kg/d) = No. of Bakeries x Fuel Consumption (kg/d) x Emission Factor
Number of registered bakeries with NMMC = 8
Wood consumption in a day = 250 (kg/d/oven) x 2 Ovens = 500 kg/d
Emission factor used are listed **Annexure I**
Emission Factor for Wood Burning = 17.3 (kg/t) (PM_{10})
Emission from wood burning (PM_{10}) = 8 x 500 x 17.3 = 69.2 (kg/d)

Table 3.1 : Fuel Consumption and Emission Loads from Bakeries for all Wards

Ward	Wood Bakeries	Wood Consu. (Kg/day)		Emission Load (Kg/day)						
				PM_{10}	$PM_{2.5}$	SO_2	NOx	HC	CO	CO_2
Belapur - A	2	1000		17.3	11.8	0.2	1.3	114.5	126.3	1700.0
Vashi – C	1	500		8.7	5.9	0.1	0.7	57.3	63.2	850.0
Turbhe – D	3	1500		26.0	17.7	0.3	2.0	171.8	189.5	2550.0
Koparkhairane -E	1	500		8.7	5.9	0.1	0.7	57.3	63.2	850.0
Ghansoli - F	1	500		8.7	5.9	0.1	0.7	57.3	63.2	850.0
Total	**8**	**4000**	**Kg/d**	**69.2**	**47.1**	**0.8**	**5.2**	**458.0**	**505.2**	**6800.0**
			T/Yr	**25.3**	**17.2**	**0.3**	**1.9**	**167.2**	**184.4**	**2482.0**

As there are 3 bakeries registered in Ward -D, the emission load for all the parameters from Ward D is highest, followed by Ward A. Total PM_{10} load emission from bakeries comes around 69.2 kg/d. The other major pollutant reflected as HC and CO_2 as there is wood burning activity.

3.2.2 Crematoria

Hindus consider a fiery dissolution of the body as death rites for cremation. According to NMMC there are around 27 Hindu crematoria in the city. Of these, 25 are wood based and 2 are electrically operated by NMMC or privately owned. As per the assumption from previous studies and in consultation with NMMC, the average wood requirement for burning a dead body is about 300 kg and 3 liters (2.43 kg) of kerosene. Emission from this category of Area source release major pollutants like PM_{10}, CO, HC, SO_2, and NOx. Data regarding crematoria in each ward was obtained from NMMC's Public Health Department. The number of crematoria operating wards wise and number of Hindu deaths reported in each ward as per NMMC is given in **Table 3.2**. The wood and diesel consumption of crematorium for each ward is represented in **Table 3.3**.

Table 3.2 : Ward Wise Distribution of Crematoria and Registered Hindu Deaths (2018-19)

Ward /Name	Crematoria Locations	Wood	Electric	Bodies incarcerated at Wood Crematorium	Bodies incarcerated at Electric Crematorium
A Belapur	Belapur	1	--	314	--
	Devale	1	--	39	--
	Karave	1	--	243	--
	Darave	1	--	76	--
B Nerul	Juinagar_Sarsole	1	--	578	--
	Nerul Gaon	1	--	34	--
	Sector 2_Shirvane	1	1	24	9

Table 3.2 (Contd..): Ward Wise Distribution of Crematoria & Registered Hindu Deaths

Ward /Name	Crematoria Locations	Wood	Electric	Bodies incarcerated at Wood Crematorium	Bodies incarcerated at Electric Crematorium
C Vashi	VashiGaon	1	--	41	--
	Juhu Gaon	1	--	18	--
	Kopari Gaon	1	--	9	--
D Turbhe	Sector 19 Turbhe	1	1	215	67
	Sector 5 Sanpada	1	--	39	--
	Sector 23 Juipada	1	--	3	--
E Koparkhairane	Mukti Dham	1	--	395	--
	Vakunta Dham	1	--	22	--
	Bonkode	1	--	26	--
	Pawane Gaon	1	--	11	--
	Mahape Gaon	1	--	22	--
	Advali Butavali	1	--	5	--
F Ghansoli	Rabale Gaon	1	--	111	--
	Talavali Gaon	1	--	11	--
	Gothivali	1	--	11	--
	Ghansoli Gaon_1	1	--	66	--
	Ghansoli Gaon_2	1	--	17	--
G Airoli	Divagaon	1	--	174	--
	Airoli Gaon	1	--	412	--
H Digha	Digha 3 Nos.	3	--	365	--
Total		**25**	**2**	**3281**	**76**

-- Crematoria is not present in the respective war

Table 3.3 : Ward Wise Distribution of Bodies Burnt and Wood and Kerosene Consumption

Ward	Number of Bodies burnt in Wood Crematoria	Number of Bodies burnt in Electric Crematoria	Total Wood Consumption (kg)	Total Kerosene Consumption (kg)
A	672	--	201600	1632.96
B	636	9	190800	1545.48
C	68	--	20400	165.24
D	257	67	77100	624.51
E	481	--	144300	1168.83
F	216	--	64787	525
G	586	--	175800	1424
H	365	--	109500	887
Total	**3281**	**76**	**984287**	**7973**

Emission Estimations:

Emission (TSP) =No. of Hindu Death /yr * wood required per body (kg) * emission factor

And Number of Hindu Death /yr * fuel used (kerosene -liters) * emission factor

Number of Registered death in Navi Mumbai = 3357

Total dead bodies in fire wood crematoria = 3281 (deaths/yr)

Total dead bodies in fire wood crematoria = 76 (deaths/yr)

Emission factor for wood burning, kerosene and electric crematoria are listed in **Annexure I.**

Emission Factor (PM_{10}) Wood Consumption = 17.3 (kg/t)

Emission Factor (SPM) Kerosene = 1.95 (kg/t)

Emission Factor (PM_{10}) Kerosene = 0.61 (kg/t)

Emission Factor Electric crematoria = 0.000025 (kg/body)

Emission (PM_{10}) from wood burning = 3281 (deaths/yr) * 0.3 (t) * 17.3 (kg/t) =17028.4 (kg/yr)

[Average kerosene consumption /body =3 liters*0.81 (density in kg/l) = 2.43 (kg) =0.00243 (T)]

Emission (PM) from Kerosene burning = 3281 (deaths/yr) * 0.00243 (T) * 1.95 (SPM) (kg/t) * 0.61 (PM) (kg/t) = 4.86 (kg/year)

Emission (PM_{10}) from Electric burning = 76 (deaths/yr) * 0.000025 (kg/t) = 0.0019 (kg/yr)

In similar way emission for others pollutants and their ward wise distribution have been estimated and presented in **Table 3.4.** Along with emissions from fuel consumptions, body burn emissions are also accounted for. Crematoria related emissions load were majorly estimated from Ward A (Belapur) and Ward B (Nerul) as number of reported is high in a year.

Table 3.4 : Total Emission Estimates for Crematoria

Wards	**Total Crematoria Emissions /yr.**							
	PM_{10}	**$PM_{2.5}$**	**SO_2**	**NOx**	**HC**	**CO**	**CO2**	**NVOC**
A	3488.7	2372.3	83.4	473.1	23123.0	25658.1	342720	8.7
B	3301.8	2245.2	79.4	450.6	21884.3	24284.8	324360	8.3
C	353.0	240.1	8.4	47.9	2339.8	2596.4	34680	0.9
D	1334.2	907.3	35.5	201.6	8844.0	9822.1	131070	3.3
E	2497.1	1698.0	59.7	338.7	16550.8	18365.4	245310	6.3
F	1121.1	762.4	26.8	152.0	7430.9	8245.6	110138	2.8
G	3042.2	2068.7	72.7	412.6	20163.8	22374.5	298860	7.6
H	1894.9	1288.5	45.3	257.0	12559.3	13936.3	186150	4.7
Kg/day	**46.7**	**31.7**	**1.1**	**6.4**	**309.3**	**343.2**	**4584.4**	**0.1**
Ton./year	**17.0**	**11.6**	**0.4**	**2.3**	**112.9**	**125.3**	**1673.3**	**0.04**

Table 3.4 (Contd..) : Fuel wise Emission Estimates for Crematoria

Wards	Wood Emissions /yr.							Electric Emissions /yr.					
	PM_{10}	$PM_{2.5}$	SO_2	NOx	HC	CO	CO2	PM_{10}	$PM_{2.5}$	SO_2	NOx	HC	CO
A	3487.7	2371.6	40.3	262.1	23083.2	25462.1	342720	--	--	--	--	--	--
B	3300.8	2244.6	38.2	248.0	21846.6	24098.0	324360	0.0002	0.0002	0.490	2.772	0.117	1.269
C	352.9	240.0	4.1	26.5	2335.8	2576.5	34680	--	--	--	--	--	--
D	1333.8	907.0	15.4	100.2	8828.0	9737.7	131070	0.0017	0.0011	3.6448	20.6360	0.8710	9.4470
E	2496.4	1697.5	28.9	187.6	16522.4	18225.1	245310	--	--	--	--	--	--
F	1120.8	762.2	13.0	84.2	7418.1	8182.6	110138	--	--	--	--	--	--
G	3041.3	2068.1	35.2	228.5	20129.1	22203.5	298860	--	--	--	--	--	--
H	1894.4	1288.2	21.9	142.4	12537.8	13829.9	186150	--	--	--	--	--	--
Kg/day	**46.7**	**31.7**	**0.5**	**3.5**	**308.8**	**340.6**	**4584.4**	**5.21E-06**	**3.54E-06**	**1.13E-02**	**6.41E-02**	**2.71E-03**	**2.94E-02**
Ton./year	**17.0**	**11.6**	**0.2**	**1.3**	**112.7**	**124.3**	**1673.3**	**1.90E-06**	**1.29E-06**	**4.13E-03**	**2.34E-02**	**9.88E-04**	**1.07E-02**

Wards	Kerosene Emissions /yr.						Body Burn Emissions/yr					
	PM_{10}	$PM_{2.5}$	SOx	NOx	HC	CO	PM_{10}	$PM_{2.5}$	SOx	NOx	HC	CO
A	1.00	0.68	6.53	4.08	31.03	101.24	0.02	0.01	36.56	206.98	8.74	94.75
B	0.94	0.64	6.18	3.86	29.36	95.82	0.02	0.01	34.60	195.89	8.27	89.68
C	0.10	0.07	0.66	0.41	3.14	10.24	0.00	0.00	3.70	20.94	0.88	9.59
D	0.38	0.26	2.50	1.56	11.87	38.72	0.01	0.00	13.98	79.16	3.34	36.24
E	0.71	0.48	4.68	2.92	22.21	72.47	0.01	0.01	26.17	148.15	6.25	67.82
F	0.32	0.22	2.10	1.31	9.97	32.54	0.01	0.00	11.75	66.51	2.81	30.45
G	0.87	0.59	5.70	3.56	27.06	88.29	0.01	0.01	31.88	180.49	7.62	82.63
H	0.54	0.37	3.55	2.22	16.85	54.99	0.01	0.01	19.86	112.42	4.75	51.47
Kg/day	**0.01**	**0.01**	**0.09**	**0.05**	**0.42**	**1.35**	**0.0002**	**0.0002**	**0.5**	**2.8**	**0.1**	**1.3**
Ton./year	**0.005**	**0.003**	**0.032**	**0.020**	**0.151**	**0.494**	**0.0001**	**0.0001**	**0.2**	**1.0**	**0.04**	**0.5**

Issues

- Hindu cremation processes vary substantially due to the quantity and type of wood used and type of pyres prepared.

3.2.3 Open Eat-outs

In India, the national policy for urban street vendors /hawkers notes that street vendors constitute approximate 2% of the population of a metropolis. Municipal Corporation /government consider street vendors as encroachers, but this forms an important unorganized sector of business and livelihood. This informal sector even though being small in size, contribute emission load on large area because of the fuel consumption for their operations and absence of any control measures for these emissions. On the basis of primary survey, 40% of the vendors use kerosene as fuel followed by LPG-50% and coal-about 10%. The average consumption of kerosene per day is approximately 8 liters, 4 kg/day of LPG and 10 kg/day of coal for cooking purpose. Average operating hours of street vendors is 12 hours. Data regarding number of street vendors is not available since it is considered as illegal operation in NMMC jurisdiction. Therefore, NMMC regularly takes action on street vendors and the data is documented. Based on the data of areas of such action taken on number of street vendors by NMMC (License Department), fuel consumption pattern was quantified. It was found that there are considerable amount of open eat-outs and hawkers operating at Ward -D (Turbhe), where the floating population is concentrated around industrial areas. These number have been checked by visiting representative where these eat outs are prevalent. Distribution of open eats outs and their respective fuel consumption is presented in **Table 3.5**.

Assumption

- Fuel use pattern was estimated on the basis of primary survey which involved consultations with operators, municipal authorities and vendors.

Table 3.5 : Ward wise Distribution of Open Eat-outs

Wards	Street Vendors	S. Vendors Operated on Kerosene	S. Vendors Operated on LPG	S. Vendors Operated on Coal	Kerosene Consumption (litres)	LPG Consumption (kg)	Coal Consumption (kg)
A	28	11	14	3	90	56	28
B	32	13	16	3	102	64	32
C	57	23	29	6	182	114	57
D	263	105	132	26	842	526	263
E	74	30	37	7	237	148	74
F	19	8	10	2	61	38	19
G	65	26	33	7	208	130	65
H	34	14	17	3	109	68	34
Total	**572**	**229**	**286**	**57**	**1830**	**1144**	**572**

Emission Estimates

Per capita consumption for each type of fuel is taken as
For Kerosene – 8 lits/stall/day, For LPG – 4 kg /day, For Coal – 10 kg/day
Total emissions = emissions from kerosene burning + LPG burning + Coal burning

Emission from kerosene burning (PM) per day
= Number of street vendors operating on kerosene x fuel consumption per day x emission factor
= 229 x 8 x 0.81 (density)/ 1000 x 0.61x 0.06 =0.0543 kg/d

Emission from LPG burning (PM) per day
= Number of street vendors operating on LPG x fuel consumption per day x emission factor
= 286 x 4 / 1000 x 2.10 = 2.4 kg/d

Emission from Coal burning (PM) per day
= Number of street vendors operating on Coal x fuel consumption per day x emission factor
= 57 x 10 /1000 x (20 EF SPM) x 0.6 (EF PM)= 6.84 kg/d

Emission for others pollutants and Ward-specific contribution have been estimated, and is presented in **Table 3.6.**

Table 3.6 : Fuel wise Emission Load from Open Eat-out

Wards	SPM	PM_{10}	$PM_{2.5}$	SOx	NOx	HC	CO
	Kerosene Emissions (kg/d)						
A	0.004	0.003	0.002	0.293	0.183	1.391	4.539
B	0.005	0.003	0.002	0.335	0.209	1.590	5.188
C	0.009	0.005	0.004	0.596	0.373	2.832	9.241
D	0.041	0.025	0.017	2.751	1.719	13.067	42.638
E	0.012	0.007	0.005	0.774	0.484	3.677	11.997
F	0.003	0.002	0.001	0.199	0.124	0.944	3.080
G	0.010	0.006	0.004	0.680	0.425	3.229	10.538
H	0.005	0.003	0.002	0.356	0.222	1.689	5.512
KG/Day	**0.090**	**0.055**	**0.037**	**5.983**	**3.739**	**28.419**	**92.734**
Tons/Yr	**0.033**	**0.020**	**0.014**	**2.184**	**1.365**	**10.373**	**33.848**

Wards	LPG Emissions (kg/d)						
	PM_{10}	$PM_{2.5}$	SOx	NOx	HC	CO	CO_2
A	0.12	0.12	0.02	0.10	0.004	0.01	96.10
B	0.13	0.13	0.03	0.12	0.005	0.02	109.82
C	0.24	0.24	0.05	0.21	0.008	0.03	195.62
D	1.10	1.10	0.21	0.95	0.038	0.13	902.62
E	0.31	0.31	0.06	0.27	0.011	0.04	253.97
F	0.08	0.08	0.02	0.07	0.003	0.01	65.21
G	0.27	0.27	0.05	0.23	0.009	0.03	223.08
H	0.14	0.14	0.03	0.12	0.005	0.02	116.69
KG/Day	**2.40**	**2.40**	**0.46**	**2.06**	**0.082**	**0.29**	**1963.10**
Tons/Yr	**0.88**	**0.88**	**0.17**	**0.75**	**0.030**	**0.11**	**716.53**

Table 3.6 (Contd..) : Fuel wise Emission Load from Open Eat Out

Wards	Coal Emissions (kg/d)						Total Open Eatout Emissions (kg/d)						
	PM_{10}	$PM_{2.5}$	SOx	NOx	HC	CO	PM_{10}	$PM_{2.5}$	SOx	NOx	HC	CO	CO_2
A	0.3	0.2	0.4	0.1	0.01	0.7	0.46	0.35	0.69	0.40	1.41	5.25	96.10
B	0.4	0.3	0.4	0.1	0.02	0.8	0.52	0.40	0.79	0.45	1.61	6.00	109.82
C	0.7	0.5	0.8	0.2	0.03	1.4	0.93	0.71	1.40	0.81	2.87	10.69	195.62
D	3.2	2.1	3.5	1.0	0.13	6.6	4.29	3.27	6.46	3.72	13.24	49.32	902.62
E	0.9	0.6	1.0	0.3	0.04	1.8	1.21	0.92	1.82	1.05	3.72	13.88	253.97
F	0.2	0.2	0.3	0.1	0.01	0.5	0.31	0.24	0.47	0.27	0.96	3.56	65.21
G	0.8	0.5	0.9	0.3	0.03	1.6	1.06	0.81	1.60	0.92	3.27	12.19	223.08
H	0.4	0.3	0.5	0.1	0.02	0.8	0.55	0.42	0.84	0.48	1.71	6.38	116.69
kg/day	**6.9**	**4.7**	**7.6**	**2.3**	**0.29**	**14.3**	**9.32**	**7.11**	**14.05**	**8.08**	**28.79**	**107.28**	**1963.10**
Ton/year	**2.5**	**1.7**	**2.8**	**0.8**	**0.10**	**5.2**	**3.40**	**2.59**	**5.13**	**2.95**	**10.51**	**39.16**	**716.53**

Accounting the commercial and mixed activities in and around Ward D & E, the likelihood of floating population is high. The number of illegal and unorganized open eat outs in this region is highest as compared to other wards. Thus, the emission load from these wards is maximum and lowest from Ward A (Belapur) and Ward F (Ghansoli). CO & HC are the major other contributors to total emission load from open eat outs.

Issues

- Fuel consumption given by street vendor during primary survey may not be very reliable
- The actual number of street vendors could be high /low than the estimated depending upon time, season and locations.

3.2.4 Hotels & Restaurants

Information of hotels and restaurant was obtained directly from License Department of NMMC**.** There are around 1166 Hotels registered with the NMMC License department. Ward-wise break up is presented in **Table 3.7**. During the discussions with the authorities, it was concluded that the large proportion actual number of tea stalls/snack corners/fast food centers could be more than twice the registered number and remains unaccountable. In addition, institutions and organizations have their own canteen/hotels within their premises and their fuel consumption patterns are unknown. Hotels and Restaurants use LPG cylinders and coal for their operation. LPG commercial cylinders are used for cooking and coal is used in the tandoor bhattis, which are often operated in open or without any efficient control measures. The primary survey of Hotels and Restaurants gave an average LPG consumption of 2 Cylinders (19 kg capacity) and coal consumption of 8 kg per hotel/restaurant as per the survey. The total LPG consumption of hotels in the city is around 44308 kg/day.

Table 3.7 : Ward wise Number of Hotels & Restaurants and their Fuel Consumption (Registered under NMMC : 2018-19)

Name	Registered Hotels & Restaurants	LPG Consumption (Kg)	Coal Consumption (Kg)
A	188	7144	1504
B	210	7980	1680
C	197	7486	1576
D	178	6764	1424
E	195	7410	1560
F	60	2280	480
G	130	4940	1040
H	8	304	64
Total	**1166**	**44308**	**9328**

Emission Estimations

- Emission Load from LPG

  Since LPG burning doesn't comprise of coarse particles, an assumption that only $PM_{2.5}$ particles are present in the LPG emissions is made and considered as PM.

  Total emissions ($PM_{2.5}$) due to LPG burning in Hotels

  = Number of Hotels x LPG consumption (Tons/day) x Emission Factor (Kg/MT) **(Annexure I)**

  Total $PM_{2.5}$ emissions due to LPG burning in Hotels

  = 1166 x (2 x 19/1000 Tons/day) x 2.1 Kg/MT = 93.05 Kg/Day

  However, for calculation purposes, it has been referred to as PM_{10}.

The emission load calculated for different fuel pattern and their ward distribution is presented in **Table 3.8.**

- Emission Load from Coal

Total emissions (PM) due to coal burning in Hotels = No. of Hotels x Coal consumption (Tons/day) x Emission Factor (Kg/MT)
= 1166 x 8/1000 Tons/day x 20 kg/MT (EF SPM) x 0.6 (PM) = 111.94 Kg/Day

Table 3.8 : Fuel wise Distribution of Emission Load from Hotel and Restaurants

Wards	LPG Emission (kg/d)							Coal Emission (kg/d)					
	PM_{10}	$PM_{2.5}$	SO_2	NO_2	HC	CO	CO_2	PM_{10}	$PM_{2.5}$	SO_2	NO_2	HC	CO
A	15.0	15.0	2.9	12.9	0.51	1.8	12259.1	18.0	12.3	20.0	6.0	0.75	37.5
B	16.8	16.8	3.2	14.4	0.57	2.0	13693.7	20.2	13.7	22.3	6.7	0.84	41.9
C	15.7	15.7	3.0	13.5	0.54	1.9	12846.0	18.9	12.9	21.0	6.3	0.79	39.3
D	14.2	14.2	2.7	12.2	0.49	1.7	11607.0	17.1	11.6	18.9	5.7	0.71	35.5
E	15.6	15.6	3.0	13.3	0.53	1.9	12715.6	18.7	12.7	20.7	6.2	0.78	38.9
F	4.8	4.8	0.9	4.1	0.16	0.6	3912.5	5.8	3.9	6.4	1.9	0.24	12.0
G	10.4	10.4	2.0	8.9	0.36	1.2	8477.0	12.5	8.5	13.8	4.1	0.52	25.9
H	0.6	0.6	0.1	0.5	0.02	0.1	521.7	0.8	0.5	0.9	0.3	0.03	1.6
Kg/day	**93.0**	**93.0**	**17.7**	**79.8**	**3.19**	**11.2**	**76032.5**	**111.9**	**76.1**	**124.1**	**37.2**	**4.66**	**232.5**
Ton/Yr	**34.0**	**34.0**	**6.5**	**29.1**	**1.16**	**4.1**	**27751.9**	**40.9**	**27.8**	**45.3**	**13.6**	**1.70**	**84.8**

	Total Emission Hotel and Restaurants (Kg/d)						
	PM_{10}	$PM_{2.5}$	SO_2	NO_2	HC	CO	CO_2
A	33.1	27.3	22.9	18.9	1.3	39.3	12259.10
B	36.9	30.5	25.5	21.1	1.4	43.9	13693.68
C	34.6	28.6	24.0	19.8	1.3	41.2	12845.98
D	31.3	25.8	21.6	17.9	1.2	37.2	11607.02
E	34.3	28.3	31.3	15.0	1.3	40.7	12715.56
F	10.5	8.7	7.3	6.0	0.4	12.5	3912.48
G	22.9	18.9	15.8	13.0	0.9	27.2	8477.04
H	1.4	1.2	1.0	0.8	0.1	1.7	521.66
Kg/day	**205.0**	**169.2**	**149.4**	**112.4**	**7.9**	**243.6**	**76032.53**
Ton/Yr	**74.8**	**61.7**	**54.5**	**41.0**	**2.9**	**88.9**	**27751.87**

Nerul is an up market residential and commercial node in Navi Mumbai, and the number of registered hotel is highest in this area. The emissions attributed to these sources are highest from Ward B (Nerul), followed by Ward C (Vashi). Next highest emissions are from Ward E, A, D, G, F and H, respectively as residential block have also witness the Hotels/ Restaurants. About 205 kg/day of PM_{10} is being released from these area sources, while $PM_{2.5}$ is released in the concentration of 169 kg/day. HC, NOx and SOx are also higher contributing to the total emission load. [**Issues :** Domestic cylinders are also consumed in the commercial sector illegally for which data was not easily available].

3.2.5 Domestic Sector

There are 8 wards under Navi Mumbai Municipal Corporation. The fuel usage pattern of slum and non-slum population is different. As non-slum population is more organized considering source of income, their primary domestic fuel is LPG. The recent infrastructural changes brought by the oil companies, has made PNG an easily available domestic fuel. The total number of gas agencies distributing LPG across city is 22, with 14590 subscriptions per agencies. Mahanagar Gas Ltd. is the major shareholders for the supply of LPG in the city. In the year 2016-17, numbers of LPG connections 3,20,980 were registered with the gas agencies of the city. The average LPG consumption of the Navi Mumbai for the day was estimated to be around 156210 Kg/d, while that of PNG consumption was found to be 3335.2 Kg/day. Out of the total population of 1.5 million, the highest slum population is found in Ward F- Ghansoli and the lowest is in Ward A- Belapur. Based on the survey, it was observed that the consumption of kerosene in slum population is prevalent. Average kerosene consumption by a slum household is about 25 Liters/month and average kerosene consumption by a non-slum household is 3 Liters/month. The number of members in a slum household and non-slum household is assumed to be 6 and 5 respectively. Ward wise fuel consumption viz. LPG -Cylinder consumption and Slum and Non-slum kerosene consumption is presented in **Table 3.9**. Ward wise LPG cylinders consumption data is obtained from State Level Oil Coordination Committee (SLOC).

Table 3.9 : Ward wise Fuel Consumption in Domestic Sector

Ward	Area	LPG Consumption (kg/day)	PNG Consumption (kg/day)	Slum Kerosene Consumption (lit/d)	Non Slum Kerosene Consumption (lit/d)
A	Belapur	7100	152	2321	1337
B	Nerul	35502	758	8553	4929
C	Vashi	14201	303	4464	2572
D	Turbhe	21301	455	6752	3891
E	Koparkhairane	28402	606	6998	4032
F	Ghansoli	21301	455	8811	2962
G	Airoli	14201	303	4204	2759
H	Digha	14201	303	5953	1593
	Total	**156210**	**3335.2**	**3335**	**48057**

Emission Estimation

- Emission Load from LPG

Total emissions (PM) from LPG burning for domestic cooking
= Number of LPG cylinders consumed x Capacity of the cylinder (14.6 Kg) x Em. Factor (Kg/MT)
= 156210 x 2.1/1000 kg/d= 328.04 Kg/Day (**Annexure I)**

Census data was obtained from Census 2001, Percentage of Slum population from each ward is calculated according to *(Dr.D.P.Singh, Slum Population in Mumbai: Part I, Population – ENVIS Centre IIPS, Vol.3, No.1, March, 2006)*
Number of Household was calculated on the assumption that there are 6 members from one slum-household and 5 members in non -slum household

Kerosene consumption per slum household = 25 liters/month = 0.833Liters/day
Kerosene consumption per non-slum household = 3liters/month = 0.1 Liters/day

Total emissions (PM) from kerosene burning per day in a household = number of households x kerosene consumption (tons/day) x emission factor (Kg/MT)

Total emissions (PM) from kerosene burning per day in a slum household
= 48056.83 (l/d) x 0.61 g/Kg = 23.95 Kg/day

Total emissions (PM) from kerosene burning per day in a non-slum household
= 24075 x 0.61 g/Kg = 14.68 Kg/day

In case of LPG/PNG consumption, all $PM_{2.5}$ emissions are estimated to be in terms of PM_{10}. Domestic emission load from LPG, PNG and kerosene with respect to their pollutants have been estimated and their ward wise distribution is presented in **Table 3.10.**

Table 3.10 : Fuel wise Distribution of Emission Load from Domestic Sector

Wards	LPG Emissions (Kg/d)							PNG Emissions (Kg/d)					
	PM_{10}	$PM_{2.5}$	SO_2	NOx	VOC	CO	CO_2	PM_{10}	$PM_{2.5}$	SO_2	NOx	HC	CO
A	14.91	14.91	2.8	357.9	14.3	50.1	341163	0.00001	0.00001	0.000001	0.00042	0.00001	0.00004
B	74.55	74.55	14.2	1789.3	71.6	250.5	1705816	0.00007	0.00005	0.000007	0.00212	0.00004	0.00021
C	29.82	29.82	5.7	715.7	28.6	100.2	682326	0.00003	0.00002	0.000003	0.00085	0.00001	0.00008
D	44.73	44.73	8.5	1073.6	42.9	150.3	1023490	0.00004	0.00003	0.000004	0.00127	0.00002	0.00012
E	59.64	59.64	11.4	1431.5	57.3	200.4	1364653	0.00006	0.00004	0.000006	0.00170	0.00003	0.00016
F	44.73	44.73	8.5	1073.6	42.9	150.3	1023490	0.00004	0.00003	0.000004	0.00127	0.00002	0.00012
G	29.82	29.82	5.7	715.7	28.6	100.2	682326	0.00003	0.00002	0.000003	0.00085	0.00001	0.00008
H	29.82	29.82	5.7	715.7	28.6	100.2	682326	0.00003	0.00002	0.000003	0.00085	0.00001	0.00008
Kg/d	**328.04**	**328.04**	**62.5**	**7873**	**314.9**	**1102.2**	**7505591**	**0.00033**	**0.00022**	**0.00003**	**0.00934**	**0.00016**	**0.00091**
T/year	**119.74**	**119.74**	**22.8**	**2873.6**	**114.9**	**402.3**	**2739541**	**0.00012**	**0.00008**	**0.00001**	**0.00341**	**0.00006**	**0.00033**

Wards	Kerosene Emissions from Slums (Kg/d)					Kerosene Emissions from Non Slums (Kg/d)					Total Kerosene Emissions from Slum + Non Slums (Kg/d)				
	PM_{10}	$PM_{2.5}$	SO_2	NOx	CO	PM_{10}	$PM_{2.5}$	SO_2	NOx	CO	PM_{10}	$PM_{2.5}$	SO_2	NOx	CO
A	1.16	0.79	7.59	4.74	117.59	0.67	0.45	4.37	2.73	67.76	1.83	1.24	11.96	7.47	185.35
B	4.26	2.90	27.96	17.47	433.34	2.46	1.67	16.11	10.07	249.70	6.72	4.57	44.07	27.54	683.04
C	2.23	1.51	14.59	9.12	226.17	1.28	0.87	8.41	5.26	130.33	3.51	2.38	23	14.38	356.5
D	3.37	2.29	22.07	13.79	342.10	1.94	1.32	12.72	7.95	197.13	5.31	3.61	34.79	21.74	539.23
E	3.49	2.37	22.87	14.30	354.52	2.01	1.37	13.18	8.24	204.29	5.5	3.74	36.05	22.54	558.81
F	4.39	2.99	28.80	18.00	446.41	1.48	1.00	9.68	6.05	150.05	5.87	3.99	38.48	24.05	596.46
G	2.10	1.42	13.74	8.59	212.99	1.38	0.94	9.02	5.64	139.78	3.48	2.36	22.76	14.23	352.77
H	2.97	2.02	19.46	12.16	301.59	0.79	0.54	5.21	3.25	80.69	3.76	2.56	24.67	15.41	382.28
Kg/d	**23.95**	**16.29**	**157.08**	**98.17**	**2434.72**	**12.00**	**8.16**	**78.69**	**49.18**	**1219.72**	35.95	24.45	235.77	147.35	3654.44
T/year	**8.74**	**5.95**	**57.33**	**35.83**	**888.67**	**4.38**	**2.98**	**28.72**	**17.95**	**445.20**	13.12	8.93	86.05	53.78	1333.87

Table 3.10 (Contd..) : Fuel wise Distribution of Emission Load from Domestic Sector

Wards	Total Domestic Emissions (Kg/d)						
	PM_{10}	$PM_{2.5}$	SO_2	NOx	VOC (HC)	CO	CO_2
A	16.7	16.2	14.8	365.3	14.3	235.4	341163.2
B	81.3	79.1	58.3	1816.9	71.6	933.5	1705816.1
C	33.3	32.2	28.7	730.1	28.6	456.7	682326.4
D	50.0	48.3	43.3	1095.3	42.9	689.5	1023489.7
E	65.1	63.4	47.4	1454.0	57.3	759.2	1364652.9
F	50.6	48.7	47.0	1097.6	42.9	746.8	1023489.7
G	33.3	32.2	28.4	730.0	28.6	453.0	682326.4
H	33.6	32.4	30.3	731.1	28.6	482.5	682326.4
Kg/d	**364.0**	**352.5**	**298.3**	**8020.4**	**314.9**	**4756.7**	**7505590.9**
T/year	**132.9**	**128.7**	**108.9**	**2927.4**	**114.9**	**1736.2**	**2739540.7**

Domestic sector maximum emission of PM is from Ward B Nerul area (i.e 81.3 kg/d). Both kerosene and LPG emissions are high in Ward B as compared to other wards (where higher population 3,08,044 reflect). Ward E Koparkhairane has the next maximum emission of PM (65.1 kg/d) (as population 252015 is high). Total PM load is around 364 kg/d. The NOx emission is high 8020 kg/d as LPG cylinders consumption is high 156210 kg/d. The other major pollutant reflected as CO, HC, and SO_2, CO_2.

3.2.6 Open Burning

It is estimated that solid waste generated in small, medium and large cities and towns in India is about 0.1 kg, 0.3-0.4 kg and 0.5 kg per capita per day respectively. Rapid urbanization combined with development will double the solid waste generation. Urban centres generate disproportionately high waste, sometimes creating unrest around the way they are disposed. Most of the waste is sent to landfills, or worse, to open dumps, raising concerns about air pollution, social unrest, and impact on poverty and so on. Open burning is one of the major contributors in Area Sources. Open burning is an illegal method of burning solid waste; materials commonly disposed of in this manner include municipal waste, auto body components, wood refuse, small scale industrial refuse and leaves. As these open burning cases often get unreported and data for the same is missing, it was assumed that about 1% of the total solid waste generated in each ward is openly burnt and about 4% of the total solid waste is burnt in the wards containing solid waste landfill sites as given in **Table 3.11**. The quantity of ward wise solid waste generated was obtained from corporation, solid waste management division.

Table 3.11 : Ward wise & Landfill Site, Solid Waste Generation and Their Open Burnt Percent Contribution

Wards	Region	Solid waste generation in Tonnes	Open Burning
A	Belapur	36.36	0.36
B	Nerul	134.00	1.34
C	Vashi	69.94	0.70
D	Turbhe	105.79	1.06
E	Koparkhairane	109.63	1.10
F	Ghansoli	92.03	0.92
G	Airoli	73.18	0.73
H	Digha	53.29	0.53
TOTAL (MTD)		**674.21**	**6.74**

Landfill Sites	Solid Waste at Landfill Site	Open Burning (4%)
Turbhe	725	29

Emission Estimation

Total emissions (PM) from open burning of solid waste = Amount of solid waste generated (tons) x percentage of solid waste burnt x emission factor (Kg/MT) = [674.21 (tons) x 1% (non dumping site) + 725 (Landfill site) x 4%] x 8 (Kg/MT) = **285.9 Kg/Day.**

In similar way emission for others pollutants have been estimated and their ward wise distribution is presented in **Table 3.12**. It was estimated that the highest emission load was contributed mainly from Nerul, Koparkhairane and Turbhe Ward. Being less populated, contribution of Digha to emission load across all categories is lowest. Total 285 kg/day of PM load is released within the city limits from open burning of waste in wards and landfill site. Contribution of CO emission load is highest across all wards and landfill site towards final emission load, followed by HC.

Table 3.12 : Ward Emission Load from Open Burning (Kg/d)

Wards	PM_{10}	$PM_{2.5}$	SO_2	NOx	HC	CO
A	2.91	1.98	0.18	1.09	7.82	15.27
B	10.72	7.29	0.67	4.02	28.81	56.28
C	5.60	3.80	0.35	2.10	15.04	29.37
D	8.46	5.75	0.53	3.17	22.74	44.43
E	8.77	5.96	0.55	3.29	23.57	46.04
F	7.36	5.01	0.46	2.76	19.79	38.65
G	5.85	3.98	0.37	2.20	15.73	30.74
H	4.26	2.90	0.27	1.60	11.46	22.38
Total Kg/d	**53.94**	**36.68**	**3.37**	**20.23**	**144.95**	**283.17**
Total T/yr	**19.69**	**13.39**	**1.23**	**7.38**	**52.91**	**103.36**

Table 3.12 (Contd..) : Emission Load from Landfill Open Burning(kg/d)

Wards	PM_{10}	$PM_{2.5}$	SO_2	NOx	HC	CO
Turbhe	232	157.76	14.5	87	623.5	1218
Total Kg/d	**232**	**157.76**	**14.5**	**87**	**623.5**	**1218**
Total T/yr	**84.68**	**57.58**	**5.29**	**31.76**	**227.58**	**444.57**

Issues: Refuse burning refers to common burning of street litter and leaves, although little is known about the magnitude of the practice. No documented data on rate of burning, area of dump, unauthorized activity of the rag pickers are available. Landfill sites burning do not come under any of the seven sampling sites representing 2 Km x2 Km area.

3.2.7 Building Construction

Real Estate sector is booming in the city. With a scope of being developed as planned city, there are drastic infrastructural changes taking place in Navi Mumbai. The handling and construction activities contribute towards fugitive dust particulate matter in large proportions. Particulate emissions are predominantly due to site preparation work, which may include scrapping, grading, loading, digging, compacting, lights -duty vehicle travel and other operations. Data related to construction activity in past one year, was obtained from Building construction department of NMMC. 117 construction and building related activities were reported with the department. The number of construction activities ward wise is given in **Table 3.13**.

Assumption

- The project duration was estimated as 18 months for new buildings, 6 months for addition /alteration.
- The area of influence of each construction activity was taken as 0.5 acres for new building and 0.2 acres for addition /alteration. This was the most prevalent areas noticed during the primary. However, some places sizes vary more than the above mentioned values.

Table 3.13 : Ward Wise distribution of Construction Activities

Wards	Build Construction	New Building	Alteration/ Addition
A	5	2	3
B	6	1	5
C	3	3	2
D	4	2	2
E	7	4	3
F	7	1	6
G	21	15	7
H	4	3	1
Total	60	31	29

Emissions Estimation

For the purpose of estimating emissions, it is assumed that the fugitive dust emission is related to the acreage affected by construction

Step 1 –Total No. of construction activities in each region. This was obtained from NMMC.

Step 2 – Acres disturbed

For new buildings, = 0.5 acres are disturbed per activity

For addition / alteration = 0.2 acres per activity are disturbed

Step 3 – Months of activity

New buildings = 18 months, Addition / alteration = 6 months

Step 4 – Acre –months of activity

For new building = 18 x total number of acres disturbed

For addition / alteration = 6 x total number of acres disturbed

Step 5 – PM_{10} Tons /years = 1.2 x total number of acre – months

(AP42, Section 13.2.3.3– PM_{10} - 1.2 tones/ acres months)

Ward wise emission load of PM during construction activity is presented in **Table 3.14**.

Table 3.14 : Ward wise Emission Load of PM in acre months during Construction Activity

Wards	New Building (Kg/day)	Alteration (Kg/day)
A	40	24
B	20	40
C	60	16
D	40	16
E	80	24
F	20	48
G	300	56
H	60	8

Total Emission Load = 310.98 tones /year
(New Building = 620 kg/day, alternation building = 232 kg/day)

The number of construction and building project are on rise along the Thane-Belapur Road, due to upcoming and establishment of commercial and IT hubs around the regions. The highest PM emission load was calculated from the area of Airoli Wards G.

Issues

- The activity is assumed to occur 6 days a week with 8 hours duration of working hours
- The current methodology assumes that all construction operations emit the same levels of PM on per acre basis.
- The methodology assumes that construction dust emissions are directly proportional to the number of acres disturbed during construction. The estimates of acreage disturbed are limited in their accuracy, as explained above
- Emission due to vehicle movement during construction activity is not calculated

3.2.8 Road Dust (Paved & Unpaved)

As motor vehicle moves over road surface, it leads to resuspension of dust from unpaved roads or settled dust from the paved surface by the turbulent wake of the vehicle and emitted as particulate matter. Emissions are estimated as a function of the silt loading of the paved surface and mean weight of the vehicles traveling over the surface. Data source such as road length, vehicle Km traveled and depot, truck terminal was obtained from MMRDA, NMMC and RTO, Navi Mumbai and primary survey of some roads for vehicle counting.

- **Emission Estimates for Paved Road Dust**

Vehicle Weight –Navi Mumbai *

Vehicle Count 2017		%Vehicle Count (A)	Avg.Weight (kg) (B)	Veh. Weight by % (A*B) (kg)
2 W	13172	0.41	175	72.0
3 W	8075	0.25	450	113.6
HDDV	2232	0.07	20000	1395.0
Cars	8521	0.27	1425	379.5
Total	32000	1		**2.0**

** Strengthening Environmental Management at the State Level (Cluster) Component E- Strengthening Environmental Management at West Bengal Pollution Control Board, TA No. 3423-IND, Asian Development Bank, Nov. 2005*

Emission Estimation for Paved Dust

Annual /Long Term Avg. E. Factor E = (k (sL/2)^0.65 (W/3)1.5-C) (1-P/4N)

E= particulate emission factor (having units matching the units of k)
k= particle size multiplier for particle size range and units of interest
sL= road surface silt loading (grams per square meter) (g/m^2)
W= average weight (tons) of the vehicles traveling on the road
P= No. of wet days with at least 0.254 mm of precipitation during avg. period
C= Break and tire wear correction (PM2.5=0.1005, PM10=0.1317)
N = No. of days in averaging period (365 /year, 30/monthly, 91/seasonal);
Values of k (g/vkt) PM2.5 -1.1, PM10-4.6

EF (PM_{10}) = (k (sL/2)0.65 (W/3)1.5-C) (1-P/4N)
= (4.6*((0.505/2)^0.65)*((2/3)^1.5)-0.1317)*((1-120/(4*365)))= 0.818 g/vkt

EF ($PM_{2.5}$) = (k (sL/2)0.65 (W/3)1.5-C) (1-P/4N)
= (1.1*((0.752/2)^0.65)*((2/3)^1.5)-0.1005)*((1-120/(4*365))) = 0.198 g/vkt

For VKT – calculate: lb/vmt to gms/vkt =0.98 (VKT * 0.98)
VKT from all shifts * $PM_{2.5}$ (EF) AND VKT from all shifts * PM_{10} (EF) = Emission paved Road Dust

Emission Estimation for Unpaved Dust

Annual /Long Term Avg. E. Factor, E = {([k (s/12)^a (S/30) ^d] /(m/0.5) ^c-C)} *(365-P)/ 365
E = size specific emission factor, (lb/vmt),
s = surface material silt content (%),
m= surface material moisture content (%),
S= mean vehicle speed (mph);

k = particle size multiplier (lb/vmt),
P= No. of wet days with at least 0.254 mm of precipitation during avg. period
C= Break and tire wear correction ($PM_{2.5}$=0.00036, PM_{10}=0.00047) - lb/VMT
Public Roads- Constant k (lb/vmt) - $PM_{2.5}$= 0.27, PM_{10}=1.8;
a. $PM_{2.5}$=1, PM_{10}=1, b. $PM_{2.5}$=0.2, PM_{10}=0.2; c. $PM_{2.5}$=0.5, PM_{10}=0.5

EF (PM_{10}) = {([k (s/12)a (S/30)d] /(m/0.5)c-C)} *(365-P)/ 365
= (((1.8*(12/12)^1*(12.5/30)^0.5)/(6.65/0.5)^0.2-0.00047))*(365-120)/365
0.464488 lb/vmt = 130.93 g/vkt

EF ($PM_{2.5}$) = {([k (s/12)^a (S/30) ^d] /(m/0.5) ^c-C)} *(365-P)/ 365
=(((0.27*(12/12)^1*(12.5/30)^0.5)/(6.65/0.5)^0.2-0.00036))*(365-120)/365
0.069479 lb/vmt = 19.58 g/vkt

Emission Load

- Total **Paved** Dust Emission Load for Whole City =
  PM_{10}= **3283.5 Kg/d** and $PM_{2.5}$= 794.4 Kg/d
- Total Unpaved Dust Emission Load for Whole City =
  PM_{10}= **8020 Kg/d** and $PM_{2.5}$ = 1199.6 Kg/d

Emission Load

Total Paved Dust Emission Load for Whole City : **PM= 11303.3 Kg/d**

Site-specific contribution of the pollutant emission load is given in **Table 3.15.**

Table 3.15 : Ward wise Emission Load from Paved & Unpaved Road Dust

Ward	Region	Paved Roads		Unpaved Roads	
		$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}
A	Belapur	122.6	506.6	185.1	1237.3
B	Nerul	169.4	700.0	255.8	1709.8
C	Vashi	184.1	761.0	278.0	1858.7
D	Turbhe	87.8	362.9	132.6	886.3
E	Koparkhairane	57.7	238.4	87.1	582.2
F	Ghansoli	62.6	258.9	94.6	632.4
G	Airoli	59.5	246.0	89.9	601.0
H	Digha	50.7	209.8	76.6	512.3
Total (kg/day)		794.4	3283.5	1199.6	8020.0
Total (Tons/yr)		290.0	1198.5	437.9	2927.3

* Values expressed as kg/d

PM emission load is highest at Ward B and C, i.e, Nerul and Vashi attributing to the highest VKT in these regions. Even though the emission load from Digha ward is lowest, this region is still not developed as compared to other regions. The paved road dusts get resuspended and act as source due to vehicles movement and friction of tires with roads. Uncertainty with respect to all sites across whole city will be high as silt loadings can vary from place to place.

3.3. Line (Vehicular) Source

A counter magnet for Mumbai**,** Navi Mumbai has been developed as a planned city by City and Industrial Development Corporation (CIDCO) to meet the infrastructural needs of a modern metropolis. It has been developed as an independent, fully self-contained metro city. Navi Mumbai has a robust infrastructure, is well connected to other parts of the state and country. Navi Mumbai's CIDCO boasts of a 650 Km-long road network that connects nodes and neighbouring towns, besides 5 major bridges, 8 flyovers, 15 road-over bridges and a couple of foot-over bridges. The Palm Beach Marg, a 10 Km and six lane road connects Vashi to CBD Belapur running parallel to the Thane creek. The road transport wing of Navi Mumbai includes connectivity from bus operators of Navi Mumbai Municipal Transport (NMMT), BrihanMumbai Electric Supply and Transport (BEST), Kalyan- Dombivali Municipal Transport (KDMT) and Khopoli Municipal Transport (KMT) which provide bus services to entire Navi Mumbai city as well as to & fro from certain parts of Mumbai, Thane, Kalyan, Dombivli, Badlapur, Taloja, Panvel and Uran. The number of operational buses under NMMT was 390 in the year 2015-16. As per the data records of NMMT, the average number of passengers travelling per month by NMMT buses is around 55,37,375. The distance travelled by buses per day is on an average 281.1 Km. The Trans-harbor and Harbor lines of central railways pass through the municipal region of Navi Mumbai with total 12 stations connecting to other parts of Mumbai. Auto rickshaws provide inter as well as intra nodal public transport across the city. Taxis operating from designated taxi stands provide the means to travel to further destinations. Taxis charge a fixed rate approved by the R.T.O. details of which can be found on popular local transit apps of the city. Navi Mumbai has the largest container terminal in India, Jawaharlal Nehru Port at Nhava Sheva near Uran. It is well connected by road and rail, and handles approximately 56.13% of India's container traffic. The Chatrapati Shivaji International Airport, 30 Km away, is the nearest airport to the city. The Navi Mumbai Metro is an under construction rapid transit system in Navi Mumbai. A network of as many as six lines have been planned of which four lines will be constructed by CIDCO in the Navi Mumbai south region, the second and third line of the metro system will be constructed by NMMC and MMRDA respectively.

With the increasing infrastructural changes being implemented in the city from the government, there is a mass migration of population towards Navi Mumbai. Growing population led to increase in the number of registered vehicles at RTO across city. At the population density of 10,315 persons /sq.Km, the office/ region wise growth of vehicle in the city was 11% in 2016-17 as compared to 2015-16. Trend of vehicle growth is presented in **Table 3.16 and Figure 3.2**.

Table 3.16 : Trend of Vehicular Growth in Navi Mumbai

a) Office/ Region wise Growth of Vehicles as on 31st March 2009-10 to 2016-17

Name of the office/region	2009-10	2010-11	% Growth	2011-12	% Growth	2012-13	2013-14	% Growth
Vashi – New Mumbai	202252	231449	14.44	257831	11.4	275275	301731	9.62
	2014-15	**% Growth**	**2015-16**	**% Growth**	**2016-17**	**% Growth**		
	310959	3.06	351620	13.08	392987	11.76		

b) Office / Region wise Yearly Registration of Vehicles & Their Growth (2012-13 to 2016-17)

Name of the office/region	2012-13	2013-14	% Growth	2014-15	% Growth	2015-16	% Growth	2016-17	% Growth
Vashi – New Mumbai	35844	29927	-16.51	38594	28.96	45711	18.44	41367	-9.5

c) Category wise Number of Registered Vehicles in Navi Mumbai (2017 to 2018)

Sr	Category	Financial Year 2015-16	Financial Year 2016-17	% Growth
1	Motor Cycles	24404	22535	-7.7
2	Scooter	0	0	0
3	Moped	0	0	0
4	Cars	10805	10343	-4.3
5	Jeep	0	2	--
6	Station Wagon	0	0	0
7	Taxis Meter Fitted	203	2560	1161.1
8	Luxury Tourist Cabs	1763	644	-63.5
9	Auto rickshaw	2445	1944	-20.5
10	Stage Carriage	44	109	147.7
11	Contract Carriage	334	158	-52.7
12	School Bus	143	36	-74.8
13	Private Service Vehicle	11	13	18.2
14	Ambulance	18	14	-22.2
15	Other (Arti/Multi.Veh.)	364	28	-92.3
16	Trucks	2751	1001	-63.6
17	Tankers	267	256	-4.1
18	Delivery Van (4 Wheeler)	284	397	39.8
19	Delivery Van (3 Wheeler)	1866	967	-48.2
20	Tractor	0	37	0
21	Trailer	0	278	0
22	Others	9	45	400
	Total	**45711**	**41367**	**-9.5**

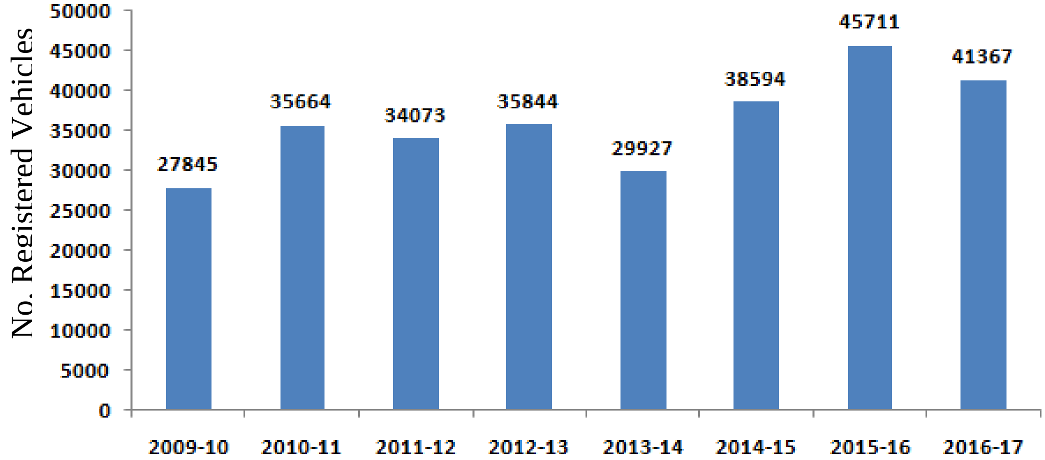


Figure 3.2 : Vehicular Growth at Navi Mumbai City

Source : RTO, Navi Mumbai Region & NMMC ESR -2016-17

The variation in different type of registered vehicles over a period of time is depicted in **Figure 3.3**.

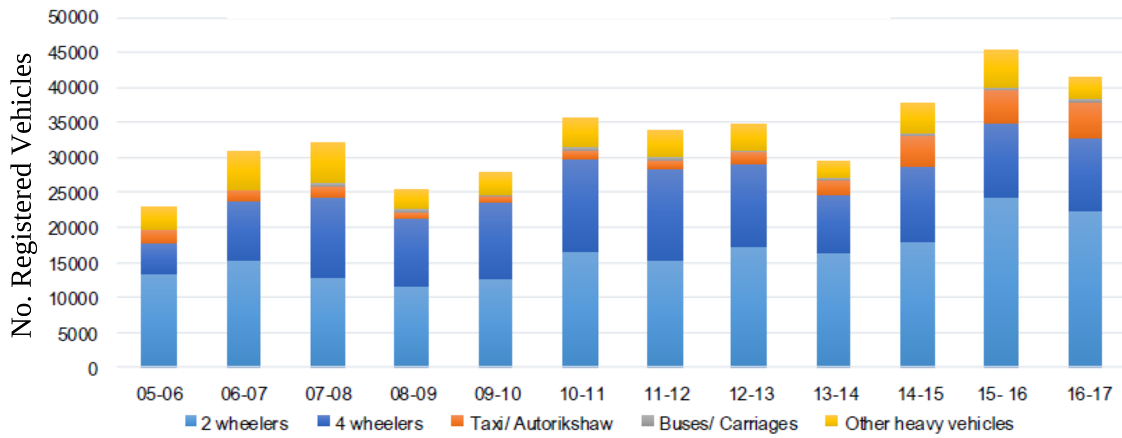


Figure 3.3 : Trend of Registered Vehicles in Navi Mumbai

Source : RTO, Navi Mumbai Region & NMMC ESR -2016-17

3.3.1 Primary Survey and Methodology

The methodology of study included preparation of vehicular emission by taking into consideration:

- Vehicle counts at representative major traffic junctions and congestion zones spread across the city limits
- Estimation of grid-wise road length.
- Estimation of VKT (Vehicle Kilometers Travelled) for different categories of vehicles.
- Selection of appropriate emission factors from the ARAI vehicle emission study.
- Preparation of emission inventory (grid-wise) and identification of major sources / hot spots in each grid.
- Emission growth projections.

Grid wise emission inventory preparation includes the following procedural steps:

- Division of study area into grids of 2 Km X 2 Km size
- Identification of major nodes which represent major traffic junctions
- Calculation of road length between the nodes and estimation of grid-wise road length
- Collection of data on number and type of vehicles traveling between nodes through field studies
- Estimation of vehicle kilometers (Km) traveled by each type of vehicle in each grid

$$VKTI = RLj * NI$$

Where, VKTI = Vehicle Km traveled by vehicle type I,
RLj= Road length in grid j
NI = Number of vehicles travelling between nodes for vehicle type I per day,

- Selection of appropriate emission factor for each type of vehicle
- Estimation of particulate matter emissions from each grid

$$PM_j = N * \sum_{J=1}^{m} VKT_I * EfI$$

Where, PMj= Particulate matter load in tones/year for grid j
N = Number of activity days in a year
EfI= Emission factor for a vehicle type I

- Projected emission inventory (with alternative control options) preparation

$$PM\ projected_j = N * \sum_{J=1}^{m} VKT_I * EfI * \eta_k$$

Where, PM Projected j = Projected particulate matter load in tones/year for grid j
η_k= Efficiency of control option K

3.3.2 Vehicle Count

In order to estimate the actual grid-wise vehicular emissions across city, vehicular counts on major traffic corridors and congestion zones as well as within the city were carried out. Road map of the city as given in **Figure 3.4** was used to determine the locations for the vehicle counting survey. For this purpose, the Navi Mumbai transportation network were divided into different parts (I) Western transportation network along Thane Creek (ii) Eastern Corridor transportation network from Belapur to Thane and (iii) Internal transportation network spread across sectors of wards of study area.

Manual counting of the traffic movement was carried out at each of the identified traffic junction for a whole day. Around 31 monitoring locations were selected for the vehicular count assessment, taking suggestions of RTO-Navi Mumbai into consideration. The counting was continuously carried out considering peak and slack periods of the day representing the following time slots.

Shift	Traffic	Duration	No. of Hrs
I	Morning Peak	0700 to 1100	4
II	Afternoon Average	1100 to 1700	6
III	Evening Peak	1700 to 2200	5
IV	Night Average	2200 to 0700	9

Following categories of vehicles were covered in these counts:

Cars, Taxis, Heavy Duty Diesel Vehicles (HDDV) + Buses, Three Wheelers, 2 Wheelers

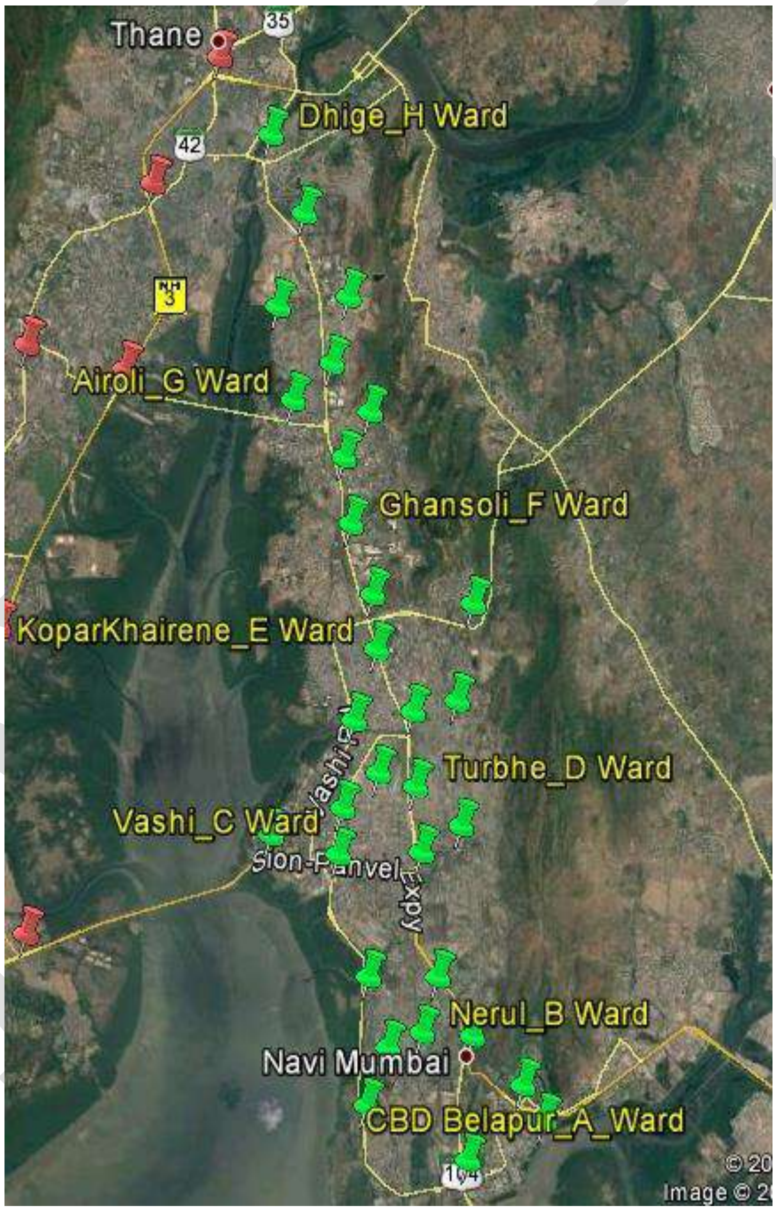


Figure 3.4 : 2 Km x 2 Km Grid-wise Distribution of City and 31 Vehicular Counting Survey Locations Selected Across Navi Mumbai City

3.3.3 Vehicle Kilometers Traveled (VKT) Estimation

Temporal and spatial vehicle emissions are determined by the emission factors and distributions of Vehicle Kilometers Traveled (VKT). Percent vehicle count distribution is given in **Figure 3.5**. Major and minor roads were also covered to assess the emissions from vehicles traveling on internal roads among settlements **Table 3.17**.

Table 3.17 : Identified Roads/ Traffic Junctions around Monitoring Sites for Vehicle Counts

Turbhe Transportation Department			
Sr.	**Congestion Zone/Junction**	**Sr.**	**Congestion Zone/Junction**
1	Sterling College Chowk, Near Hawre Mall	10	Indiranagar Circle, Turbhe
2	Ruparel Circle	11	Savita Chemical, Turbhe
3	Nerul Railway Station Chowk	12	Turbhe Store Cut
4	Shiwaji Chowk, Nerul	13	Sanpada Police Station Chowk
5	Nerul Post Office Chowk	14	Sanpada Junction
6	L.P Circle	15	Turbhe Under bridge Chowk
7	Shani Mandir Chowk, Nerul	16	Shivaji Maharaj Statue Chowk
8	Shani Mandir Kaman Chowk, Nerul	17	Moraj Circle
9	Turbhe Naka	18	Shalimar Chowk, Turbhe MIDC
Koparkhairane Transportation Department			
Sr.	**Congestion Zone/Junction**	**Sr.**	**Congestion Zone/Junction**
1	Koparkhairane D-Mart Chowk	4	Varisht Chowk
2	Teen Taki Chowk	5	Kalash Garden Chowk
3	MSEB Chowk		
Seawoods Transportation Department			
Sr.	**Congestion Zone/Junction**	**Sr.**	**Congestion Zone/Junction**
1	Moraj Chowk – Palm Beach Rd	7	Sec 50 Chowk – Palm Beach Rd
2	Saarsale Chowk – Palm Beach Rd	8	Sawla Chowk
3	Varzani Chowk – Palm Beach Rd	9	Sanjay Joshi Chowk
4	T.S. Chanakya Chowk – Palm Beach Rd	10	Seawoods Station Chowk
5	Akshar Chowk – Palm Beach Rd	11	Nerul Station Chowk
6	NIR Chowk – Palm Beach Rd		
Vashi Transportation Department			
Sr.	**Congestion Zone/Junction**	**Sr.**	**Congestion Zone/Junction**
1	Vashi Plaza Chowk	5	Opp. Vijay Dairy Chowk, Sec. 28
2	Sambhaji Chowk	6	Rajmata Chowk, Sec. 17
3	Apna Bazar Chowk	7	Mahatma Phule Chowk, Sec. 17
4	Shivaji Chowk	8	Noor Masjid Chowk, Sec. 9
APMC Transportation Department			
Sr.	**Congestion Zone/Junction**	**Sr.**	**Congestion Zone/Junction**
1	Annapurna Chowk	5	Bonkode Chowk
2	Areja Chowk	6	Mathadi Bhavan Chowk
3	MSEB	7	Dakshta Station Chowk
4	Kopri Signal		

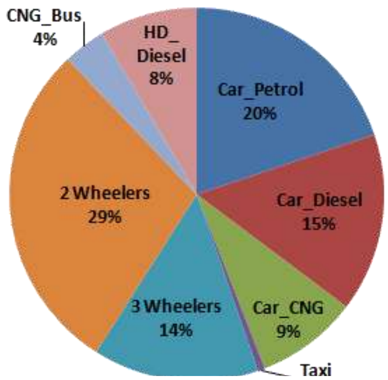


Figure 3.5 : Percent Vehicle Count Distribution in Navi Mumbai

Vehicle Kilometers Traveled (VKT) estimation by each type of vehicle in each grid per day was estimated by using length of roads between major nodes/traffic junctions from Navi Mumbai Region Map as also length in each grid (**Figure 3.6**). Road length in each grid and number of vehicles (of different types) plying in the same are taken into account while estimating vehicle kilometer traveled in each grid by the respective vehicle.

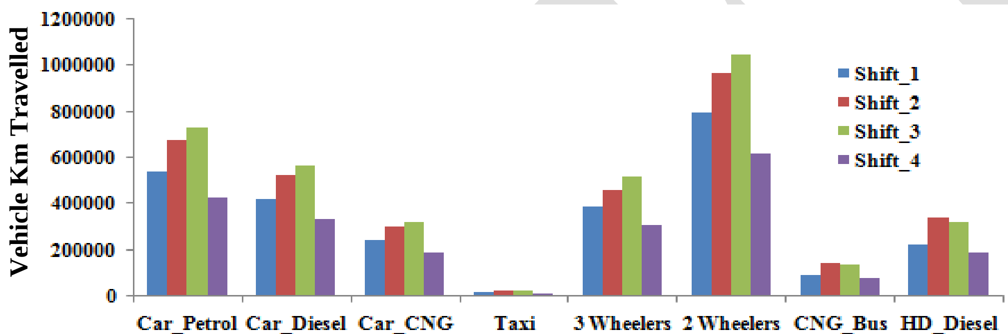


Figure 3.6 : Vehicle Km Travelled by Different Categories of Vehicles

Considering peak office hours, VKT were higher in morning during 8 am to 12 pm and in evening during 6 pm to 10 pm. It was observed that the overall VKT of 2 wheelers was highest in all the shifts, followed by Petrol Cars. There is an average annual increase of 10% in the number of registration for 2 wheelers, as per RTO, Navi Mumbai. The VKT was highest in Shift 3 (1700 hrs. to 2200 hrs.), followed by in Shift 2 (1100 hrs. to 1700 hrs.). The VKT of taxis and CNG buses is lowest compared to other categories of vehicle in the study, as the number of CNG operated Bus fleet by the corporation is minimum and dependency on 3 wheelers for point to point transit is more. An average VKT of 1496605 Km/day was estimated for all categories of vehicles travelling within city limits. As observed from the **Figure 3.5**, the movement of 2 wheelers (29%) were more followed by Private owned petrol cars (20%), diesel operated cars (15%) and 3 wheelers (14%) in vehicular count survey at different location across city jurisdiction.

3.3.4 Vehicular Emission Factors

Emission factors for different categories of vehicles along with variation with fuel were developed by ARAI in 2007. The summary of emission factor developed by ARAI is represented in **Table 3.18**.

Table 3.18 : Emission Factors Calculated by Automotive Research Association of India (ARAI)

Vehicular Emission Factors (Gm/Km)	Car Petrol Post 2005 Fuel BSII	Car Diesel Post 2005 Fuel BSII	Car CNG BSI, Post 2000, Fuel BSII	Two Wheeler Post 2005 4 Stroke Fuel BS II	Three Wheeler CNG Retro 25 Post 2000 Fuel BS II	CNG Buses Post 2000 Fuel BS II	Trucks Diesel Post 2000 Fuel BSII
PM	0.002	0.015	0.006	0.013	0.118	0.044	1.240
NOx	0.090	0.280	0.740	0.150	0.190	6.210	9.300
CO	0.840	0.060	0.060	0.720	0.690	3.720	6.000
HC	0.12	0.080	0.460	0.520	2.06	3.750	0.370

Factors used for emission load calculation Source: Air Quality Monitoring Project-
Indian Clean Air Programme (ICAP), The Automotive Research Association of India, 08, 2007

3.3.5 Ward wise Vehicle Emission Inventory

Tailpipe emissions estimates were made from 2 Km x 2 Km grids with respect to the entire city taking ARAI emission factor for PM, NOx, CO and HC. SO_2 emissions are calculated based on VKT and sulphur content (Diesel 300 ppm and Gasoline 30 ppm) as SO_2 emission factor was not available. These estimates have been further used for grid wise projections, input to dispersion modeling and scenario generation.

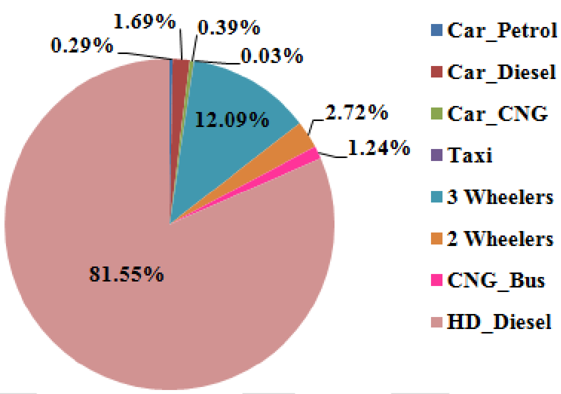
Particulate matter is the solid form of fuel which is left behind after combustion. PM emission load within the city limit is largely contributed by mobile sources. Out of the total emission of PM, 25.67% of emissions are from Ward C-Vashi, contributing 838.4 Kg/day of PM. The lowest PM emission load was found at Ward H- Digha (4.14%). Emission load of PM from Ward A (Belapur) & B (Nerul) is also considerable from other wards of Navi Mumbai. Out of the total PM emission load of 3266.4 Kg/day from the line source, load contributed by Belapur ward is 474.5 Kg/day and that of Nerul was 756.4 Kg/day. Almost all categories of vehicular load for PM are observed at Vashi among them heavy duty and 3 wheelers are impacting more. CNG Buses are also contributing 40.5 Kg/d as there percent contribution is less 1.24%. The Heavy duty diesel vehicles contribute 81.55% (2663.8 Kg/d) to the total load followed by 3 wheelers 12% (394.8 Kg/d). As heavy duty vehicles are more plying (approx 2148235 VKT) on industrial belt of Thane Belapur are as well as movement from Sion Panvel Highway. The emission load from 2 wheelers (88.90 Kg/d; i.e. 2.7%) is almost 10 times the emission load from Car operating on Petrol (9.48 Kg/d; i.e. 0.29%) and half of

Car Diesel (55.3 Kg/d; i.e. 1.7%) to the total load. As diesels are heavier oils which have large number of ‘C - bonds and are tough to break completely, this incomplete breaking appears as particulate matter. Petrol is more refined than diesel. The region wise PM emission load in a day with respect to its vehicular distribution is given in **Table 3.19 and Figure 3.7**.

Table 3.19 : PM Vehicular Emission Load from Different Sector and Zones of Navi Mumbai City

Wards	Car Petrol	Car Diesel	Car CNG	Taxi	3 Wheelers	2 Wheelers	CNG Bus	Heavy Duty Diesel Veh.	Total Kg/day
A	1.60	9.4	2.1	0.11	36.4	11.7	6.2	407.0	474.5
B	2.37	13.8	3.2	0.22	54.9	18.6	9.9	653.5	756.4
C	2.36	13.8	3.1	0.48	111.9	21.9	10.3	674.6	838.4
D	0.72	4.2	1.0	0.04	55.6	8.4	3.8	252.4	326.1
E	0.61	3.6	0.8	0.04	34.2	6.3	4.0	265.2	314.7
F	0.80	4.6	1.1	0.04	30.3	7.9	2.7	179.3	226.7
G	0.65	3.8	0.9	0.02	34.5	7.9	2.2	144.4	194.3
H	0.36	2.1	0.48	0.02	37.0	6.3	1.3	87.5	135.2
Kg/day	**9.48**	**55.29**	**12.64**	**0.97**	**394.79**	**88.90**	**40.51**	**2663.81**	**3266.4**
Tones/Yr	**3.46**	**20.18**	**4.61**	**0.36**	**144.10**	**32.45**	**14.79**	**972.29**	**1192.2**

Wards : *A-Belapur; B-Nerul; C-Vashi; D-Turbhe; E-Koparkhairane; F-Ghansoli; G-Airoli; H-Digha*



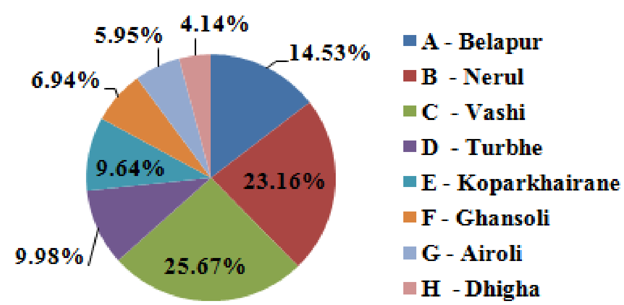


Figure 3.7 : Percent Contribution Vehicle Categories and Ward wise Emission Load Distribution of PM (Kg/d) in Navi Mumbai

NOx is produced from the reaction of nitrogen and oxygen gases in the air during combustion, especially at high temperatures. The total NOx emission load for all the wards of the city is 30494.5 kg/day. The highest percentage contribution of NOx concentration was at Ward C-Vashi (25.42%), followed by Nerul (24.23%). The lowest NOx emission load was from Digha (3.59%). Ward A, B and C comprises of more than 65% share of total emission of NOx load from the city. With 65.52% the emission load of NOx concentration is highest from Heavy Duty Vehicles; the load of NOx from CNG Buses is second largest (18.75%); followed by Car CNG 5.11%. The 2 and 3 wheelers contribution is around 3.36% and 2.08% respectively as also Car Diesel 3.38%. While the emission from Taxi for NOx is lowest (0.39%). This low concentration is attributed to number of taxis registered in the city (Taxis Meter Fitted – 2560, Luxury/Tourist Vehicles – 644; 2016-17). The region wise PM emission load in a day with respect to its vehicular distribution is given in **Table 3.20 and Figure 3.8.**

Table 3.20 : NOx Vehicular Emission Load from Different Sector and Zones of Navi Mumbai City

Wards	Car Petrol	Car Diesel	Car CNG	Taxi	3 Wheelers	2 Wheelers	CNG Bus	Heavy D. Diesel Veh.	Total Kg/day
A	72.2	174.7	263.9	13.1	58.6	135.5	873.5	3052.3	4643.8
B	106.7	258.2	389.9	27.5	88.3	214.2	1402.6	4901.2	7388.5
C	106.3	257.1	388.3	59.7	180.2	252.3	1447.9	5059.3	7751.1
D	32.3	78.2	118.1	5.1	89.6	96.3	541.7	1892.8	2854.2
E	27.6	66.7	100.8	5.0	55.1	72.7	569.1	1988.6	2885.6
F	35.8	86.7	131.0	5.2	48.8	90.7	384.8	1344.6	2127.7
G	29.3	71.0	107.2	1.9	55.5	90.9	310.0	1083.1	1749.0
H	16.2	39.3	59.3	2.5	59.6	73.1	187.9	656.6	1094.6
Kg/day	**426.5**	**1032.0**	**1558.5**	**120.0**	**635.7**	**1025.7**	**5717.4**	**19978.6**	**30494.5**
Tones/Yr	**155.67**	**376.68**	**568.87**	**43.82**	**232.02**	**374.39**	**2086.84**	**7292.19**	**11130.5**

Wards : *A-Belapur; B-Nerul; C-Vashi; D-Turbhe; E-Koparkhairane; F-Ghansoli; G-Airoli; H-Digha*

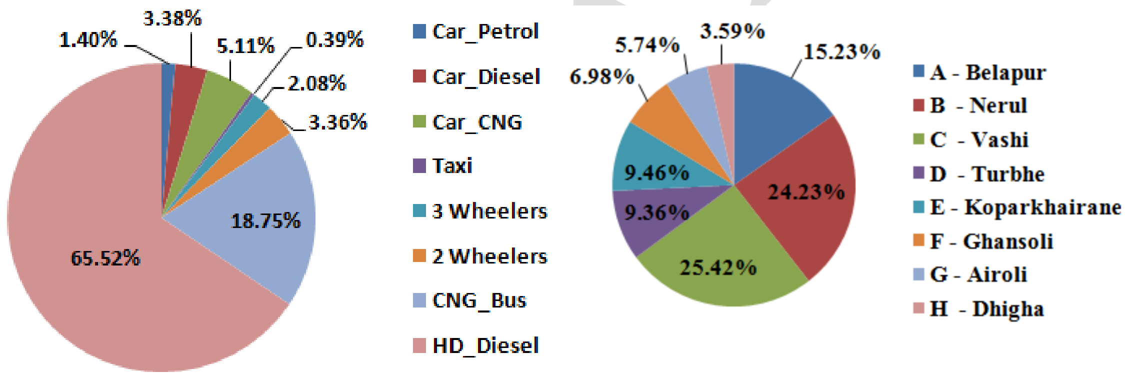


Figure 3.8 : Percent Contribution Vehicle Categories and Ward wise Emission Load Distribution of NOx (Kg/d) in Navi Mumbai

Sulfur dioxide is also present in motor vehicle emissions, as the result of fuel combustion. In the past, motor vehicle exhaust was an important, but not the main, source of sulfur dioxide in air. The emission load of city of SO_2 from different category of vehicle was estimated to be around 0.585 kg/day. The highest emission load of SO_2 was found from Ward C- Vashi (25.17%), followed by emission load of Ward B- Nerul (24.65%). This emission load can be attributed to the presence of commercial activities engaging around APMC market. The maximum SO_2 load was emitted by HDD Vehicle (62.91%) and lowest from 2 wheelers (1.56%). The diesel operated car in the city contributes on an average of 0.184 kg/day (i.e. 31.48%) of SO_2 emission load.

The region wise PM emission load in a day with respect to its vehicular distribution is given in **Table 3.21 and Figure 3.9**.

Table 3.21 : SOx Vehicular Emission Load from Different Sector and Zones of Navi Mumbai City

Wards	Car Petrol	Car Diesel	2 Wheelers	Heavy Duty Diesel Veh.	Total Kg/day
A	0.004	0.031	0.001	0.056	0.093
B	0.006	0.046	0.002	0.090	0.144
C	0.006	0.046	0.002	0.093	0.147
D	0.002	0.014	0.001	0.035	0.052
E	0.002	0.012	0.001	0.037	0.051
F	0.002	0.015	0.001	0.025	0.043
G	0.002	0.013	0.001	0.020	0.035
H	0.001	0.007	0.001	0.012	0.021
Kg/day	**0.024**	**0.184**	**0.009**	**0.368**	**0.585**
Tones/Yr	**0.009**	**0.067**	**0.003**	**0.134**	**0.214**

Wards : *A-Belapur; B-Nerul; C-Vashi; D-Turbhe; E-Koparkhairane; F-Ghansoli; G-Airoli; H-Digha*

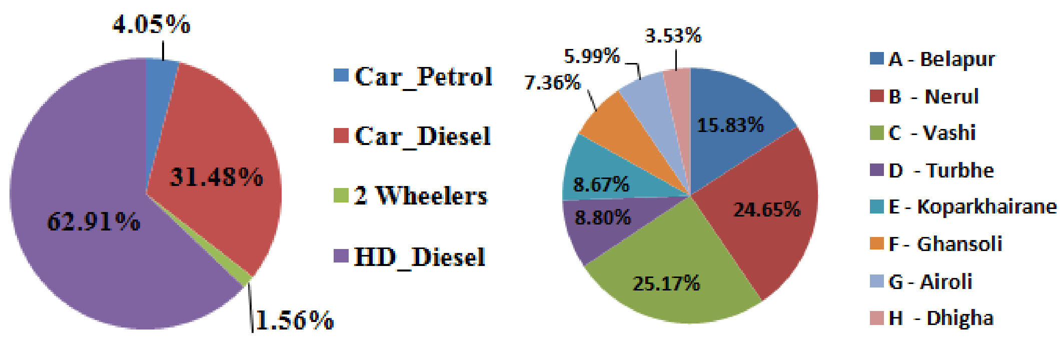


Figure 3.9 : Percent Contribution Vehicle Categories and Ward wise Emission Load Distribution of SOx (Kg/d) in Navi Mumbai

Motor vehicle fuel contains hydrocarbons, which are its primary source of energy. Any hydrocarbons emitted from a vehicle indicate unused fuel, which results from incomplete fuel combustion. This can be due to lesser amount of O_2, incomplete mixing of fuel or lesser lapse time for the fuel to burn. As for the concentration of HC, the highest emission load was calculated at Ward B- Nerul (25.28%) and the lowest was found at Ward H- Digha (5.08%), while Ward A & C contributes around 41% of emission load. As also vehicular movement around Ward C- Vashi is often found to be high, the percent is more i.e. 22%. The HC emission load of the city is largely contributed by the 3 wheelers and 2 wheelers i.e around 41% and 22% respectively. Heavy duty diesel vehicles are not impacting much as emission factor for HC is 0.37 gms/km, whereas it is 2.06 gm/km for 3 wheeler and 3.75 gm/km for CNG buses. Maharashtra itself accounts for almost 10% of the overall three-wheeler market annually in the country. According to industrial reports, the three-wheeler market is likely to cross the major milestone of 1 million units in production in the next couple of years, with domestic market crossing its previous peak of 5.5 lakh units per annum to about 6-7 lakh units. Passenger carrying three-wheelers will be crossing a critical half a million mark in the domestic market by 2019-2020. Following emissions from 3 wheelers CNG Buses contributes (20.86%). The total HC emission load of the city is 10863.7 kg/day. The region wise PM emission load in a day with respect to its vehicular distribution is given in **Table 3.22 and Figure 3.10**.

Table 3.22 : HC Vehicular Emission Load from Different Sector and Zones of Navi Mumbai City

Wards	Car Petrol	Car Diesel	Car CNG	Taxi	3 Wheelers	2 Wheelers	CNG Bus	Heavy D. Diesel Veh.	Total Kg/day
A	95.1	49.3	162.0	8.0	632.6	467.7	522.5	120.3	2057.5
B	120.4	62.4	205.1	13.3	851.6	647.0	688.0	158.4	2746.2
C	70.7	36.7	120.5	20.0	1162.2	457.4	419.7	96.6	2383.8
D	23.1	12.0	39.4	2.0	551.1	180.0	176.3	40.6	1024.6
E	20.3	10.5	34.6	1.5	343.1	128.6	195.3	45.0	779.0
F	24.6	12.7	41.8	1.7	280.8	168.5	119.1	27.4	676.6
G	20.1	10.4	34.3	0.6	296.3	173.9	88.8	20.5	644.9
H	11.2	5.8	19.0	0.8	316.8	128.4	56.1	12.9	551.0
Kg/day	**385.5**	**199.9**	**656.8**	**47.9**	**4434.6**	**2351.4**	**2265.9**	**521.7**	**10863.7**
Tones/Yr	**140.7**	**73.0**	**239.7**	**17.5**	**1618.6**	**858.3**	**827.0**	**190.4**	**3965.3**

Wards : *A-Belapur; B-Nerul; C-Vashi; D-Turbhe; E-Koparkhairane; F-Ghansoli; G-Airoli; H-Digha*

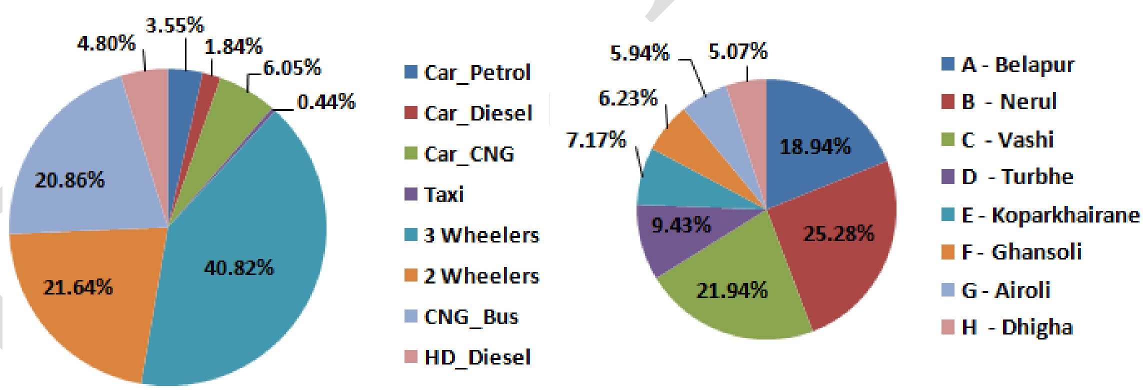


Figure 3.10 : Percent Contribution Vehicle Categories and Ward wise Emission Load Distribution of HC (Kg/d) in Navi Mumbai

Carbon monoxide (CO) a colorless, odorless, tasteless, and toxic air pollutant is produced in the incomplete combustion of carbon-containing fuels, such as gasoline, natural gas, oil, coal, and wood. This is due to insufficient air present to completely burn the fuel. At 25.39%, the CO emission load was estimated highest at Ward C- Vashi, followed by Ward B-Nerul (23.08%), Ward A-Belapur (14.67%) and lowest at Ward H-Digha (4.55%). Ward A, B and C contribute almost 63% of total emission load of CO. This CO emission load is emitted maximum from Heavy Duty vehicles i.e., around 46.22% (i.e. 12889.4 kg/d). The cumulative CO emission load of the city was estimated to be 27885.9 kg/day. Whereas emission load from 2 wheelers is around 4923.5 kg/day, contributing 17.66% of total load, followed by emission from Petrol Cars stands around 14.27%. The lowest emission load was found from vehicle category of Taxis (0.04%). The region wise PM emission load in a day with respect to its vehicular distribution is given in **Table 3.23 and Figure 3.11.**

Table 3.23 : CO Vehicular Emission Load from Different Sector and Zones of Navi Mumbai City

Wards	Car Petrol	Car Diesel	Car CNG	Taxi	3 Wheelers	2 Wheelers	CNG Bus	Heavy D. Diesel Veh.	Total Kg/day
A	673.9	37.4	21.4	1.3	212.8	650.4	523.3	1969.2	4089.6
B	995.8	55.3	31.6	2.7	320.7	1028.1	840.2	3162.1	6436.5
C	991.8	55.1	31.5	5.6	654.4	1210.9	867.3	3264.1	7080.7
D	301.7	16.8	9.6	0.47	325.3	462.5	324.5	1221.2	2661.9
E	257.4	14.3	8.2	0.48	200.0	349.1	340.9	1283.0	2453.3
F	334.6	18.6	10.6	0.50	177.4	435.4	230.5	867.5	2074.9
G	273.9	15.2	8.7	0.18	201.7	436.2	185.7	698.8	1820.2
H	151.5	8.4	4.8	0.24	216.4	351.0	112.6	423.6	1268.6
Kg/day	**3980.6**	**221.1**	**126.4**	**11.4**	**2308.5**	**4923.5**	**3424.9**	**12889.4**	**27885.9**
Tones/Yr	**1452.9**	**80.7**	**46.1**	**4.2**	**842.6**	**1797.1**	**1250.1**	**4704.6**	**10178.3**

Wards : *A-Belapur; B-Nerul; C-Vashi; D-Turbhe; E-Koparkhairane; F-Ghansoli; G-Airoli; H-Digha*

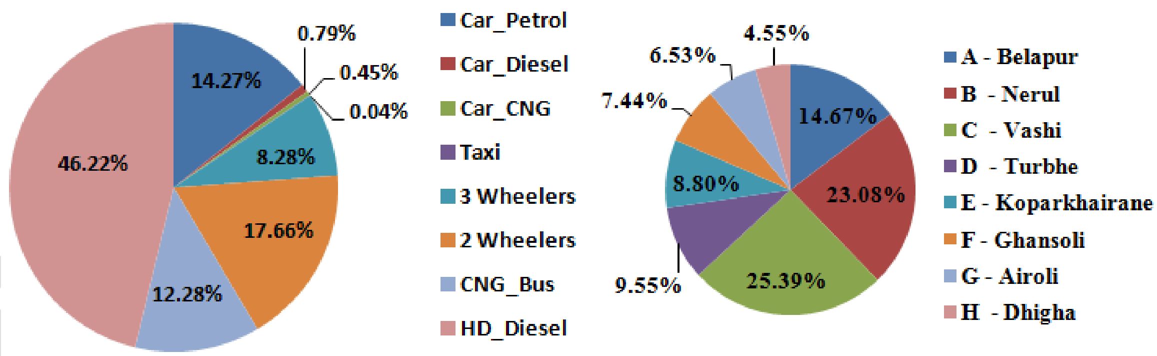


Figure 3.11 : Percent Contribution Vehicle Categories and Ward wise Emission Load Distribution of CO (Kg/d) in Navi Mumbai

Besides ward wise vehicle emission inventory as presented earlier, the data collected for vehicle counts and road lengths were used to prepare city emission inventory. Methodology described earlier remains same; however, the estimates have been made for 2 Km x 2 Km grids with respect to the entire city. These estimates have been further used for grid wise projections, input to dispersion modeling and scenario generation. **Table 3.24** presents the total emission loads as per different vehicle categories.

Table 3.24 : Total Emission Load from Different Categories of Vehicle for Navi Mumbai

	PM	SOx	NOx	HC	CO
2 Wheelers	88.9	0.009	1025.7	2351.4	4923.5
3 Wheelers	394.8	--	635.7	4434.6	2308.5
Car Petrol	9.5	0.024	426.5	385.5	3980.6
Car Diesel	55.3	0.184	1032.0	199.9	221.1
Car CNG	12.6	--	1558.5	656.8	126.4
Taxi	1.0	--	120.0	47.9	11.4
HD Diesel	2663.8	0.368	19978.6	521.7	12889.4
CNG Bus	40.5	--	5717.4	2265.9	3424.9
Total (Kg/day)	**3266.4**	**0.585**	**30494.5**	**10863.7**	**27885.9**
Total (Tons/Yr.)	**1192.2**	**0.214**	**11130.5**	**3965.3**	**10178.4**

* Values are in kg/day

Considering the distribution of vehicles on the basis of their fuel consumption, the categories wise vehicle registered in the city are as follows. It can be observed that the proportion of CNG operated vehicle in the city is low as compared to diesel and petrol based vehicles.

Office-wise No. of Diesel, Petrol, LPG & CNG Motor Vehicles Newly Registered During 31st March, 2016

Name of the office/region	Diesel	Petrol	LPG	CNG	Others	Total
Vashi - New Mumbai	113283	212623	385	25298	31	351620

Emission from different categories of cars is considerable. The percent distribution of pollutant gives highest emission of PM i.e. 82%, whereas 66% and 63% of NOx and SOx and 46% of CO is mainly contributing from HDDV. The NOx contribution in a day is around 19978.6 kg, followed by CNG operated vehicles (5717.4 kg/d). HDDV also dominate PM_{10} emission load with about 2663.8 kg/d followed by 3 Wheelers with a load of 394.8 kg/d towards the final emission load. Even for CO, HD vehicles were major contributor at 12889.4 kg/day of emissions. Whereas, the percentage of emission load from HD vehicles of HC (4.80%) is low. The Agricultural Produce Market Committee (APMC) market, Asia's largest market, located at Vashi has pulled in huge truck traffic in the area which is the prominent reason for the reflecting the pollution load.

The emission load of PM and CO from CNG operated car is lower than the Diesel and Petrol cars, whereas the emission load for NOx and HC is higher as compared to other two categories of cars. Three wheelers on the other hand give highest HC, followed by CO, NOx; whereas 2 wheelers give higher contribution of CO followed by HC. Similar trend was observed for CNG buses and also contribute NOx substantially. Shift wise total emission varies considerably according to vehicle category wise. It has been seen that most of the places, evening peak hours are extended late in the night and therefore, night emissions load are also high.

3.4 Point (Industrial) Sources

In terms of absorbing the incremental population shock from the mega city of Mumbai, Navi Mumbai recorded a decadal population growth by more than 51% between 2001 and 2011. The population of NMMC (Navi Mumbai Municipal Corporation) area was estimated to be about 14.69 lakhs 2016–17 which was 1.4% more compared to last year as per the survey data of UHPs (Urban Health Posts), Health department NMMC. The development of industrial belt in Navi Mumbai attracted a large population as it gave rise to employment opportunities. This increase in population brought growth in medium and small scale industrial establishments, educational hub, economic activities and infrastructure, in turn exerting pressure on the resources of the city. This thrust alters the normal state of the resources either in terms of resource availability (land and water supply) or pollution loads (water and air pollution).

The industrial sector under NMMC jurisdiction is regulated by Maharashtra Pollution Control Board (MPCB) & Maharashtra Industrial Development Corporation (MIDC). The city development and infrastructure is jointly managed by NMMC and CIDCO. The core sector of Navi Mumbai mainly comprises of Residential Cluster, Residential & Industrial Cluster and Industrial Cluster (TTC Industrial, MIDC Area). MIDC has established an industrial estate at Thane Belapur Road, Navi Mumbai in the year 1963, known as Trans Thane Creek (TTC) which is located at Thane-Belapur Road (**East**: Parsik Hill Range; **West**: Thane Municipal Area; **North**: Residential Area; **South**: Thane Belapur Rd, and Navi Mumbai Township). The total area of the industrial estate is 27 Sq.kms and about 16% of total area in Navi Mumbai falls under MIDC zone **(Figure 3.12)**.

The Trans Thane creek (TTC) Industrial area and Taloja MIDC are main industrial zones in Navi Mumbai. The Trans Thane creek (TTC) Industrial area lies within the NMMC limits while the Taloja MIDC area lies in close proximity of NMMC area. The TTC industrial area accounts for more than 3000 industries while the Taloja industrial area consists of large, medium and small industrial units. Various types of processing industries including chemical, dyes, dye- intermediates, bulk drugs, pharmaceuticals, textile auxiliaries, pesticides, petrochemicals, engineering units, paper, plastic and so on are located in these industrial areas.

Some of the well-known industries in these areas include Balmer Lawrie & Co. Ltd., Reliance Paper Products, E Merck (I) Ltd., Hindustan Lever Ltd. and Pidilite Industries Ltd, Pfizer, Lubrizol India Ltd., Polyolefins Industries Ltd., Herdillia Chemicals Ltd., BASF (India) Ltd., Star Chemicals, Indofil Chemicals Ltd., and Phoenix Chemical Works are located in this area.

Apart from industrial units, there exists a CBD (Central Business District) located at Belapur spreads over 575 hectare which has been developed to house various corporate as well as government and administrative institutions. The area is known to account for country's most prominent IT- BPO establishments. Employments observed in CBD Belapur are around 32% while 37% jobs are IT-BPO establishments located in Vashi.

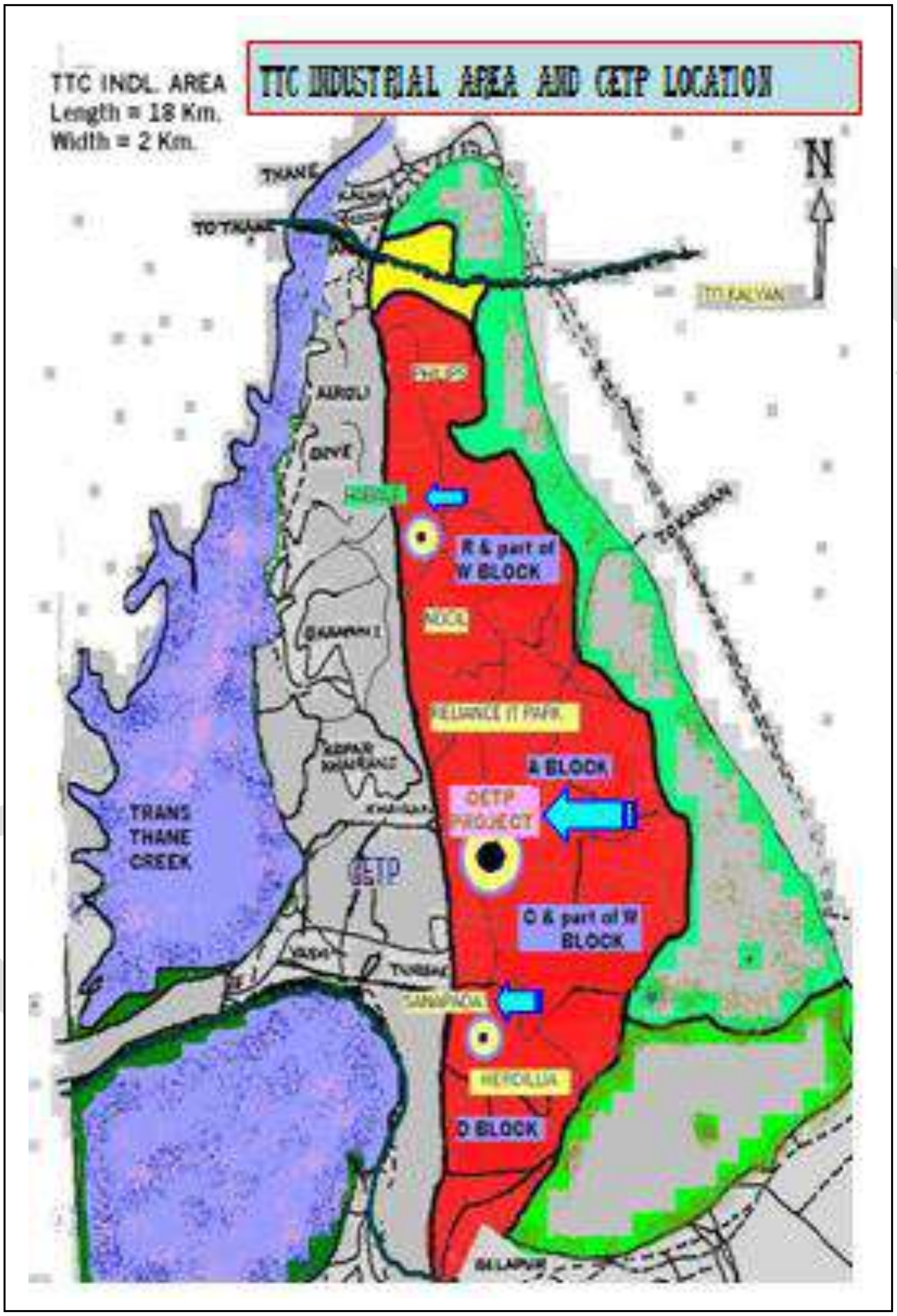


Figure 3.12 : Industrial Area of Navi Mumbai Region

As per MPCB, Navi Mumbai had aggregate Comprehensive Environmental Assessment of Industrial Cluster in December 2009 having CEPI Score of 73.77, which improvised to 56.48 as on March 2017. There are 241 Air Polluting industries in area/cluster. Major pollutants are TPM/SPM, SO_2, NOx, NH_3, Cl_2, and VOC from pesticide and bulk drug units.

At present there are 4 CAAQMS (Continuous Ambient Air Monitoring Stations) installed at Airoli, Koparkhairane, Turbhe, and Nerul. NMMC has also proposed installation of a CAAQMS at CBD-Belapur. NMMC operates a mobile monitoring van which is deputed at various locations in the nodes of Navi Mumbai to monitor the air quality. As per NMMC ESR 2016-17, the Air Quality Index was non-polluting for more than half year at Koparkhairne and Turbhe and for less than 10% of observation day's air pollution quality was recorded in 'Poor' or 'Very Poor' category.

The regions of Turbhe and Koparkhairne were observed to be polluted under Moderate to Very poor category for particulate matter. 15% of observations were seen under Poor category followed by 3% under Severe category for $PM_{2.5}$ (RSPM) more than 50% observation were noted under Moderate category for PM_{10} (SPM) for these region as per ESR. This can be attributed to due presence of TTC industrial belt within NMMC limits.

Stationary sources can be divided into two major subcategories, viz. point and area sources. Point sources are generally large emitters with one or more emission points at a permitted facility with an identified location. Examples include food processing facilities, oil production and refinery facilities, steam generators, boilers, process heaters, glass manufacturing, etc. The emissions from point sources are generally calculated using emission factors obtained from direct measurements (e.g., source testing). EPA's document entitled, Compilation of Air Pollutant Emissions Factors (AP-42), or California Air Resource Board's material balance formulas are the major resources for emission factors of point sources. The simplest method of calculating emissions is to multiply the process rate (how much or how often an activity occurs) by an emissions factor (mass of air pollutant emitted per unit time of activity) and a control factor (percent of emissions not allowed to reach the atmosphere). Chemical, oil refineries, petrochemical, fuel-based power plant, textiles, fertilizer and other industries are the major point sources of emissions in Navi Mumbai region.

The status of different types of industries with their grading 'Red (highly polluting), Orange (moderately polluting) and Green (low polluting)' based on labour employed and consumption of water, fuel and power under Maharashtra Pollution Control Board Regional office of Navi Mumbai is given in **Table 3.25**.

Table 3.25 : Category wise Different Types of Industries located in TTC MIDC Area

Category	LSI	MSI	SSI	Total
RED	42	27	549	620
ORANGE	20	13	436	469
GREEN	5	7	2091	2103
Total	**69**	**47**	**2529**	**3192**

As per 'Environmental Status and Revised Action Plan for Prevention and Control of Pollution of Industrial Cluster -Navi Mumbai' prepared by MPCB -2016-17' the most highly polluting industries are given in **Table 3.26 a & b**.

Table 3.26 a : List of Highly Polluting Industries in TTC MIDC Area

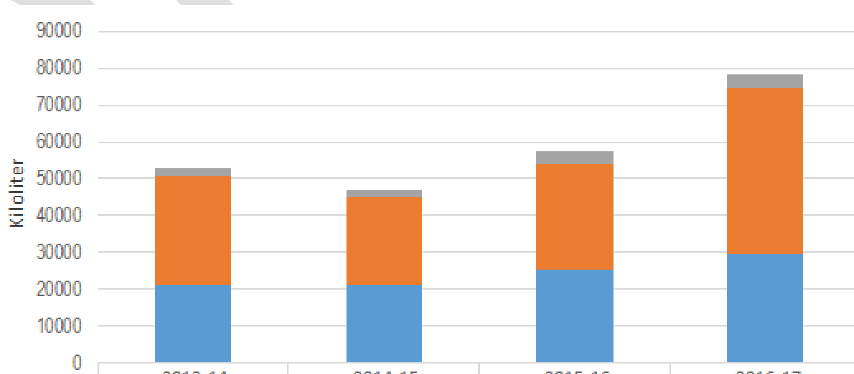
Sr.	Industries Name	Industry Type
1.	M/s. Sandoz Pvt.Ltd., Plot No. D-31/32, TTC, MIDC, Turbhe, Navi Mumbai	Basic Drugs & Pharma Mfg.
2.	M/s. Hemmo Pharmaceutical Pvt. Ltd., Plot No.C-43, TTC, MIDC Pawane, Navi Mumbai	Basic Drugs & Pharma Mfg.
3.	M/s. Modepro India Pvt. Ltd., Plot No. D-16/2, TTC, MIDC Pawane, Navi Mumbai	Basic Drugs & Pharma Mfg.
4.	M/s. R.P.G. Life Science Ltd. Plot No. 25& 25A, TTC, MIDC Pawane, Navi Mumbai	Basic Drugs & Pharma Mfg.
5.	M/s. Zydus Takeda Health Care Ltd., Plot No. C-4, TTC MIDC, Thane Belapur Road, Navi Mumbai 400705	Basic Drugs & Pharma Mfg.
6.	M/s. Zoeitus Plot No. 16, TTC MIDC Indl., Turbhe Navi Mumbai	Basic Drugs & Pharma Mfg.
7	M/s. S.I.Group India Ltd. Plot No.2, TTC, MIDC Turbhe, Navi Mumbai	Basic Drugs & Pharma Mfg.
8.	Padarsh Pharmaceuticals Pvt.Ltd., Plot No.C-45/1, TTC MIDC, Pawane, Navi Mumbai	Basic Drugs & Pharma Mfg.
9.	Paramount Chemical Industries, Plot No.C-384, TTC MIDC, Pawane, Navi Mumbai	Basic Drugs & Pharma Mfg.
10.	Paras Organics Pvt. Ltd., Plot No.D-119, TTC, MIDC Shirvane, Navi Mumbai	Basic Drugs & Pharma Mfg.
11.	Great Pacific Exports Pvt. Ltd., Plot No. D-5/8, TTC MIDC, Shirvane, Navi Mumbai	Basic Drugs & Pharma Mfg.
12.	NGL Fine Chem Limited Plot No. W-142, TTC MIDC Khiarane, Navi Mumbai	Basic Drugs & Pharma Mfg.
13.	Deepa Chemicals, Plot No. W-20, TTC, MIDC Pawane, Navi Mumbai	Dyes and Dye Intermediates
14.	Reliance Life Sciences Pvt. Ltd., Plot No. R-282. MIDC Rabale, Thane Belapur Road, Navi Mumbai	Basic Drugs & Pharma Mfg.
15.	Indoco Remedies Ltd., R-104, MIDC Rabale, Thane Belapur Road, Navi Mumbai	Basic Drugs & Pharma Mfg.
16.	Maharashtra Polybutens Ltd., R-104, MIDC Mahape, Thane Belapur Road, Navi Mumbai	Petrochemical

Table 3.26 b : Summarized Status of Compliance of Category Industries in TTC- MIDC Area

Category of Industry	Total	No. of Operational and Complying Units	No. of Operational and Non Complying Units.	Closed Units
Basic Drugs & Pharmaceuticals Mfg.	17	13	0	4
Dyes & Dye Intermediate	1	1	0	
Pesticide Formulation & Mfg.	2	0	0	2
Petrochemical	2	1	1	
Total	**22**	**15**	**1**	**6**

Fossil fuel used by the industries for boilers or manufacturing process remains the single potential source of discharging emissions into the atmosphere from their stacks. For proper estimate of emissions, the effectiveness of an existing control device must be applied in the emission calculation. Emissions are estimated for pollutants such as SPM, PM_{10}, CO, HC, SO_2 and NOx. In order to workout emission loads from industries due to burning of fossil fuel, information on fuel consumption in industries and the information on industries typology capacity etc. was obtained from Maharashtra Pollution Control Board (MPCB).

Two main grades of diesel fuel are marketed in India, High Speed Diesel (HSD) and Light diesel oil (LDO). The former is a 100% distillate fuel while the latter is a blend of distillate fuel with a small proportion of residual fuel. It was observed that there is huge demand for petroleum products like Furnace oil and HSD in industries too. In 2016-17, the total petroleum sale within Navi Mumbai is noted to be around 78 thousand Kiloliters (KL) **(Figure 3.13)**.



	2013-14	2014-15	2015-16	2016-17
Furnace Oil	1998	1993	3210	3758
HSD	29871	23988	29011	45446
Motor Spirit	20889	20934	25135	29411

Figure 3.13 : Trend in Sale of Petrol, Diesel and Furnace Oil in NMMC Area by HPCL

Source : HPCL

The sale in Navi Mumbai has grown by 37% as compared to previous year 2015-16. In the year 16-17, the sale of HSD has increased by 57%, followed by Motor Spirit and Furnace oil by 17% as compared to previous year. The decrease in LDO is seen by 63% as compared to last year **(Figure 3.14)**.

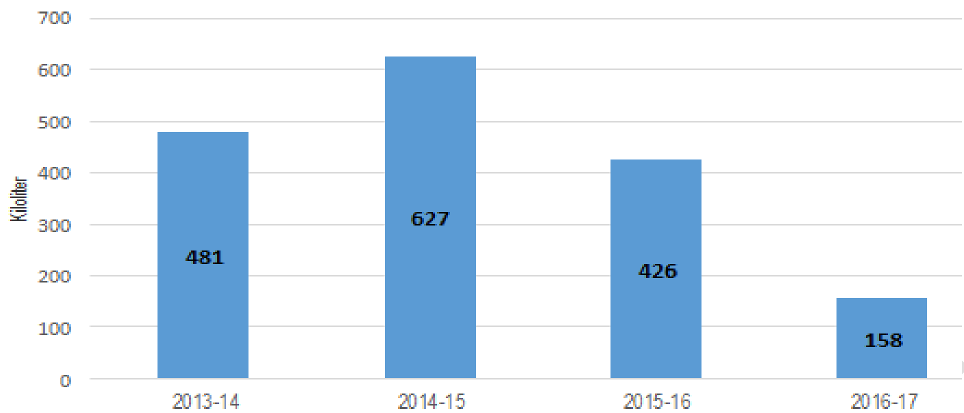


Figure 3.14 : Trend in Sale of LDO in NMMC Area in NMMC Area by HPCL

Source : HPCL

3.4.1 Approach/Methodology

From the data furnished by MPCB, a total of 241 industries were identified as air polluting industries in Navi Mumbai region. Data for Fuel consumption such as Furnace Oil (FO), Light Diesel Oil (LDO), Low Sulphur Heavy Stock (LSHS), and Compressed Natural Gas (CNG), by the industries in the Navi Mumbai area has been obtained from MPCB **(Table 3.27)**. The gross emissions are estimated for all types of industries viz. LSI, MSI and SSI. Accounting to the number of MSI and SSI establishment, emission from the fuel consumption is considerable as from LSI.

Table 3.27 : Fuel Consumption from Industries (TPD)

	FO	LSHS	LDO	HSD	NG	Coal	LPG	Wood	Diesel	CNG	PNG
Red_All	347.4	0.0	135.2	94.4	1434.8	764.1	931.6	0.6	64.7	2.6	22.8
Orange_All	12.5	1.4	16.5	1054.5	0.0	7.0	0.0	0.0	30.8	0.0	112.8
Green_All	2.2	0.0	0.9	13.0	0.0	0.0	0.4	0.0	21.3	0.0	0.0
Total (TPD)	**362.0**	**1.4**	**152.6**	**1161.8**	**1434.8**	**771.1**	**931.9**	**0.6**	**116.9**	**2.6**	**135.6**

Emission inventory from industries has considered working hours considered: for industries, MSI =16 hrs, LSI = 22 hrs, SSI = 12 hrs. 1 Barrel–159 lit, LSHS, FO is assumed to be residual oil. LDO and HSD are assumed to be distilled oil.

Emission factors published by TERI, New Delhi are used because the data on type of combustion equipment used for firing and other operating parameters like fuel quality, efficiency of boilers were not readily available with the industries in the region which are essential.

As per the regulation, many of the industries have installed control equipment after stringent action from MPCB officials in recent times. The emission load was calculated based on 90% reduction due to control equipments in industries for PM and SOx viz. bag filters, industrial scrubbers, electro static precipitator, use of low sulphur fuel oil, cylinder lubrication and for NOx 30% reduction was assumed by way of different technologies for reduction of NOx viz. Flue-gas recirculation, Hybrid SNCR/SCR technologies, reagents to reduce these emissions, humid air method, water injection and water emulsion, high scavenge pressure and compression ratio and selective catalytic reduction. The sulfur and ash content was taken from the consent of respective industry, for those industries without any ash and sulfur contain is calculated based on **Table 3.28**.

Table 3.28 : Emission Factors applied for Industrial Emissions

S. No.	Type of Fuel	Unit	S	**Emission Factors (Kg/Unit)**					
				TSP	**SO_2**	**NO_x**	**HC**	**CO**	**Ash**
1.	LSHS	KL	0.45	1.25*S + 0.38	19.25*S	7.5	0.12	0.63	
2.	FO	KL	4.0	1.25*S + 0.38	19.25*S	7.5	0.12	0.63	
3.	LDO	KL	1.8	0.25	17.25*S	2.75	0.12	0.63	
4.	HSD	KL	1.0	0.25	17.25*S	2.75	0.12	0.63	
5.	LPG/FG[$$]	KL	0.02	0.072	0.01*S	2.52	0.07	0.43	
6.	NG	m^3	-	160 E-06	9.6 E-06	2800 E-06	48 E-06	272 E-06	
7.	Coal /Coke	MT	0.5*	6.5*A	19S	7.5	0.5	1.0	45
8.	Kerosene[##]	Kg/t	0.25	0.06	17S	2.5	--	--	--
For Power Plant**									
1.	LSHS	KL	0.45	1.25*S + 0.38	19.25*S	6.25	0.12	0.63	
2.	NG	m^3	-	160 E-06	9.6 E-06	2800 E-06	48 E-06	272 E-06	
3.	Coal	MT	0.15	6.5*A	19*S	7.5	0.5	1	6

Source: URBAIR Report, Bombay, 1992
A: Percentage ash in coal = 45% and S: Percentage Sulphur
Other than Power Plant, efficiency of Cyclone considered as 75%
* * Power plant
$$Emission Factors for LPG from Revised AP-42 (Ref. PMRAP, NEERI, 2003 (Table 3.2)

Density[b] of Fuels (Kg/m[3])

LSHS	943
FO	943
LDO	860
LPG	504
HSD	860

Π **Coal**
A - % Ash: 2- 10% Avg. 6%, S - % Sulphur: 0.1 – 0.2%, Avg. 0.15%
ESP Eff. : 99.5%, FGD Eff. : 99%

Π **LSHS** Sulphur: 0.45%

Source:

a. Environmental effects of energy production, transformation and consumption in the National Capital Region submitted to the Ministry of Environment & Forest, by Tata Energy Research Institute (TERI), New Delhi, February 1992
b. Indian Oil Corporation Ltd, Vadodara

Releases from point sources can include complex mixtures of substances and the pollutants released will be dependent on process input materials, type of process, etc. Taking all the type of industry into consideration, the emission load from MSI and LSI category is much more liable for regulation than emissions from LSI units. Large number of SSI and MSI set up in commercial and residential zone are accountable, considering units in industrial zone. Inventorization of their fuel consumption is not being maintained, as they are often left unsupervised from the regulatory end. The emission from LSI units across all category contributed maximum load towards the final emission.

Total estimation load was calculated on the basis of fuel consumption required for the different process in the industries. For grid wise emissions estimation, the whole region of the city was divided into equal grids of 2 Km x 2 Km size and the wards were overlaid on these grids. Total emissions were calculated and distributed into various wards in accordance with the actual location of industries. Most industrial point sources release pollution into the atmosphere through chimneys at a height sufficient to provide ample dilution before the pollutants reach ground level. However, certain meteorological conditions may prevent or reduce the effectiveness of this dispersion and pollutants may become trapped near the source and descend to ground level where they may cause poor air quality. The industrial emission load from different pollutants and whole of Navi Mumbai city is given in **Table 3.29**.

Table 3.29 : Emission Load for Point Source from Different Pollutants

Category	PM_{10}	SOx	NOx	HC	CO
Red LSI	4212.9	3497.4	12368.4	608.8	2198.6
Red MSI	32.6	293.3	353.1	9.8	43.0
Red SSI	120.9	652.3	887.9	29.0	112.4
Orange LSI	24.3	2091.2	3592.6	143.2	754.4
Orange MSI	4.0	86.5	89.7	2.2	11.4
Orange SSI	16.2	68.4	93.6	3.3	11.5
Green LSI	1.8	49.5	63.8	2.0	10.7
Green MSI	0.1	2.5	2.4	0.0	0.2
Green SSI	4.8	82.9	81.1	1.4	7.2
Total (kg/day)	**4417.6**	**6824.1**	**17532.7**	**799.6**	**3149.3**
Total (TPD)	**4.42**	**6.82**	**17.53**	**0.80**	**3.15**

The emission load from all Red Category Polluting Industries are higher 4366.5, 4443.1 and 13609.5 kg/d for PM, NOx and SOx respectively, whereas total all category Orange and Green industries emission load reflect as 0.05, 2.38 and 3.92 kg/d. The Red category emission load is mainly reflected by mostly fuel consumption from (Coal 764, FO 347, LDO 135 and HSD 94 TPD) as also NOx and HC is reflected by (NG 1434, LPG 931 and PNG 22 TPD). The all LSI contribution to PM load is around 96% and other pollutants in the range of 83 to 94%, whereas all MSI percent emission load is around 0.8 to 2.5%, except SOx 5.6% and SSI percent emission load is around 3.2 to 6.1% except SOx 11.8%; among them SOx and NOx are the major. The Orange and Green category fuel consumption is higher for HSD 1067, Diesel 52 and FO 15 TPD which shows the SOx and NOx emission. Overall substantial amount of NOx comes from fossil fuel combustion utilities. Considering the NOx emission loads certain action measures will be required in future context to control the emissions. The percent contribution of emission load from fuel consumption is given in **Figure 3.15**.

The contribution of the PM10 emission load can be attributed towards the consumption of fossil fuel like coal. The total emission load of PM10 was calculated to be around 4.42 tons/day. Out of which the load contributed by coal was highest by 94.7% (771 TPD), followed by FO 3% (362 TPD). The Particulate matter (PM) emissions from large combustion plants burning solid fuels are often lower than emissions from smaller plants (per unit of energy input); the physical and chemical characteristics of the particulate matter also differ. This is because different combustion and abatement techniques are applied. Combustion of fuels can generate solid residues, which may be deposited within combustion chambers (furnace bottom ash) within the furnace, boiler surfaces or ducting (fly ash) or on heat exchanger surfaces (soot and fly ash). Coal and other fuels with significant ash content have the highest potential to emit particulate matter. The emission load of PM from RED-LSI units was alone calculated to be around 4212.9 kg/day. While calculating emission load for PM and SOx, 90% reductions are considered, as we assuming industries are taking precautions to control dust by way of bag filters, industrial scrubbers, electro static precipitator etc.

Nitrogen oxides are produced in the combustion process by at least two different mechanisms: one source is from the molecular nitrogen in the combustion air (thermal NOx), and the other is from the nitrogen in the fuel being burnt (fuel NOx). 22.6% of NOx is emitted from coal based industries [from 771.1 TPD], followed by NG, 20% as Red category is single source (fuel 1434.8 TPD for NG); as also 18% to 19% emitted by burning of fuel like LPG and HSD respectively, approximately 1000 TPD each is the source. Another input is from FO (362 TPD) gives 12% emission, the LDO and Diesel are the minor sources as there fuel source is around 100-150 TPD. The Red LSI contributes 71% and Orange LSI share 20%, and others are 9% to the total emission load. We assume that industries are implementing reduction technologies such as Flue-gas recirculation, Hybrid SNCR/SCR, reagents to reduce these emissions, high scavenge pressure and compression ratio and selective catalytic reduction etc. so as the calculation are worked out on the basis of 30% reduction in total load, else the NOx load will be higher.

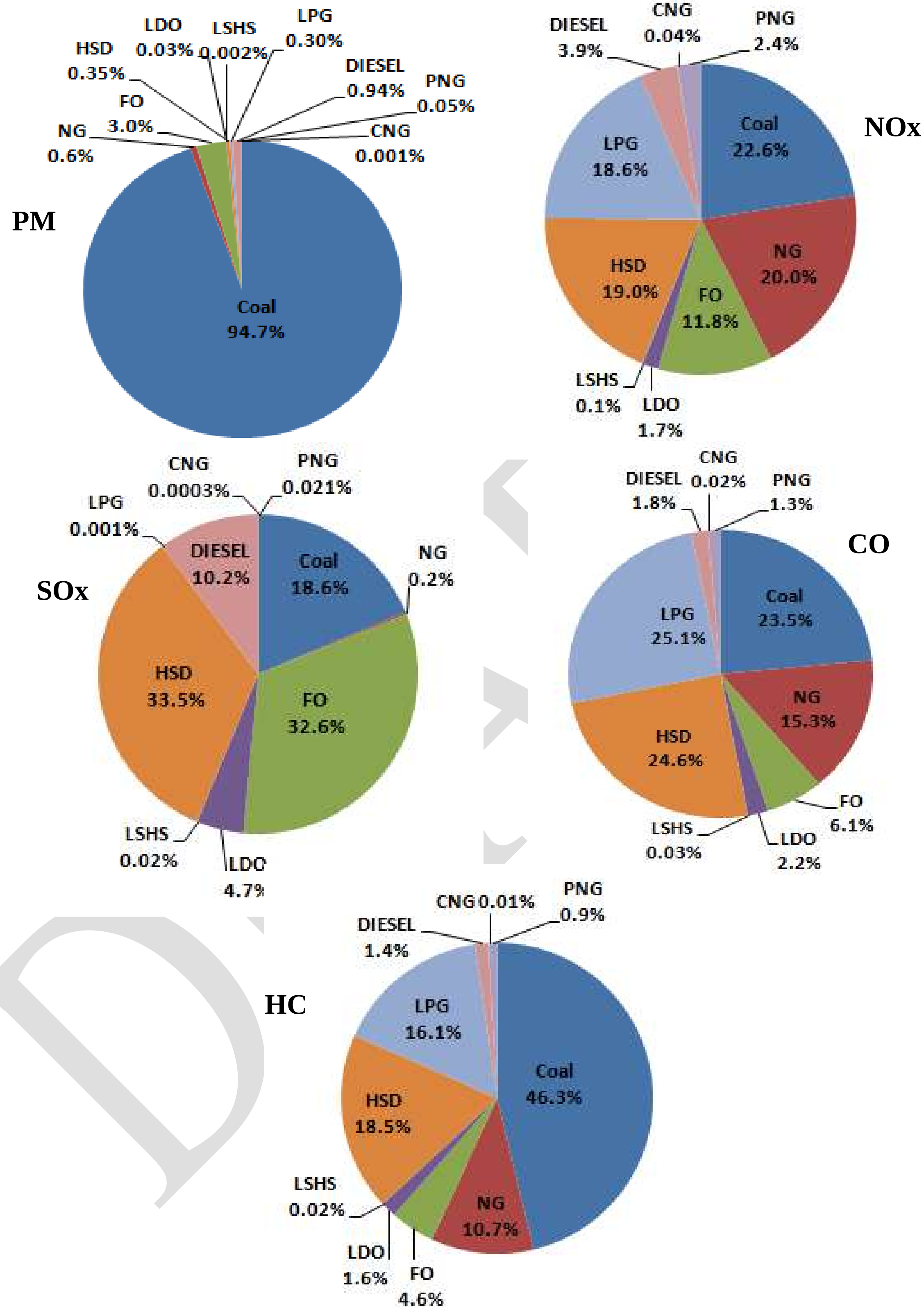


Figure 3.15 : Percent Distribution of Pollutant from Different Source Category (Navi Mumbai Industries)

Sulphur dioxide is found in many industrial gases emanating from plants involved in roasting, smelting and sintering sulphide ores, or gases from furnaces burning, high sulphur coal or fuel oils or other sulphurous ores or other industrial operations involved in the combustion of sulphur-bearing fuels, such as fuel oil. The total SOx emission is around 6.82 TPD, and is mainly contributing from FO and HSD i.e. 32.6% and 33.5% respectively as their fuel consumption is around (362 TPD and 1162 TPD). FO is mainly used by Red industries, whereas HSD is by Orange. The other contributors are Coal 18.6% and Diesel 10.2%, the least contribution is from LDO 4.7%. The Red LSI contribute 51% and Orange LSI share 31%, others are 18% to the total emission load.

Hydrocarbons are either evaporated from fuel or are remnants of fuel that did not burn completely. About 46% of HC is released from burning of coal in the industries; HSD is also contributing 18.5% as fuel consumption from all categories is 1161.8 TPD. The LPG and NG are cleaner fuel as compared to solid fuels but HC is contributing some extent i.e. 16% and 10% respectively to the total emission. The percent contribution from sector The Red LSI contributes 76% and Orange LSI share 18%, and others are 5% to the total emission load. Out of the total 3149 TPD of CO emission load around 25% is coming from LPG, Coal and HSD each categories of fuel. Carbon monoxide is produced when organic materials, such as gasoline, coal, wood, and trash, are incompletely burned. 70% is mainly contributing from Red LSI and 24% is from Orange LSI. The percent contribution of CO emission i.e. 3.9% and 1.7% from SSI and MSI are vey negligible emission load.

Very less amount of fuel consumption pattern was observed for FO, LDO, LSHS and CNG/PNG which reflect negligible amount of emission load. The MSI and SSI Industries are also using the low cost and easy availability fuel such as briquette and wood which add up the emission load. The overall emission contributing areas are Pawane, Turbhe, Rabale, Koparkhairane, Mahape, Sanpada and Ghansoli, where mostly number of industries operates in TTC belt.

Data Constraints / Assumptions

- Emissions have been worked on the basis of fuel consumption only. The estimation of DG sets emission while load shading time is not worked out, as also the briquette because of its inadequate data and unidentified source and type.
- A wide variation in the data on fuel supplied to the industries as per survey and the data obtained from the consent forms of MPCB on fuel consumption is observed. This indicates some other source of fuel supply and consumption whose details are not available for estimating the point source emissions. It necessarily does not mean that the fuel supplied goes to industries alone.
- The surrounding industrial areas (Taloja Belt) in Navi Mumbai Region are not taking for estimation as whole emission inventory is developed on the basis of city level.

3.5 Whole Navi Mumbai City Total Emission Load

Cumulating all the emission loads from significant sources viz., Area, Point and Line sources for Navi Mumbai city vide emission inventory was developed as shown in **Table 3.30**.

Table 3.30 : Navi Mumbai City wide Emission Load from All the Sources

Sector	**PM**	**%**	**NOx**	**%**	**SOx**	**%**	**HC**	**%**	**CO**	**%**
Bakeries	69.2	0.33	5.2	0.01	0.8	0.01	458.0	3.38	505.2	1.31
Crematorium	46.7	0.22	6.4	0.01	1.1	0.02	309.3	2.28	343.2	0.89
Open Eatout	9.3	0.04	8.1	0.01	14.1	0.19	28.8	0.21	107.3	0.28
Hotels & Res.	205.0	0.98	112.4	0.20	149.4	2.04	7.9	0.06	243.6	0.63
Domestic Sect.	364.0	1.75	8020.4	14.25	298.3	4.08	314.9	2.32	4756.7	12.36
Open Burning	285.9	1.37	107.2	0.19	17.9	0.24	768.5	5.67	1501.2	3.90
Building Const.	852.0	4.09	5.2	0.01	0.8	0.01	458.0	3.38	505.2	1.31
Total Area (A)	**1832.12**	**8.80**	**8259.7**	**14.67**	**481.5**	**6.59**	**1887.39**	**13.93**	**7457.2**	**19.37**
Red LSI	4212.9	20.24	12368.4	21.97	3497.4	47.87	608.8	4.49	2198.6	5.71
MSI & SSI-ROG	204.7	0.98	5164.2	9.17	3326.6	45.53	190.9	1.41	950.8	2.47
Total Point (B)	**4417.6**	**21.22**	**17532.6**	**31.15**	**6824.0**	**93.40**	**799.7**	**5.90**	**3149.4**	**8.18**
2 Wheelers	88.9	0.43	1025.7	1.82	0.01	0.0001	2351.4	17.35	4923.5	12.79
3 wheelers	394.8	1.90	635.7	1.13			4434.6	32.73	2308.5	6.00
Car_Petrol	9.5	0.05	426.5	0.76	0.02	0.0003	385.5	2.84	3980.6	10.34
Car_Diesel	55.3	0.27	1032.0	1.83	0.18	0.0025	199.9	1.48	221.1	0.57
Car_CNG	12.6	0.06	1558.5	2.77			656.8	4.85	126.4	0.33
Taxies	1.0	0.00	120.0	0.21			47.9	0.35	11.4	0.03
HDDV	2663.8	12.79	19978.6	35.49	0.37	0.0050	521.7	3.85	12889.4	33.49
CNG Buses	40.5	0.19	5717.4	10.16			2265.9	16.72	3424.9	8.90
Total Line (C)	**3266.4**	**15.69**	**30494.4**	**54.18**	**0.6**	**0.01**	**10863.7**	**80.17**	**27885.8**	**72.44**
Paved Rd. Dust	**3283.5**	**15.77**								
Unpaved Rd.D.	**8020.1**	**38.52**								
Total of Resuspension Dust 11303.7 kg/d (55.74% of Total PM)										
Total (A+B+C) Kg/day	**20819.8**		**56286.7**		**7306.1**		**13550.8**		**38492.4**	
Total Tons/Yr.	**7599.2**		**20544.6**		**2666.7**		**4946.0**		**14049.7**	

* Values of Concentrations are in kg/d

Percent contribution of pollutant due to different source categories for PM and NOx and percent distribution of all pollutant is presented in **Figure 3.16 and 3.17.** To devise an efficient air quality management framework, the estimation of a robust emission inventory is crucial.

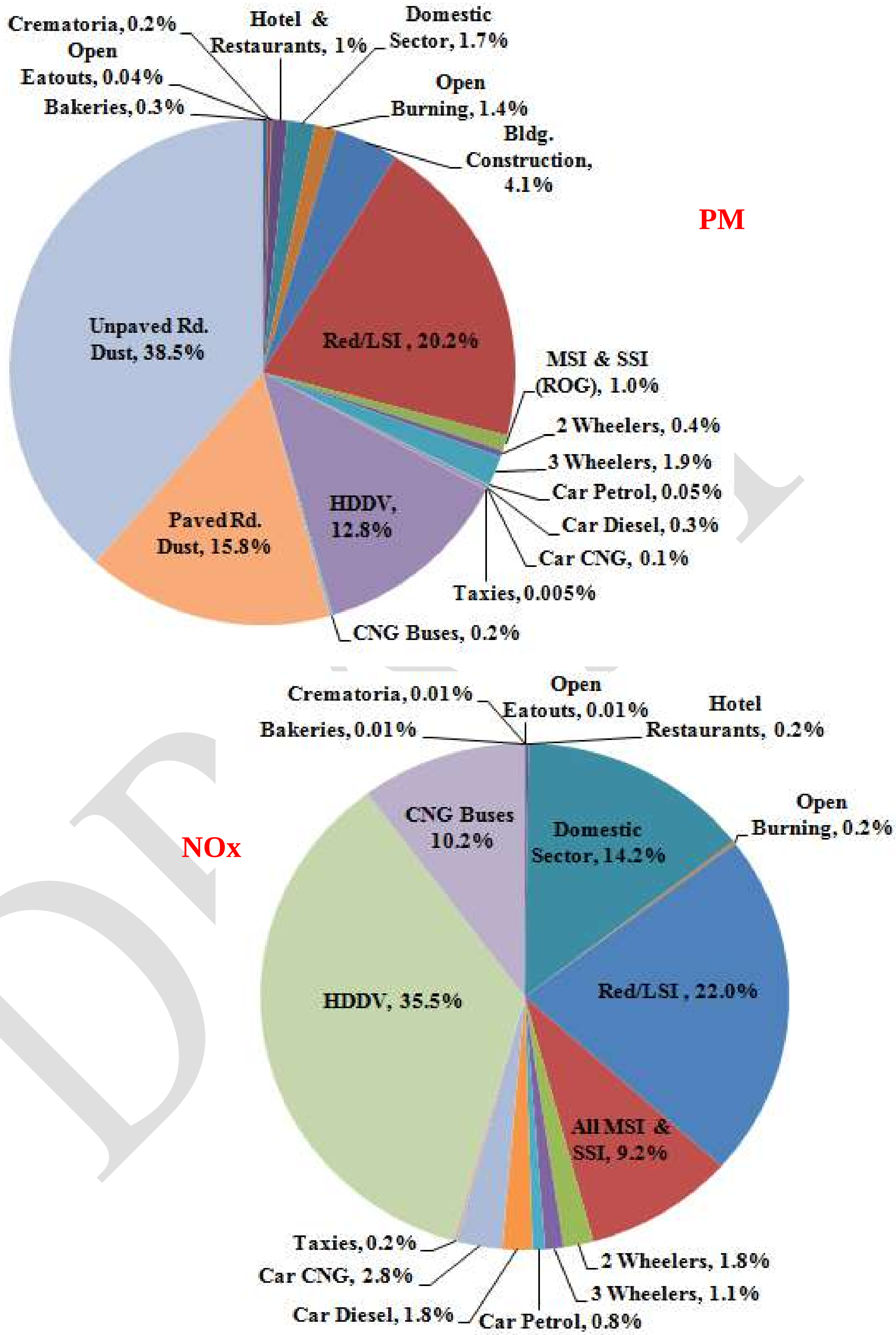
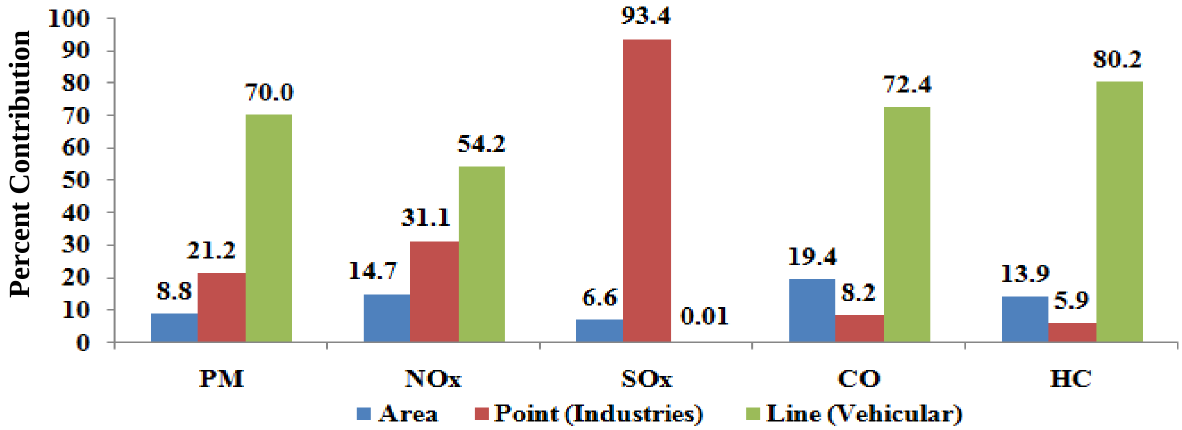


Figure 3.16 : Percent Contribution of PM and NOx from Different Sector in Navi Mumbai



Line Source also includes with Paved + Unpaved Rd. Dust for PM

Figure 3.17 : Percent Contribution from All Sources for Whole of Navi Mumbai

In Navi Mumbai city, PM is mainly contributed from collective sources of road dust and vehicular sector i.e. 70%; among road dust Paved dust share 15.77% and unpaved 38.52% (both 54.29%) and tailpipe emissions of vehicular sources contribute 15.69%. The second largest percent contribution is from industrial source (21.2%), whereas area source share is 8.8%. Among the total area source i.e. 1832 kg/day domestic sector reflect 1.75% and construction activities 4.09% followed open burning 1.37% and hotels and restaurants 1% to the total emission load. Negligible percent contribution is observed from bakeries, crematoria and open eatouts. The total industrial load comes around 4417.6 kg/d and amongst them all Red LSI is the highest contributors 20.24% (4212.9 kg/d). The Orange, Green and Red (MSI and SSI) is very less impactive i.e. 1% (204.7%). The fuel consumption of Red industries (Coal 764, NG 4134, FO 347, LDO 135, HSD 94, and Diesel 64 TPD) is the main source, whereas only 1054 TPD of HSD is observed Orange Industries. All other fuels from all sector i.e. MSI, SSI are in the range of 2 to 21 TPD resulting less pollution. The vehicular sector gives 3266.4 kg/d to the total load, the percent contribution from heavy duty is more 12.79 (2663.8 kg/day), the major vehicular movement of Thane Belapur Road, Sion Panvel Highway, way to JNPT -Uran Road are the influencing point, the APC Market and industrial transportation gives the momentum to transport sector. Because of the heavy movements of vehicles the re-suspension of dust shows the high volume of load. The other category of vehicles viz. 3 wheelers, 2 wheelers, all cars, CNG buses are only gives 2.89%. The total PM load of the city gives around 20819.8 Kg/d and yearly accounts to7599.2 tones/year.

The total NOx load of the city gives around 56286.7 kg/d and yearly accounts to 20544.6 tones/year. The NOx contribution mainly reflects by vehicular source i.e 54.2% (30494.4 kg/d) and secondly by industrial 31.1% (17532.6 kg/d). Among industries Red LSI contributes (12368.4 kg/day) 21.97%, and from Orange, Green and Red, all MSI & SSI categories (5164.2 kg/day) shares 9.17%. The

35.49% i.e. 19978.6 kg/d alone comes from HDDV vehicles followed by 5717.4 kg/d (10.16%) is from CNG Buses. Approximately 1000 to 1500 kg/d is coming from 2 Wheelers, Car Diesel and Car CNG collectively and gives 6.42% to the vehicular NOx. The 3 Wheelers are also gives 635 kg/d i.e. 1.13% to the total NOx. The area source percent contribution is 14.67% (8259.6 kg/d) and entire mainly reflected by domestic sector (8020.4 kg/d) the residential consumption of LPG is around 156210 which reflect the highest contribution.

The 6824 kg/day of SOx emission is mainly from industries i.e. around 93.4%. Out of this 3497.4 kg/day and 3326.6 kg/day comes from Red LSI industries and all MSI & SSI (R,O,G) industries and contributing 47.87% and 45.33% respectively. Only 6.59% shares come from area source among them domestic sector is higher 4.08% (i.e. 298.3 kg/d). For vehicles SOx emissions are calculated based on sulphur content (Diesel 300 ppm and Gasoline 30 ppm) which reflect 0.37 (kg/d) from HDDV, 0.18 from Car Diesel.

The total CO from all sources comes around 38492.3 (kg/d). The line source contribute 72.44% (27885.8 kg/d) among them 33.49% comes from HDDV, whereas 12.79% is from 2 Wheelers. The second highest contribution is from area source 12.36% (4756.7 kg/d) in domestic sector followed by open burning i.e 3.90% (1501.2 kg/d). The total industrial sector gives 8.18%, Red LSI gives 5.71% (2198.6 kg/d) and all MSI and SSI (ROG) gives 2.47% (950.8 kg/d). The total hydrocarbon emission is 13550.79 kg/d; the vehicular source contributes substantially i.e. 80% (10863.7 kg/d); and the major operators are 3 wheelers 32.73% (4434.6 kg/d) followed by 2 wheelers and CNG Buses i.e. 17.35% and 16.72% respectively. Only 5.9% is coming from industries among Red LSI once comes around 608.8 kg/d. The area source gives 14% to the total emission load, around 4-5% is coming mostly from bakeries, crematoria, domestic sector and open burning.

It is important to note that high load contribution does not necessarily lead to high ambient contribution of a particular source at the receptor site. This is due to the fact that emission distribution in atmosphere depends upon multitude of factors such as local meteorology, location, height of release, atmospheric removal processes and diurnal variation. Further, it is equally important that fine particles which constitute higher fractions of toxics are mostly released at ground level sources such as vehicles, refuse burning, bakeries-crematoria, road side eateries, airport and railways ground operations etc. Since mass based emission inventories do not provide the complete picture of real contributions at the levels of exposure, it is pertinent to use chemical analysis data with appropriate dispersion and receptor models.

Chapter 4

Receptor Modelling & Source Apportionment

4.1 Source Apportionment Study Using EPA PMF v5.0

Positive matrix factorization (PMF) is a receptor modeling tool used for identification and quantification of sources and their contribution (Norris *et al.*, 2014). It is a multivariate statistical approach to factor analysis used for the source apportionment of atmospheric particulate matter (Paatero and Hopke, 2003; Gupta *et al*., 2012; Das *et al.*, 2015; Cesari *et al.*, 2016; Habil *et al.*, 2016; Sharma *et al.*, 2016; Zong *et al*., 2016; Gadi *et al.*, 2019). It requires concentration dataset of samples and associated uncertainty as inputs and gives several variables such as factor profiles, their contribution and error in modeling as output (Polissar, 1998; Paatero and Hopke, 2003; Pakbin *et al.*, 2011). The chemically speciated air samples can be assembled as a data matrix 'X' of i x j dimensions, in which i is the number of samples and j is the number of chemical species measured during analysis. It is based on chemical characterization of collected particles, are aimed to solve Eq 1.1:

$$x_{ij} = \sum_{k-1}^{p} g_{ik} f_{jk} + e_{ij} \qquad \textbf{……Eq 1.1}$$

where p is the number of factors contributing to the atmospheric particulate matter, x_{ij} is the j^{th} compound concentration measured in the i^{th} sample, g_{ik} is the gravimetric concentration of the j^{th} element in material from the k^{th} source, and f_{kj} is the airborne mass concentration (mg/m^3) of material from the k^{th} source contributing to the i^{th} sample and e_{ij} is the residual for each species, difference between the measured and calculated amount.

PMF is a weighted least square problem in which a certain number of factors have to be determined in order to minimize an 'object function' as shown in Eq 1.2. Factor contributions and profiles are calculated by minimizing the object function 'Q' in the PMF model.

$$Q = \sum_{i=1}^{n} \sum_{j=1}^{m} \left(\frac{x_{ij} - \sum_{k-1}^{p} g_{ik} \; f_{kj}}{u_{ij}} \right)^2 \qquad \textbf{……..Eq 1.2}$$

Where, u_{ij} is an estimate of uncertainty in the j^{th} variable in i^{th} sample. Q is a significant parameter in the PMF model for which two values, Q (true) and Q (robust), are calculated in the model results. The apportionment technique relies on many trial attempts to arrive at an acceptable solution (Reff *et al.*, 2007; Jiang *et al*., 2015). More description with results analysis of the apportionment approach is included in Section 4.2; technical details can be found elsewhere (Paatero and Hopke, 2003; Pakbin *et al.*,2011; Jiang *et al.*, 2015).

4.2 Methodology

For the present study EPA PMF v.5.0 developed by US EPA (URL 1) was used. This model predicts the source profiles or fingerprints as Factors, relative contributions, and uncertainties for identification of sources and their positive contributions to ambient air pollution.

The study was carries out for representative samples of $PM_{2.5}$ and PM_{10} collected during November, 2019, sampling campaign at 6 locations: Maritime University, Nerul, APMC Mkt, Vashi Plaza, Vasai Toll Naka, TBIA Ind. area Juinagar. The concentration and uncertainty data were obtained from the gravimetric analysis ($PM_{2.5}$ and PM_{10}); Elemental carbon and Organic carbon analysis; Elemental analysis by ED-XRF (46 elements: Na, Mg, Al, Si, P, S, Cl, K, Ca, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, Ge, As, Se, Br, Rb, Sr, Y, Zr, Mo, Rh, Pd, Ag, Cd, Sn, Sb, Te, I, Cs, Ba, La, W, Au, Hg, Pb, Bi, Th and In); and Ionic Analysis (12 ions: Na^+, NH_4^+, Ca^{2+}, Mg^{2+}, F^-, Cl^-, NO_2^-, Br^-, NO_3^{2-}, PO_4^{3-} and SO_4^{2-}) for both PM_{10} and $PM_{2.5}$ for all sources as listed above.

EPA PMF requires 2 input files: 'Concentration' files and 'Uncertainty' file. The input file is prepared using concentration data set of samples and associated uncertainty and both these data sets should be in same format (csv or xls) with all the elements analysed for the study in same units ($\mu g/m^3$). The Concentration file is prepared by multiplying the concentration data as well as the uncertainty (i.e., standard deviation of analysis) obtained in $\mu g/cm^2$ with area of Filter paper (i.e., 11.9 cm^2 @ 39mm ϕ deposit area) from the ED -XRF and ionic analysis and then dividing the mass by the flow rate of Mini volume samplers (7.2 m^3, taking the sampling time as 24 hours @ 5lpm. Here note that PMF works on non-negative aspect so if the concentration of any species is below detection limit or zero then that value needs to be replaced by 0.5 x Minimum Detection Limit (MDL) of that species. The MDL of all the elements is given in **Table 4.1**.

The uncertainty for measured values of elemental, ionic, gravimetric and EC-OC Analysis are calculated with Eq. 1.3 (Norris *et al.*, 2014). This calculation includes field as well as analytical uncertainty. If the value of uncertainty is missing it can be replaced by 5/6 x MDL (Norris et al., 2014).

$$\text{Unc} = \sqrt{(conc\ of\ ion\ X\ 0.05)^2 + (Mdl * 0.5)^2} \qquad \textbf{……Eq 1.3}$$

Where, Conc of ion = Concentration of ion, $\mu g/m^3$; Del relativity = Delta Relativity ~ 5%,
Smp Unc = Sampling uncertainty ~5%; MDL = Minimum Detection Limit, $\mu g/m^3$

These two files are then used as input for EPA PMF v5.0 software. The model uses input files to display the summary of concentration data species in the form of minimum value, 25^{th}, 50^{th} and 75^{th} percentile value, maximum value and 'Signal to Noise' (S/N) ratio. Based on this ratio the species are assigned as strong, weak or bad, as error is minimum in strongest variable and maximum in weakest variable, those labelled bad are excluded from the analysis (Paatero and Hopke, 2003; Jiang *et al.*, 2015). The Species having S/N ratio more than 3 are assigned Strong, ratio between 1 to 3 are assigned as weak and species with ratio less than 1 are assigned as bad species for running of the model. Species with 80% values below MDL are considered Bad species.

The model requires many trial and error attempts to arrive at the solutions. Thus, a wide range of factors (3-8 in number) were tried, and trial runs of 100 with a random start were attempted each time. The ratio Q_{true}/Q_{robust} has also been used to assess the modelled results. Q_{true} is estimated by considering entire data whereas Q_{robust} is estimated excluding outliers (Waked *et al.*, 2014). This ratio when close to 1.0, signifies good solution and negligible influence of outlier whereas if ratio is greater than 1.5 indicates, non-negligible influence (Waked et al., 2014; Jiang *et al.*, 2015).

Table 4.1 : Minimum Detection Limit (MDL) of Target Analytes

Elements (a)	**µg/cm^2**	**µg/m^3#**	**Elements (a)**	**µg/cm^2**	**µg/m^3#**
Na	0.0876	0.211	Ag	0.0192	0.046
Mg	0.0414	0.1	Cd	0.0260	0.063
Al	0.0128	0.031	Sn	0.0488	0.118
Si	0.0050	0.012	Sb	0.0700	0.169
P	0.0134	0.032	Te	0.0866	0.209
S	0.0090	0.022	I	0.1176	0.283
Cl	0.0100	0.024	Cs	0.0040	0.01
K	0.0162	0.039	Ba	0.0092	0.022
Ca	0.0048	0.012	La	0.0054	0.013
Sc	0.0074	0.018	W	0.0060	0.014
Ti	0.0020	0.005	Au	0.0022	0.005
V	0.0042	0.01	Hg	0.0020	0.005
Cr	0.0020	0.005	Pb	0.0056	0.013
Mn	0.0110	0.026	In	0.0274	0.066
Fe	0.0102	0.025	Se	0.0010	0.002
Co	0.0044	0.011	Br	0.0010	0.002
Ni	0.0030	0.007	Rb	0.0102	0.025
Cu	0.0050	0.012	Sr	0.0086	0.021
Zn	0.0020	0.005	Y	0.0090	0.022
Ga	0.0020	0.005	Zr	0.0100	0.024
Ge	0.0010	0.002	Mo	0.0104	0.025
As	0.0092	0.022	Rh	0.0108	0.026
Pd	0.0126	0.03	**Ions (b)**	**PPM**	**µg/m^3#**
Ions (b)	**PPM**	**µg/m^3#**	NO_2^-	0.01	0.001
Na^+	0.008	0.001	Br^-	0.02	0.003
NH_4^+	0.009	0.001	NO_3^{2-}	0.02	0.003
K^+	0.02	0.003	NO_3^{2-}	0.06	0.008
Mg^{2+}	0.02	0.003	PO_4^{3-}	0.02	0.003
Ca^{2+}	0.03	0.004	SO_4^{2-}	0.02	0.008
F^-	0.002	0.0002	**EC-OC (c)**	**PPM**	**µg/m^3#**
Cl^-,	0.005	0.001	EC	0.06	0.063
			OC	0.45	0.013

#Based on nominal air sampled @ 5LPM per sampling day
ED- XRF; (b) IC; (c)Based on DRI SOP for EC/OC (URL 2)

Hence for the present study the recommended protocol of convergence of all the runs and factors were selected for the cases where $Q_{robust} < 1.5\ Q_{true}$ (Jiang *et al.,* 2015: Zong *et al*., 2016; Gadi *et al.*, 2019). Also, the correlation coefficients (R^2) between measured and modelled metal concentration were checked for >0.80, which indicate better fit of the model to the measured data.

PMF can produce non-unique solutions because of many possible rotations of the solutions (Paatero *et al.,* 2002; Norris *et al.,* 2014), also referred to as rotation ambiguity. Rotating a given solution and investigating how rotated solution fill the solution space is one way to minimize the number of solutions. F-peak, a parameter for rotation of solution, is controlled to ensure minimum change in Q to produce unique solution. F-peak values were varied between −3 and 3 and Q-values were monitored. The lowest Q-value indicated negligible presence of rotational ambiguity and thus solution at that F-peak was considered. The results are then check for mapping of the factors with respect to base model. Near to 100% mapping indicates that model is showing the efficiency of model results. If unmapped factors are more then, base factors and other parameters may need to be revised for getting better results. For the present work mapping of factors above 95% were accepted for all the cases.

Bootstrapping is a technique to estimate uncertainty in the solution by using series of dataset that are modified version of the original data (Norris *et al.,* 2014). Bootstrap runs indicated less than 5% variability in percentage of species. Minimum correlation value of 0.8 was selected with the default block size for every case. The above criteria, with reasonable control over numerous statistical parameters, substantiate that the solutions arrived were acceptable.

After matching all the criteria as described above, the model runs were considered for further analysis. The factor fingerprints, factor profiles and contribution obtained from these optimized runs were matched with the standard factor fingerprints and previous studies (Maykut *et al*., 2003; Gupta *et al*., 2012; Patil *et al.,* 2013; Sharma *et al.,* 2016; Zong *et al*., 2016; Police *et al*., 2016; Jain *et al*., 2017; Mukherjee *et at*., 2018; Taghvaee *et al.,* 2018; Garaga *et al*., 2020) to identify the sources. Also, all the results from various run and error estimation were obtained in the form of datasheets which were used for further analysis to obtain percentage contributions of each source at receptor locations and percentage of elemental contribution from that source.

4.3 Results

The results for both cases of $PM_{2.5}$ & PM_{10} mentioned in Section 1.2 are explained below.

4.3.1 PM$_{10}$

After the EPA PMF run analysis, 6 factors were identified in the study location for PM_{10} Samples as shown below. The factor finger prints are shown in **Figure 4.1 (a and b)**. The final source contributions are shown in **Table 4.2**. Base factor profiles and their contributions for $PM_{2.5}$ and PM_{10} is presented in **Figure 4.2 (a to b).**

Factor 1: Resuspended Road Dust/ Wind Blown Dust /Construction Dust

Factor 1 was identified by the significant levels of Al, Ti, P, Si, Ca, Mg, K and NO_3^- (~8%, 0.8%, 0.5%, 21%, 8%, 14%, 3% and 2.6%) and minor indicators such as Fe, Zn, and SO_4^{2-} that contributed to 28.5% of total PM_{10} emissions. Al, Si and SO_4^{2-} are major indicators of resuspended road dust; whereas Zn and Fe are deposited by vehicular emissions which are resuspended due to wind-driven airborne dust from surface soils and paved roads (Gupta *et al.,* 2011; Rai *et al.,* 2016; Zong *et al.,* 2016; Buyan, 2018).

Factor 2: Fossil Fuel Combustion

Factor 2 was identified by significant levels of Br, As, Pb, EC, OC, F^-, SO_4^{2-} and S (~0.3%, 0.06%, 1%, 1.2%, 7.9%, 0.01%, 27.86%, and 8.6%) with minor indicators such as Cr, K, Fe and Pb contributed to 12.8% of total PM_{10} emissions. F^-, Cl and Fe along with SO_4^{2-} have been widely used as a marker of coal combustion in industrial plants as well as in some studies as Fossil fuel combustion (Kumar *et al.*, 2001; Patil *et al.,* 2013; Rai *et al.,* 2016; Sharma *et al.,* 2016; Jain *et al.,* 2018).

Factor 3: Secondary Aerosol / Marine Aerosols

Factor 3 is identified as Secondary and Marine aerosols which accounted for 11.8% of total PM_{10} contribution. Major and minor indicators are NO_3^-, SO_4^{2-}, NH_4^+, (~ 10.76%, 38.9% and 10.13%) with Cl^-, Na^+, OC, (~2.98%, 0.69% and 2.8%). The studies indicated that NH_4^{3-}, NO_3^{2-} and SO_4^{2-} are major indicators for secondary aerosols and Na^+ and Cl^- are indicators of Marine source (Patil *et al.,* 2013; Police *et al.,* 2016; Sharma *et al.,* 2016; Jain *et al.,* 2017; Mukherjee *et al.,* 2018; Garaga *et al.,* 2020). As Navi Mumbai is located in the vicinity of Mumbai which is a coastal city the impact of Marine and Secondary aerosols as background source is justified.

Factor 4: Industrial Emissions

Factor 4 was identified as Industrial emissions with the presence of tracers, such as As, Cr, Zn, Cl^-, Fe, P, Mn and S (~0.03%, 0.11%, 1.59%, 1.89%, 15.15%, 0.37%, 0.2%, and 6.08%) with minor indicators such as Cr, Cd, Na^+, Mg, Br, OC and Pb suggest the source of Industrial emissions contributed to about 16.4%. of total PM_{10} pollution. Earlier studies reported that Fe, Cr and Mn are the indicators of the industrial emissions as these elements are greatly used in various industries like machinery, battery and electroplating purposes (Taghvaee *et al.,* 2018). As and S is a major indicator of metal Smelting and coal combustion (Kumar *et al.,* 2001; Shukla & Sharma, 2008; Police *et al.,* 2016, Rai *et al.,* 2016). Cl^-, Mg, SO_4^{2-} and Br are indicators of industries combustion at plant as well as Cl^- and Cd is also a major indicator of incinerator (Rai *et al.,* 2016, Sharma *et al.,* 2016; Jain *et al.,* 2017). Major industrial pocket in the study area could be the possible reason of industrial source.

Factor 5: Biomass Burning

Factor 5 is identified as Biomass burning which accounted for contributions of 14.6%. Major proportions of Cl^-, K^+, EC, OC, NH_4^+ and SO_4^{2-} (~4.73%, 2.45%, 0.2%, 1.6%, 2.62% and 8.7%). Fe, Mg, and Na^+ as minor indicators contributed to this source. There have been many studies in the past suggesting that OC, K^+ and SO_4^{2-} are clear indicator of biomass burning and NH_4^{3-} is an indicator of Wood Combustion (Shukla and Sharma, 2008; Police *et al.,* 2016; Sharma *et al.,* 2016; Jain *et al.,* 2017; Mukherjee *et al.,* 2018; Garaga *et al.,* 2020).

Factor 6: Vehicular Emissions

Factor 6 accounted for 15.7%, with major indicators such as EC, OC, Fe, Mn, Zn and Pb (~1%, 6.8%, 15.24%, 0.2%, 1% and 0.24%) and minor indicators are Mg, NO_3^-, NH_4^{3-}, SO_4^{2-}, Br and S. Emissions arising from road vehicles are generally contributed by a mixture of tailpipe emissions, and wear and tear of tyres. Zn is usually used as an additive in lubricating oil in two-stroke engines and is also a major trace metal component of wear and tear of tyres and Pb is the indicator of emission due to engines in vehicles (Shukla and Sharma, 2008; Jain *et al.*, 2017; Mukherjee *et al.*, 2018, Pawar *et al.*, 2020). Also, EC, SO_4^{2-} & OC were present in this factor indicating emissions from burning of fossil fuel from vehicles (Jain *et al.*, 2018; Keerthi *et al.*, 2018). The said major contributing metals are tracers of vehicular exhaust emissions as shown by various previous studies (Gupta *et al.*, 2012; Sharma *et al.*, 2016; Jain *et al.*, 2018; Keerthi *et al.*, 2018; Jain *et al.*, 2017; Pawar *et al.*, 2020).

4.3.2 $PM_{2.5}$

After the EPA PMF run analysis, 7 factors were identified in the study location for $PM_{2.5}$ samples as shown below. The factor finger prints are shown in **Figure 4.1 (a and c)**. The final source contributions are shown in **Table 4.2.** Base factor profiles and their contributions for $PM_{2.5}$ and PM_{10} are presented in **Figure 4.2 (c to d).**

Factor 1 : Industrial Emissions

Factor 1 was identified as Industrial emissions with the presence of tracers, such as As, SO_4^{2-}, Fe, P, Pb, Mg, Mn, OC and Zn (~0.17%, 48.5%, 7.04%, 0.2%, 0.5%, 12.52%, 0.1, 1.7%, % and 0.6%) with minor indicators such as Cr, Cd, Na^+, Ca, V and Mg^{2+} suggest the source of Industrial emissions contributed to about 13.2%. of total $PM_{2.5}$ pollution. Earlier studies reported that Fe, Cr and Mn are the indicators of the industrial emissions as these elements are greatly used in various industries like machinery, battery and electroplating purposes (Taghvaee *et al.,* 2018). Cd, Mn, Fe is a major indicator of metal Smelting and coal combustion (CMB Manual, 2004, Kumar *et al.,* 2001; Shukla & Sharma, 2008; Police *et al*., 2016, Rai *et al.,* 2016). Cl^- and Cd is also a major indicator of incinerator (Rai *et al.,* 2016, Sharma *et al.,* 2016; Jain *et al.,* 2017). Major industrial pocket in the study area could be the possible reason of industrial source.

Factor 2 : Resuspended Road Dust/ Wind Blown Dust

Factor 2 was identified by significant levels of Ti, Si, Fe, Ca and Mg (~0.2%, 10.51%, 6.64%, 0.3% and 28.46%) and minor indicators such as Al, Na^+, Mn, Zn and NO_2^- contributed to 11.5% of total $PM_{2.5}$ emissions. Al, Si, K and OC are major indicators of resuspended Road dust, whereas Zn and Fe are deposited by vehicular emissions which are resuspended due to wind-driven airborne dust from surface soils and paved roads (Gupta *et al.,* 2011; Rai *et al.,* 2016; Zong *et al.,* 2016; Buyan, 2018).

Factor 3: Vehicular Emissions /Secondary Aerosol

Factor 3 accounted for 19.3% of total $PM_{2.5}$ emissions with major and minor indicators such as NO_3^- NH_4^+, OC, EC, SO_4^{2-}, Mn, Pb, Zn and Fe (~10.62%, 10.17%, 6.15%, 0.78%, 33.76%, 0.08%, 0.03%, 0.95% and 3.97%). Emissions arising from road vehicles are generally contributed by a mixture of tailpipe emissions, and wear and tear of tyres. Zn is usually used as an additive in lubricating oil in two-stroke engines and is also a major trace metal component of wear and tear of tyres and Pb is the indicator of emission due to engines in vehicles (Shukla and Sharma, 2008; Jain *et al.,* 2017; Mukherjee *et al.,* 2018, Pawar *et al.,* 2020). The said major contributing metals are tracers of vehicular exhaust emissions as shown by various previous studies (Gupta *et al.,* 2012; Sharma *et al.,* 2016; Jain *et al.,* 2018; Keerthi *et al.,* 2018; Jain *et al.,* 2017; Pawar *et al.,* 2020).

Factor 4 : Marine Aerosols

Factor 4 is identified as Marine aerosols which accounted for contributions of 10.7% of total $PM_{2.5}$ emissions. Major proportions indicated as Cl^-, Br, Na^+, Mg and K (~13.7%, 0.15%, 1.4%, 27.47% and 3.5%). The Na^+ and Cl^- are indicators of Marine source (Patil *et al.,* 2013; Police *et al.,* 2016; Sharma *et al.,* 2016; Jain *et al.,* 2017, Mukherjee *et al.,* 2018; Garaga *et al.,* 2020). As Navi Mumbai is located in the vicinity of Mumbai which is a coastal city the impact of Marine and Secondary aerosols as background source is justified.

Factor 5 : Secondary Aerosols

Factor 5 accounted for 21.9% of Secondary Aerosols which mainly contributes by Cl^-, NO_3^-, EC, OC, SO_4^{2-}, and NH_4^+ (~5.9%, 11.31%, 5.20%, 0.64%, 30.86%, and 5.69%). The studies indicated that NO_3^{2-} and SO_4^{2-} are major indicators for secondary aerosols and Na^+ and Cl^- are indicators of Marine source (Patil et al., 2013; Police et al., 2016; Sharma et al., 2016; Jain et al., 2017, Mukherjee et al., 2018; Garaga et al., 2020).

Factor 6 : Construction Dust

Factor 6 is identified as crustal dust which accounted for 11.1% of total $PM_{2.5}$ contributions. Major indicators of this source are Ca, K, Ti, Mg, Si, Al and Fe (~6.43%, 7.08%, 0.02%, 15.04%, 1.5%, 0.02% and 1.57%). Ca, K and Mg are major indicators of crustal dust/ soil as per previous studies reported (Kothai *et al.,* 2008; Sharma *et al.,* 2016; Jain *et al.,* 2017; Mukherjee *et al.,* 2018; Pawar *et al.,* 2020).

Factor 7 : Fossil Fuel Combustion/ Biomass Burning

Factor 7 was identified by the significant levels of K, EC, OC, Cl^-, Pb, Br and SO_4^{2-} (~5.23%, 0.8%, 6.5%, 4.25%, 0.4%, 0.024% and 22.73%). with minor indicators such SO_4^{2-}, Ca, and Fe contributed to 12.2% of total $PM_{2.5}$ emissions. F^-, Fe, Cl^- along with SO_4^{2-} have been widely used as marker of coal combustion in power plants as well as in some studies as Fossil fuel combustion (Kumar *et al.,* 2001; Patil *et al.,* 2013; Rai *et al.,* 2016; Sharma *et al.,* 2016; Jain *et al.,* 2018). There have been many studies in the past suggesting that K^+ and SO_4^{2-} are clear indicator of biomass burning whereas NH_4^{3-} is a major indictor of wood combustion and Br is an indicator of combustion (Shukla and Sharma, 2008; Police *et al.,* 2016; Sharma *et al.,* 2016; Jain *et al.,* 2017; Mukherjee *et al.,* 2018; Garaga *et al.,* 2020). Biomass/ wood are used as low-cost fuel contributing to ambient air pollution.

Table 4.2: Percentage Source Contribution for Navi Mumbai

Most likely source(s)	%Contribution	
	PM_{10}	**$PM_{2.5}$**
Resuspended of Road dust/ Wind Blown Dust	28.5	11.5
Fossil Fuel Combustion	12.8	12.2
Secondary Aerosol /Marine aerosol	11.8	21.9
Industrial Emissions	16.4	13.2
Biomass Burning	14.6	--
Vehicular Emission	15.7	19.3
Marine Aerosol	--	10.7
Construction Dust	--	11.1

4.4 PMF Conclusion

After PMF analysis, six factors for PM_{10} and seven factors for $PM_{2.5}$ were identified. The major contributors from both the fractions for PM pollution ranges as Resuspended of Road dust/ Wind Blown Dust (11-28%), vehicular emission (15-19%), secondary and marine aerosol (11-21%), fossil fuel combustion (12%) and industrial emission (13-16%) and others are biomass (14%), marine aerosol (10%) and construction dust (11%). Both source categories were found to be contributing almost the same for both $PM_{2.5}$ and PM_{10} Pollution.

Figure 4.1: A) Percentage Contribution of Sources & Factor Fingerprints for B) PM_{10} C) $PM_{2.5}$ for Navi Mumbai

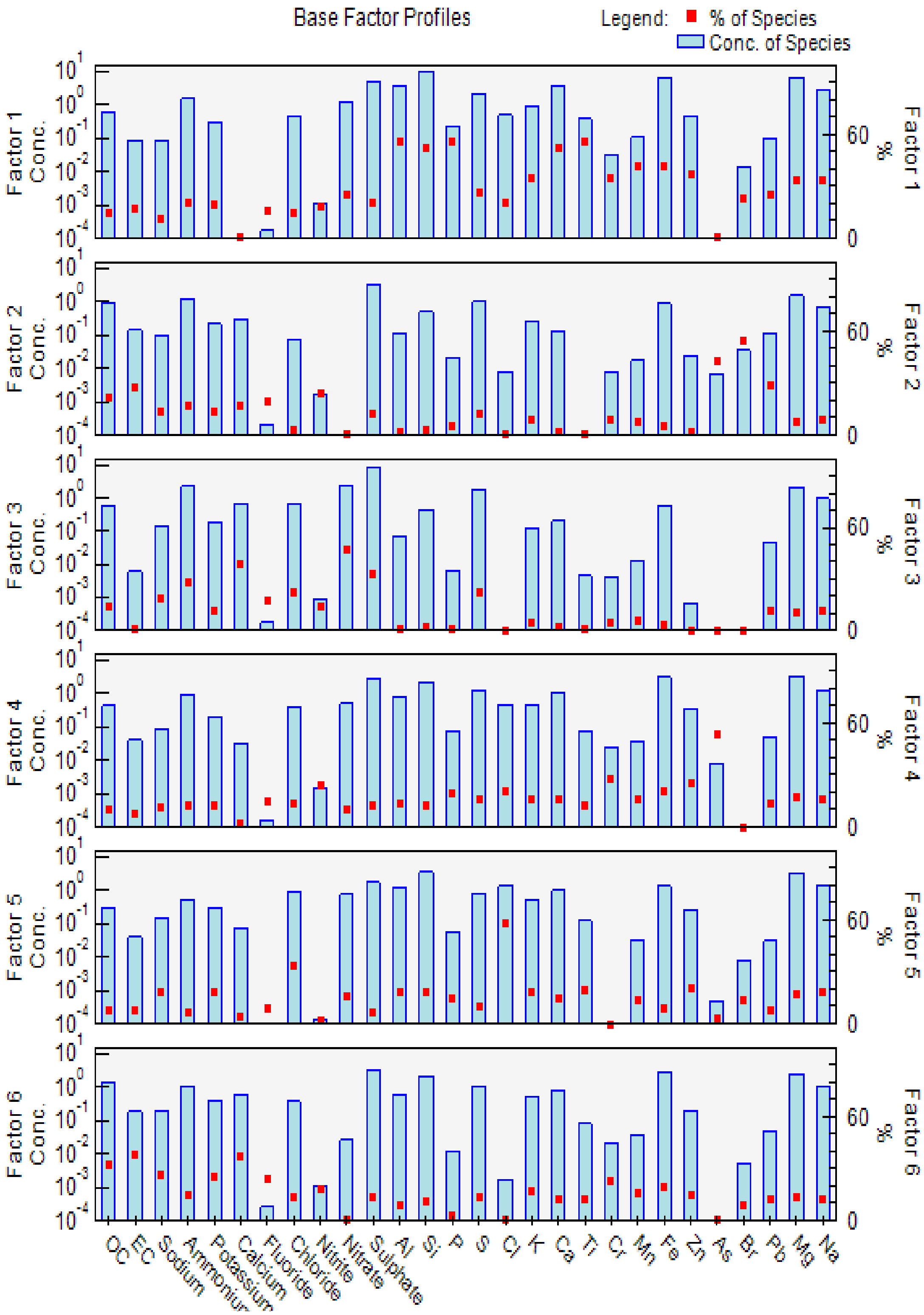


Figure 4.2 a : PM_{10} Base Factor Profiles

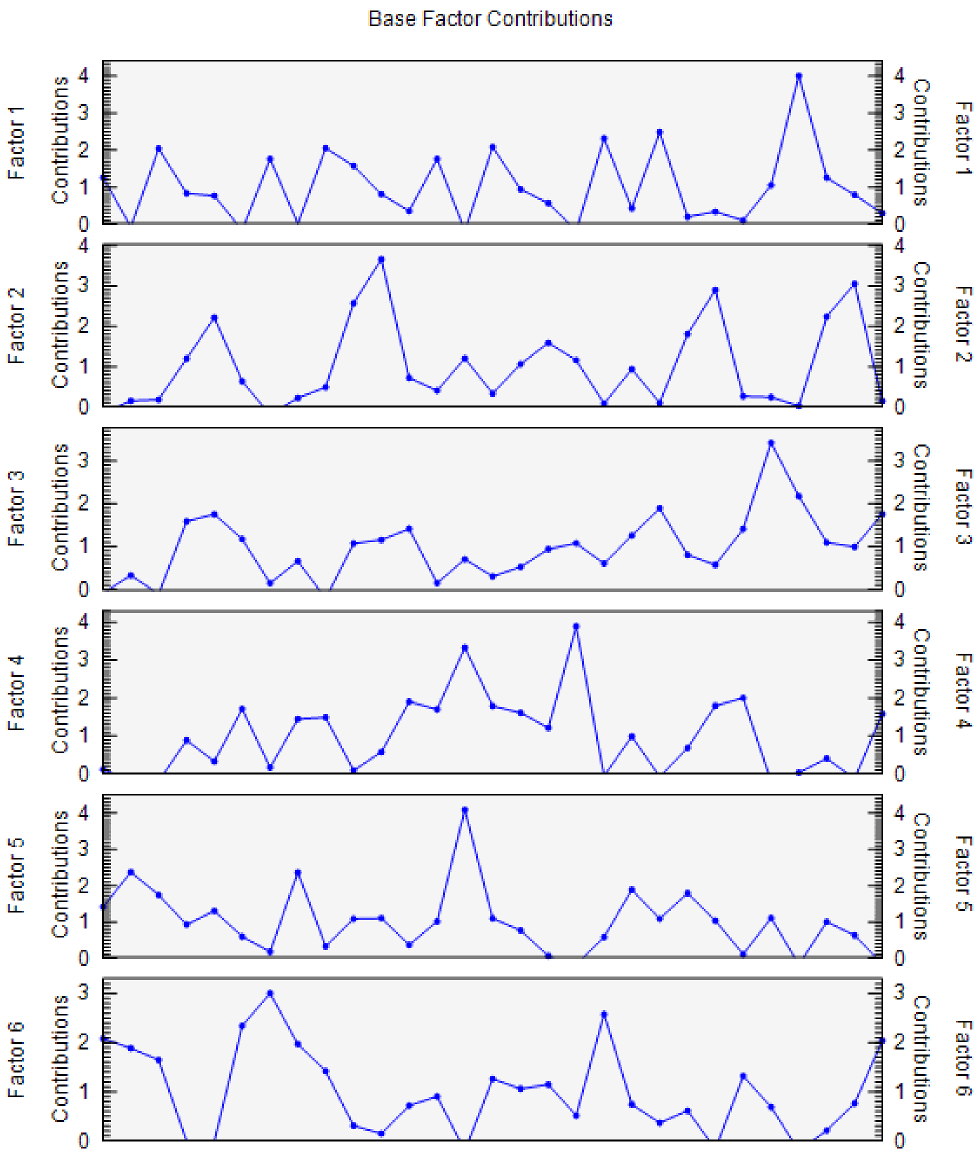


Figure 4.2 b : PM_{10} Base Factor Contributions

	Predominant factors	% Contribution	Factor Name
Factor 1	Al, Ti, P, Si, Ca, Mg, K, NO_3^-	28.5	Resuspended of Road Dust/ Wind Blown Dust/ Construction Dust
Factor 2	As, Pb, EC, OC, F^-, SO_4^{2-}, S	12.8	Fossil Fuel Combustion
Factor 3	NO_3^-, SO_4^{2-}, NH_4^+ Cl^-, Na^+, OC	11.8	Secondary Aerosol /Marine Aerosol
Factor 4	As, Cr, Zn, Cl^-, Fe, P, Mn, S	16.4	Industrial Emissions
Factor 5	Cl^-, K^+, EC, OC, NH_4^+, SO_4^{2-}	14.6	Biomass Burning
Factor 6	EC, OC, Fe, Mn, Zn, Pb	15.7	Vehicular Emission

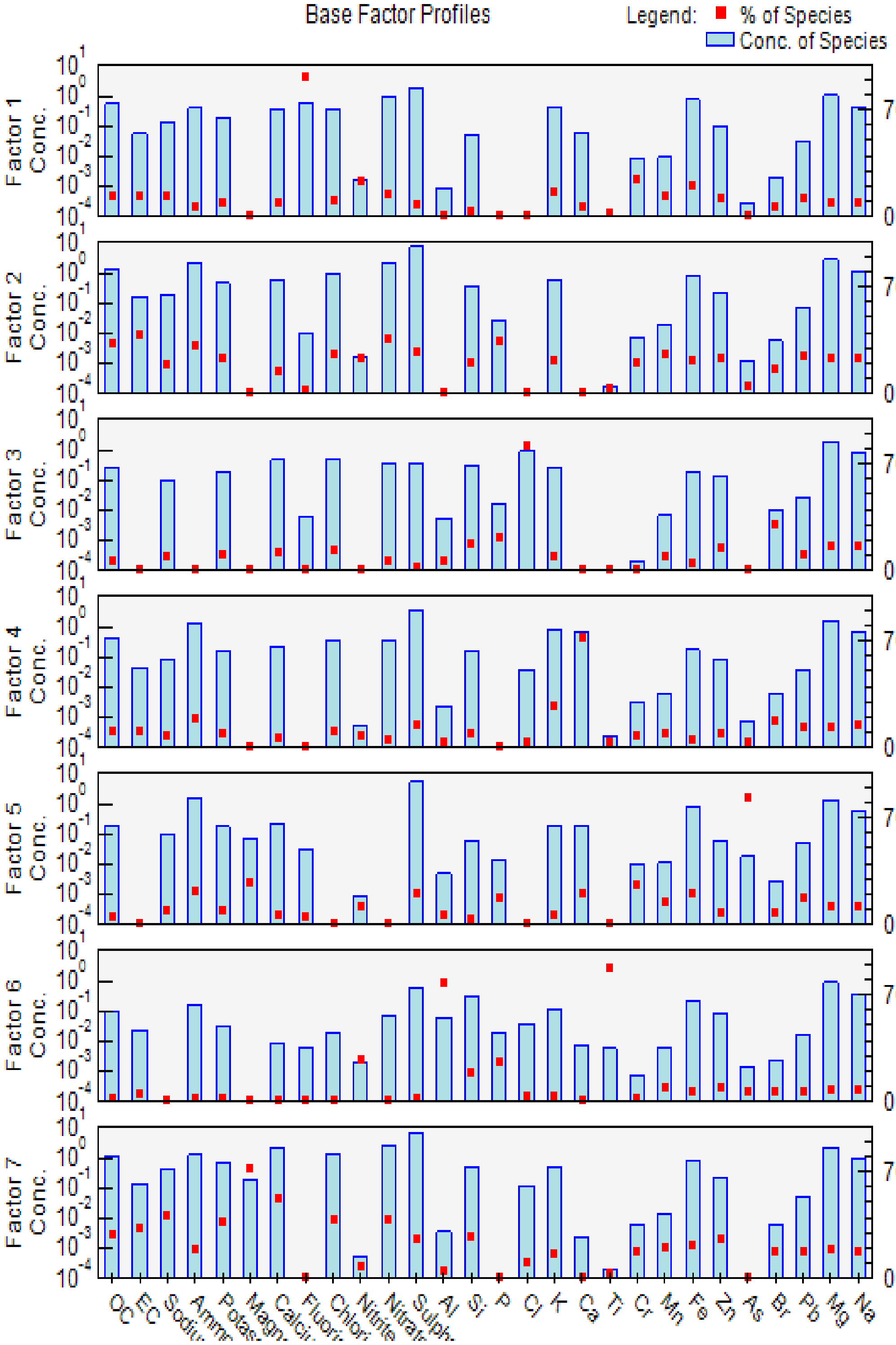


Figure 4.2 c : PM$_{2.5}$ Base Factor Profiles

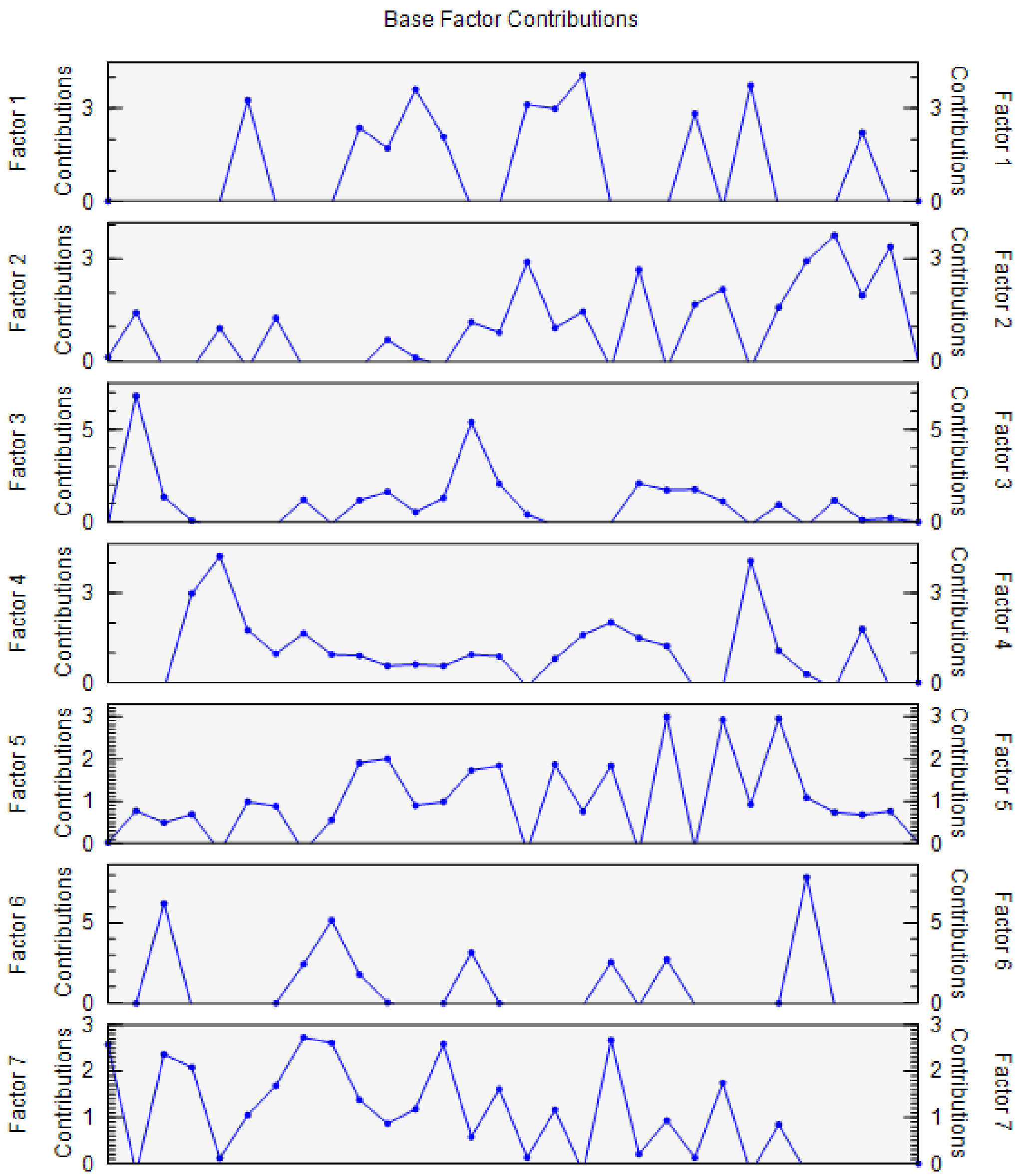


Figure 4.2 d : $PM_{2.5}$ Base Factor Contributions

	Predominant Factors	% Contribution	Factor Name
Factor 1	As, SO_4^{2-}, Fe, P, Pb, Mg, Mn, OC, Zn	13.2	Industrial Emissions
Factor 2	Ti, Si, Fe, Ca, Mg	11.5	Resuspended Road Dust/Wind Blown Dust
Factor 3	NO_3^-, NH_4^+, OC, EC, SO_4^{2-}, Mn, Pb, Zn, Fe	19.3	Vehicular Emission
Factor 4	Cl-, Br, Na^+, Mg, K	10.7	Marine Aerosols
Factor 5	Cl^-, NO_3^-, EC, OC, SO_4^{2-}, NH_4^+	21.9	Secondary Aerosols
Factor 6	Ca, K, Ti, Mg, Si, Al, Fe	11.1	Construction Dust
Factor 7	K, EC, OC, Cl^-, Pb, Br, SO_4^{2-}	12.2	Fossil Fuel Combustion/ Biomass Burning

4.5 Emission Inventory and Source Apportionment

Emission inventory is a comprehensive listing by sources of air pollutant emissions and amount of air pollutants released into air as a result of a specific process in a particular geographic region during a specific time period. Source apportionment (SA) is the technique which relates a source emission (an activity sector or an area) to the ambient air concentration of a pollutant.

Industrial Source: The entire industrial emission load is about 4417.6 kg/d, with the Red LSI group of industries accounting for 20.24 percent (4212.9 kg/d), or 96 percent of total industrial emissions, primarily due to fossil fuel combustion such as coal. The overall emission load from coal was the highest (94.7 percent, or 771 TPD), followed by FO at 3%. (362 TPD). LDO (152.6 TPD), HSD 1161.8 TPD, and Diesel (116.9 TPD) are some of the other fuels used, and they all contribute significantly to the total PM load from industry. The significant amount of particulate matter emission comes from coal and other fuels with a high ash content. Industrial gases containing sulphur dioxide, are primarily emitted from smelting and furnaces. unit Total SO_x emissions are over 6.82 TPD, with 32.6 percent and 33.5 percent coming from FO (362 TPD) and HSD (1162 TPD), respectively. MSI and SSI Industries also use low-cost, readily available fuels like briquettes and wood, which adds to the overall emission burden from point sources. About 46% of HC is discharged through coal combustion, and 18.5 percent is emitted from the industries' 1161.8 Tonne per Day of HSD combustion.

The results are well corroborated with apportionment of particulate matter; the overall factor emphases industrial source contributions of 16.4 percent in PM10 sample load, compared to 13.2 percent in PM2.5 sample load. In PM10, Factor Profiles (% of species sum) of the significant indicators such as As, Cr, Zn, Cl-, Fe, P, Mn, and S was found in concentrations ranging from 17 to 54 %. In PM2.5 the indicators of As, SO_4^{2-}, Fe, P, Pb, Mg, Mn, OC and Zn are the dominant contributors in the range of 15 to 84%. The other Factor Profiles (% of species sum) of the minor indicators are Cd, Na^+, V, Mg, Br, OC and Pb. Machinery, battery and electroplating industries emit Fe, Cr and Mn. Also, As, S Cd, Mn and Fe are the source of smelting and coal combustion industries. Cl^-, Mg, SO_4^{2-} and Br are indicators of industrial combustion, and Cl^- and Cd are emitting from incinerator /furnaces.

Another factor, fossil fuel combustion contributes 12.8% and 12.2% of PM_{10} and $PM_{2.5}$ emission load, respectively. The Factor Profiles (% of species sum) of the predominant species Br, As, Pb, EC, OC, F^-, SO_4^{2-} and S are in the range of (~12 to 54%) in PM_{10}, whereas (~10 to 16%) of K, EC, OC, Cl^-, Pb, Br and SO_4^{2-} are the major species in $PM_{2.5}$. The Factor Profiles (% of species sum) of the minor indicators are Cr, Fe, SO_4^{2-}, Ca, and Fe. In studies reported, F^-, Cl and Fe along with SO_4^{2-} have been widely used as a marker of coal combustion in industrial plants. The overall all trace indictors and emission loads prominence the industrial fossil fuel burning is high in Navi Mumbai.

Vehicular Source: As per emission inventory the vehicular sector contributes around 3266.4 kg/d of PM to the total city load, the percent contribution from heavy duty vehicles is highest i.e.12.79 (2663.8 kg/day). The Heavy duty diesel vehicles contribute around 81.55% (2663.8 Kg/d) of PM emission load, followed by 3 wheelers i.e., 12% (394.8 Kg/d) of the total load estimated. Traffic of heavy duty vehicles is observed (approximately 2148235 VKT) on industrial belt of Thane Belapur as well as to and fro movement of vehicle on Sion Panvel Highway. The emission load from 2 wheelers (88.90 Kg/d; i.e. 2.7%) is almost 10 times the emission load from Car operating on Petrol (9.48 Kg/d; i.e. 0.29%) and almost half of Car Diesel (55.3 Kg/d; i.e. 1.7%). The main source of NO_x contribution is vehicular source i.e. 54.2% (30494.4 kg/d). 35.49% of NOx emission load is estimated from HDDV vehicles followed by 5717.4 kg/d (10.16%) from CNG Buses. 2 Wheelers, Car Diesel and Car CNG collectively and gives 6.42%.

The vehicular Factor Profiles (% of species sum) of the dominant species are EC, OC, Fe, Mn, Zn and Pb, ranging from 13 to 38% in PM_{10} sample load, whereas NO_3^-, NH_4^+, OC, EC, SO_4^{2-}, Mn, Pb, Zn and Fe ranging from 22 to 38% was found in $PM_{2.5}$ sample load. The minor tracer indicators found are Mg, NO_3^-, NH_4^{3-}, SO_4^{2-}, Br and S. The overall source contribution of vehicular emission factor is around 15.7% and 19.3% in PM_{10} and $PM_{2.5}$, respectively. Vehicles emissions are majorly mixture of tailpipe emissions, exhaust, wear and tear of tires, brakes, brake lining and exhaust system, and also different additives in the fuel. Zn and Pb is indicator of additive in lubricating oil in two-stroke engines as also component of wear and tear of tyres. Also, EC, SO_4^{2-} & OC were present in this factor indicating emissions from burning of fossil fuel from vehicles. The said major contributing metals are tracers of vehicular exhaust emissions as shown by various previous studies. The influencing vehicular traffic supports the source characterization.

The resuspended road dust and wind blowing dust contributes 28.5% from PM_{10} and 11.5% in $PM_{2.5}$ sample load. The Factor Profiles (% of species sum) of the major indicators Al, Ti, P, Si, Ca, Mg, K and NO_3^- were contributing around (26 to 56%) in PM_{10}, whereas Ti, Si, Fe, Ca and Mg were in the range of around 6 to 89%. The minor trace indictors are Zn, SO_4^{2-}, Na^+, Mn and NO_2^-. Al, Si and SO_4^{2-} are the major indicators of resuspended road dust, whereas Zn and Fe are deposited by vehicular emissions which are resuspended due to wind-driven airborne dust from surface soils and paved roads. The Unpaved and Paved road dusts get resuspended and act as source due to vehicles movement and friction of tires with roads. The percent contribution of this source in overall city estimated emission load from unpaved road is observed to be 38.5% (8020.1 kg/d), while that from paved road is around 15.8% (3283.5 kg/d).

Area Source: The estimated emission of the city shows total area source contribution of around 1832 kg/day, amongst which emission from domestic sector is estimated to be 364 kg/d, 46.7 kg/d from crematorium and 69.2 kg/d from bakeries.

As per the study, unorganized and illegal open eat outs uses 10 kg/d of coal and wood as a fuel source and contribute 9% to open eatouts. Total 285 kg/day of PM load is released from open burning of waste in wards limits of NMMC and landfill site.

As per the PMF matrix factorization, biomass burning/ wood combustion and as well minor contribution of waste burning and construction/crustal/soil dust are the prominent sources. The biomass burning factor, accounted for 14.6% in PM_{10} sample load. Factor Profiles (% of species sum) of the Major tracers are Cl^-, K^+, EC, OC, NH_4^+ and SO_4^{2-} which accounts for around 18 to 33% of the total load. The minor indicators are Fe, Mg, and Na^+. The past studies suggesting that OC, K^+ and SO_4^{2-} are clear indicator of biomass burning and NH_4^{3-} is an indicator of Wood Combustion. The construction dust tracer of contributes 11.1% in $PM_{2.5}$ the major indicators are Ca, K, Ti, Mg, Si, Al and Fe ranging around 9 to 72%. As per previous studies Ca, K and Mg are the major indicators of crustal and soil dust.

As per characterization, secondary and marine aerosols factor are mixed source which accounted for 11.8% of total PM_{10} sample load. Whereas, secondary aerosol factor is 21.9% and marine aerosol factor is 10.7% in $PM_{2.5,}$ are separate factors. The Factor Profiles (% of species sum) of the traces viz. NO_3^-, SO_4^{2-}, NH_4^+ are contributing around 29 to 47% and Cl^-, Na^+, OC ranges from 14 to 22% in PM_{10}. The markers in $PM_{2.5}$ are Cl^-, NO_3^-, EC, OC, SO_4^{2-}, and NH_4^+ which are in the range of 18 to 38% for secondary aerosol. The different studies indicated that NH_4^{3-}, NO_3^{2-} and SO_4^{2-} are major species of secondary aerosols and Na^+ and Cl^- are indicators of Marine source. As Navi Mumbai is located in the vicinity of coastal city, Mumbai and also has creek in its surrounding, the impact of Marine and secondary aerosols are found as definite background source.

4.6 Past Studies for Source Apportionment

- *Source Apportionment of Coarse and Fine Particulate Matter at Navi Mumbai, India*
  Kothai et al., Aerosol and Air Quality Research 8(4):423-436, DOI:10.4209/aaqr.2008.07.0027

Atmospheric particulate matter in two size fractions 2.5-10 µm and <= 2.5 µm were collected on nuclepore polycarbonate filter papers and were analysed for elements using NAA and EDXRF. Varimax rotated factor analysis identified five major sources contributing to coarse and fine particulate mass. FA-MLR technique is applied to apportion the sources. Source apportionment studies showed maximum contribution of the coarse fraction was from sea salt (35%) and crustal (25%) sources. A considerable amount of the mass was also contributed from industrial (14%), vehicular (10%) and fugitive emissions (7%). These results also showed the percentage contribution of soil, two-stroke emission with fugitive dust, industrial emission, motor vehicles and sea salt to the average fine mass concentration was 3%, 18%, 23%, 29% and 9%, respectively. The contribution of each source to their constituent elements also has been determined using the same technique.

- *Chemical Characterization and Source Identification of Particulate Matter at an Urban Site of Navi Mumbai, India.* Kothai et al., *Aerosol and Air Quality Research, 11: 560–569, 2011*

Particulate matter samples were collected using a dichotomous sampler at a residential area of Vashi situated in Navi Mumbai, India during the period of 2008. The sampler facilitates the simultaneous collection of atmospheric particulates in coarse and fine size fractions. The filter samples collected were analysed for trace elements using Proton Induced X-ray Emission (PIXE) technique. The particulate matter trends show higher concentration during winter season compared to other seasons. High concentrations of elements related to soil and sea salt were found in the coarse fraction of particulate matter. Enrichment Factor (EF) analysis with respect to Fe showed enrichment of Cu, Cr, and Mn only in the fine fraction suggesting their origin from anthropogenic sources. The EF value was observed to be maximum for As, Pb and Zn in the fine particulates. However, crustal and marine derived elements showed very low EF values indicating their origin from soil and sea salt respectively. The Principal Component Analysis (PCA) based multivariate studies identified soil, sea salt and combustion as common sources for coarse and fine particles. Additionally a source contributing to coarse fraction Br concentration as well as an industrial and Se source contributing to fine fraction particles has been identified.

In our study Positive matrix factorization (PMF) is a receptor modeling tool was used for identification and quantification of sources and their apportionment of atmospheric particulate matter. After PMF analysis seven factors were identified contributing to both $PM_{2.5}$ and PM_{10} pollution. The contribution of vehicular pollution (19%) & Marine Aerosols (22%) are dominated in $PM_{2.5}$ size range, followed by Industrial and fossil Fuel combustion emissions (12 to 13%), Resuspended Road dust and biomass burning is 11%. As the case of PM_{10}, Resuspension of road and windblown dust (22%) and Industrial emissions (17%) contributing dominate source. Vehicular sector and marine aerosol contribute around 12 to 13% each. Biomass wood combustion is around 16% and incinerator and fossil fuel gives 9-10% contribution.

There are limited numbers studies reported for emission inventory and source apportionment for Navi Mumbai city. The prominent sources identified are resuspension dust crustal elements, fossil fuel combustion, industrial and vehicular emission and marine aerosols, wherein increasing contribution of emission load from anthropogenic source is further deteriorating AQI of the city.

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URL

- URL 1: EPA PMF v5.0 Software link: https://www.epa.gov/air-research/positive-matrix-factorization-model-environmental-data-analyses
- URL 2: DRI EC-OC Manual : https://www.epa.gov/sites/production/files/2018-10/documents/csn_improvea_ model2015_2-231r0_053118_508comp-dri.pdf
- URL 3 : US EPA Speciates : https://www.epa.gov/air-emissions-modeling/speciate-0

Chapter 5

Dispersion Modelling

Air quality dispersion modeling exercise was undertaken with a view to delineate the immediate sources and their impact on measurement locations. Dispersion modeling tool (AERMOD model) was also used for the whole city air quality scenario generation for different emission loads of PM and NOx. The existing scenario model runs were undertaken to establish the dispersion pattern of pollutants due to local meteorology and emission from all possible sources. Model runs also provide an idea about missing sources or additional sources which may have been accounted for earlier. The scenarios for different seasons, locations and sources have been generated to bring out the contributions and their variability. The comparison of concentrations for the scenario has been carried out by considering the highest ten concentrations.

5.1 Description of AERMOD Model

The AMS/ EPA Regularity Model (AERMOD, EPA 2004) is a steady-state plume model. AERMOD was developed in collaboration between the USEPA and the American Meteorological Society (AMS). Air quality model provides a mathematical prediction of ambient concentration of pollutants using simulation of physical and chemical processes of atmosphere, affecting air pollutants and determining the dispersion, reaction and behaviour of pollutants. The model is capable to assess the pollutant concentrations from number of sources and considers the dispersion of pollutants from stationary sources for a short-range (up to 50 Km). In the stable boundary layer (SBL), it assumes the concentration distribution to be Gaussian in both the vertical and horizontal. In the convective boundary layer (CBL), the horizontal distribution is also assumed to be Gaussian, but the vertical distribution is described with a bi- Gaussian probability density function. The convective boundary layer is the lower troposphere layer in contact with the ground heated by the sun and moves by the wind. The convective phenomena and wind causes significant air mixing with horizontal and vertical turbulences. The model is capable of accepting single station data assuming that the weather status is horizontally homogenous over the study area.

Additionally, in the CBL, AERMOD treats “plume lofting,” whereby a portion of plume mass, released from a buoyant source, rises to and remains near the top of the boundary layer before becoming mixed into the CBL. AERMOD also tracks any plume mass that penetrates into the elevated stable layer, and then allows it to re-enter the boundary layer when and if appropriate. The AERMOD model is applicable to rural and urban areas, flat and complex terrain, surface and elevated releases, and multiple sources (including, point, area and volume sources).

The modelling system of AERMOD contains an air dispersion model processor, a meteorological data pre-processor called AERMET, and a terrain data pre-processor called AERMAP. The AERMET meteorological pre-processor program provides the meteorological data as the basic input data in AERMOD. AERMET presents two types of meteorological data files consisting of surface scalar parameters and vertical profiles of meteorological data. AERMET uses the steady hourly surface and upper air meteorological observations to develop the meteorological inputs for AERMOD through calculating the hourly boundary layer parameters such as the Monin-Obukhov length, sensible heat flux, surface friction velocity, convective velocity scale, temperature scale and mixing height. AERMAP facilitates the generation of hill heights scales for AERMOD. The details of AERMOD model and its application guide have been presented in EPA, 2004.

5.2 Application of AERMOD for Air Quality Management

Air quality management studies have been done across the World using AERMOD. In China, it was applied for near future air quality simulation using change in emissions based on proposed development plan to predict the concentration for the industrial city, Xuanwei of Yunan province (Ma *et al.*, 2013). The impact of emission control policy was studied for the five year (2011-2015) plan for Xuanwei. Emission reduction scenarios were prepared for the emission control policy for SO_2, NOx and PM_{10}. Emission inventory was built based on general investigation of pollution sources and pollutant source monitoring report (2008). This included the industrial plant and six important factories around the city. In this case, average meteorological data in same time period was to be used to predict the future air quality. One way ANOVA test was used to show effectiveness of the emission control policy. Spatial contour plots helped to identify the high concentration regions, which required the attention of the special environmental supervisors. Gulia *et al.*, 2015 used AERMOD to appraise the air quality surrounding the heritage site of Amritsar. Amritsar is a tourist place and religious heritage complex which is crowded during festivals. Free open kitchens operate next to the heritage structure to provide free meals to the visitors. Apart from this, coal based tandoor, diesel generators, local industries and vehicle movement are main source of emission. In this study conducted to predict concentration from June to September 2012, AERMOD was used. Various management options were discussed to decrease pollution levels at the heritage site. Recently in 2010, air quality monitoring, emission inventory and source apportionment study for Indian Cities were conducted by CPCB and MoEF-CC. Dispersion modelling is an important component of the study that was used for projecting air quality profiles (iso-concentrations plots) of the city, under different scenarios viz. business as usual, future projections with implementations of control options, etc. It was also used to evaluate efficacy of various control options for evolving city-specific action plans for air quality improvements.

Meteorological data required for AERMET includes upper air and onsite data. The requirement of meteorological data for air quality modelling can be accomplished by either onsite monitoring or meteorological modelling. The onsite meteorological measurement in Navi Mumbai is limited to surface measurement and limited upper air data is available at IMD station. Therefore, meteorological model can help to generate onsite meteorological data to use in air quality models. Meteorological and air quality models have been applied in many studies with several objectives and addressed various scientific research questions across the world.

Meteorological models calculate three-dimensional gridded meteorology using mathematical equations to simulate atmospheric processes like the variation in temperature, wind direction and speed over time. The main purpose of the meteorological model is to forecast and simulate the weather parameters.

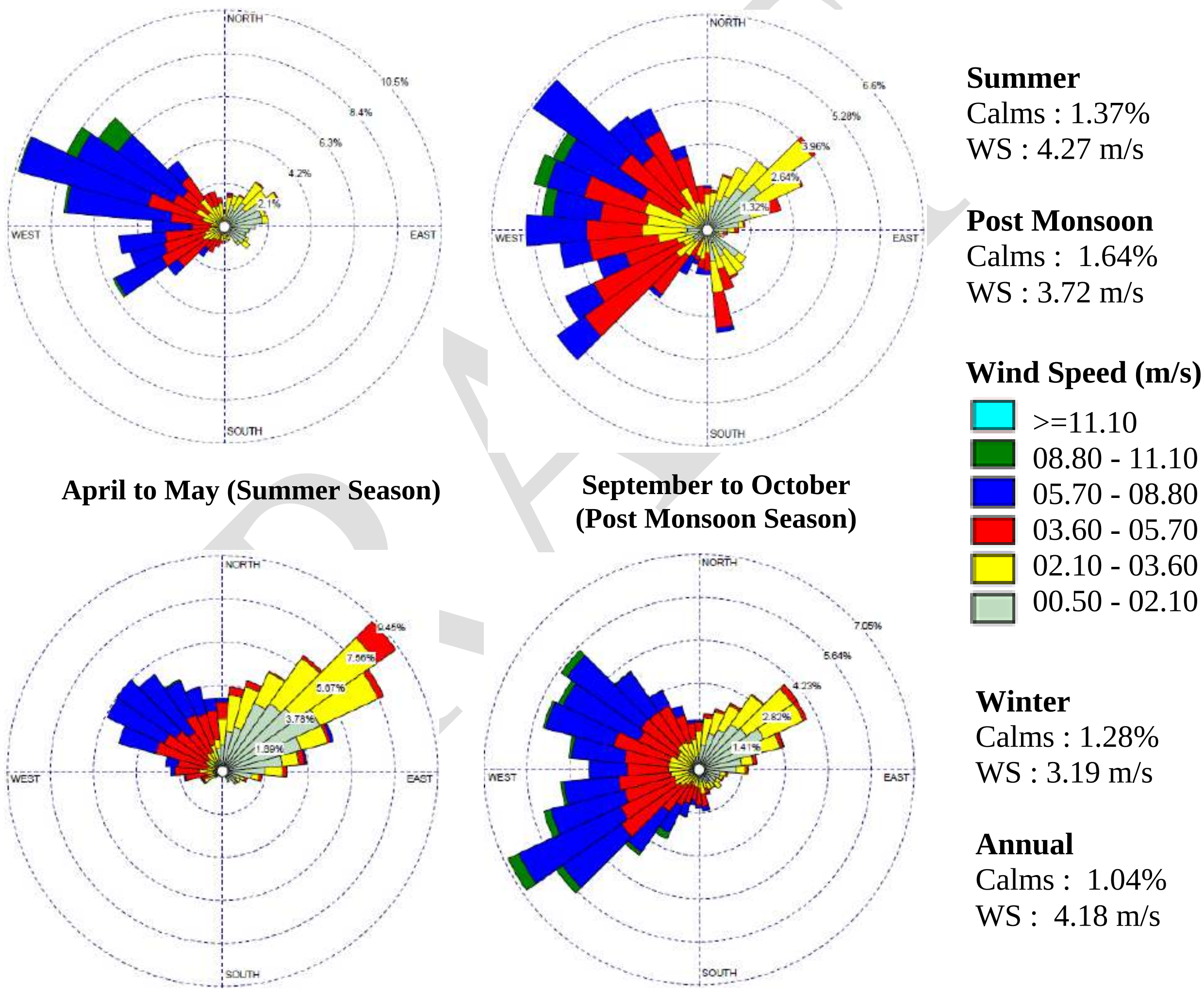
In the early nineties, mesoscale meteorological models were developed. Mesoscale is an intermediate scale between those of weather systems and of microclimates, on which storms and other phenomena occur. The mesoscale meteorological modelling system was upgraded to the fifth generation of mesoscales meteorological model by Penn State University and National Center for Atmospheric Research which is commonly referred to as MM5 (1994).

Weather Research and Forecasting Model (WRF) was developed as an evolutionary successor to the MM5 model and incorporates current state-of-the-science atmospheric physics improvements. WRF use 1 Km by 1 Km gridded land use to estimate surface properties (surface boundary conditions). It also uses the pre-processed wind field for the global weather simulations to obtain the initial time boundary condition at t=0 and at other times as well.

Regarding low wind conditions, the majority of meteorological data is collected from airport met stations. An airports primary concern is high wind speeds which may affect aircraft. Therefore, low wind speeds are often not recorded with sufficient accuracy for air dispersion modelling purposes. This is of particular concern for air dispersion modelling because low wind speeds often result in higher concentrations. The WRF models avoid this issue as all wind speeds are calculated with equal accuracy.

The uncertainties of meteorological model create negative impact to air quality model simulation (Sistla *et al.*, 1996). Significant errors have still been observed during the routine assessment of the performance of the next generation air quality models despite having made use of the advanced techniques for data collection and numerical modelling with high computational abilities *(Russell and Dennis, 2000)*.

Hourly meteorological data has been collected from Lakes Environmental for 2016 which includes both surface and upper air data and considered as representative for whole Navi Mumbai city. The Albedo, Bowen ratio and Surface roughness length were set to default, as 0.2075, 1.625 and 1 respectively. Wind roses of December to January (winter season) and March to April (summer season) of Mumbai are presented in **Figure 5.1**.



April to May (Summer Season)

September to October (Post Monsoon Season)

December to January (Winter Season)

Annual

Figure 5.1 : Wind Rose of the Winter and Summer for the Study Area (Navi Mumbai)

Annual windrose shows, the predominant direction is from WSW (7%), WNW (5%); in WSW direction wind speed mostly is in the range 5.7 to 8.0 m/s or less. In WNW direction predominant wind speed is in the ramge of 2.1 to 3.6 m/s. Calm condition is around 1.04%. Average wind speed is 4.18 m/s. During December to January (winter season) the predominant directions are blowing from NE (9.5%), N (3.7%) or less and WNW (5.67%). The predominant wind speeds are 2.1 to 3.6 m/s in NE direction, whereas N is 3.6 to 5.7 m/s and in WNW direction shows, it is around 5.7 to 8.8 m/s or less. Calm condition is around 1.28%. Average wind speed is 3.19 m/s. During Post Monson the predominant wind directions are blowing mostly from WNW, W and WSW, the wind speed is moving from 3.6 to 5.7 m/s. Average wind speed is 3.72 m/s and calm condition is 1.64%. In Summer seasons the predominant wind directions are blowing from WNW towards W and some part inclined towards WSW, the wind speed moves around 5.7- 8.8 m/s. Average wind speed is 4.27 m/s and calm condition is 1.37%.

5.3 Terrain Data

The terrain is characterized by the AERMIC terrain pre-processor (AERMAP) which also generates elevations for receptor grids. Gridded terrain data are used to model the area, where the gridded elevation data is made available to AERMAP in the form of a Digital Elevation Model (DEM) data and all sources (Area–wards, Line –vehicular and Point –industry), are presented in **Figure 5.2 and Table 5.1**. This data also proves useful when the associated representative terrain influence height has to be calculated for each receptor location. Thus, elevations for all sources both discrete receptors and receptor grids are computed by the terrain pre-processor.

Table 5.1 : Summary of Type and Number of Sources

Emission Source	Modelled Source Type	Number of Sources
Area sources	Area sources includes bakery, crematoria, building construction, hotels & Restaurants, domestic sector, open burning, open eatouts	8 Navi Mumbai Municipal Wards
Vehicles	Line Volume (Major & Arterial Roads, connecting State & National Highways)	72 Roads
Major Industries with stack heights more than 10m	Point	97 Stacks
Industries which include Medium and small scale industries with less than 15m stacks	Area (MSI 8 and SSI 8)	16 Ind
Road dust	Line Volume on each road	72 Roads

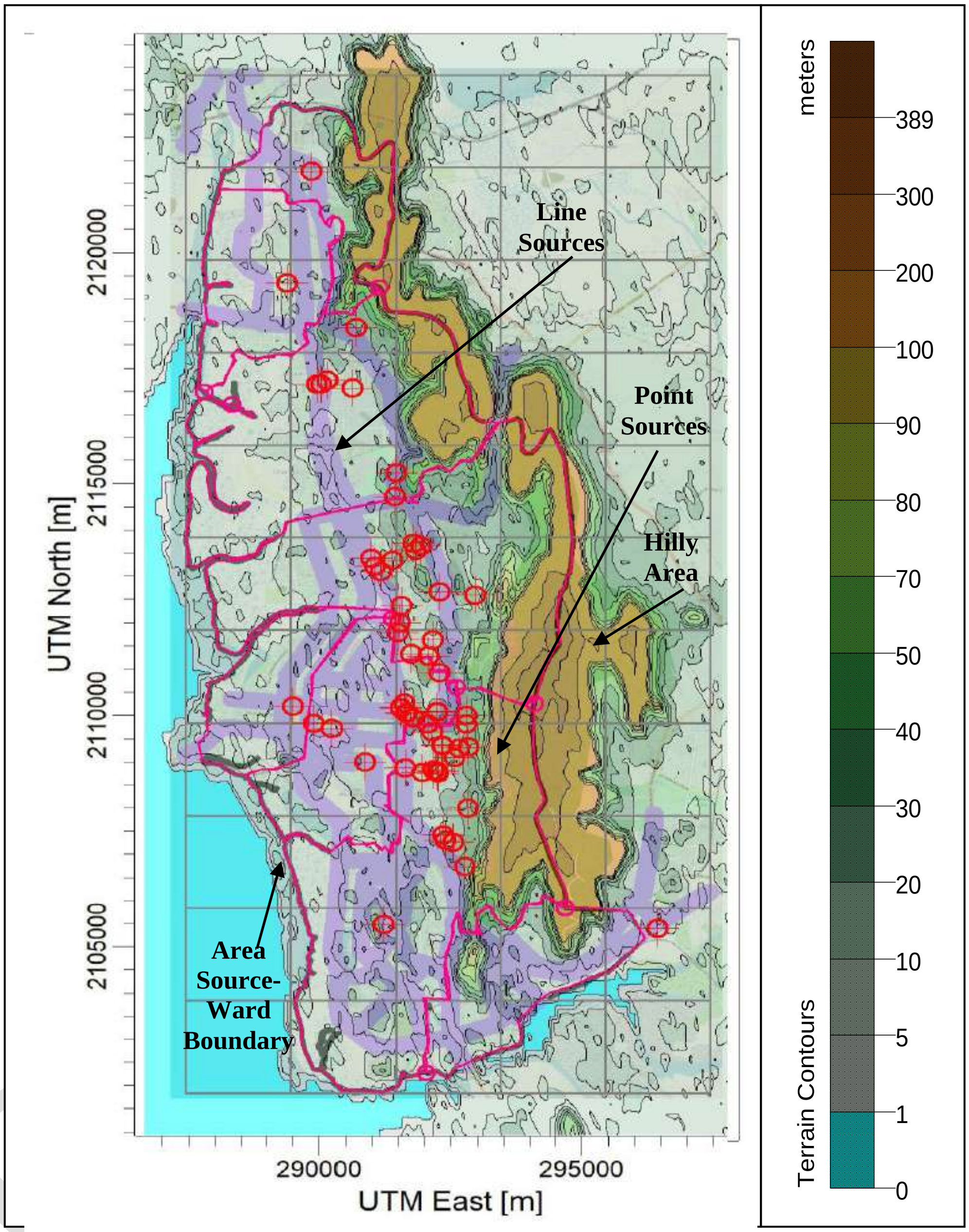


Figure 5.2 : AERMAP Digital Elevation Model (DEM) Data for Navi Mumbai

SRTM3- Shuttle Radar Topography Mission (SRTM) 3 with resolution of 90 m was used as Terrain Data for running the model. A uniform Cartesian grid receptor covering 22 (h) x 10 (w) Km^2 of the study areas was considered as input in the AERMOD model. The model was set to simulate the 24-h ground level concentrations (GLC) of at the selected receptor network.

5.4 Model Simulations

The modelling exercise was carried out for PM_{10} and NOx for three seasons as well as for annual, by making use of meteorological data and emission loads and other related inputs for area, line and point sources. Meteorological inputs were put in AERMET. Based on the emission load discussed eelier, the future estimation were worked out.

5.4.1 Model Performance for PM

Table 5.2 shows the average PM_{10} concentration observed at 5 monitoring locations, which was observed in the range of 43 to 119 µg/m^3 during winter season, averaging to about 89 µg/m^3. The predicted dispersion concentrations at these sites ranged from 35 to 140 µg/m^3. Likewise, during the summer season the average concentrations observed at monitoring sites was about 105 µg/m^3. The predicted average PM_{10} concentrations at these sites during summer ranged from 26 to 115 µg/m^3. Whereas in post monsoon season, concentrations varied between 38 to 87 µg/m^3; with an average of about 65 µg/m^3. The predicted concentrations at these sites ranged from 15 to 108 µg/m^3. The annual concentration differs from 36 to 107 µg/m^3 for observed, whereas it is 24 to 124 µg/m^3 for predicted. The factor of 2 (FAC2) value is most commonly used to assess the performance of the air quality models. It is defined as the ratio of predicted to observed concentration and varied between 0.2 to 1.7. All the predicted values were lying within FAC2. Variations in are presented in **Figure 5.3**.

Table 5.2 : Seasonal PM_{10} Average Concentrations (µg/m^3) of the 24 Hourly Model Simulations

	Observed Concentration (µg/m^3) #				**Predicted Concentration (µg/m^3)**			
	Summer	**Post Monsoon**	**Winter**	**Annual**	**Summer**	**Post Monsoon**	**Winter**	**Annual**
Airoli	36.2	38.5	43.3	36.4	26.9	15.6	35.8	24.9
Rabale	165.5	68.5	111.4	107.8	68.2	32.3	60.4	53.6
Mahape	83.5	69.5	119.2	93.5	56.9	52.4	62.8	68.2
Vashi	105.4	62.5	109.1	89.8	115.2	108.6	140.9	124.6
Nerul	136.4	87.5	65.5	97.3	49.7	18.3	52.6	43.8
Ratio of Predicted to Observed Concentration								
Airoli	0.7	0.4	0.8	0.7				
Rabale	0.4	0.5	0.5	0.5				
Mahape	0.7	0.8	0.5	0.7				
Vashi	1.1	1.7	1.3	1.4				
Nerul	0.4	0.2	0.8	0.5				

Sum –Summer, PostMon- Post Monsooon, Win –Winter, Ann - Annual
 # Observed Concentration (Air Quality Status of Maharashtra 2018-19, MPCB

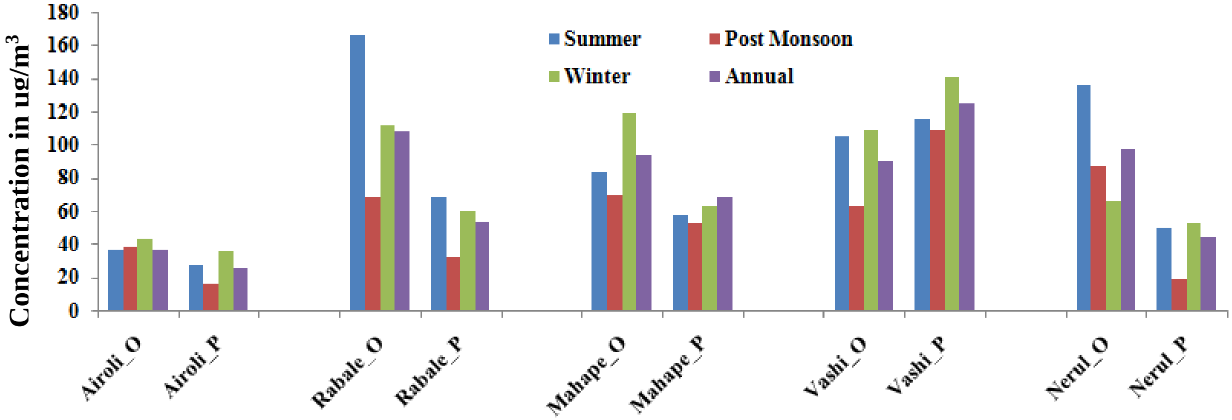


Figure 5.3 : Observed and Predicted Concentration for All Seasons (PM - µg/m^3)

From modeling results discrete cartesian location where identified based on pollution control sampling points, and the difference where match for observed and predicted concentrations. It has been observed that less prediction is reflected at Rabale and Nerul sites in all seasons, whereas over prediction indicated in Vashi Site. The Mahape site also reflects little less prediction, impact is observed in summer season, whereas Airoli near to observed and predicted, except post monsoon. The less prediction in all seasons shows the meteorological effect i.e. the wind speed is almost 3.7 to 4.2 m/s over a period. The 24 hourly concentrations gets dispersed due to wind speed and reflect less concentrations, the effect of PM reporting in observed concentrations is high due to local /regional impact.

5.4.2 Existing Scenario Concentration Contours for PM_{10}

The models were run for annually and all seasons for different source group combinations **(Table 5.1)**. The iteration for different source groups were estimated and presented in **Table 5.3** for PM concentrations. The annual and seasonal 24 hourly average concentrations at grid points were plotted for all the source group is presented in **Figures 5.4 through 5.7**. The sector wise distribution (area, line, point, resuspended dust) of all the seasons for PM is depicted **Annexure 2** and ground level concentration of 10th concentrations is presented in **Annexure 3**.

Table 5.3 : Predicted PM Concentrations for Different Source Group for Navi Mumbai City

Sources Group	Summer	Post Monsoon	Winter	Annual
All Group	164.2	133.4	236.1	182.4
Area Source	5.3	4.8	6.5	5.7
Line Source	18.7	17.1	23.2	20.4
Point Source (LSI)	48.5	57.6	166.2	65.2
Point Source (MSI)	0.270	0.225	0.304	0.275
Point Source (SSI)	1.11	0.951	1.56	1.16
Resuspension Dust	136.3	124.2	168.1	148.3

- Concentrations in µg/m^3

Observations

- The average annual concentration of dispersed PM emission load from all the sources exceeds the CPCB standard, which is also observed in summer and further deteriorates in winter.
- The maximum 24 hourly predicted concentration from all the sources in winter was around 236 $\mu g/m^3$. Whereas, the predicted concentration due to re-suspended dust is 168 $\mu g/m^3$ and Tailpipe emission from Vehicles is 23.2 $\mu g/m^3$. The pockets of high concentration are observed close to major traffic junctions in central part of the city i.e near Vashi and Pawane area, where major interlinkages or roads viz. Thane Belapur and Sion Panvel Highway exist. Due to APMC market and industrial connectivity, approx 2148235 VKT movement was observed for Heavy Duty Vehicles. Amongst the total emission of PM from vehicular sector, 25.67% of emissions are from Ward C-Vashi, contributing 838.4 Kg/day of PM. The Heavy Duty vehicles contribute 12.8% of the total PM load. Due to heavy vehicular movements, resuspension of dust is also higher. The Annual average PM from dispersion of emission load from all the sources is around 182 $\mu g/m^3$, and in summer and post monsoon the concentration ranges between 133 to 164 $\mu g/m^3$.
- The maximum 24 hourly predicted dispersed concentration due to area sources was 6.51 $\mu g/m^3$ in winter season. The overall impact of areas source is due to domestic cooking and DG sets (commercial/industrial), which are almost similar in all the wards. Building construction is also one of the prominent sources, contributing around 4.1% of the total emission of PM.
- Industries are located mainly at Thane Belapur Road, MIDC area, Mahape, Rabale, and Pawane. The annual maximum 24 hourly predicted concentration due to industries is 65.2 $\mu g/m^3$, which is highest in winter i.e. 166 $\mu g/m^3$, and moves around 48 to 57 $\mu g/m^3$ in summer and post monsoon for LSI category of industries. Red LSI contributes 20% to the total PM emission load (ie. 4212.9 Kg/d).
- The resuspension of dust is major issue in the study area, the overall concentrations was in the range of 124 to 168 $\mu g/m^3$ for all seasons. The resuspension of dust from unpaved road contributes around 38.5% and that from paved road is around 15.8% to the total estimated PM load in the city.

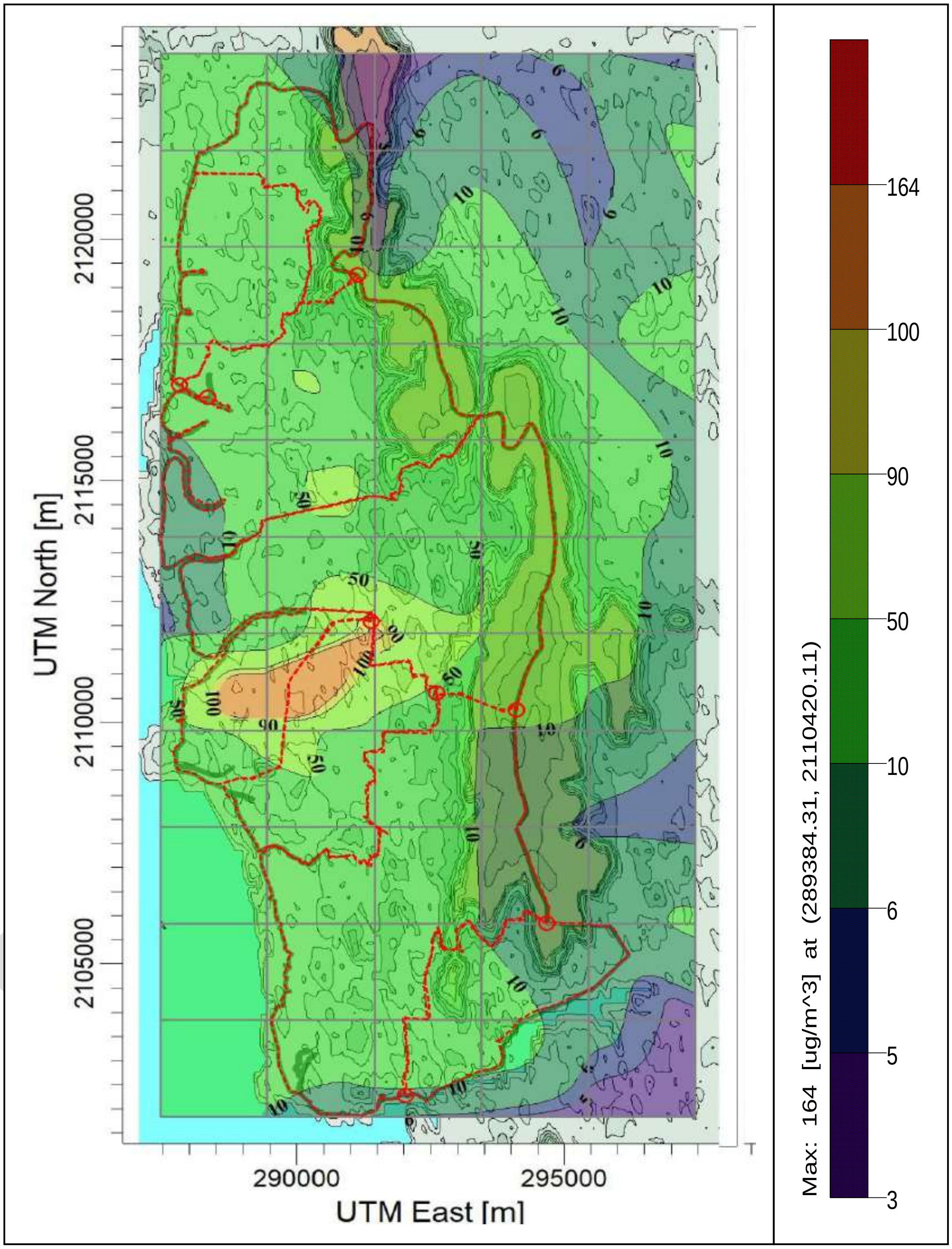


Figure 5.4 : Isopleths of PM Due to All Source– Summer Season (Navi Mumbai City)

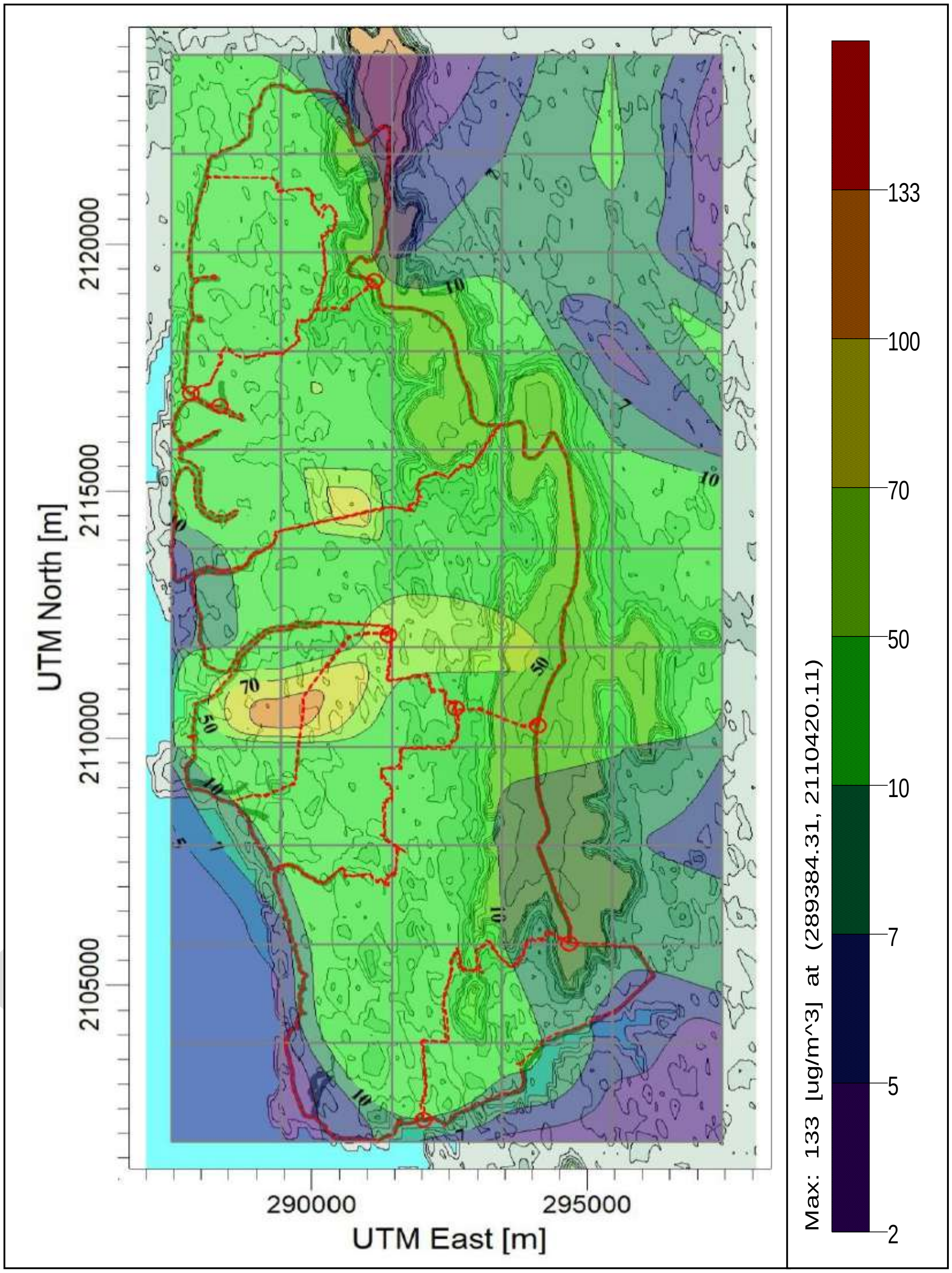


Figure 5.5 : Isopleths of PM Due to All Source– Post Monsoon Season (Navi Mumbai City)

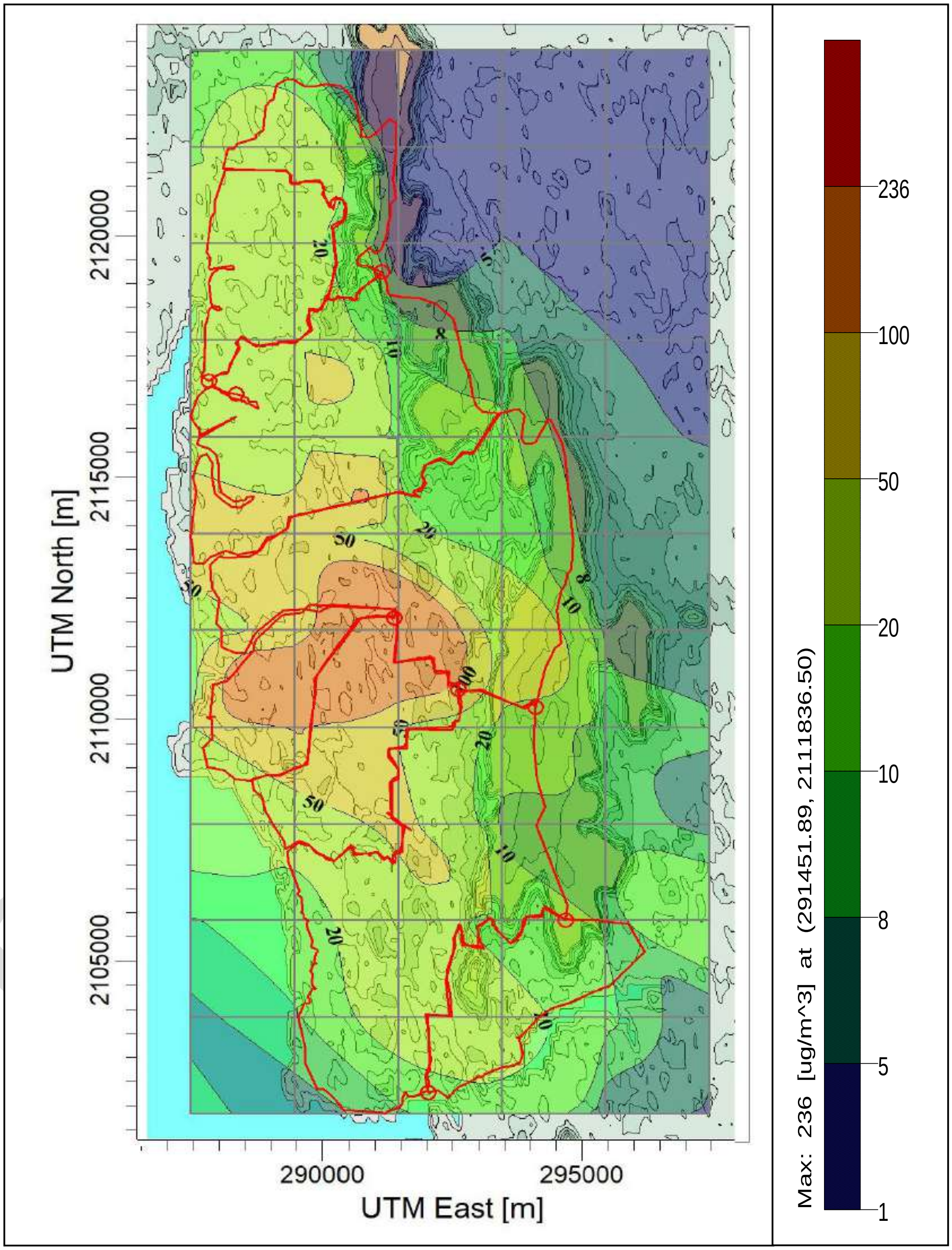


Figure 5.6 : Isopleths of PM Due to All Source– Winter Season (Navi Mumbai City)

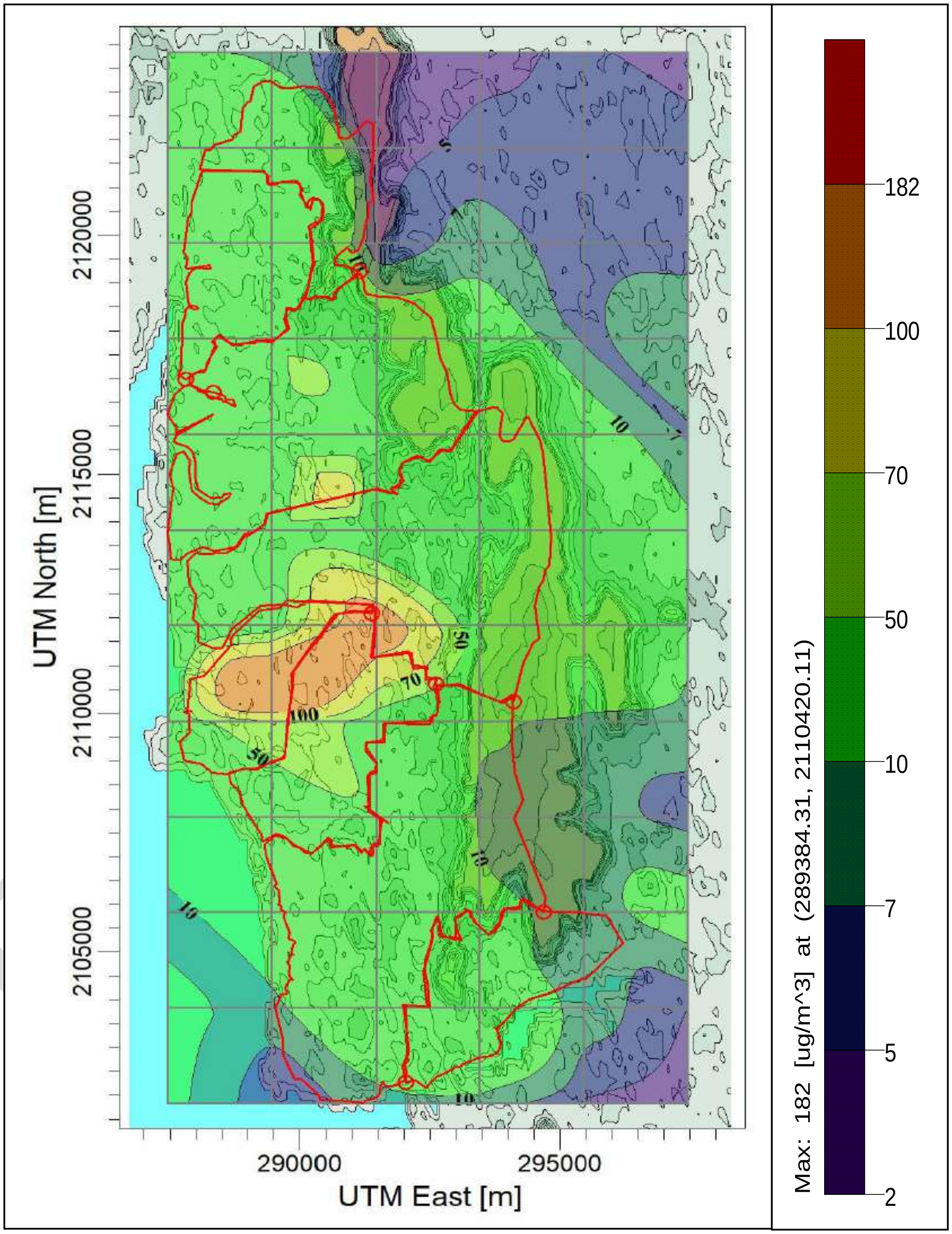


Figure 5.7 : Isopleths of PM Due to All Source– Annual (Navi Mumbai City)

5.4.3 Model Performance for NOx

As for PM_{10}, the modelling exercise was also carried out for NOx for all seasons. **Table 5.4** shows the average NOx concentration observed at 5 monitoring locations which were in the range of 31 to 55 µg/m^3 during the winter season, with an average of about 42 µg/m^3. The predicted dispersion concentrations at these sites were in the range of 42 to 59 µg/m^3. Likewise during the summer season, the average concentrations observed at monitoring sites ranged from 45 to 58 µg/m^3 with an average of about 51 µg/m^3. The predicted average NOx dispersion concentrations at these sites during summer ranged from 20 to 54 µg/m^3; whereas, in post monsoon season concentrations varied between 34 to 47 µg/m^3, with an average of about 42 µg/m^3. The predicted dispersion concentrations at these sites ranged from 26 to 54 µg/m^3. The annual concentration differs from 41 to 45 µg/m^3 (averaging about 43 µg/m^3) for observed concentration, whereas, it is 38 to 58 µg/m^3 (with an average of about 51 µg/m^3) for predicted values. The factor of 2 (FAC2) value is most commonly used to assess the performance of the air quality models. It is defined as the ratio of predicted to observed concentration and varied between 0.5 to 1.8. All the predicted values were lying within FAC2. Variations in are presented in **Figure 5.8**.

Table 5.4 : Seasonal NOx Average Concentrations (µg/m^3) of the 24 Hourly Model Simulations

	Observed Concentration (µg/m^3) #				Predicted Concentration (µg/m^3)			
	Summer	**Post Monsoon**	**Winter**	**Annual**	**Summer**	**Post Monsoon**	**Winter**	**Annual**
Airoli	58.2	34.7	31.2	41.2	54.2	43.7	42.5	52.6
Rabale	52.4	47.5	55.5	45.1	24.8	54.2	58.4	58.4
Mahape	53.5	43.5	43.7	44.6	28.4	30.4	52.7	38.6
Vashi	45.0	43.8	33.7	44.6	48.7	43.1	59.2	56.9
Nerul	47.1	41.5	45.5	41.4	20.6	26.4	55.1	51.4
Ratio of Predicted to Observed Concentration								
Airoli	0.9	1.3	1.4	1.3				
Rabale	0.5	1.1	1.1	1.3				
Mahape	0.5	0.7	1.2	0.9				
Vashi	1.1	1.0	1.8	1.3				
Nerul	0.4	0.6	1.2	1.2				

Sum –Summer, PostMon- Post Monsooon, Win –Winter, Ann - Annual
 # Observed Concentration (Air Quality Status of Maharashtra 2018-19, MPCB

From modeling results discrete cartesian location where identified based on pollution control sampling points, and the difference where match for observed and predicted concentrations. It has been observed that annual over prediction is noticed at all the sites except Mahape.

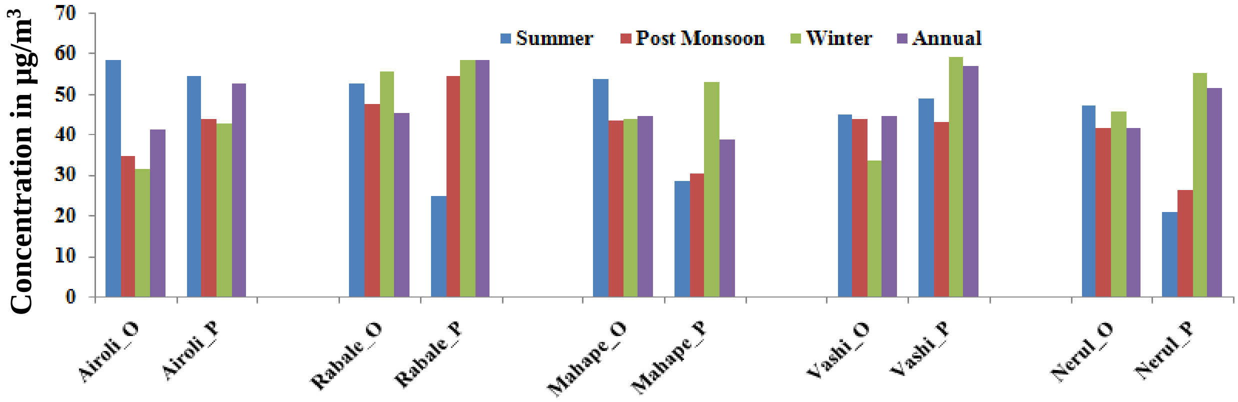


Figure 5.8 : Observed and Predicted Concentration for All Seasons (NOx - µg/m^3)

For summer season, the ratio at Airoli and Vashi is similar, predicted concentration was nearer to observed, whereas for Rabale, Mahape and Nerul it is under predicted. The values in winter are over predicted at all the sites except Rabale. In post monsoon season, Vashi is similar and Airoli and Rabale are over predicted Mahape. The values at Nerul are less predicted for NOx concentrations. The percentage vehicular share and industrial emission load resulted in higher prediction of NOx as well as the local /regional impact as a source. The less prediction reflect due to meteorological effect i.e. the wind speed is almost 3.7 to 4.2 m/s over a period. The 24 hourly concentrations get's dispersed due to wind speed. The Vashi intersection (vehicular and industrial) area and Rabale industrial area are the most influential area.

5.4.4 Existing Scenario Concentration Contours for NOx

The models were run for annually and all seasons for different source group combinations **(Table 5.1)**. The iteration for different source groups were estimated and presented in **Table 5.5** for NOx concentrations. The annual and seasonal 24 hourly average concentrations at grid points were plotted for all the source group is presented in **Figures 5.9 through 5.12.** The sector wise distribution (area, line, point, resuspended dust) of all the seasons for NOx is presented in **Annexure 4** and ground level concentration of 10th concentrations is presented in **Annexure 5**.

Table 5.5 : Predicted NOx Concentrations for Different Source Group for Navi Mumbai

Sources Group	Summer	Post Monsoon	Winter	Annual
All Group	182.3	178.2	269.6	206.2
Area Source	16.6	16.4	23.0	18.5
Line Source	153.2	150.1	212.1	169.0
Point Source (LSI)	37.8	38.8	153.2	91.3
Point Source (MSI)	2.1	2.1	3.3	2.2
Point Source (SSI)	7.1	6.8	9.8	7.8

- Concentrations in µg/m^3

Observations

- The average annual concentration of dispersed PM emission load from all the sources exceeds the CPCB standard, which is also observed in summer and further deteriorates in winter. The observed and predicted ratio is highest in winter and worst in Vashi and nearby area.
- The maximum 24 hourly predicted concentration due to all sources in winter was 269 µg/m^3, where maximum is from Tailpipe emission from Vehicles and Red LSI i.e. 212 and is 153 µg/m^3, respectively. The pockets of high concentration are observed close to major traffic junctions in central part city i.e near Vashi and Pawane area, where major interlinkages or roads viz. Thane Belapur and Sion Panvel Highway exist. The NOx vehicular emission is higher at Vashi area, i.e. around 7751 Kg/d. Due to APMC market and industrial connectivity of roads, approx 2148235 VKT movement was observed for Heavy Duty Vehicles. The NOx vehicular emission is around 30494 Kg/d out of which 19978 Kg/d is coming from HDDV i.e. 35.4% of total emission load from all the sources, whereas Red LSI alone contributes 12368 Kg/d i.e. 21.9% of the total NOx emission load. The Annual predicted concentration of NOx is 206 µg/m^3, whereas summer and post monsoon it is ranging from 170 to 180 µg/m^3. Amongst them, the dispersed emission form line source is in the range of 150 to 212 µg/m^3 and that from Red LSI varies between 38 to 91 µg/m^3. Industries are located mainly at Thane Belapur Road, MIDC area, Mahape, Rabale, and Pawane, where impact is noticed.
- The maximum 24 hourly predicted concentration due to area sources was 23 µg/m^3 in winter. The overall impact of areas source is due to domestic cooking and DG sets (commercial/ industrial), which is spatially distributed over all wards. The NOx percent contribution from domestic sector is 14% of the total city emission load.
- The dispersed concentration of NOx from medium scale industrial sources is predicted in the range of 2.16 to 3.36 µg/m^3, similarly from small scale industries the concentration was found to be in the range of 6.8 to 9.8 µg/m^3. The concentration in winter is the highest i.e. 9.85 µg/m^3.

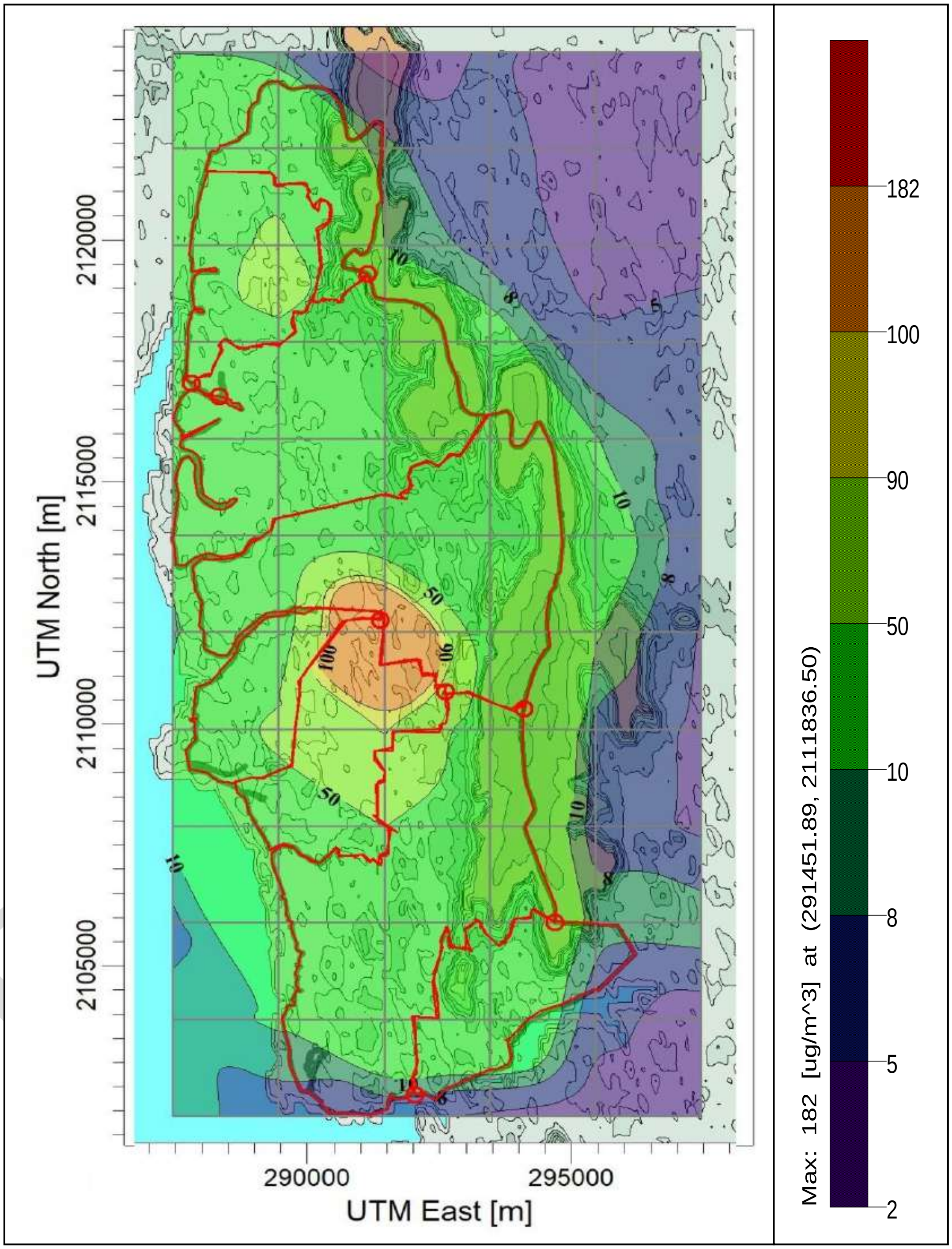


Figure 5.9 : Isopleths of NOx Due to All Source– Summer Season (Navi Mumbai City)

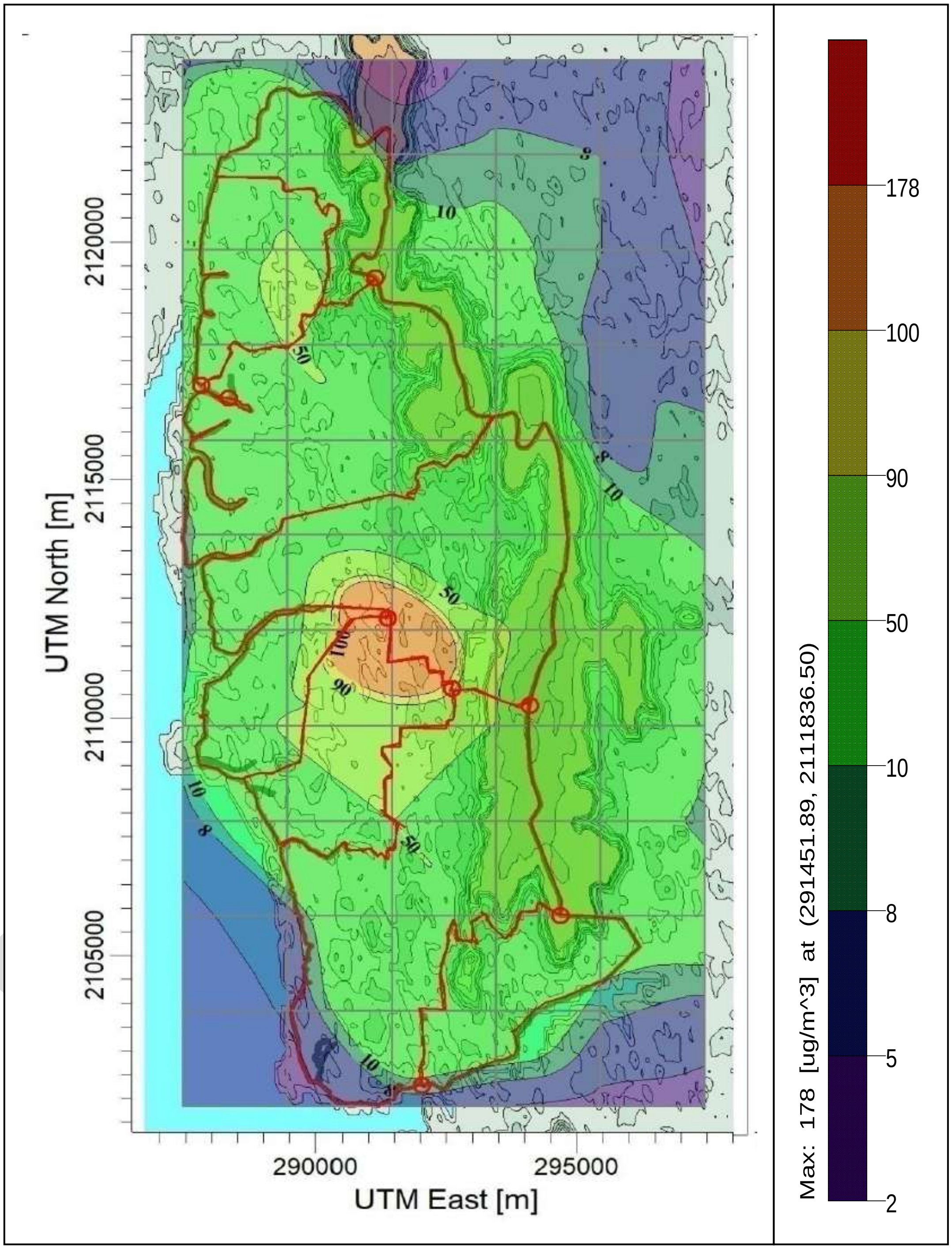


Figure 5.10 : Isopleths of NOx Due to All Source– Post Monsoon Season (Navi Mumbai City)

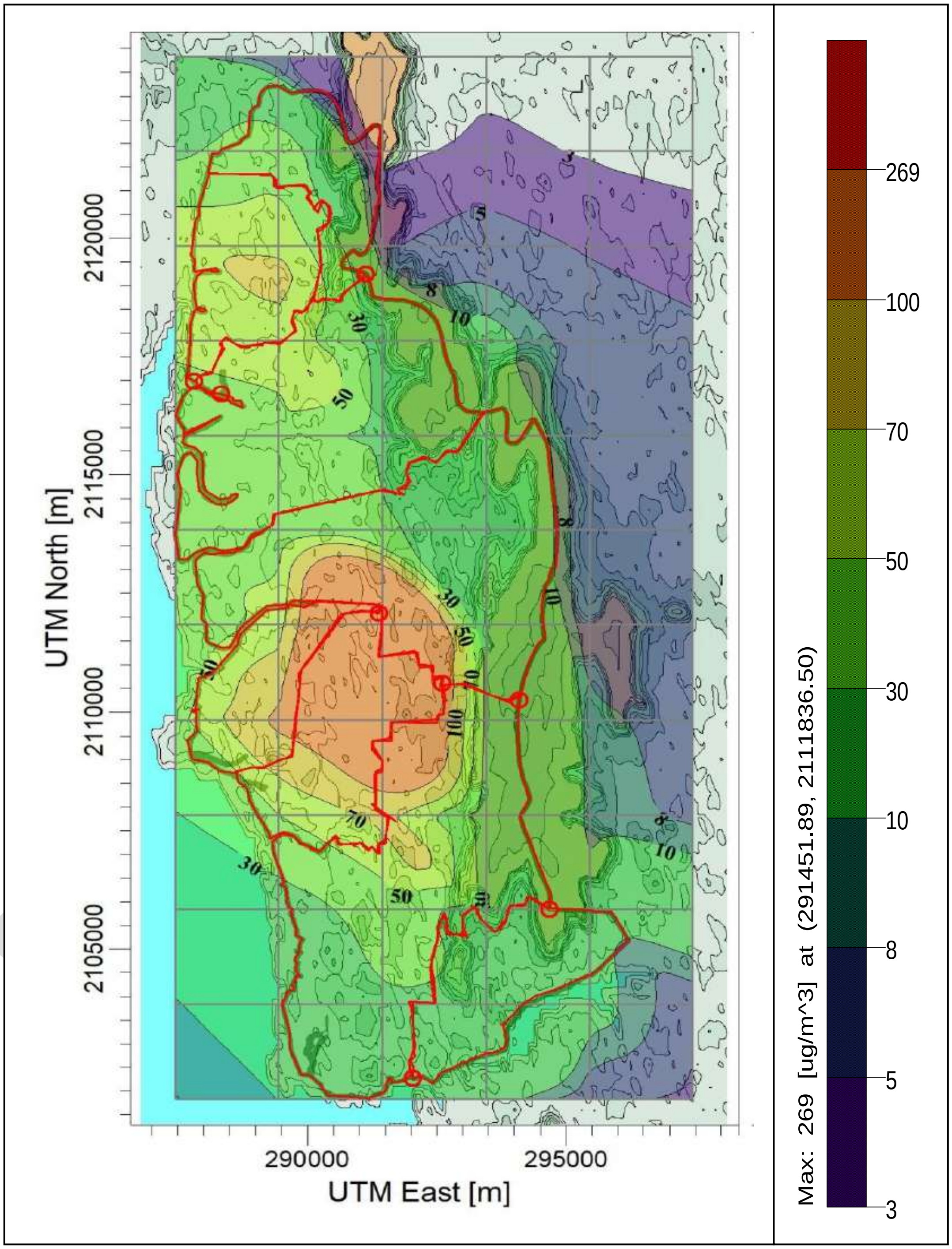


Figure 5.11 : Isopleths of NOx Due to All Source– Winter Season (Navi Mumbai City)

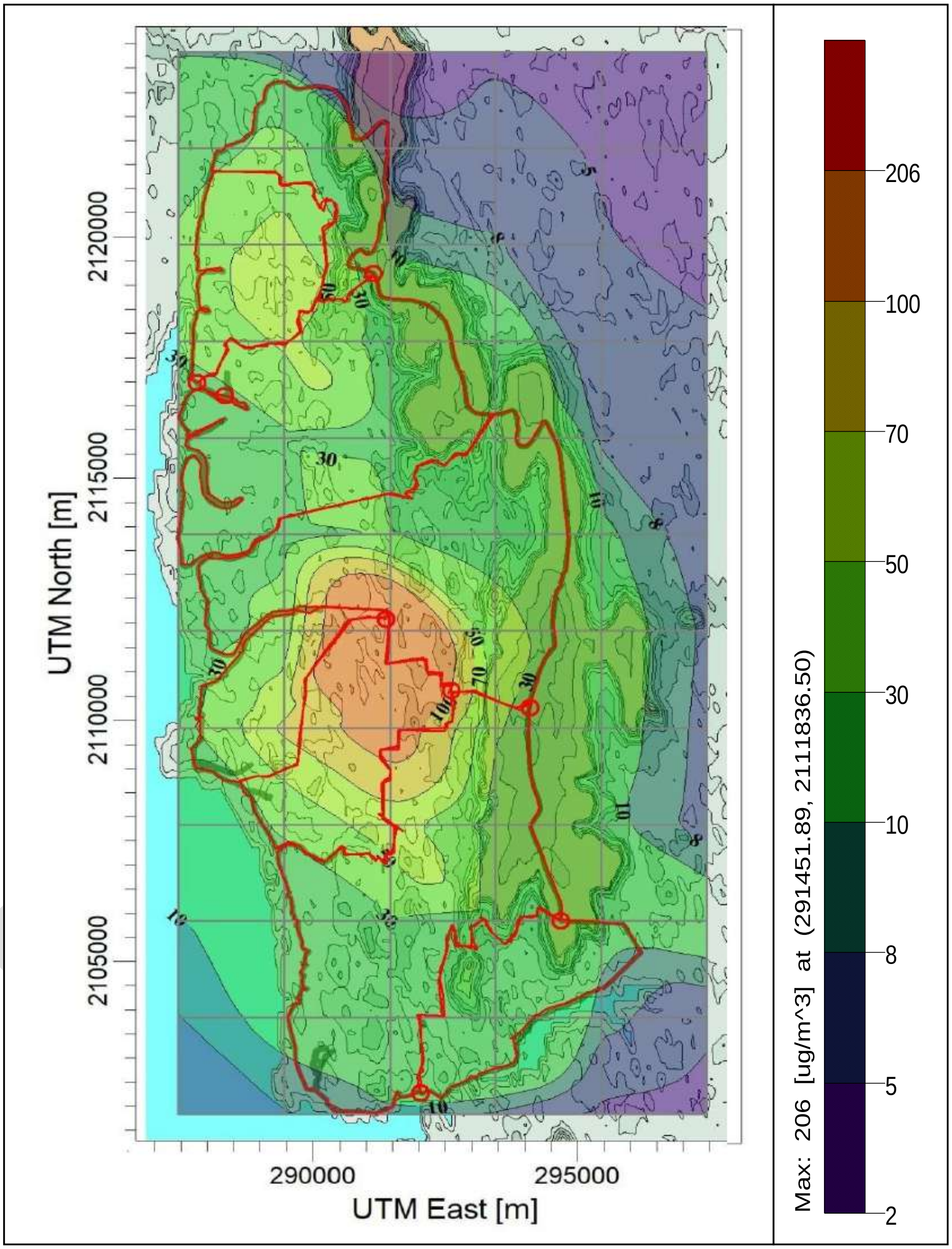


Figure 5.12 : Isopleths of NOx Due to All Source– Annual (Navi Mumbai City)

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Chapter 6

Emission Reduction Action Plan for Navi Mumbai

For city administrators, regulating air pollution is the primary concern and accurate knowledge of the source contributions is vital to developing an effective air quality management program. The action plan presented later therefore, makes an attempt to delineate strategies on the basis of understanding of the PM and NOx sources and their possible contribution to the ambient and kerb side air quality. Each of the strategies will have to be looked at from the point of view of its impact level in terms of reduction in PM and NOx emissions (low, medium, high); its feasibility from implementation and administrative point of view (easy, moderately difficult and difficult); financial viability (low, medium and high costs) besides issues relating to their long and short term impacts. With the implementation of these action plan the total reduction in particulate matter from area sources would be more than 37% (**Table 6.1)**.

6.1 Area Source

The area sources which emit at ground level also have significant impact on the PM levels in the atmosphere; however it could be more localized, particularly from the sources such as bakeries, crematories, construction, garbage burning etc. Some of these sources can have significant local impact on the ambient air quality for a shorter duration. Overall a city growth pattern indicates that domestic fuel has become cleaner, bakeries, crematoria, construction/ demolition situation have not changed so much. Refuse burning has increase and road dust related emissions have also shown grown up. From the estimation of emission inventory, contribution of regional ground level emission load of PM_{10} is 1.83 tons/day and from road resuspension is 11.3 tons/day out of the total PM_{10} emission load. Out of the total area source emission, the most contribution is from domestic and household consumption of fuels and construction activity. The same trend was observed for NOx emission load. This can be attributed to recent settlement and migration of huge population towards the region and inclination of new building and construction project in and around the region. Based on the survey and assessment, following points emerge to curb area source emissions:

- Inventorization of LPG quantity from supply agencies should be maintained.
- Mahanagar Gas Ltd. and ULB should take initiative to sensitize people from the slum & non slum to make the shift from conventional domestic fuel (LPG, Kerosene, wood) to Piped Natural Gas (PNG).

- Development of roads - Navi Mumbai is interconnected by Asphalt /Cement roads however; internal roads in MIDC area require improvement. There are internal roads of 95 Km in TTC MIDC area, Navi Mumbai Municipal Corporation authority informed that 98% construction work of internal roads in MIDC area is completed and the remaining work will be completed at the earliest. Dusty materials such as sand and cement should be kept covered. City pathways and footpath design needs a norm. UTTIPEC design manual has been recently created by Delhi Development authority for uniform roadside, drains, footpath and related design. The same should be adopted for all future design for roads and pathways.
- Resuspension of dust can be minimized through regular sweeping and application of treated sewage for road side bioswale system, which will not only keep the kerb-side green but also help in arresting air pollution. Appropriate barricading of the under construction site to avoid dispersion of the dust and particulate matter in the ambient air. Water spraying on the tires of trucks and vehicles at the entry/exit point of construction as well as industrial sites. Constructing a water pit at the entry/exit points of the construction site to avoid dispersion of particulate matter through movement of trucks while entering and exiting the site.
  - Navi Mumbai also faces pressures from mining and quarrying activities. A total of 80 leases have been provided in 5 different regions of the city which account to a total area of 823988 sq.m (0.82 sq.km). Two years back there are over 200 quarries in NMMC area (Nerul-106, Turbhe-92, Koparkhairane- 8, and Digha-3). The operators were permitted to carry out mining activities in the area till the year 2016 (September 2016). An approved period of lease for existing sites for stone mining and quarrying has been over. As per ESR Report prepared by NMMC, air pollution with high RSPM level can be observed in the area near the mining sites. In view of land degradation due to stone quarrying in NMMC, restoration of these areas is a challenge for NMMC, it needs to construct and barricading using of curb stones for preventing access of vehicle for illegal dumping and trespassers. Towards this NMMC has proposed actions for restoration of abandoned quarries and protection of hills by using them as follows :
    - Use of abandoned quarries for Rainwater harvesting
    - Planting trees for restoration of land under abandoned quarries
    - Abandoned quarries can be restored by sanitary land filling with innocuous inorganic wastes, especially construction debris by adopting suitable slopes from stability angle and with due compaction.
    - Stone quarries and crushing units were identified as one of main source for particulate matter as per a survey study was carried out by NEERI & IIT under MPCB, 2015. Post

  the survey action against 24 defaulting units, was taken out of which 19 stone crushers units have taken steps towards improvement of air pollution control system by installing dust suppression system, water sprinkling arrangement & metal road.

  - Use of Sweeping machines for vacuum suction of dust/fine particles at Palm Beach road, Thane-Belapur and other major roads to reduce air pollutants. Number of quarries are closed which has resulted in decline of particulate matter within the Navi Mumbai municipal limits.

- In the year 2016-17, the daily average MSW was 725 Metric Tonnes (MT) which has increased by about 30 tons as compared to the last year. The major share of about 92% (672 MT) of the total waste is generated from residential NMMC has achieved more than 60% waste segregation at source through various awareness drives. The presence of APMC (Agriculture Produce Marketing Committee) right within the city is also a major source of solid waste, and accounts to about 7.1% (51.69 MT) of the total solid waste generated in the city. Presence of all these solid waste management, there may be open burning activities would happen in the city, so in our report we assumed that 1% waste from each ward and 4% at landfill site may be openly burnt. As per NMMC official there was not reported any open burning activities, so the quantum of open burning waste may be differ.
- Under Swachh Bharat Abhiyaan, NMMC is in the process of establishing a 300 tons/day capacity C&D recycling plant at its Turbhe Landfill facility. Around 5 acres of areas has been reserved to construct the facility on a PPP (Public Private Partnership) basis. The plant shall segregate the waste into sand, metals and stone dust and also use part of it to manufacture paver blocks/tiles. Policy level modifications/interventions are under discussion to decide (i) arrangement on levying of charges for collection of C&D waste and (ii) strategizing mainstreaming of usage of the products for usage in the construction sector.
- For the current year 2016-17, the residential properties mark the highest recording 82% of total 3,07,710 properties. This is followed by commercial buildings with 17% share and MIDC commercial with least of 1% share. These entire resource loads on environment in future will reflect the different activities of area sources and emission load as well.
- Thus trees play a vital role in regulating the city's environment and helps maintain proper balance. NMMC has carried out tree plantations in every block consecutively as per the requirement, out of the total trees present in the city 1.14 Lakhs (1,14,931) have been planted on road dividers. As per the provisional figures, the total tree count of the city is around 8.5 Lakhs.

Source: Environmental Status Report (2016-17), NMMC

Table 6.1 : Emission Reduction Action Plan for Area Source

Area Sources	Short Term 2019	Long Term 2022	Action required
Domestic	50% of slums to use LPG/ PNG	100% of slum to use LPG/ PNG	Proper dispensing and easy availability of cylinder to the consumer of slum population should be made. Increase the infrastructure and availability of LPG/PNG to whole of Navi Mumbai region. Ensure proper ventilation reforms to be implemented in kitchens through periodic information dissemination of indoor air quality.
Hotel & Restaurants	50% of coal to replace by LPG	50% of coal to replace by LPG	Hotels & Restaurants should be regulated for their operation and maintenance of chimneys. Designated areas should be designed for the coal and wood based operations within the premises. Options of fuel shift should be implanted in phase wise.
Open Eat outs	Since these operations are illegal, they are difficult to quantify. An effective redressal system towards their total no. and fuel consumption should be made.		If we restrict the activities with proper rehabilitation or their conversion from traditional fuels to clean fuels, then per unit /day reduction of PM- 0.12, and NOx- 0.039 kg/day can be achieved, considering the large number of vendors and eat outs.
Bakeries	25% LPG /NG & 25% Electric	50% LPG /NG 75% Electric	Clean fuels like LPG/NG or electricity can be attempted for bakery operations. Initial incentives and rebate should be provided for the conversion from traditional fuel. There are illegal and unaccounted small and mid-scale bakeries that have significant contribution to final emission load. They should be taken in confident by the regulatory bodies for their accountability, inventeriozation of their fuel consumption and conversion of their existing facilities. This will require change in current baking practices for which a separate study involving techno-economic feasibility is recommended.
If consumption of wood in a bakery is considered to be 500 kg/day, then emission load of pollutants are PM - 8.65 kg/d, CO - 63.15 kg/d, NOx -0.65 kg/d, HC-57.25 kg/d and if we manage to replace the wood quantity by other fuel i.e only 100 kg/days of wood is being used, there will be 80% reduction in load, with final emission per 100 kg will be PM -1.73 kg/d, CO -12.6 kg/day, NOx- 0.13 kg/d and HC - 11.4 kg/d. This conversion can be towards natural gas, as emissions from them are relatively much less than solid fuels.			

Table 6.1 (Contd..) : Emission Reduction Action Plan for Area Source

Area Sources	Short Term 2019	Long Term 2022	Action required
Crematoria	50% Electric	75% Electric	There are sentiments involved in the activities that are carried out in crematorium. Still all crematoria should be provided with efficient pyres and chimneys with bag filters for release of emissions through stacks at appropriate height. Further, a study involving usage of NG burners in a closed furnace like electrical crematoria may be explored as substitute to existing practices. This will require participation of social organizations for increasing the awareness about need to change from the traditional methods. Concept like Green Crematoria should be explored.
Similarly, for wood consumption of 300kg/body cremation at crematoria is replaced by electric or gas cremation, an overall PM-5.19, CO- 37.89, NOx -0.39, HC -34.35 and CO2 – 510 kg/yr of emission load reduction can be achieved per unit cremation.			
Open & Landfill Burning	100% immediate and stringent redressal of open burning cases 100% control of Landfill burning events	Feasibility study for establishment of Waste to energy plant facility	It has been observed that the unaccounted or mismanaged waste from SWM system, often are reported into road side open burning cases. The waste generated from the residential sector highest quantity (108.58 MT/day) of waste was generated and collected from Turbhe node. The APMC accounts to about 7.1% (51.69 MT) of the total solid waste generated in the city. Assessing the demography, an efficient and strategic SWM plan should be implanted for the region. Also at the landfill site, surveillance facility and response team should be brought in place.
If we restrict the activities of open and landfill burning we can reduce pollutant load per Tonne by PM -8, CO- 42, HC -21.5 kg/t			

Table 6.1 (Contd..) : Emission Reduction Action Plan for Area Source

Area Sources	Short Term 2019	Long Term 2022	Action required
Bldg. & Road Construction	50% control on dust emission	75% control on dust emission	Building construction/demolition codes need to be used with specific reference to PM control. UTTIPEC design manual has been recently created by Delhi Development authority for uniform roadside, drains, footpath and related design. The same should be adopted for all future design for roads and pathways. Road construction/repair uses wood for melting tar, this technology needs to be abolished as over a large period of time, emissions are high.
Paved & Unpaved Road Dust	Paving : 75% control on dust Unpaving: 15% of remaining road if any	Paving : 100% control on dust Unpaved : 100% of remaining road if any	99.5% of roads were considered to be paved. Pavement of road should be made wall to wall, especially the shoulders. The silt on partially paved shoulders of road are re-entrained, or resuspended, into air through vehicle-induced turbulence and shearing stress of the tires. A Road dust suspension is an increasing concern in terms of being a source of atmospheric PM. Better sweeping management system should be implemented. A total of 1317 Km length of road is swept everyday an average one sweeper sweeps 700 running meters of road length. NMMC has 8 mechanical sweepers for efficient sweeping of roads. About 196.16 Km road is swept by the sweeping machines per day, which is very low. A strategic plan should be devised so as to cover larger area of region. This will help in effective management of 2646 manual sweeping labors in other resuspension control activities such as frequent sweeping, sprinkling of roads and collection of dust. Feasibility study for road construction material that can be used in the region so as to control resuspension should be initiated.

6.2 Point Source

As per MPCB, Navi Mumbai had aggregate Comprehensive Environmental Assessment of Industrial Cluster in December 2009 having CEPI Score of 73.77, which improvised to 56.48 as on March 2017. There are 541 Air Polluting industries in area/cluster. Major pollutants are TPM/SPM, SO_2, NOx, NH_3, Cl_2, and VOC from pesticide and bulk drug units. All the Air polluting industries have provided emission control systems as required i.e. Dust collectors, Scrubbers, and Stack of sufficient height. The number of D.G sets in the region is very high and emissions from their stacks are accountable. A recent report prepared by MPCB, 2017 '*Environmental Status and Revised Action Plan for Prevention and Control of Pollution of Industrial Cluster of Navi Mumbai'*, highlighted some of the facts and action under taken by the board as :

- Total 69 industries have changed their fuel pattern and are using PNG as fuel from LDO/FO and the remaining 13 industries using coal as fuel has been directed to switch over for use of PNG. However because of economic viability out these 13 units 11 has upgraded ECS (Energy Conservation Scheme) and provided Bag filter and ventury scrubbers. Work is in progress for remaining 2 units.
- M/s. Mahanagar Gas Ltd. is lying down gas pipeline, which is to be commissioned in the next year. All the industries are proposed to use natural gas soon after commissioning of Gas supply. 17 industries have changed their fuel pattern and are using CNG as fuel.
- Presently, 16 industries identified as a Hazardous air pollutant emitting units. They should be issued directions to install Leak detection & repair system (LDAR) within 6 months. Presently, 10 industries are installed with LDAR.
- All the bulk drug and pesticides manufacturing units should be proposed to improve efficiency of their VOC scrubbers. Total 16 industries have been identified to install VOC analyzer. Out of this 10 industries have installed VOC analyzer system. 2 units are not in operation. And remaining 4 units has been directed for compliance.
- Air pollution control measures adopted in the 458 industrial units with respect to efficiency, operation, maintenance and implementation along with up- gradation of air pollution control equipment's. Online display system implemented at all Large and medium scale industries. 15 units had updated PCS and their performance is under vigilance.

- Repairing of internal roads & proper maintenance of the same, there are internal roads of 95 Km in TTC MIDC area. NMMC authority informed that 98% construction work of internal roads in MIDC area is completed and the remaining work will be completed at the earliest.
- It needs to be inventories of prominent industries with inclusion of technological gaps.
- Industries should adopt stack emission norms prescribed by CPCB for Industries, which should be followed by regular QA/QC and performance audit.
- Use of Furnace Oil should be regulated. The chemical and dyes units should improve their scrubbers and dust collectors.
- NMMC, MIDC & MPCB should survey for the identification of illegal SSI and their levels of operation and their contribution in each of the grids in the city. Needs to regulate for such units.

With the implementation of the short and long term scenarios, the total reduction in particulate matter from point sources would be 54% and 98% respectively **(Table 6.2)**.

Table 6.2 : Emission Reduction Action Plan for Point Source

Point Sources	Short Term 2019	Long Term 2022	Action Plan
Red (LSI) FO (347 TPD), LDO (135 TPD) HSD (94 TPD) Diesel (65 TPD) Coal(764 TPD), LPG 931 TPD), NG (1434 TPD) And CNG & PNG (25 TPD) are the major contributors towards PM and NOx emission loads	Shift to cleaner fuels in both the category of industries - 50% of FO, LSHS, HSD to LDO, Coal & Others to NG	Shift to cleaner fuels - 100% All types of fuel to Natural gas	There are 541 Air Polluting industries in area/cluster. While Indian coal has a low sulfur content in comparison with other coals, ash levels are reported to be quite high and can contribute to coarse PM emissions. Mahanagar Gas Co. already started commissioning of pipeline for the supply across the region. The civic regulatory bodies should intervene to make sure it is facilitated at all levels of demography, management and organizational scale. Industries should be regulated to install air monitoring devices within their premises and same data should be regularly submitted to MPCB. Inter organizational stakeholder meetings and workshop should be held industry wise, so as to collaboratively devise measures that can be adopted within their operation and process. Fiscal measures can be shared on mutual understanding. Industries should adopt stringent stack emission norms beyond those prescribed by CPCB Industries with periodic audits like QA/QC of units from both the parties. Inventorisation of prominent industries with technological gaps and detailed feasibility study is required as dispersion of pollution with modeling and formulate land can be used to devise regulatory policy. Identification of low cost and advanced cleaner technology for air pollution control with policy intervention at specific zones.
Red, Orange and Green (MSI & SSI) FO (15 TPD), LDO (17 TPD), HSD (1068 TPD Diesel (52 TPD) and PNG (113 TPD) are the major contributors towards PM and NOx emission loads			

Table 6.2 (Contd..) : Emission Reduction Action Plan for Point Source

Point Sources	Short Term 2019	Long Term 2022	Action Plan
Red (LSI) & Red, Orange and Green (MSI & SSI)	Shift to cleaner fuels in both the category of industries - 50% of FO, LSHS, HSD to LDO, Coal & Others to NG	Shift to cleaner fuels - 100% All types of fuel to Natural gas	Feasibility of changing combustion technology to facilitate usage of gaseous fuels may be undertaken with financial incentives. Energy Conservation Scheme should be encouraged in the industries that are not economically capable towards shifting to eco-friendly fuel use or advanced clean technology. Fuel consumption in DG set operation in industrial should be regulated with stringent surveillance and made to follow stack emission standards with installation of efficient air control equipment. The dependency on DG set on power cut should be replaced by conventional source of energy. Only 6 out of 16 Hazardous Air Polluting Units are yet to install Leak detection & repair system (LDAR). They have been directed by MPCB for the installation within next 6 months. The number of illegal MSI and SSI are left unaccountable. Their identification and consent to operation should be provided with proper regulations. Stringent regular monitoring should be initiated by the authority. NMMC has agreed for provision of land to Industrial Authorities for the development of green zone in and around industrial region of Navi Mumbai
One tree will offset an average about 10 kg of CO_2 each year. According to this we will need 500 million additional trees in 2020 and 1200 million trees in 2051.			

6.3 Line Source

The presences of increased truck traffic in the area apart from construction activity are the reasons for the increased pollution. The Agricultural Produce Market Committee (APMC) market, Asia's largest market, has pulled in huge truck traffic in the area as well from industries truck to and pro movements. The number of vehicles has increased above estimates here and there is no check on their emissions. As per RTO, the vehicle population in Navi Mumbai is around 41,367 ('thousand) for the year 2016-17 and the year wise growth in number of registration of vehicle is observed to be in the range of 11%. As per current study the emission from vehicular source is calculated to be around 3.27 Tonnes/day for PM. The line source vehicular emission contributes around 16% of the total city load. Heavy Duty vehicles contributing 13% of total vehicular emissions of PM. While, emission due to resupension is about 16% for paved roads and 39% for unpaved roads. The NOx, share from vehicular sector is 54% and 70-80% for CO and HC.

Regional Transport officer in collaboration with ULB and private and PPP entity should be directed to give information about the time bound strategy to control the vehicular pollution and traffic management for:

- Synchronizing traffic line strategy to phase out of the old commercial vehicles say more than 15 years old, most of which are diesel driven. Stringent Emission standards for the new vehicle in line with Bharat Stage VI Emission Standards should be adopted.
- Need to frame legislation for the Retro-fitment of new engine/Emission Control Devices (Diesel Particulate Filter (DPF) /Diesel Oxidation Catalyst (DOC) that could help in major reduction of PM. Cost sharing by the agencies will help in immediate provision of retrofitment devices.
- Better quality fuel by adopting stricter fuel supply and dispensing system along with Chemical Marker system to keep check on adulterations in fuel. The current fuel specification are too board and therefore, analysis of conventional parameters does not reflect adulteration. Finer fuel specifications are needed for implementation. Success of marker system shall be highly dependent upon the collaboration of Oil Companies and Anti Adulteration Cell. Fiscal Measures for development of alternative fuel technology.
- Conversion of existing public transport buses/tempos/mini buses to CNG fuel operation. Concession/rebates by NMMC for erecting CNG fuel.
- Hybrid buses can be introduced in NMMTs fleet of buses. Biodiesel (B5/B10:5 – 10% blends) should be considered as a fuel option. Promotion of electric public transport. Battery Operated transport vehicles providing point to point service can also be initiated.

- Prepare a traffic dispersal model for efficient mobility & connectivity and should be undertaken by regulatory bodies like NMMC, RTO, MIDC and Departments of Police. Develop North-South road links in the suburbs including Mass Rapid Transit connectivity. Appropriate quality and smooth surface roads should be developed. Facilitate safe and convenient movement for pedestrian (Subways/ FOBs/ Footpaths including Skywalks).
- NNMC operates bus services in Navi Mumbai as well as to certain parts of Mumbai, Thane, Kalyan, Dombivli, Badlapur, Taloja, Panvel and Uran. NMMT operates a total of 475 buses on 77 routes with some special services covering total route length for all the services is 1895 Km, which needs to improve as a public transport and better connectivity.
- Being the IT hub, the contract carriers are mainly operated in north of Navi Mumbai. As per the provisions of 73 (3), Central Govt. can restrict and limit number of contract carriers in the cities / towns were heavy population is not less than 5 lakhs. Traffic of heavy goods vehicles may be routed outside city area by creating by-passes & ring roads before entry and exit of the city
- NMMC, RTO, MSRDC & MIDC should collaborate to formulate time bound design and construction of under passes, fly-overs and widening of roads to control the traffic jams and congestion along Thane - Belapur and Mumbai - Pune Highway and pre-determined junctions. All buses (STC/PVT/PPP/School/Airport) in the city should be regulated to run only on clean fuels (LPG or CNG) or clean diesel of 10 ppm sulphur with particulate trap for exhaust.
- To provide easy access and infrastructure to commuters travelling from Mumbai towards Thane- Belapur and Panvel-Pune. Currently, Navi Mumbai International Airport is an under construction at Ulwe Kopar-Panvel in Maharashtra which is 35 Km far from existing Chhatrapati Shivaji International Airport, Mumbai; which will increase the traffic movement. A comprehensive mobility plan needs to be drawn looking into the future demand.
- Finally, awareness programme should be undertaken with no vehicle day and assessment for air pollution to share the benefits among the general population.

Many potential emission reduction options have been considered based on viability in the city and the major issues are pertaining to the overall vehicular sector emission reduction have been discussed in **Table 6.3**.

Table 6.3 : Emission Reduction Action Plan for Line Source

Line Sources	Short Term-2019	Mid Term-2022	Long Term-2024	Action required
Reduction Emission per Unit of Fuel				
Fuel Adulteration	Strict Banning of Fuel Adulteration-50%	Strict Banning of Fuel Adulteration-80%	Strict Banning of Fuel Adulteration-100%	There is significant contribution from adulterated fuel as compared to clean fuel. There seem to be a loop hole in distribution system of pure fuel to the end customers. Ministry of petroleum has constituted anti adulteration cell for preventing the malpractices of fuel adulteration. A local level body should be developed for the periodic vigilance and fair distribution in the region. At petrol pumps, facility should be provided for identification of fuel adulteration by way of marker Oil companies should use colour codes on the tanker transporting the fuel, regular testing of the fuel before it is filled in the bunks and after. Promotion of better lubricants. Oil companies should also put their own manpower and machineries in checking effectively their products being sold from their outlets. (e.g. BPCL's Pure for Sure; HPCL's Club HP and IOC's Q & Q etc., which are being carried out in, limited way. Economic measures such as removing the disparity in petrol, diesel and kerosene prices will be required to remove incentives for such large scale malpractices Fines and cancellation of license are some of the stringent tools.
CNG/ LPG	Privately operated Vehicles viz. OLA, Uber and other contract buses, public transport should be converted -30%	Privately operated Vehicles viz. OLA, Uber and other contract buses, public transport should be converted -50%	Privately operated Vehicles viz. OLA, Uber and other contract buses, public transport should be converted -75%	NMMC has a fleet of both AC (82) and Non AC (398) buses in its inventory. Buses run either on Diesel or CNG. All can be converted to CNG phase wise. Private aggregator vehicles from institution, schools and services should be regulated to convert to CNG/LPG. Incentives for fast paced successful implementation. Incentive for new owners to buy CNG/LPG vehicles. Developed infrastructure for easy availability of fuel station for CNG/LPG refueling and availability of subsidiary kits for such conversion to the older vehicles.

Table 6.3 (Contd..) : Emission Reduction Action Plan for Line Source

Line Sources	Short Term-2019	Mid Term-2022	Long Term-2024	Action required
Reduction Emission per Unit of Vehicle /Congestion				
Banning of 15 year Old Commercial Vehicle	50% banning	70% banning	100% banning	Encouragement by provision of incentives in form of scrap value, tax rebate, and transferrable discount rewards for new vehicles and registrations. All the existing and newly vehicles should go through inspection and certification every two years. Corporation and metropolitan authority should demark designated places and system facility for scrapping vehicles, as such there is no provision in the city. According to reports, the government has set up a central depository called 'VAHAN' to store data relating to all vehicles. A city level depository of all the vehicles should be made by the administrative bodies in collaboration with traffic and RTO bodies, which can be linked to the central depository with appropriate information technology structure. This can help the city administration for the monitoring and management for future perusal.
Synchronization of traffic signals Sensor Based - Real time tracking	Major & minor roads, excluding feeder roads (or about 35% of the all arterial roads)	Major & minor roads, excluding feeder roads (or about 65% of the all arterial roads)	Major & minor roads, excluding feeder roads (or about 80% of the all arterial roads)	There are significant emissions at signals and congestion zones, especially because of hot and cold start due to unsynchronized and delayed traffic signals. Pre-feasibility study should be undertaken for some hotspots. Detail study should be worked out on signaling network with sensor based monitoring and apply fuzzy logic, mathematical model gives the real time picture.
New Vehicle Standards (Sulphur Reduction)	Currently BS-IV standards are in operation	Implement BS- VI from 2020 -50% (adopt progressive increment)	Implement from 2020 -75% (adopt progressive increment)	Sulphur specification for petrol and diesel will be reduced 50 times from a level of 50 ppm for BS-IV fuel to 10 ppm in BS-VI. Cities in the national capital region like Noida, Ghaziabad, Gurugram and Faridabad as well as 13 major cities, including Mumbai, Chennai, Bengaluru, Hyderabad and Pune, will switch over to Euro-VI grade fuel from January 1 next year. Rest of the country will follow suit from April 2020. The cleaner fuel should cost around 50 paise a litre more. There presently exists no better fuel than this anywhere in the World. Oil refineries will need to invest Rs 30,000 crore in upgrading petrol and diesel quality to meet cleaner fuel specifications by 2020.A strategic plan should be devised for its successful implantation across all levels. Vehicle manufacture should be taken in confidence for the respective modification of engines.

Table 6.3 (Contd..) : Emission Reduction Action Plan for Line Source

Line Sources	Short Term-2019	Mid Term-2022	Long Term-2024	Action required
Reducing Fuel Consumption Per Unit Distance				
Share of Electric vehicles in Total City Fleet	Two wheeler: -15%, 3 wheeler and Taxi: - 15% Public transport buses -20%	Two wheeler: -30%, 3 wheeler and Taxi: -30% Public transport buses -40%	Two wheeler: -60%, 3 wheeler and Taxi: - 60% Public transport buses -80%	The government is focusing on creating charging infrastructure and policy framework so that by 2030, more than 30 percent of vehicles are electric vehicles. The flagship program to boost electric technologies in India is the Faster Adoption and Manufacturing of Hybrid & Electric Vehicles (FAME) scheme from the Central Government, launched in April 2015. The FAME scheme offers a subsidy on the retail price of passenger cars. These subsidies range as follows: for electric vehicles, from INR 60,000 to INR 1,34,000. Subsidies are also available for two-wheelers, three-wheelers, light-commercial vehicles, buses, and for retrofit kits. There are 24 two-wheeler models, all battery-operated electric, registered to receive demand incentives under the FAME scheme. The Central Government of India and some state governments, provide tax incentives that treat hybrid and electric vehicles preferentially over conventional technologies. The administration should devise some incentives and rebate at local level. For example, the Central Government of India levies an excise duty of up to 30% on conventional car technologies while electric vehicles are subjected to flat duties of 6%. In the national FY 2016-17 budgets, the Central Government of India also subjected conventional motor vehicles to an infrastructure cess ranging from 1% to 4% of the vehicle price and exempted electric vehicles from this cess. The Ministry of Heavy Industries recently gave its approval to the introduction of EV-based public transportation systems in 11 cities across the country. These include Delhi, Mumbai, Ahmedabad, Bengaluru, Jaipur, Lucknow, Hyderabad, Indore, Kolkata, Jammu and Guwahati. Same can be assessed at regional levels at their own capacity. While the FAME scheme provides incentives for all market segments, presently only two wheeler models appear to be taking advantage of the scheme. The life-cycle emissions intensity of electric vehicles in India is poised for substantial reductions in alignment with India's post 2020 climate action plans.

Table 6.3 (Contd..) : Emission Reduction Action Plan for Line Source

Line Sources	Short Term-2019	Mid Term-2022	Long Term-2024	Action required
Reducing Fuel Consumption Per Unit Distance				
Share of Hybrid vehicles in Total City Fleet	(Gasoline powered four-wheelers only) – 10%	(Gasoline powered four-wheelers only) – 20%	Gasoline powered four-wheelers only) – 30%	Hybrids with efficient internal-combustion engines and other non-polluting power trains will contribute to a cleaner environment. The flagship program to boost hybrid technologies in India is the Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles (FAME) scheme from the Central Government, launched in April 2015. The FAME scheme offers a subsidy on the retail price of passenger cars. These subsidies range as follows: for mild hybrids, from INR 11,000 (USD 165) to INR 24,000 (USD 360); for strong hybrids, from INR 59,000 (USD 885) to INR 71,000 (USD 1,065); Subsidies are also available for two-wheelers, three-wheelers, light-commercial vehicles, buses, and for retrofit kits. The Central Government of India and some state governments, provide tax incentives that treat hybrid and electric vehicles preferentially over conventional technologies. The administration should devise some incentives and rebate at local level. For example, the Central Government of India levies an excise duty of up to 30% on conventional car technologies while hybrid vehicles are subjected to flat duties of 12.5%. In the national FY 2016-17 budgets, the Central Government of India also subjected conventional motor vehicles to an infrastructure cess ranging from 1% to 4% of the vehicle price and exempted hybrid vehicles from this cess. While the FAME scheme provides incentives for all market segments, presently only passenger car models appear to be taking advantage of the scheme. Hybrid buses hold potential to gain significantly under FAME, as the allocations available cover a significant portion of the technology costs

Here are some of the subsidiary benefits from government and emission reduction study conducted at Delhi explained with examples for various hybrid/electric models available in the market.

Passenger Cars Currently Eligible for Demand Incentives Under FAME Scheme

Vehicle	Technology	Segment[25]	Curb Weight (kg)	Length (mm)	Displacement (cc)	Price Range (INR Lakhs)[26]	Gasoline Equivalent Fuel Consumption (liter/100Km)	Life-Cycle CO2 e Emissions (Tonnes /5 Yrs.)
Maruti Ciaz SHVS	Mild Hybrid (Diesel)	Midsize	1,115	4,490	1,248	8 to 10.5	3.98	6.73
Maruti Ertiga SHVS	Mild Hybrid (Diesel)	Utility Vehicle (UV1)	1,235	4,265	1,248	7.5 to 9.5	4.55	7.71
Toyota Camry Hybrid	Strong Hybrid (Gasoline)	Premium	1,635	4,850	2,494	28 to 32	5.22	8.12
Mahindra E2O	Battery Operated Electric	Mini	830	3,280	NA	4.5 to 7.5	0.86	5.06
Mahindra eVerito	Battery Operated Electric	Midsize	1,140	4,277	NA	9.5 to 10	1.47	9.94

Fuel Consumption Savings of Models Under FAME Scheme Compared with Base Models

Technology	Hybrid/ Electric Model (BEER Fuel Efficiency Star Rating	Non-Hybrid /Non Electric Base Model (BEE Fuel Efficiency Star Rating)	Gasoline Equivalent Fuel Consumption Reduction over Base Model
Diesel –Based Mild Hybrid	Maruti Ciaz, VDI SHVS (5 Star)	Maruti Ciaz, VDI (5 Star)	7%
Diesel –Based Mild Hybrid	Maruti Ertiga, VDI SHVS (5 Star)	Maruti Ertiga, VDI (4 Star)	15%
Gasoline Based Strong Hybrid	Toyota Camry, Hybrid (5 Star)	Toyota Camry, At 2.5 L (2 – Star)	32%
Battery Operated Electric	Mahindra E-Vertio D2 (5 Star)	Mahindra Verito D2 (4 Star)	68%
Battery Operated Electric	Mahindra E2Om (5 Star)	--	--

Fuel Consumption Limits for Two-Wheelers Under FAME Scheme Compared with Non-Electric Benchmark

	Maximum Speed (kmph)	Maximum Power Output (w)	Gasoline Equivalent Fuel Consumption (t/100 Km)	Life Cycle CO2 Emission (tons/5 Yrs.)
Low speed Electric Scooters	25	250	< 0.51	< 3.04
High Speed Electric Scooters	45-55	1,500 – 1,800	< 0.82	< 4.86
Honda Activa 3G	82	5.966	1.5	2.33

Source: International Council on Clean Transportation

Table 6.3 (Contd..) : Emission Reduction Action Plan for Line Source

Line Sources	Short Term-2019	Mid Term-2022	Long Term-2024	Action required
Inspection and Maintenance	New I&M regulations (30% population of vehicles of a RTO region)	New I&M regulations (50% population of vehicles of a RTO region)	Full compliance -100%	In MMR, there are 219 Nos. of PUC centres for Petrol, 56 Nos. for diesel & 244 Nos. for petrol & diesel. Overall, 8% of vehicles come for inspection and failure rate is 1%. The Vahan-nagari area should be developed for I&M which is equipped with state-of-the-art testing set-up for all the types of emission as well as fitness testing. The test design should have the basis of engine and overall vehicles fitness (roadworthiness). Set up a mechanism of Inspection and Maintenance programme for all vehicles in the district through RTO with automated system assessment. Implementation of penalties should be laid on vehicles if found exceeding the emission limits. The I &M center should also test all vehicles for their in-built emission tests. All private vehicles should be subjected to proper assessment and fitness tests through I&M centers. All autos and buses shall also be subjected to I&M tests. On-road emission tests for vehicles plying on Indian roads will be mandatory once the Bharat Stage VI norm kicks in from 2020, for which testing agency Automotive Research Association of India (ARAI) is developing a unified test cycle. The European Commission will begin conducting these tests on new models from September 2017 and on new vehicles by 2019. India, however, will begin collecting data through these tests from 2020 and set permissible limits for emissions by 2024.
Ban of odd /even vehicles	It is feasible to take trail for commercial / office areas – 20%	Identified interlinking roads and traffic hotspots and implement for trail road -20%	Identified interlinking roads and traffic hotspots and implement for trail road -50%	A trial run should be arranged to study the impact. Alternate arrangements should be made to bolster public transport. All private vehicles even having registration numbers issued by neighboring states will have to follow the odd-even number formula.

Environment Pollution (Prevention and Control) Authority (EPCA) for Delhi NCR for submitted a "Report of assessment of Pollution Under Control (PUC) Programme in Delhi and NCR: Recommendations for improvement to ensure pollution from in-use vehicles is under control" to Supreme court. Some of the measures can be followed as recommendation for existing PUCs of the city:

EPCA states that without a robust system of emissions monitoring and compliance, the investments in emission monitoring of on-road vehicles as well as advanced emissions control systems in new vehicles to meet tighter emissions standards, can go waste and negate air pollution control efforts in our cities. Management of emissions from on-road vehicles will require an integrated approach to ensure all generations of vehicles -old and new remain low emitting for as long as the vehicles are on the road.

This will require strengthening of the PUC systems for all on-road vehicles - Bharat stage (BS) I to IV generations of vehicles combining both physical tests as well as On-board Diagnostic (OBD) tests. This will also require appropriate emissions monitoring system for the new generation of BSVI vehicles to come within three years. PUC will not be the relevant programme for that genre of vehicles. The BSVI standards and regulations have already provided for real driving emissions testing when vehicles move on the road. But the roadmap for its implementation needs to be charted quickly to allow Delhi and NCR to be prepared in time.

Simultaneously, the newly amended Motor Vehicle Act and Rules has given the opportunity to implement emissions recall programme so that the vehicle manufacturers can be held responsible for any manufacturing defect that increase on-road emissions. Both EPCA and Auto Fuel Policy committee had recommended emissions recall programme in 2003. Thus, addressing all the three element of the programme, PUC both physical testing and OBD testing; real driving emissions testing for in-use compliance; and manufacturer responsibility for manufacturing defects, are the critical steps to get a robust system to keep vehicles low emitting on roads. This is needed for both consumers as well as manufacturers' responsibility. In view of this the following recommendations are made:

1. Limit the numbers of PUC centres, upgrade them and bring them under strong supervision and quality control:
   The current practice of allowing mushrooming of small time and numerous PUC centres in refuelling stations across the NCR must be stopped. It is more important to limit their numbers, upgrade their capacity to carry out proper credible and authentic testing and bring them within a strong accountability framework

2. For improving compliance with the PUC programme, MoRTH and state transport departments "should do the following":
   2.1 Ensure 100 per cent compliance by linking annual vehicle insurance with PUC certificates. Annual vehicle insurance cannot be obtained without all the requisite PUC certificates. Currently, PUC certificates need to be obtained every quarter in Delhi and every six months in the NCR. This periodicity of PUC certification can be made uniform across Delhi and NCR later only after PUC norms and oversight systems have been adequately upgraded and made stringent. Issue of authentic certificates must be ensured based on authentic and credible tests.

   2.2 Introduce automatic online network for transmission of PUC data to the central server to minimize manual interference and allow proper analysis of data for remote auditing of PUC centres. Adopt uniform and standardized data recording and reporting format and uniform software across Delhi NCR. Mandate periodic analysis of data to refine enforcement and for monitoring and submission of compliance report every six months. Software used in different make of testing equipment across NCR needs to be standardized to prevent fake values. MoRTH needs to develop the standardized protocol for uniform application across Delhi-NCR.

   2.3 Mandate pre-payment of PUC fees before the tests are conducted. No test should be conducted without taking the fee in advance. The software should be modified accordingly.

   2.4 Strengthen inspection of the PUC centres for quality control and strengthen the licensing programme to ensure proper calibration, authentic tests; annual maintenance contact for the maintenance of all testing equipment and accessories; training of operators, calibration of equipment etc are carried out. Make quality audit of centres and calibration quarterly. Introduce annual third party inspection of PUC centres immediately. State Pollution Control Boards with guidance from Central Pollution Control Board should coordinate this.

   2.5 Phase in big centralized emissions testing centres capable of conducting automatic and upgraded tests for commercial vehicles on a priority basis. Delhi already has Burari vehicle inspection and fitness centre in Delhi for commercial vehicles. The commercial vehicles visit it for annual vehicle fitness and roadworthiness tests. This needs to be upgraded for high level of automatic emissions testing so that operators and vehicle drivers do not come in contact to influence the test results and credible and upgraded tests are conducted. MoRTH is also setting up centralized inspection centres in NCR as in Rohtak. These should be aligned to firm up the roadmap. Add more such centres as needed.

2.6 Introduce well equipped mobile test centres and a programme to check visibly polluting vehicles:

- In addition to stationery testing centres, mobile units are also needed for surprise checks as well as to catch the visibly polluting vehicles on road. There should be appropriate penalty for visibly polluting vehicles.
- Enforce stringent penalty for PUC centres for non-compliance and malpractices.

3. For improving the effectiveness of the PUC tests and inspection, MoRTH should do the following:

3.1 Tighten the PUC emissions norms for pre-Bharat Stage IV vehicles: Analysis of large data set on actual emissions concentration tested in large number of PUC centres in Delhi and UP has also brought out that the actual observed emissions values of pre-Bharat Stage IV vehicles are significantly lower than their prescribed norms. In most cases 80 per cent lower than the limits. These norms cannot identify at least 15 to 20 per cent grossly polluting vehicles in the on-road fleet. Nearly all vehicles pass the tests. Due to poor recording of failed tests and due to very lax norms the overall failure rate in Delhi is 4.69 per cent. For the diesel vehicles tested, the failure rate stands at 1.68 per cent, compared to 5.18 per cent for petrol vehicles and 4.65 per cent for all other fuel categories requires urgent attention and action. In UP NCR cities, the overall failure rate is abysmally low, at 0.49 per cent – 0.39 per cent in two-wheelers and 0.59 per cent in four wheelers. The MoRTH needs to tighten the PUC standards for the pre-Bharat Stage IV emissions standards. This will also help to weed out very old non-compliant vehicles and speed up fleet renewal based on improved standards.

3.2 Overhaul emissions tests and tighten norms for diesel vehicles: The review of available data shows that the smoke density tests – the only test that is carried out in diesel vehicles is very lax for the pre Bharat Stage IV diesel vehicles. More than 80 per cent of vehicles tested show smoke density levels that are below the norm prescribed for the Bharat Stage IV vehicles. Therefore, the current norms for Bharat Stage IV norms should be made uniform for the pre-Bharat Stage IV vehicles as well. This can be further weed out the very old and polluting vehicles and speed up fleet renewal.

Moreover, as explained earlier globally smoke tests are being upgraded with more advanced test procedures to make these tests more rigorous and effective. MoRTH may review those advanced testing procedures and provide a roadmap for the introduction of these tests in the large centralized testing centres for commercial vehicles quickly.

3.3 Make lambda test for petrol cars mandatory across NCR: Lambda testing for petrol cars equipped with three way catalytic converters – introduced in BSII-III level is already mandatory in Delhi as per the MORTH 2004 notification, but not in NCR. Lambda value represents the air to fuel ratio. It is important to maintain the optimum ratio for proper functioning of the catalytic converters that play a crucial role in cleaning up the exhaust gases from petrol cars. It is not possible to directly test the efficacy of the catalytic converters. That is why it is important to ensure that the operative systems in the vehicles needed for its optimum performance are maintained. Lambda is an indicator of that. Such tests will require upgradation of the test equipment from two gas analysers to four gas analyzers capable of doing lambda testing. Petrol cars are already tested for carbon monoxide, hydrocarbon based on two speeds. If done along with lambda measurement, the test procedures for petrol cars can become more robust and effective. As the MoRTH has already provided for lambda tests in its 2004 notification, the concerned state governments need to issue orders for implementation in the NCR.

3.4 Integrate OBD with inspection and maintenance programme: The MoRTH needs to develop the protocol for implementation of OBD for vehicle inspection programme that will be implemented by the state governments. This will complement the physical testing.10 It is also important to detail out how this will be operationalized at the ground level and how the transport department will implement this programme.

3.5 Detail out the strategy for advanced real driving emissions monitoring of new generation vehicles to come with BSVI emissions standards in 2020: Any roadmap for improving vehicle inspection programme at this juncture will have to keep in view the dramatic transition in emissions control technologies within a short span of three years when BSVI emissions standards will be enforced. The current PUC is not designed to address those vehicle technologies. The notification of MoRTH on BSVI standards has already provided for the introduction of Real Driving Emissions Test Procedures and Standards based on portable emissions monitoring system to monitor emissions as vehicles move on the road. This is needed to ensure that all the advanced emissions control devices that to be fitted in the new vehicles will continue to perform effectively in real world conditions.

This has become necessary in view of the rapid deterioration in emissions noted in new Euro VI vehicles in Europe and the US and also to prevent use of defeat devices to cheat emissions standards. The data available from Europe shows that the actual NOx emissions from Euro VI diesel cars can be as bad or worse than a Euro I diesel car as on-road emissions can be as higher as upto 16 times higher than their certification level EPCA strongly believes that as India is now making this crucial transition to a very advanced genre of vehicles proactive and preventive policies and systems should be put in place to these advanced systems continue to perform efficiently on road and for emissions to all generation of vehicles remain low emitting during their useful lifetime. MoRTH along with the state governments of the NCR-Delhi need to put in place the systems for introduction of Real Driving Emissions testing for BSVI vehicles.

Table 6.3 (Contd..) : Emission Reduction Action Plan for Line Source

Line Sources	Short Term-2019	Mid Term-2022	Long Term-2024	Action required
Retrofitment of Diesel Oxidation Catalyst (DOC) and Diesel Particulate Filter in HDDV	Retrofitting devices-50% conversion for HDDV in city registered vehicles	Retrofitting devices-75% conversion for HDDV in city registered vehicles	Retrofitting devices-1000% (Excluding the heavy duty city outside vehicles)	A pilot study is required to test the need and efficacy of emission control device and retrofitting it in the older vehicles As retrofitment of emission control devices also needs a certain levels of fitness of the vehicle, it would be desirable to follow the norm after developing the same through the inspection and certification procedures It will be helpful to Maharashtra State Transport Corporation, Old BEST buses, Contract carriers. Impose restriction of truck movement in the city for plying without retrofitment to HDDV vehicles (base on age and engine type). Tighter diesel fuel standards particularly for Sulphur to bring down its level up to 50 ppm. Differential taxation to those with and without after treatment devices. On August 16, 2017, the government of India, in consultation with the Bureau of Energy Efficiency (BEE), published final fuel efficiency standards for commercial heavy-duty vehicles (HDVs). The regulations are aimed at reducing fuel consumption and greenhouse gas (GHG) emissions from diesel-powered trucks and buses with a gross vehicle weight (GVW) of 12 tonnes or greater.

On August 16, 2017, the government of India, in consultation with the Bureau of Energy Efficiency (BEE), published final fuel efficiency standards for commercial heavy-duty vehicles (HDVs). The regulations are aimed at reducing fuel consumption and greenhouse gas (GHG) emissions from diesel-powered trucks and buses with a gross vehicle weight (GVW) of 12 tonnes or greater. The new standards include two phases of regulatory compliance. Phase 1 goes into effect April 1, 2018, while Phase 2 is effective beginning April 1, 2021. The regulatory classes affected by this rule are as follows (Vahan Sewa, 2017) :

- Category M3: motor vehicles for the carriage of passengers, comprising nine or more seats in addition to the driver's seat with GVW exceeding 5 tonnes
- Category N3: motor vehicles for the carriage of goods with GVW exceeding 12 tonnes

Although, the M3 regulatory subclass includes vehicles 5 tonnes and above, the rule applies only to vehicles greater than 12 tonnes GVW. Tables 1 and 2 summarize the limit value equations for all of the subcategories within the M3 and N3 vehicle classifications.

Table 1 : Stringency Equations for Phase 1 (Effective April 1, 2018)

Vehicle Category	Gross Vehicle Weight (tones)	Axie Configuration	Equation	Fuel Consumption (l/100 Km)	
				Value at lower weight limit	Value at upper weight limit
40 Kilometer per hour					
N3 Rigid Vehicles	12.0- 16.2	4 x 2	Y=0.362X + 10.327	14.7	16.2
	16.2- 25.0	6 x 2	Y=0.603X + 6.415	16.2	21.5
	16.2- 25.0	6 x 4	Y=0.723X + 4.482	16.2	22.6
	25.0- 31.0	8 x 2	Y=0.527X + 8.333	21.5	24.7
	25.0- 31.0	8 x 4	Y=0.928X – 0.658	22.5	28.1
	31.0- 37.0	10 x 2	Y=0.960X – 5.100	24.7	30.4
N3 Tractor Trailers	35.2- 40.2	4 x 2	Y=0.986X – 7.727	27.0	31.9
	40.2- 49.0	6 x 2	Y=0.628X – 6.648	31.9	37.4
	40.2- 49.0	6 x 4	Y=1.255X – 18.523	31.9	43.0
M3 Vehicles	12.0 and above	4 x 2 & 6 x 2	Y=0.509X – 11.062	17.2	
60 Kilometer per hour					
N3 Rigid Vehicles	12.0- 16.2	4 x 2	Y=0.788X + 9.003	18.5	21.8
	16.2- 25.0	6 x 2	Y=0.755X + 9.546	21.8	28.4
	16.2- 25.0	6 x 4	Y=1.151X + 3.122	21.8	31.9
	25.0- 31.0	8 x 2	Y=0.650X + 12.160	28.4	32.3
	25.0- 31.0	8 x 4	Y=0.968X + 7.692	31.9	37.7
	31.0- 37.0	10 x 2	Y=0.960X + 5.100	24.7	30.4
N3 Tractor Trailers	35.2- 40.2	4 x 2	Y=0.208X + 32.198	39.5	40.6
	40.2- 49.0	6 x 2	Y=0.628X + 15.298	40.5	46.1
	40.2- 49.0	6 x 4	Y=1.342X + 13.390	40.6	52.4
M3 Vehicles	12.0 and above	4 x 2 & 6 x 2	Y=0.199X + 19.342	21.7	

* *Source: International Council On Clean Transportation*

The standards are represented in an equation based on GVW and axle configuration, providing normalized values of fuel consumption in liters per hundred kilometers (l/100 km). The regulations are a minimum performance requirement, similar to the existing Bharat Stage (BS) emission norms.

Table 2. Stringency Equations for Phase 2 (Effective April 1, 2021)

Vehicle Category	Gross Vehicle Weight (tones)	Axie Configuration	Equation	Fuel Consumption (l/100 Km)	
				Value at lower weight limit	Value at upper weight limit
40 Kilometer per hour					
N3 Rigid Vehicles	12.0- 16.2	4 x 2	Y=0.329X + 9.607	13.6	14.9
	16.2- 25.0	6 x 2	Y=0.523X + 6.462	14.9	19.5
	16.2- 25.0	6 x 4	Y=0.673X + 4.032	14.9	20.9
	25.0- 31.0	8 x 2	Y=0.430X + 8.780	19.5	22.1
	25.0- 31.0	8 x 4	Y=0.732X + 2.558	15.7	20.1
	31.0- 37.0	10 x 2	Y=0.963X – 7.753	22.1	27.9
N3 Tractor Trailers	35.2- 40.2	4 x 2	Y=0.826X – 3.165	25.9	30.0
	40.2- 49.0	6 x 2	Y=0.630X + 4.732	20.6	26.1
	40.2- 49.0	6 x 4	Y=1.008X – 10.480	30.0	38.9
M3 Vehicles	12.0 and above	4 x 2 & 6 x 2	Y=0.659X + 6.582	17.2	
60 Kilometer per hour					
N3 Rigid Vehicles	12.0- 16.2	4 x 2	Y=0.600X + 9.890	17.1	19.6
	16.2- 25.0	6 x 2	Y=0.515X + 11.271	19.6	24.6
	16.2- 25.0	6 x 4	Y=0.932X + 4.515	19.6	27.8
	25.0- 31.0	8 x 2	Y=0.382X + 14.598	24.2	26.4
	25.0- 31.0	8 x 4	Y=1.318X – 5.148	27.8	35.7
	31.0- 37.0	10 x 2	Y=1.043X – 5.913	26.4	32.7
N3 Tractor Trailers	35.2- 40.2	4 x 2	Y=0.260X + 27.888	37.0	38.3
	40.2- 49.0	6 x 2	Y=0.236X + 28.838	38.3	40.4
	40.2- 49.0	6 x 4	Y=0.563X + 15.728	38.4	43.3
M3 Vehicles	12.0 and above	4 x 2 & 6 x 2	Y=0.340X + 14.300	18.4	

** Source: International Council On Clean Transportation*

To demonstrate compliance, each vehicle model and configuration is required to meet the fuel consumption levels shown in Tables 1 and 2. This stands in contrast to the fuel consumption and greenhouse gas standards in the United States and Canada, which are based on sales-weighted averaging.

For evaluating the performance of the vehicles, manufacturers are required to use a Constant Speed Fuel Consumption (CSFC) driving cycle. This means that the fuel consumption is measured over a set speed without any transient behavior. In this particular regulation, the CSFC test is run at two separate speeds one at 40 km/h, and the other at 60 km/h. The CSFC testing has been used in India as part of the vehicle certification process for several years *(Sharpe & Delgado, 2015)*. The CSFC cycle is different from the regulatory cycles adopted in HDV standards for other countries.

The efficiency standards are required for both vehicle manufacturers and importers. The conformity-of-production test will be undertaken by MoRTH once every two years. The CSFC testing and reporting also needs to be done at least once before April 1, 2020. There is no such requirement before Phase 1 goes into effect April 1, 2018, because the standards reflect averages found in HDV baseline testing between 2014 and 2015.

As per internal government records, the Phase 1 stringency for each vehicle subcategory represents the average fuel consumption from CSFC testing. Thus, starting April 1, 2018, for every segment of the market, the maximum allowable fuel consumption is equal to the average fuel consumption from the baseline testing campaign. The Phase 2 stringency represents the 20th percentile of the baseline testing data, meaning that 20% of the baseline vehicles had fuel consumption levels lower than the limit curve.

Fuel Consumption Stringency : Phase 1 to Phase 2

Assuming equal weighting for the two test cycles, an estimated fuel-consumption reduction from Phase 1 to Phase 2 can be calculated as shown in Table 3. The average stringency is calculated using sales weighting, which comes from data that was acquired from Segment Y Automotive Intelligence for the year 2013-2014.

Table 3: Required reduction in fuel consumption from Phase 1 to Phase 2 and market shares by vehicle category in fiscal year 2013-14

	GVW Bin (tones)	Axie Configuration	Required Fuel- Consumption Reduction Between Phase1 and Phase 2	Market Share
Rigid Truck	12.0- 16.2	4 x 2	8.2%	23.3%
	16.2- 25.0	6 x 2	10.7%	13.9%
	16.2- 25.0	6 x 4	9.6%	16.8%
	25.0- 31.0	8 x 2	13.3%	12.9%
	25.0- 31.0	8 x 4	8.9%	6.5%
	31.0- 37.0	10 x 2	11.5%	0.5%
Tractor-Trailers	35.2- 40.2	4 x 2	5.4%	8.9%
	40.2- 49.0	6 x 2	7.2%	0.0%
	40.2- 49.0	6 x 4	10.0%	2.6%
Bus	12.0 and above	All Configuration	15.5%	14.5%
Sales weighted average stringency			10.4%	

* *Source: International Council On Clean Transportation*

The Phase 1 to Phase 2 stringency analysis shows that transit buses face the largest reduction in fuel consumption from 2018 to 2021 at 15.5%. The fleet-wide fuel-consumption reduction from Phase 1 to Phase 2 is estimated at 10.4%. This is calculated on a vehicle-population weighted average and therefore is not necessarily representative of the overall fuel savings that will be achieved as a result of the regulation. This is due to the difference in fuel consumption that the different vehicle configuration may have. For example, changing the stringency of for a tractor-trailer by 1% will not have the same result as changing the value for a rigid truck. Because the regulation applies only to trucks and buses greater than 12 tonnes GVW, a significant percentage of the HDV market in India is not subject to these standards. Sales data from Segment Y provides evidence that nearly half of the HDV market is less than 12 tonnes and thus is not covered by this regulatory program.

Table 6.3 (Contd..) : Emission Reduction Action Plan for Line Source

Line Sources	Short Term-2019	Mid Term-2022	Long Term-2024	Action required
Regulating Road Site Parking	Road site parking to be reduced by 50% (On street parking spaces as per IRC: SP: 12:2015.)	Road site parking to be reduced by 75%	Road site parking to be reduced by 100%	Currently, parking in city is either free or priced very low. Increased parking cost, if coupled with the parking locations, so that they are as far as the bus and the rail stops, will make public transportation an attractive option Parking on roads should be regulated along with a rule to allow purchase of vehicles only if parking place is available. Municipal corporation should define designated space in the localities and develop elevated pay and park zones. Higher parking fee for longer period of time. Diversion of non-destined traffic especially the trucks trough by-pass roads. Major haul trucks with heavy loads should not be left to pass through the main city; instead a Truck Terminal can be established at recently vacated Vashi Octroi check post. Construction of multi storied parking complexes. Pay and Park Schemes on major roads and mass transit stations. Road side parking should be regulated on internal roads.
Encourage Public Transport	Increase Public Transport - 20% Which reflect 10% VKT reduction from private vehicles.	Increase Public Transport - 50% Which reflect 40% VKT reduction from private vehicles	Increase Public Transport - 75% Which reflect 60% VKT reduction from private vehicles	NMMC has a fleet of both AC (82) and Non AC (398) buses in its inventory. It can be achieved by way of providing better frequency to reduce congestion during peak period, better bus quality in terms of sitting as well as standing space The public transport should be cross-supported directly from the personalized vehicles either being purchased newly or older one running on the road. Funds generated from measures such as higher car user charges, higher parking charges, high registration fees, higher taxes on private mode of transport etc. should be directly transferred to them to achieve the low cost, better comfort, better frequency and faster travel. Diesel or any fuel used for public transport should be sold at lower price to keep the bus fare lower. Exclusive bus lanes should be identified. There is a need to undertake a project to demonstrate effectiveness of such system in Navi Mumbai at one or two road stretches Management of Intermediate Public Transport - IPT (auto rickshaws / shared auto rickshaws / taxis) can be done considering the travel demand management. One way traffic movement on few roads. Widening of roads approaching towards mass transit stations.

Buses are critical as spine of city mobility, 40-60 per cent of daily trips. These allow greater flexibility to allow more efficient geographical coverage and score high on space efficiency. Buses move people in most cost-effective way and emit a lot less per person.
Yet city have Inadequate and unreliable services, poor fleet utilization, under-utilization of passenger carrying capacity, no route rationalization and poor geographical and population coverage, operated kilometer are much less than scheduled kilometer and no dedicated right of way for buses.
Bus numbers of the state transport corporations are extremely inadequate and dwindling over time. According to the bus transport guidelines of the Ministry of Urban Development framed with support from Asian Development Bank states that a city should ideally have at least 60 buses per lakh of population. Estimating this number for cities is extremely difficult as in most cities public transport buses are operated by both state owned city transport corporations and private agencies.

For example for one km of travel a car consumes nearly five times more energy than a 52-seater bus with an average load factor of 82 percent. The corresponding consumption factor for two-wheeler is 2.6. The comparative fuel costs of a car and two wheelers are 11.8 and 6.8 times respectively for the same distance. Besides, the major issues are that a car occupies 38 times more road space compared to a bus for a kilometer of travel. Two wheelers space requirement is even higher at 54 times that of a bus*.
Further, the emission from a two wheeler equivalent to a bus could add 27 percent higher, whereas the cars would cause 17 percent more pollution. The age of the bus can be of no major concern, when we compare the benefits that it could give in term of fuel savings, emission and safety.
Report of the Expert Committee on Auto Fuel Policy, Chapter 15, Government of India, 2002.

Promotion of NMT

The vehicle ownership in India is low as compared to foreign countries and also traditional mixed-use design of the cities makes the majority share of trips by walk or cycle. In big cities with higher population density, in the absence of dedicated Non-Motorized Transport infrastructure (NMT), people owning two-wheelers and cars are encouraged to use their vehicles, even for walk-able distances. In the context of growing cities, the measures to improve air quality should include NMT policies as an integral part.

Congestion Pricing

Some economic measures should also be designed to force the use of public transport. One such measure is the congestion pricing where the motorists are charged to use a network of roads during periods of the peak hours. Its purpose is to reduce automobile (mostly car) use during peak congestion periods, thereby easing traffic and encouraging commuters to walk, bike, or take mass transit rail/bus as an alternative.

Congestion pricing programs were successfully implemented in Singapore, London, and Stockholmb *(Eliasson, 2009; Menon and Guttikunda, 2010; Litman, 2011)*. On average, in London, congestion pricing is estimated to have reduced 20-30% of the downtown passenger car traffic and promote the non-motorized transport, whereas Stockholm experienced an immediate reduction of at least 20% in the daily car use. In Singapore, the average traffic speeds increased by at least 15 km/h. In all three cities, 10-20% reduction in eCO_2 emissions was estimated, along with health benefits of reducing air pollution.

Increased Parking Cost

With increasing costs for private vehicles linked with their usage (fuel and other operational expenses), it is possible to achieve a shift to public transport, if combined with the provision of an adequate, reliable, and safe public transportation. One such measure is the increased parking cost. Currently, parking in most cities is either free or priced very low. Increased parking cost, if coupled with the parking locations, so that they are as far as the bus and the rail stops, will make public transportation an attractive option *(Barter, 2012; CSE, 2012)*.

Car Specific Taxes

According to International Energy Agency IEA's World Energy Outlook (WEO) report, in the new policies scenario, passenger car ownership will grow from less than 20 vehicles per 1,000 inhabitants today to 175 cars per 1,000 people in 2040, and overall road passenger vehicle activity will increase more than six-times. While the congestion pricing and parking policies target reduced vehicle usage, some countries have used regulatory measures to reduce the growth of private vehicles. For instance, a Chinese national regulation enacted in September, 2008, raised taxes on big cars and reduced on smaller ones. Car owners with engines above 4- L capacity have to pay a 40% tax; 15%-25% for cars with engines above 3-L capacity; and 1%-3% for cars with engines below 1-L capacity. China also introduced a policy to limit the number of licenses issued every year, where the license plates are auctioned in the cities of Beijing, Shanghai, and Guangzhou. Similar to congestion pricing, for the time being, such measures are difficult to implement under democratic political context of India.

Action on vehicle technology and fuels

In urban landscape clean air action on vehicles and mobility is the weakest. Even though vehicles are one of the most rapidly growing sources of pollution local action has remained the minimal. Emissions standards for vehicles and fuel quality are common across cities. However, it is also important to know that the central government has issued notification to leap directly to Euro VI emissions standards in 2020. This has serious implications for the implementation and compliance strategies at city level. Bharat Stage VI will bring in new genre of technology and fuel that will be subjected to a new compliance regime for the first time in the country. For the first time monitoring of real world emissions with portable monitoring system along with in-service compliance regulations will be implemented to keep an eye on real world emissions. Real driving emissions (RDE) testing will be included as an additional requirement for vehicle certification. Emissions measurements will be carried out with the help of Portable Emission Measurement System (PEMS) and onwards in-service conformity factor will be applied to ensure that emissions from vehicles remain within the stated margin. This can prevent emissions cheating and use of sub standards emissions control or defeat devices as was done by Volkswagen. However, adoption of more advanced on-board diagnostic system has been delayed until 2023. Cities will have to develop a compliance programme to integrate these emissions control approaches within this time frame for successful implementation.

Since 01 September 2017, Real Driving Emissions (RDE) has become mandatory with specific pollutant limits for new light duty vehicle approvals in Europe. This year, European Commission will finalize the RDE 4th package, with which, Europe will consolidate the most stringent approach worldwide for light duty vehicles emissions regulation. The new approach of RDE in measuring vehicle emissions during on-road driving is rapidly being adopted by many other countries. There is already a substantial diversity arising in the local applications of RDE, some examples are given below –this is not a complete list of those intending to apply RDE in future, nor does it contain a comprehensive list of all the differences in comparison to the European application:

India is developing its own RDE – currently investigations are running regarding driving speeds, conditions and potential limits as well as on the robustness of the measurement equipment under Indian driving conditions.

Indian Diesel Specification required meeting Bharat Stage II, III, & IV Emission Norms

Characteristics	Unit	Bharat Stage II	Bharat Stage III	Bharat Stage IV	Bharat Stage VI†
Implementation date		2001 (selected cities), 2005 (nationwide)	2005 (selected cities), 2010 (nationwide)	2010 (selected cities), 2017 (nationwide)	2020† (nationwide)
Ash, max	% mass	0.01	0.01	0.01	0.01
Carbon Residue (Ramsbottom) on 10% residue, max †	% mass	0.3	0.3	0.3	0.3
Cetane Number (CN), min	–	48*	51	51	51
Cetane Index (CI), min	–	46*	46	46	46
Distillation 95% vol. Recovery at °C, max	°C	–	360	360	370
Flash point Abel, min	°C	35	35	35	35
Kinematic Viscosity @ 40 °C	cst	2.0-5.0	2.0-5.0	2.0-4.5	2-4.5
Density @ 15 °C	Kg/m^3	820-860 (820-870)*	820-845	820-845	820-860
Total Sulfur, max	mg/kg	500	350	50	10
Water content, max	mg/kg	0.05% vol	200	200	200
Cold filter plugging point (CFPP) a) Summer, max b) Winter, max	 °C °C	 18 6	 18 6	 18 6	 18 6
Total contaminations, max	mg/kg	–	24	24	24
Oxidation stability, max	g/mg^3	–	25	25	25
Polycylic Aromatic Hydrocarbon (PAH), max	% mass	–	11	11	11
Lubricity, corrected wear scar diameter (wsd 1,4) @ 60 °C, max	µm (microns)	460	460	460	460
Copper Strip corrosion for 3 hrs @ 50 °C	Rating	Not worse than No. 1	Class I	Class I	Class I

Notes:† Proposed fuel quality

6.3.1 Clean Air Fund

Prioritization of Public Transport on Roads: Once, more and more people get used to personalized transport, it would be very difficult to bring them back into the fold of public transport users. The fact that personal vehicles are occupying more and more space on the road; it is felt necessary that disincentive mechanism should be developed for personal vehicle owners. There are many methods of carrying out this task, however, financial and space constraints can achieve the balance. The efficiency of the public transport can be maintained only if priority is given to the public transport vehicles. Some of the suggestions are:

In Navi Mumbai City Bus lane, there is need to find out gaps and exclusive bus lanes should be introducing base on point to point service. If one wishes to see higher bus utilization, it also has to see correspondingly higher service levels. This could be achieved by way of providing better frequency to reduce congestion during peak period, better bus quality in terms of sitting as well as standing space. Those vehicles which may travel in bus lanes will need to pay a sum to get the benefits.

Cost of Bus Ride: The cost of the bus fare has been increasing at a steady pace. This is seen as a very common practice when there is an increase in the diesel cost announced by the Government. What it leads to is that the bus fare for two-four persons becomes almost equivalent to either the auto fare or attractive enough to own a private two or four wheeler. In such a situation, it shows that increasing bus fare and purchasing power is becoming the main responsible agent for higher private vehicles purchase. The other reason, such as better roads with flyovers (faster travel) makes it attractive for private vehicle ownership.

Public transport fare pricing, therefore, should not only be dependent upon the actual cost, but on some other sources of income. Modalities and options which can be adopted for no increase in bus fares are presented below:

- The public transport should be cross-supported directly from the personalized vehicles either being purchased newly or older one running on the road.
- An Air Quality Fund could be created which will have sources of funds coming from measures such as higher car user charges, higher parking charges, high registration fees, higher taxes on private mode of transport etc. should be directly transferred to them to achieve the low cost, better comfort, better frequency and faster travel.
- Diesel or any fuel used for public transport should be sold at lower price to keep the bus fare lower. The losses can be recovered from car-users.
- Certain areas of business district or identified regions of high congestion, free bus services can be provided. The cost can be recovered from parking, congestion and high fuel costs charged to personal vehicles. (For example Pilot feasibility study may be carried out in Hotspots)
- All shopping centres (malls) must be asked to provide their own free service to nearest train and bus routes so that congestion due to their activities is reduced further. Alternately, all cars must pay an additional fee besides parking charges as congestion fee when they enter the mall. All such charges should be pooled and shared with the public transport company.

- All malls and institutions attracting outside car visitors levy a Rs. 10 per hour charges. This can either go to PMT or the fund
- Administration : Insurance cost should be inclusive of congestion charge every six months, buy sticker worth congestion charges. Annual insurance time each vehicle can pay a sum of Rs.500 extra, which can go to the fund. Collection responsibility will be with the insurance company.
- Vehicle manufacturers selling vehicles in state of Maharashtra must pay a ONE TIME air pollution tax towards the CAF

The key is that all such charges thus collected should be managed as '***Clean Air Fund'*** and should be passed on the public transport company, which could not only take care of its operational costs but also addresses other issues such as: Lower cost to passenger, Better bus quality, Faster services and Adequate growth in bus population for more people. Emission reduction from transport sector can also be achieved by forming a 'Clean Air Fund' in co-operation with public private partnership which can operate on following guidelines:

Example of how a small levy can bring additional revenue as part of **Clean Air Fund :**

Vehicle Km Travel in a Day for Navi Mumbai City (2017)

	Car Petrol	**Car Diesel**	**Car CNG**	**Taxis**	**2 Wheelers**	**3 Wheelers**	**CNG Buses**	**HDDV**
VKT	3577059	2782157	1589804	120716	5146496	2488842	692858	1616669
Rate Rs./Km	1	1	0.5	0.5	0.5	0.5	0.5	1
Cost (Rs.)	3577059	2782157	794902	60358	2573248	1244421	346429	1616669

Total Collection about Rs. 1,29,95,242 per day

The current VKT growth of the city ranges between 2-5% depending upon the region of the city. Awareness programmes for policy makers, people, drivers-mechanic, traffic police, health professionals, academicians etc. will bring the importance of better air quality. Land use and transport planning need to be looked at seriously for future sustainability of the cities. In dense cities conglomerate of NNMC, public transport saves valuable space and energy compared to private transport, and can make a healthy profit at the same time. But cities need to nurture their public transport by giving then some priority on the road over cars. If buses are always caught in traffic then a vicious cycle begins, with bus riders abandoning public transport and adding to the traffic jams. Various case studies from other places also indicate the importance of sustainable transportation. Strong leadership and governance brings radical change in achieving sustainable development of the city. The authorities responsible for the development of transport need to develop Integrated Environment Management Systems (IEMS). The goal of achieving a balanced development of the region through proper land use planning, strengthening of infrastructure facilities and formulates policies and programmes that help in preserving the environment for sustainable development.

Are Cities Monitoring of Impact of Action?

Air quality monitoring also needs to get linked with assessment of impact of action taken. Very few cities have made such efforts to demonstrate the change.

- The Karnataka State Pollution Control Board has assessed the impact of the monthly bus day scheme that was introduced by the Bangalore Metropolitan Transport Corporation (BMTC) in 2010. Monitoring is carried out on the stretch of Bus day route.
- Similarly, West Bengal Pollution Control Board has assessed the impact of phase out of old vehicles on $PM_{2.5}$ in 2009. That shows significant drop in the levels as a result of this intervention.

This is the maturity that is needed in air quality governance.

6.3.2 Non Motorized Sectors

Cycle Track : To contribute to the sustainable development of the city, provision of dedicated 3 m. wide cycle track along all road pathways having width more than 6 m, can be developed. Municipal Corporation should look after the procurement of required lands and its construction. In addition to this, 6 m. wide cycle track can be developed in the Navi Mumbai open land. The development of this cycle track can be done by public-private participation or from the funds of Municipal Corporation.

Green Belt Development : The Green Belt along the road like Pam Beach Road across the city can be developed. This belt shall be a use for plantation, cycle track, recreation, etc. which will protect the erosion of the river banks and also enhance the environment.

- Conservation and development of green belts on the road side in order to increase beauty
- Improvements of Footpaths
- Periodic manicure of tree planted on roads.
- Improvement of Traffic island & junctions.
- Awareness to citizens to keep city clean through slogans, messages, media etc.
- Maintenance of public utility buildings and Monuments.
- Total use of open land for green belt development
- Arranging the seminar/awareness programme at school & college levels.

Air quality can be improved through the use of trees and shrubs. Leaves filter the air by removing dust and other particulates in addition to specific plants which can also reduce gaseous pollutants. A green belt with pollutant tolerance trees act as mitigating air pollution in an effective manner by filtering, intercepting and absorbing pollutants. Plant species that will be considered for air pollution and dust control are given below:

Dracena deremensis (Dracena)
Colocassia esculenta (Green Taro, Arvi)
Scindapsus aures (Golden Pothos)
Chlorophytum comosum (Spider Plant, Musli)
Nerium oleander (Oleander, Kaner)
Thevetia peruviana (Yellow Oleander)
Hibiscus rosa-sinensis (China Rose, Jaswand)
Bougainvillea glabra (Bougainvillea, Booganvel)
Plumaria rubra (Plumeria)
Cassia fistula (Amaltas)
Cassia siamia

Butea monosperma (Phalas)
Mangifera indica (Aam)
Anthocephalus cadamba (Kadamba)
Chamaedorea seifrizii (Bamboo Palm)
Ficus virens (White Fig)
Ficus religiosa (Peepal)
Spathodea campanulata (African Tulip Tree)
Psidium guajava (Peru)
Terminalia arjuna (Arjun)
Bombax ceiba (Silk Cotton Tree)

Green belt development can attenuate the sound levels during the operation of the facilities. The following species can be planted within the facilities to reduce the noise levels.

Tectona grandis (Teak)
Azadirachta indica (Neem)
Syzygium cumini (Jamun)

Butea monosperma (Phalas)
Dalbergia Sissoo (Indian rosewood, Shisham)
Tamarindus indica (Imli)

6.4 Stone Crushers

Quarrying is being done for at least last 30 years in west side of the Parsik hill ranges. Till March 2017, there were 74 active quarries out of 94 quarries. Quarries in Navi Mumbai have been shut since April 1, 2017. Thane Collector office has allowed only 3 quarries in Navi Mumbai to operate as a special case, from where BMC can source raw materials for road works. During mining, crushing and transportation activity lot of dust was getting resuspended in the air. The roads outside the quarry are unpaved roads. Following measures can be adopted to control on/off-site emission and ressupension from Quarry site:

- Stringent Fugitive emission management practices and regulation should be implemented

- Most of the quarries have provided sprinkler system for dust suppression however, improvements are required. Use of water sprinklers should be made compulsory at the quarrying sites. All these units will be proposed to install efficient emission control system. Provision of chemical spray for dust suppression with R & D lab can be done.
- Trucks carrying the crushed stone material for transportation should be covered.
- Quarrying sites and activities should be regulated with strict vigilance as per the norms laid by CPCB and MPCB.
- Constructing a water pit at the entry/exit points of the construction site to avoid dispersion of particulate matter through movement of trucks while entering and exiting the site. Spraying of water on the tires of the truck and vehicles at the entry/exit of construction site.
- Tree plantation in and around the quarrying site.

6.5 Management -Stakeholders

There are three AAQM locations covered under NAMP at Nerul, Mahape and Rabale. These station being monitored since 2006. Navi Mumbai Municipal Corporation has set up two CAAQM stations at Vashi and Airoli. These stations are in operation for the last three years. The Air Quality Index (AQI) of period April to March 2017 shows AQI is satisfactory (51-100) to moderate (101-200). In November, 2016 Air quality at Turbhe & Koparkhairane is poor due to particulate matter and temperature inversion phenomenon in the winter season. The dominant parameter are Particulate matter and CO, attributed to growing vehicular traffic and construction projects as well as commercial and infrastructure development including road construction etc. Hierarchical and structured managerial system for efficient implementation should be introduced with data linkage to SPCB/CPCB (of monitoring devices).

There is a lack of collaborative policy initiative among the administrations and organization with regard to air quality improvement. These policy initiatives can be sustained and kept up-to-date only if there is an apex body, which from time to time gets feedback from various sources. These sources could be State Pollution Control Board, Regional Transport Office, Navi Mumbai Municipal Corporation, Truck Association for Navi Mumbai, CIDCO, MIDC, TBIA, MMRDA, Oil Companies, Anti-Adulteration Cell, and representative from ULB and NGOs, school and colleges. As and when, it is felt by the apex body that particular information desired is either site specific or city specific it can commission studies/ investigate on its own. Monitoring and regulatory agencies will provide all the information on monitoring to this body for data assimilation and dissemination.

Regulatory framework, if needs can be communicated to the apex body for starting the initiative for policy formation.

It is not just sufficient to measure air pollutant concentrations and assess their sources and their apportionment. It is equally important to disseminate that information to the public through various channels such as web / mobile application, information boards in public spaces as well sharing important studies conducted on air pollution with the public. This ensures public awareness of the issues and can help build ground up pressure on the concerned agents to address the problem.

MPCB & TBIA should take initiative in creating awareness program at various schools, colleges, public places, etc. through road shows, posters, banners, hand bills and various programs etc. Most of the actions can be done by adapting and reinforcing existing actions for a more integrated, comprehensive and effective approach to combating Air pollution. Other actions focus on identified gaps in our study response so far that requires new activities, the discovery of new knowledge and the creation of new partnerships. The action plan will strengthen collaboration and surveillance, will reduce data gaps and allow for the sharing of best practices within the city jurisdiction. It will create more synergies and coherence between different policies according to our study. The action plan will thus support the stakeholders in delivering innovative, effective and sustainable responses to Air Pollution.

Chapter 7

Reduction Strategies for Emission Control

Based on emission inventory results of all the sources viz. industrial, area and vehicular obtained under the present study, the subsequent sections will discuss the possible strategies for pollution reduction. The focus on reduction discussed will be mainly for PM and NOx as these pollutants are cause of concern. Other pollutants will also reduce with the adoption of strategies discussed here. Additional benefits should be taken as co benefits.

7.1 Area Source Control Options and Analysis

It is observed that the total particulate matter emissions from area sources, particularly due to building and construction activity is high, followed by emission from domestic consumption of fuels, which can be attributed to dependency on conventional solid and fossil fuel in slum population and large quantity of PNG with LPG at domestic level. The emission loads from the fuel consumption at crematorium and bakeries are almost same. The emission from other area sources is limited to few regions e.g open burning. The area sources though called area sources, are limited to small regions and therefore, their impact does not seem to be wide ranging and across the city. Hence, the efforts should focus on finding out appropriate technology/management options, particularly on conversion to natural gas in much more cost effective way. Other sectors also need large scale adoption of cleaner practices. The control scenarios as part of management plans for expected pollution load reduction due to area sources are given in **Table 7.1**.

Table 7.1 : Area Source Emission Scenario with Control Options

Source	Present Emission	PM Control Options	
		2019	2022
Bakeries	69.2	25% LPG /NG; 25% Electric	50% LPG /NG; 75% Electric
Crematoria	46.7	50% Electric	75% Electric
Open Eat outs	9.3	Since these operation is illegal, difficult to quantify. Measures related to fuel change should be incorporated. Reductions on 25-50% conversion of existing coal, wood, kerosene etc. based eateries are estimated.	
Hotel & Restaurants	204.9	50% of coal to replace by LPG	75% of coal to replace by LPG
Domestic Sec. Slums /Non Slum	363.9	50% of slums to use LPG/ PNG 50% of remaining non slums to use LPG/ PNG	100% of the remaining slum to use LPG/ PNG 100% of remaining non slums to use LPG/ PNG
Open & Landfill	285.9	50% open burning	100%
Bldg. Construction	852.0	50% control on dust emission	75% control on dust emission

With the implementation of the short and long term scenarios, the overall total reduction in particulate matter from area sources would be around 33 to 38%, whereas at individual sources 50-70% of reduction can be achieved. Anticipated sector-wise particulate matter emission loads are given in **Table 7.2** below.

Table 7.2 : Anticipated Reduction in Particulate Matter - Area Sources

	Existing	**% Contri -bution**	**BAU 2020 (5.5% Growth)**	**BAU 2025 (7.0% Growth)**	**Expected Emissions (Short Term) 2020**	**Expected Emissions (Long Term) 2025**
Bakeries	69.2	3.8	73.0	78.1	54.8	29.3
Crematoria	46.7	2.5	49.2	51.9	24.6	13.2
Open Eatouts	9.3	0.5	9.8	10.5	7.4	7.6
Hotel Restaurants	204.9	11.2	208.1	213.3	141.3	145.8
Domestic sector	363.9	19.9	389.5	447.9	368.4	373.4
Open Burning	285.9	15.6	306	328.8	153.0	82.2
Construction Activity	852.0	46.5	937.2	954.3	468.6	477.1
Total	**1831.9**		**1972.8**	**2084.8**	**1217.4**	**1128.5**
Reduction w.r.t BAU 2018					**33.54%**	**38.4%**

7.2 Point Source Pollution Reduction Options

The strategies for abatement of emissions from point sources include cleaner fuel substitution, change in basic production processes, and pollution abatement through flue gas treatment modifications of exit gas characteristics besides shifting of industries outside the city premises. The point sources emission inventory prepared indicates that power plant, some chemical industries and partly operated stone crushers are the major sources. The strategies mainly considered are based on cleaner fuel substitution as well as closing/shifting of industries outside the city region. The strategies are recommended for the following broad sectors i.e under short (5 yrs) and long (10 yrs) term scenarios. Industrial PM Emissions from Red, Orange and Green (LSI, MSI and SSI) category.

Point Source Control Options and Analysis

The industrial sector has been steadily declining in the city due to shifting development priorities and market forces. Likewise, there is huge demand for petroleum products like Furnace oil and HSD in industries too. In 2016-17 the total petroleum sale within Navi Mumbai is noted to be around

78 thousand Kiloliters (KL). There is increasing trend in shifting towards better fuel option. As per the consent, industries in Navi Mumbai currently use Coal, HSD, FO, NG as their main fuel for operation (771, 1162, 362 and 1434 TPD, respectively). The emission load of PM from RED-LSI units was alone estimated to be around 4212.9 kg/day and that of NOx was 12368.4 Kg/d. The percent emission load calculation for PM and NOx in Red LSI is around 21%, whereas that for MSI and SSI (ROG) is 1% (PM) and 9% (NOx). **Table 7.3** presents the fuel switch options and their corresponding emission loads in each case. An attempt has been made to align the use of clean fuel in the city for improving the air quality.

The control options were derived on the basis of emission inventory estimated for all categories of industries. The replacement with alternative fuel was suggested on the basis of respective calorific value of each fuel. The calorific value is energy contained in a fuel, determined by measuring the heat produced by the complete combustion of a specified quantity of it. The calorific value considered for the inter conversion of fuel for reduction strategies were: 45.00 MJ/kg (FO), 44.38 MJ/kg (LSHS), and 49.57 MJ/kg (HSD), 43.96 MJ/kg (LDO), 30.20 MJ/kg (Coal), 50.03 MJ/kg (Natural Gas), 16.0 MJ/kg (Wood) and 46.1 MJ/kg (LPG), respectively.

Table 7.3 : Point Source Strategies for Short and Long Term

Point Sources Category	**Major PM Emission Contributor**	**Control Options**	
		Short Term (2019)	**Long Term (2022)**
Red, Orange and Green Category (LSI/MSI/SSI)	FO, HSD & Coal major contributors towards PM emissions	• Shift to cleaner fuels i.e. LSHS, FO, HSD, Coal, Diesel to Light Diesel Oil (LDO) • Combustion technology up gradation for fuel change.	• Shift in cleaner fuels from LDO & Coal to Natural Gas (NG) • Combustion technology improvement with fuel change • Feasibility of conversion of thermal power production to gas based system. • Industrial development (expansion) should be based on cleaner gaseous fuel with no net increase in emissions.

After implementing short and long term control options, the reduction emission load is depicted in **Table 7.4 a to c** for PM and **Table 7.5 a to c** for NOx.

Table 7.4 : Point Source Emission Scenario Before & After Control Options: (Short & Long Term Scenarios for PM)

A. For Red (LSI/MSI/SSI)

Sr.	Present PM Emissions			PM Emissions After Control Options					
				Short Term (2020)			Long Term (2025)		
	Fuel type	Quantity (TPD)	Emissions (Kg/day)	Fuel Type	Quantity	Emissions (Kg/day)	Fuel Type	Quantity	Emissions (Kg/day)
1.	FO	347.4	128.48	LDO (100%)	333.9	4.90	LDO	621.52	9.03
2.	LSHS	0.00396	0.0004	LDO (100%)	0.004	0.000058	NG (m3/d)	2692.6	53.79
3.	LDO	135.2	1.11	LDO	135.2	1.11	LPG	931.6	13.25
4.	HSD	94.4	1.21	LDO (100%)	102.6	1.50	CNG (m^3/d)	2.6	0.035
5.	NG (m^3/d)	1434.8	28.39	NG (m^3/d)	1434.8	28.39	PNG (m^3/d)	22.8	0.320
6.	Coal	764.1	4169.58	NG (50%)	628.9	12.60			
7.	LPG	931.6	13.25	LPG	931.6	13.25			
8.	Diesel	64.6	24.06	LDO (100%)	60.7	0.90			
9.	CNG	2.6	0.035	CNG	2.6	0.035			
10.	PNG	22.8	0.320	PNG	22.8	0.320			
				Coal	379.6	1910.4			
		Total (Kg/d)	**4366.44**		Total (Kg/d)	**1973.41**		Total (Kg/d)	**76.43**
				Reduction (%)		**54.81**	Reduction (%)		**98.25**

B. For Orange (LSI/MSI/SSI)

Sr.	Present PM Emissions			PM Emissions After Control Options					
				Short Term (2020)			Long Term (2025)		
	Fuel type	Quantity (TPD)	Emissions (Kg/day)	Fuel Type	Quantity	Emissions (Kg/day)	Fuel Type	Quantity	Emissions (Kg/day)
1.	FO	12.5	3.65	LDO (100%)	12.75	0.123	LDO	1251.26	12.12
2.	LSHS	1.4	0.066	LDO (100%)	1.45	0.014	NG(m^3/d) (100%)	11.6	0.15
3.	LDO	16.5	0.23	LDO	16.5	0.23	PNG	112.8	2.068
4.	HSD	1054	13.90	LDO (100%)	1189.03	11.52			
5.	Coal	7.0	12.98	NG (m^3/d) (50%)	5.8	0.077			
6.	Diesel	30.8	11.43	LDO (100%)	31.5	0.30			
7.	PNG	112.8	2.068	PNG	112.8	2.068			
				Coal (50%)	3.5	6.49			
		Total (Kg/d)	**44.32**		Total (Kg/d)	**20.82**		Total (Kg/d)	**14.33**
				Reduction (%)		**53.02**	Reduction (%)		**67.65**

C. For Green (LSI/MSI/SSI)

Sr.	Present PM Emissions			PM Emissions After Control Options					
				Short Term (2020)			Long Term (2025)		
	Fuel type	Qty. (TPD)	Emissions (Kg/day)	Fuel Type	Qty.	Emissions (Kg/day)	Fuel Type	Qty.	Emissions (Kg/day)
1.	FO	2.2	0.53	LDO (50%)	1.10	0.01	LDO	39.52	0.2873
2.	LDO	0.9	0.01	LDO	0.9	0.01	LPG	0.33	0.0047
3.	HSD	13.0	0.17	LDO (50%)	7.30	0.05			
4.	LPG	0.33	0.00	LPG	0.33	0.00			
5.	Diesel	21.3	6.01	LDO (50%)	10.91	0.08			
				FO (50%)	1.08	0.26			
				HSD (50%)	6.48	0.08			
				Diesel (50%)	10.66	3.07			
	Total (Kg/d)		**6.71**	**Total (Kg/d)**		**3.56**	**Total (Kg/d)**		**0.29**
				Reduction (%)		**46.96**	**Reduction (%)**		**95.65**

D. Total Industrial Emissions in Navi Mumbai Before & After Control Options

Sector		Present PM Emissions (Kg/d)	Emissions After Control Options (Kg/d)	
			Short Term	Long Term
A.	**RED**	4366.44	1973.41	76.43
B.	**ORANGE**	44.32	20.82	14.34
C.	**GREEN**	6.72	3.56	0.29
Total (Kg/d)		**4417.48**	**1999.65**	**261.10**
		% Reduction	**54.73**	**94.08**

***** Shift in cleaner fuel based on equivalent heat input estimation.

The above short and long term strategies for different sectors, if implemented effectively would reduce the PM emissions from 4366.44 kg/d to 1973.41 kg/d (i.e. about 55%) and 76.43 kg/d (i.e 98%), respectively for RED category industries, About the Orange categories, PM reduction for short term is 20% and long term is 14%. Very negligible impact for green category, as fuel quantities are considerably less. The overall short term reduction from all categories is around 54.7% and for long term it will be 97.9%. The emphases were made for the conversion of conventional fossil, solid and liquid fuel to natural gas or LDO.

Table 7.5 : Point Source Emission Scenario Before & After Control Options: (Short & Long Term Scenarios for NOx)

A. For Red (LSI/MSI/SSI)

Sr.	Present NOx Emissions			NOx Emissions After Control Options					
				Short Term (2020)			Long Term (2025)		
	Fuel type	Quantity (TPD)	Emissions (Kg/day)	Fuel Type	Quantity	Emissions (Kg/day)	Fuel Type	Quantity	Emissions (Kg/day)
1.	FO	347.4	2008.06	LDO (100%)	333.9	1067.56	LDO	621.52	1829.74
2.	LSHS	0.00396	0.02	LDO (100%)	0.004	0.012	NG (m^3/d)	2692.6	7904.61
3.	LDO	135.2	239.84	LDO	135.2	239.84	LPG	931.6	3254.01
4.	HSD	94.4	215.19	LDO (100%)	102.6	328.23	CNG (m^3/d)	2.6	6.14
5.	NG (m^3/d)	1434.8	3502.35	NG (m^3/d)	1434.8	3502.35	PNG (m^3/d)	22.8	55.93
6.	Coal	764.1	3934.24	NG (50%)	628.9	2201.13			
7.	LPG	931.6	3254.01	LPG	931.6	3254.01			
8.	Diesel	64.6	394.66	LDO (100%)	60.7	194.11			
9.	CNG	2.6	6.14	CNG	2.6	6.14			
10.	PNG	22.8	55.93	PNG	22.8	55.93			
				Coal	382.05	1967.12			
	Total (Kg/d)		**13610.44**	**Total (Kg/d)**		**12816.43**	**Total (Kg/d)**		**13050.43**
				Reduction (%)		**5.83**	**Reduction (%)**		**(-) 1.83**

B. For Orange (LSI/MSI/SSI)

Sr.	Present NOx Emissions			NOx Emissions After Control Options					
				Short Term (2020)			Long Term (2025)		
	Fuel type	Quantity (TPD)	Emissions (Kg/day)	Fuel Type	Quantity	Emissions (Kg/day)	Fuel Type	Quantity	Emissions (Kg/day)
1.	FO	12.5	60.0	LDO (100%)	12.75	27.18	LDO	1251.26	2691.3
2.	LSHS	1.4	10.49	LDO (100%)	1.45	3.1	NG(m^3/d) (100%)	11.6	27.1
3.	LDO	16.5	50.62	LDO	16.5	50.62	PNG	112.8	361.90
4.	HSD	1054	3079.02	LDO (100%)	1189.03	2543.7			
5.	Coal	7.0	26.28	NG (m^3/d) (50%)	5.8	13.55			
6.	Diesel	30.8	187.58	LDO (100%)	31.5	67.28			
7.	PNG	112.8	361.90	PNG	112.8	361.90			
				Coal (50%)	3.5	13.14			
	Total (Kg/d)		**3775.89**	**Total (Kg/d)**		**3080.47**	**Total (Kg/d)**		**3080.3**
				Reduction (%)		**18.41**	**Reduction (%)**		**18.42**

C. For Green (LSI/MSI/SSI)

Sr.	Present NOx Emissions			NOx Emissions After Control Options					
				Short Term (2020)			Long Term (2025)		
	Fuel type	Qty. (TPD)	Emissions (Kg/day)	Fuel Type	Qty.	Emissions (Kg/day)	Fuel Type	Qty.	Emissions (Kg/day)
1.	FO	2.2	8.61	LDO (50%)	1.10	1.77	LDO	39.52	63.19
2.	LDO	0.9	1.37	LDO	0.9	1.37	LPG	0.33	1.65
3.	HSD	13.0	37.02	LDO (50%)	7.30	11.68			
4.	LPG	0.33	1.65	LPG	0.33	1.65			
5.	Diesel	21.3	98.61	LDO (50%)	10.91	17.46			
				FO (50%)	1.08	4.30			
				HSD (50%)	6.48	18.51			
				Diesel (50%)	10.66	49.35			
	Total (Kg/d)		147.26	**Total (Kg/d)**		106.09	**Total (Kg/d)**		64.84
				Reduction (%)		**27.96**	**Reduction (%)**		**55.97**

D. Total Industrial Emissions in Navi Mumbai Before & After Control Options

Sector		Present NOx Emissions (Kg/d)	Emissions After Control Options (Kg/d)	
			Short Term	Long Term
A.	**RED**	13610.44	12816.43	13050.43
B.	**ORANGE**	3775.89	3080.47	3080.30
C.	**GREEN**	147.26	106.09	64.84
Total (Kg/d)		**17533.59**	**16002.99**	**16195.57**
		% Reduction	**8.73**	**7.63**

***** Shift in cleaner fuel based on equivalent heat input estimation.

As per emission inventory, the total emission load of NOx from Red industries was estimated to be around 13610.4 kg/d. If action plan is implemented, the reduction in NOx is not significant, as the conversion to Natural Gas, CGN & PNG will increases the emission load of nitrogen dioxides. NOx reduction of only 5.8% (12816.43 Kg/d) is estimated in short term (as most of the conversion are to LDO, 50% coal still will be in use). But this fuel switch will increase the emission load of NOx in long term by 1.8% (13050.4 Kg/d). NOx emission from Orange categories of industries is 3775.89 Kg/d and also cannot change the dynamics much. Their emission load is around 18% (~ 3080 Kg/d) in both short term and long term control measures. The Green category of industries does not use much of NG, their basic conversion of fuel will be from FO, HSD, Diesel to LDO and NG. The 147.26 Kg/d of emission load from Green category will be reduced by 27% in short term and 56% in long term. The overall NOx emission load (i.e. 17533.59 Kg/d) will not reduce in quantum. The short term reduction is about 8.7%, whereas long term reduction is estimated to be around 7.6%. Conversion of heavy sulphur fuel to natural gas, will probably increase the overall NOx emission load to the total.

7.3 Vehicular Sources Reduction Options

One of the major contributors to Particulate Matter (PM) and NOx emissions in Navi Mumbai region is vehicular exhaust. There is an average annual increase of 10% in the number of registration for 2 wheelers, as per RTO, Navi Mumbai. As per vehicular counting survey the total VKT of 18014601 Km/day was estimated for all categories of vehicles travelling within city limits, the movement of 2 wheelers percent is around 29%, whereas, private owned petrol cars (20%), diesel operated cars (15%), 3 wheelers (14%) and HDDV vehicles comes around 13% at different location across city jurisdiction. The percent emission load of PM is 16% and NOx 54% from line source amongst the all categories of emission load of Navi Mumbai.

The most prominent sources of vehicle particulate emissions are diesel driven and two-stroke petrol driven vehicles. Vehicles are the primary source of precursor emissions for $PM_{2.5}$ pollutants in the atmosphere of high traffic congestion zones. Based on the results of emission inventory, specific strategies need to be ranked out of wide variety of reduction options available. Reduction strategies presented here take into consideration the current ambient air quality standards; exhaust emission standards, emission inventory, vehicular population composition, infrastructure availability and the techno-economic feasibility in Navi Mumbai Region.

The discussion has been presented in following order:

- Improvement in vehicle related components/technologies
- Improvement in fuel quality and alternate fuels
- After-exhaust treatment techniques and retrofitment
- Transport planning and traffic management
- Inspection & Maintenance programme
- Other options including phasing out old vehicles, revision of emission standards, anti-smoke campaign, upgraded PUC

As there are considerable differences in emission control options required for diesel and petrol driven vehicles, for new and in-use vehicles; it will be appropriate to address them separately. This approach will also help in planning and implementing the specific control options and also assessing their contributions towards emission reduction.

Factors Effecting Vehicle Emissions

1. Vehicle/Fuel Characteristics

- Engine type and technology-two stroke, four stroke; diesel, otto, wankel, other engines; fuel injection, turbo charging, and other engine design features; type of transmission system
- Exhaust, crankcase, and evaporative emission control systems in place-catalytic converters, exhaust gas recirculation, air injection, stage II and other vapor recovery systems
- Engine mechanical condition and adequacy of maintenance
- Air conditioning, trailer towing, and other vehicle appurtenances
- Fuel properties and quality-contamination, deposits, sulfur, distillation characteristics, composition (e.g., aromatics, olefin content) additives, oxygen content, gasoline octane, diesel cetane
- Alternative fuels such as CNG, LPG, Bio Diesel
- Deterioration characteristics of emission control equipment
- Deployment and effectiveness of inspection/maintenance (I/M) and anti-tampering (ATP) program

2. Fleet Characteristics

- Vehicle mix (number and type of vehicles in use)
- Vehicle utilization (kilometers per vehicle per year) by vehicle type
- Age profile of the vehicle fleet
- Traffic mix and choice of mode for passenger/goods movements
- Emission standards in effect and incentives/disincentives for purchase of cleaner vehicles
- Adequacy and coverage of fleet inspection maintenance programs

3. Operating Characteristics

- Vehicle use patterns-number and length of trips, number of cold starts, speed, loading, aggressiveness of driving behaviour
- Degree of traffic congestion, capacity and quality of road infrastructure, and traffic control systems
- Transport demand management programs

Source: Faiz and others 1995; Faiz and Aloisi de Larderal 1993

As per recent emission standards for BS IV and BS VI norms across all category of vehicles, and its implementation will yield the maximum reduction of PM and NO_x emission **(Table 7.6)**. The stipulated CO emission for diesel vehicles is 0.50 g/km and for petrol it is 1.0 g/km, whereas NO_x is regulated at 0.08 g/km for diesel and 0.06 g/km for petrol, while particulate matter (PM) is set at 0.005 g/km for both in BS VI. We should see a substantial drop in air pollutants, especially for diesel car vehicles, as current BS IV figures are 0.25 g/km for NO_x and 0.025 g/km for PM. Similarly HDDV reduction will possible from 3.5 g/km to 0.4 g/km in BS VI for NOx and 0.02 to 0.01 g/km for PM.

Table 7.6 : Emission Factors for BS IV and BS VI

Emission Factor for BS IV fuel	PM	NO_x	CO	HC
Car Petrol Car	0.002	0.08	1	0.1
Car Diesel Car	0.025	0.25	0.5	0.3
CNG Car/Taxi (LMV)	0.006	0.08	1	0.1
Two wheeler	0.013	0.79	1.403	0.39
Three wheeler	0.0425	0.38	0.38	2.06
Heavy Duty Diesel Vehicles	0.02	3.5	1.5	0.46

Emission Factor for BS VI fuel	PM	NO_x	CO	HC
Car Petrol Car	0.005	0.06	1	0.1
Car Diesel Car	0.005	0.08	0.5	0.17
CNG Car/Taxi (LMV)	0.005	0.06	1	0.1
Two wheeler	0.0045	0.06	1	0.1
Three wheeler	0.025	0.1	0.22	0.1
CNG Buses	0.01	0.46	4	0.16
Heavy Duty Diesel Vehicles	0.01	0.4	1.5	0.13

* Values in g/km Source: *https://www.transportpolicy.net/region/asia/india/*

TransportPolicy.net is collaboration between the International Council on Clean Transportation and DieselNet. On 19 Feb 2016, the Ministry of Road Transport and Highways (MoRTH) issued a draft notification of Bharat Stage (BS) VI emission standards. The standards, as proposed, will take effect throughout the country for all light-duty and heavy-duty vehicles as well as two and three wheelers manufactured on or after 1 Apr 2020. The draft proposal specifies mass emission standards, type approval requirements, and on-board diagnostic (OBD) system and durability levels for each vehicle category.

Additional provisions in the draft proposal include:

- Adoption of more stringent WHSC and WHTC test cycles
- Off-cycle emissions testing requirements and in-service conformity testing for type approval
- Specifications for Portable Emissions Measurement System (PEMS) demonstration testing at type approval. The proposed BS VI regulation establishes an important precedent for leap frogging from Euro IV-equivalent directly to Euro VI-equivalent motor vehicle emissions standards.

The World Harmonized Transient Cycle (WHTC) test is a transient engine dynamometer schedule defined by the proposed global technical regulation (GTR) developed by the UN ECE GRPE group. The GTR is covering a world-wide harmonized heavy-duty certification (WHDC) procedure for engine exhaust emissions. The proposed regulation is based on the world-wide pattern of real heavy commercial vehicle use.

a. test is performed on an engine dynamometer operated through a sequence of 13 speed and load conditions
b. a hot start steady state test cycle
c. transient test cycle with both cold and hot start requirements

Prior to 2010, emissions were tested using the ECE R49[a] test cycle. After 2010, for Bharat III and IV, the ESC (European Stationary Cycle) and ETC (European Transient Cycle) test cycles were used. BS VI will require the application of WHSC[b] (World Harmonized Stationary Cycle) and WHTC[c] (World Harmonized Transient Cycle) test cycles.

The option selection was based on much iteration with a view to achieve significant change in load and consequent reduced emission contribution. For calculation of BaU scenario for vehicle projections the average decadal registered vehicle growth was considered as 3.7% in 2020 and 7.7%

in 2025. The estimation of emission loads for new emission standards i.e. BS- IV and BS- VI was also calculated for comparison with BaU scenario. **Table 7.7** presents options which are likely to achieve desired results based on earlier discuss action plan **(Table 6.3)** for line source as also those which are relevant to Navi Mumbai city.

Table 7.7 : Vehicular Source Control Options * Emission load in kg/day

Scenario	PM		NOx	
BAU 2018	**3266.4**		**30494.5**	
BAU 2020	**3511.4**		**32781.6**	
BAU 2025	**3774.7**		**35240.2**	
Complete implementation of BS – IV norms by 2019	**462.0 (86.8%)**		**22996.1 (29.9%)**	
Complete Implementation of BS – VI norms by 2025	**223.3 (94.1%)**		**3169.8 (91.0%)**	
Control Options	**2020**		**2025**	
	PM	**NOx**	**PM**	**NOx**
Conversion vehicles to CNG/LPG 2020-Privately operated Vehicles viz. OLA, Uber and other contract buses, public transport should be converted -50% 2025-Privately operated Vehicles viz. OLA, Uber and other contract buses, public transport should be converted -75%	2346.5 **(33.2%)**	23769.5 **(27.5%)**	1898.3 **(49.7%)**	20738.0 **(41.2%)**
Banning of 15 year Old Commercial Vehicle 2020-70% banning 2025-100% banning Encouragement by provision of incentives in form of scrap value.	2047.9 **(41.7%)**	21754.9 **(33.6%)**	1522.6 **(59.7%)**	18267.8 **(48.2%)**
Synchronization of traffic signals 2020-Major & minor roads, excluding feeder roads (or about 65% of the all arterial roads) 2025-Major & minor roads, excluding feeder roads (or about 80% of the all arterial roads)	1882.9 **(46.4%)**	19286.0 **(41.2%)**	1437.2 **(61.9%)**	15983.5 **(54.6%)**
Share of Electric vehicles in Total City Fleet 2020-Two wheeler: 10%; 3 wheeler and Taxi: 10% and Public transport buses -10% 2025-Two wheeler: 10%; 3 wheeler and Taxi: 10% and Public transport buses -20%	2310.0 **(34.2%)**	23400.8 **(28.6%)**	1862.4 **(50.7%)**	19874.1 **(43.6%)**
Share of Hybrid vehicles in Total City Fleet 2020- Gasoline powered four-wheelers only) – 20% 2025- Gasoline powered four-wheelers only) – 30%	2577.0 **(26.2%)**	25681.4 **(21.7%)**	2123.2 **(43.8%)**	22359.1 **(36.6%)**
Encourage Public Transport 2020-Increase Public Transport -50% 2025-Increase Public Transport -75%	2333.6 **(33.5%)**	23769.5 **(27.5%)**	1884.0 **(50.1%)**	20832.3 **(40.9%)**
Retrofitment of Diesel Oxidation Catalyst (DOC) 4wheeler public transport (BSII) 2020-50% conversion 2025-100% conversion	1619.9 **(53.9%)**	19078.7 **(41.8%)**	1507.6 **(60.1%)**	17753.4 **(40.9%)**

Table 7.7 (Contd..) : Vehicular Source Control Options

Scenario	PM		NOx	
BAU 2018	**3266.4**		**30494.5**	
BAU 2020	**3511.4**		**32781.6**	
BAU 2025	**3774.7**		**35240.2**	
Complete implementation of BS – IV norms by 2019	**462.0 (86.8%)**		**22996.1 (29.9%)**	
Complete Implementation of BS – VI norms by 2025	**223.3 (94.1%)**		**3169.8 (91.0%)**	
Control Options	**2020**		**2025**	
	PM	**NOx**	**PM**	**NOx**
Retrofitment of Diesel particulate filter in 4 wheelers public transport (BS II 2020 -50% conversion 2025-100% conversion	2366.4 **(32.6%)**	24194.0 **(26.2%)**	1927.7 **(48.9%)**	21387.5 **(39.3%)**
Reduce Dust Resuspension (Resuspension Dust as on 2018- 11303.7 **kg/day**) 2020-Paving of all road 75%; 2025- 100%	8500.4 **(24.8%)**		5222.3 **(53.8%)**	
Banning odd/even vehicles on particular day	1689.0 **(51.9%)**	15767.9 **(51.9%)**	1653.3 **(56.2%)**	15787.6 **(55.2%)**

Out of the total PM emission load of 3.27 tons/day, the highest contribution is from HDDV vehicles (81.5%) i.e, 2.7 tons/day. Followed by HDDV, 3 and 2 wheelers, car diesel and CNG Buses emission contribution is more. The emission load of PM is attributed to movement of Heavy Duty Diesel (HDD) Vehicles within the region mostly from North and South region. As it can be observed, the complete implementation of BS VI and BS VI norms across all category of vehicles yield the maximum reduction of PM and NOx emission. For BS VI, the stipulated CO emissions for diesel vehicles is 0.50 g/km and for petrol is 1.0 g/km, NOx is regulated at 0.080 g/km for diesel and 0.060 g/km for petrol, while particulate matter (PM) is set at 0.005 g/km for both. We should see a substantial drop in air pollutants, especially for diesel vehicles, as current BS IV figures are 0.25 g/km NOx for and 0.025 g/km PM. The reduction of PM observed to be 86.8% (i.e. 462 Kg/d) from 3511.4 Kg/day after implementation of BS-IV, likewise 94% (i.e. 223.3 Kg/d) from 3774.7 Kg/day after implementation of BS-VI. Similarly, NOx reduction can possible upto 30% after implementation of BS IV, whereas drastic reduction can possible i.e. 91% after BS VI.

About 50-60% of PM and NOx reduction can be achieved on short term basis with respect to public transport, banning of odd/even vehicles and synchronization of traffic with strategic and technology based management options. Whereas in long term, almost all options are giving reduction of about 50-60%. The CNG conversion can achieve the result of 30-40% of reduction in both emissions scenario. The change of Electric vehicles and Hybrid vehicles in long term gives better results (40-50%). Among retrofitment, if technology of DOC will used in HDDV vehicles, then reduction can possible for PM around 50-60%. The paving of road will probably reduce the road dust emission by 25% in 2020 and 54% in 2025. If want substantially results collective efforts need to be implemented, and emphasis should be given to ease of access to public, techno feasible infrastructure.

Chapter 8

Prioritization of Management/Control Options

Management options for each sectors need to be prioritized with a view to understand the issue of implementation. Implementations are highly influenced not only by the idea of the improvement alone but also by the nature of the recommendations, fiscal and administrative barriers, effectiveness, implementing agencies and acceptance from large group of stakeholders. Prioritization issues are also driven by the comparative account of short term and long term implementation dilemma. Low cost with high effectiveness, low cost with shorter implementation period shall be a better option when compared with high effectiveness with high costs or long implementation period. Some of these considerations have been used here to prioritized the options in each case of vehicular, industrial and area sources.

8.1 City wise Dispersion Modeling for Selected Options for Future Scenario

A very comprehensive set of options have been examined for the purpose of understanding the issue of urban air pollution reduction and are given in **Table 8.1.** The dispersion run was carried out for many scenarios and based on options, where the effectiveness of PM and NOx reductions were significant, those were selected and included for the model run. For the successful implementation of the control measures, it is very important to categories them according to need of mitigation required. In order to achieve maximum reduction in emission loads, it is essential to prioritize selected control option, taking into account their respective sources and demography of the region. Out of the all devised control measures, few were selected according to the sources, their fuel consumption and feasibility. The implementation of these control measures were considered to be applied in stages, cumulatively across all the identified sources of the region. 2020 is considered short term measures, where for industrial and area sources the listed control measures were implemented and that for vehicles, 1 to 6 were selected **(Priority I)**. The selected control measures for point and area sources for short term 2020 are further aggressively implemented during the long term stage 2022 **(Priority II)**, so as to cover the aspects which weren't possible in short term stage. Considering their tremendous number growth, for vehicles sources, option 1 to 11 were applied with point and line source measures. The control options were compared with the Business as Usual Scenario considering the growth of vehicles and activities within the area sources, no changes will be assumed for industrial growth in Navi Mumbai city. The annual predicted concentrations for different sources in BaU and control option scenario are presented in **Table 8.2** and **Table 8.3** for PM and NOx.

Table 8.1 : Summary of Options used for City Based Model Run

Category		Control Options	Scenario 2012	Scenario 2017
Vehicle Sources	1	New Vehicle Standards	Complete implementation of BS - IV	Complete Implementation of BS - VI
	2	CNG/ LPG	Privately operated Vehicles viz. OLA, Uber, contract buses, public transport converted -50%	Privately operated Vehicles viz. OLA, Uber, contract buses, public transport converted-75%
	3	Electric vehicles	Two wheeler: 10%; 3 wheeler and Taxi: 10% and Public transport buses -10%	Two wheeler: 10%; 3 wheeler and Taxi: 10% and Public transport buses -20%
	4	Synchronization of traffic	Major & minor roads, excluding feeder roads (or about 65% of the all arterial roads)	Major & minor roads, excluding feeder roads (or about 80% of the all arterial roads)
	5	Public Transport	Increase Public Transport-50%	Increase Public Transport -75%
	6	Ban or scrapping -15 year old Veh.	70% banning	100% banning
	7	Ban of odd / even vehicles	50% reduction private vehicles	50% reduction private vehicles
	8	Retrofitment of DOC- 4 wheeler Public Transport	50% conversion (BSII)	100% conversion
	9	Retrofitment of DPF-4 wheelers public transport	50% conversion (BSII)	100% conversion
	10	Share of Hybrid vehicles in Total City Fleet	Gasoline powered four-wheelers only -20%	Gasoline powered four-wheelers only- 30%
	11	Inspection and Maintenance	New I&M regulations (50% population)	Full compliance -100%
Industrial Sources		Shifting of Fuel	Red, Orange & Green Industries (LSI, MSI & SSI) 50% fuel FO, LSHS, HSD to LDO; Coal & Others to NG	100% [Low Fuel i.e LDO to Nearly all to NG]
			Power Plant : Coal to NG -50%	100% to NG
Area Sources		Domestic	25% of slums to use LPG/ PNG 50% of non slum to use LPG/PNG	50% of slum to use LPG 100% same
		Hotel & Rest.	50% of coal use to LPG	75% of coal use to LPG
		Open Eat outs	Since these operation is illegal, difficult to quantify	
		Bakeries	25% LPG, 25% Electric	50% LPG, 25% Electric
		Crematoria	50% Electric	75% Electric
		Open Burning	50% control on open burning	100% control on open burning
		Landfill Burning	100% control of Landfill burning	100% control of Landfill burning
		Bldg. Constr.	50% control on dust emission	50% control on dust emission
		Unpaved Rd.Dust	Paving of all road 75%	Paving of all road 100%
		Ports	Awareness and Management	
		Airports	Awareness and Better Inventory	
		Railways	100% on electric	100% on electric

Though some of the options were selected on the basis of PM reduction potential, their possible co-benefits in reducing NOx and other pollutants were also considered during the process of prioritizing. The options considered are based on the discussion presented earlier in action plan, describing the city specific situation and its possible impacts on air quality. Model runs for the whole city included the major control options from all the three sources (Area, Line and Point). The model run's iso-contours maps for PM and NOx in BaU 2020, BaU 2022 and after implementation of Preferred Option I (i.e. options 1 to 6 for vehicles, and all options for industries and area) scenario's in 2020 and Preferred Option II (i.e. options 1 to 11 for vehicles and all options for industries and area) 2025 are given in **Figures 8.1 through 8.8.**

Table 8.2 : Comparison of PM_{10} Concentrations BaU With Preferred Option I (2020) & Preferred Option II (2025)

Sources Group	BaU 2018	BaU 2020	BaU 2025	Preferred Option I -2020	Preferred Option II -2025
All Group	182.4	193.8	206.3	117.3	70.6
Area Source	5.7	6.1	6.5	3.7	2.2
Line Source	20.4	21.9	23.6	13.3	8.1
Point Source (LSI)	65.2	65.2	65.2	39.5	22.3
Point Source (MSI)	0.27	0.27	0.27	0.16	0.09
Point Source (SSI)	1.16	1.16	1.16	0.71	0.40
Resuspension Dust	148.3	159.6	171.6	96.6	58.7

- Concentrations in $\mu g/m^3$

Table 8.3 : Comparison of NOx Concentrations BaU With Preferred Option I (2020) & Preferred Option II (2025)

Sources Group	BaU 2018	BaU 2020	BaU 2025	Preferred Option I -2020	Preferred Option I -2025
All Group	206.2	218.9	233.0	131.6	141.3
Area Source	18.5	19.5	20.8	11.7	12.6
Line Source	169.0	181.7	195.2	109.2	118.4
Point Source (LSI)	65.9	65.9	65.9	39.6	39.9
Point Source (MSI)	2.2	2.3	2.19	1.35	1.37
Point Source (SSI)	7.8	7.9	7.87	4.7	4.8

- Concentrations in $\mu g/m^3$

The annual predicted 24 hourly average concentrations were compared with the BaU scenarios considering the future growth and after implementation of preferred option for 2020 and 2025 for both PM and NOx is presented in **Figure 8.9 and 8.10** respectively.

A) Predicted Scenario for PM

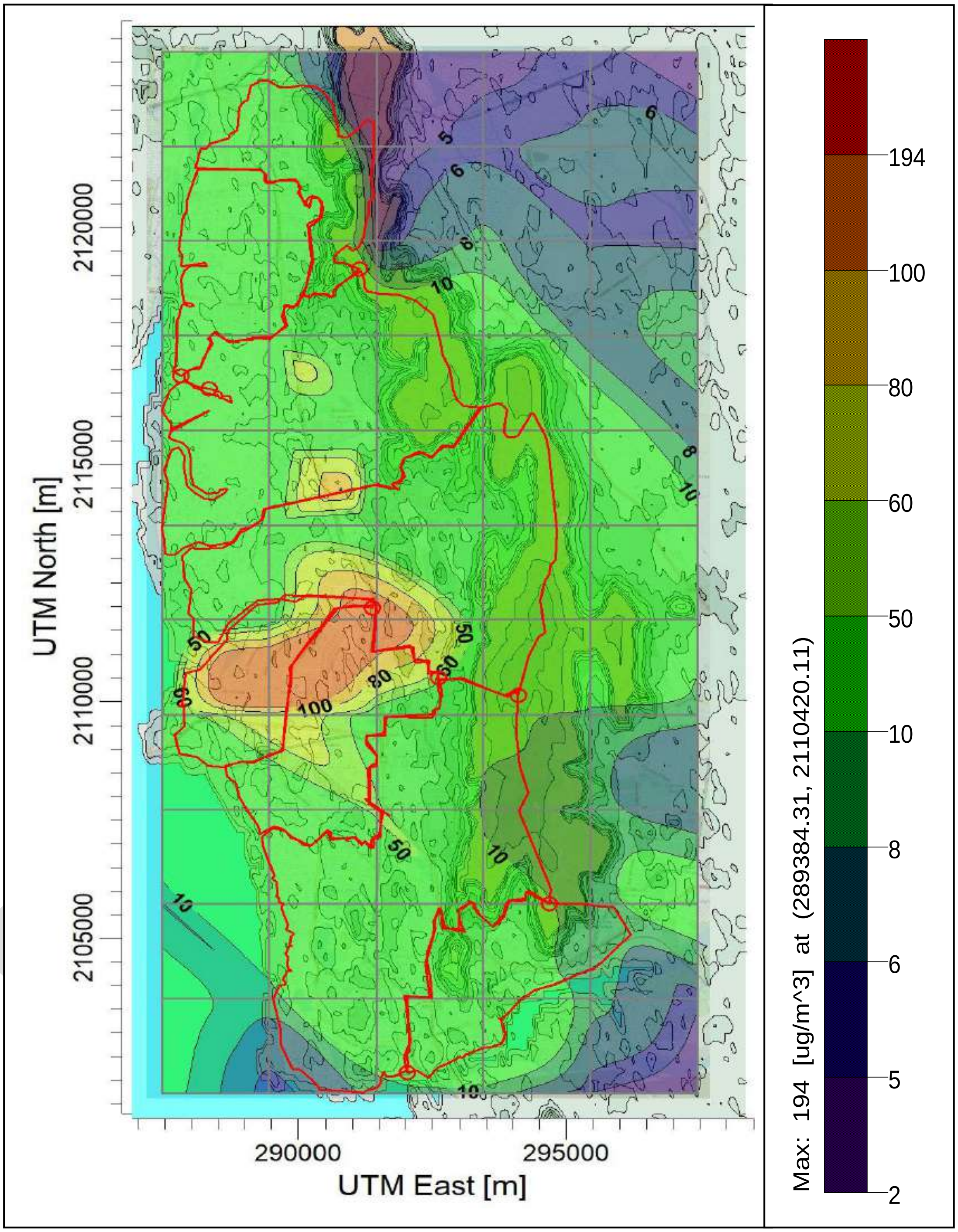

Figure 8.1 : Isopleths of PM Due to All Source– BaU 2020 (Navi Mumbai City)

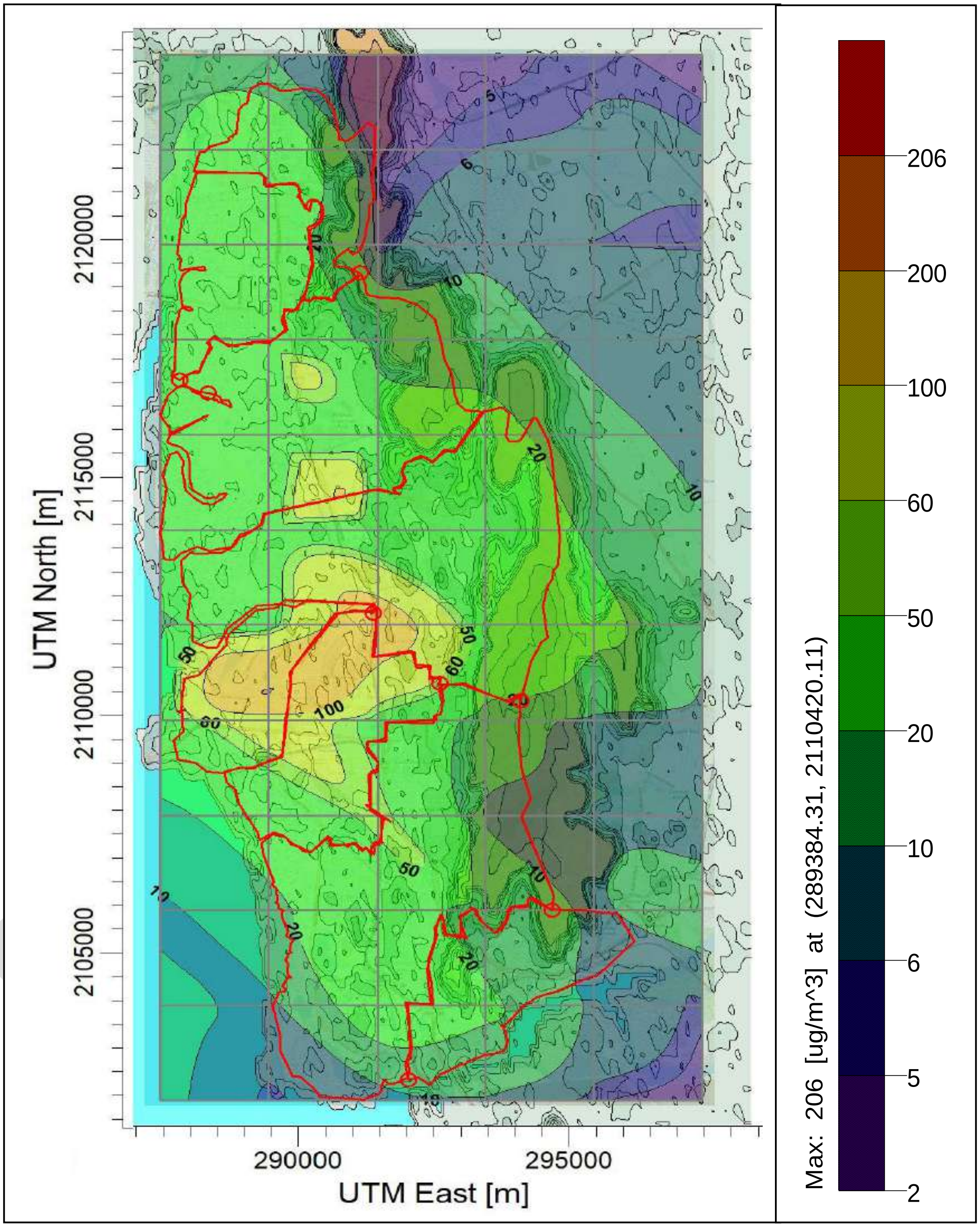

Figure 8.2 : Isopleths of PM Due to All Source– BaU 2025 (Navi Mumbai City)

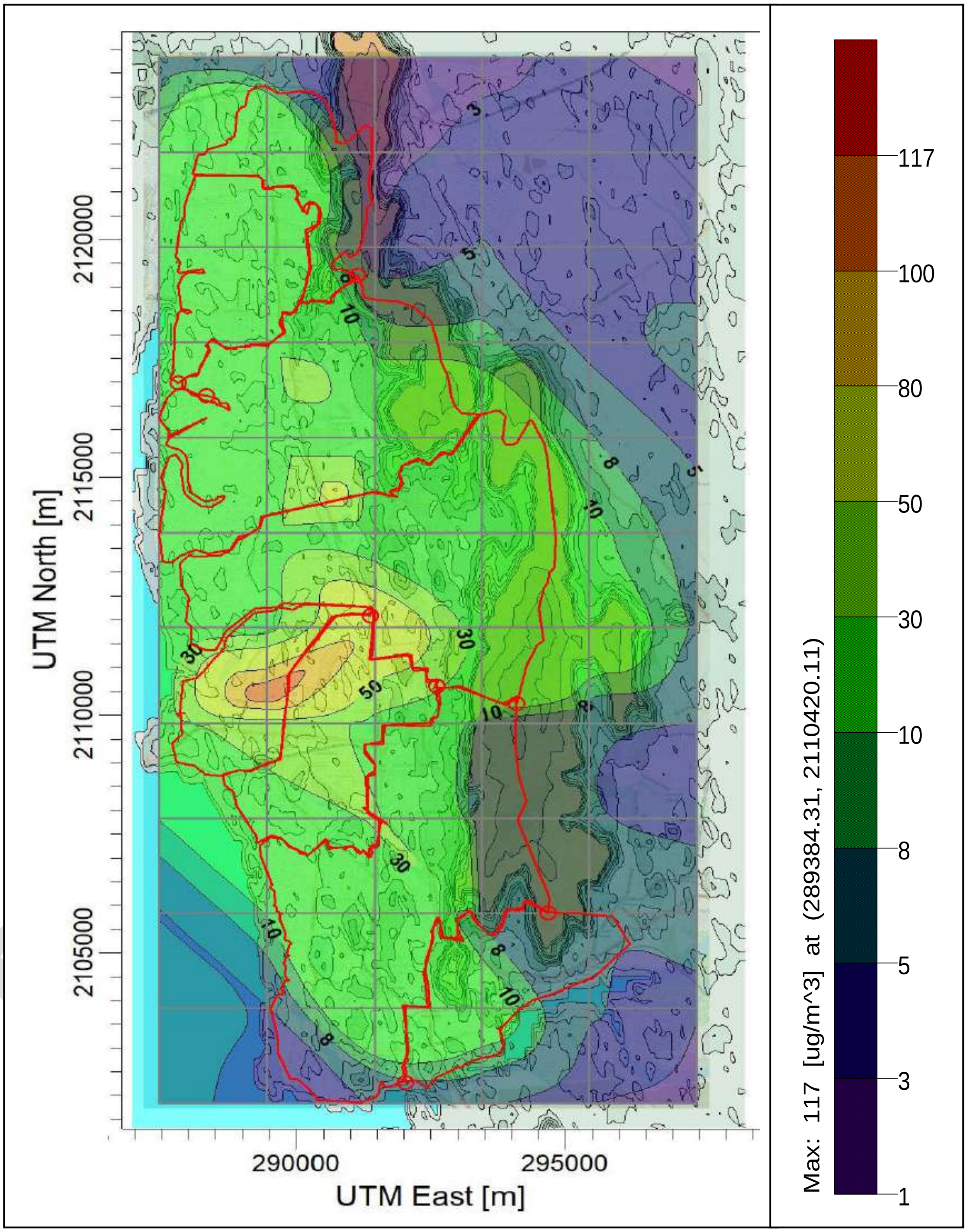

Figure 8.3 : Isopleths of PM Due to All Source– Preferred Options I - 2020 (Navi Mumbai City)

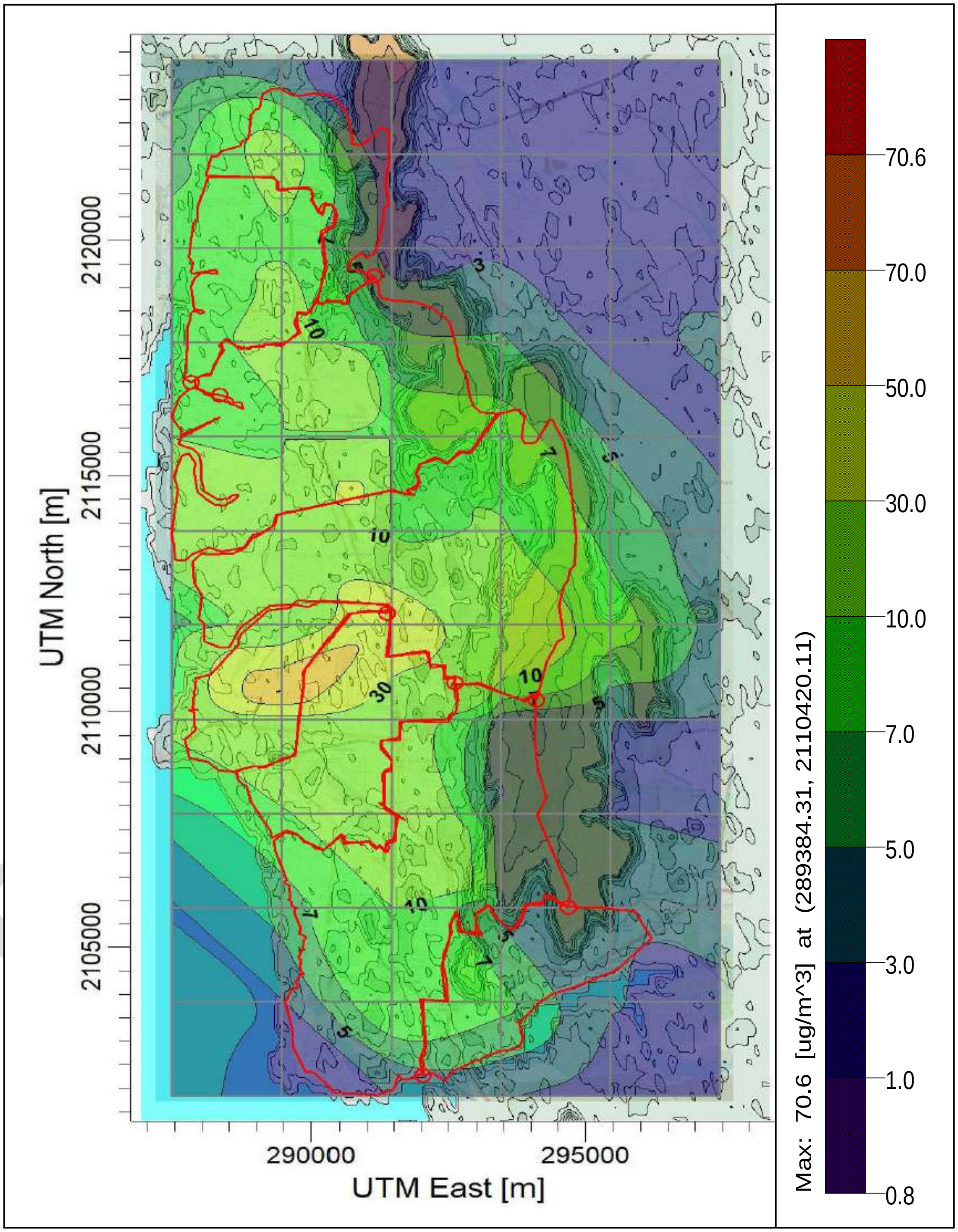

Figure 8.4 : Isopleths of PM Due to All Source– Preferred Options II - 2025 (Navi Mumbai City)

A) Predicted Scenario for NOx

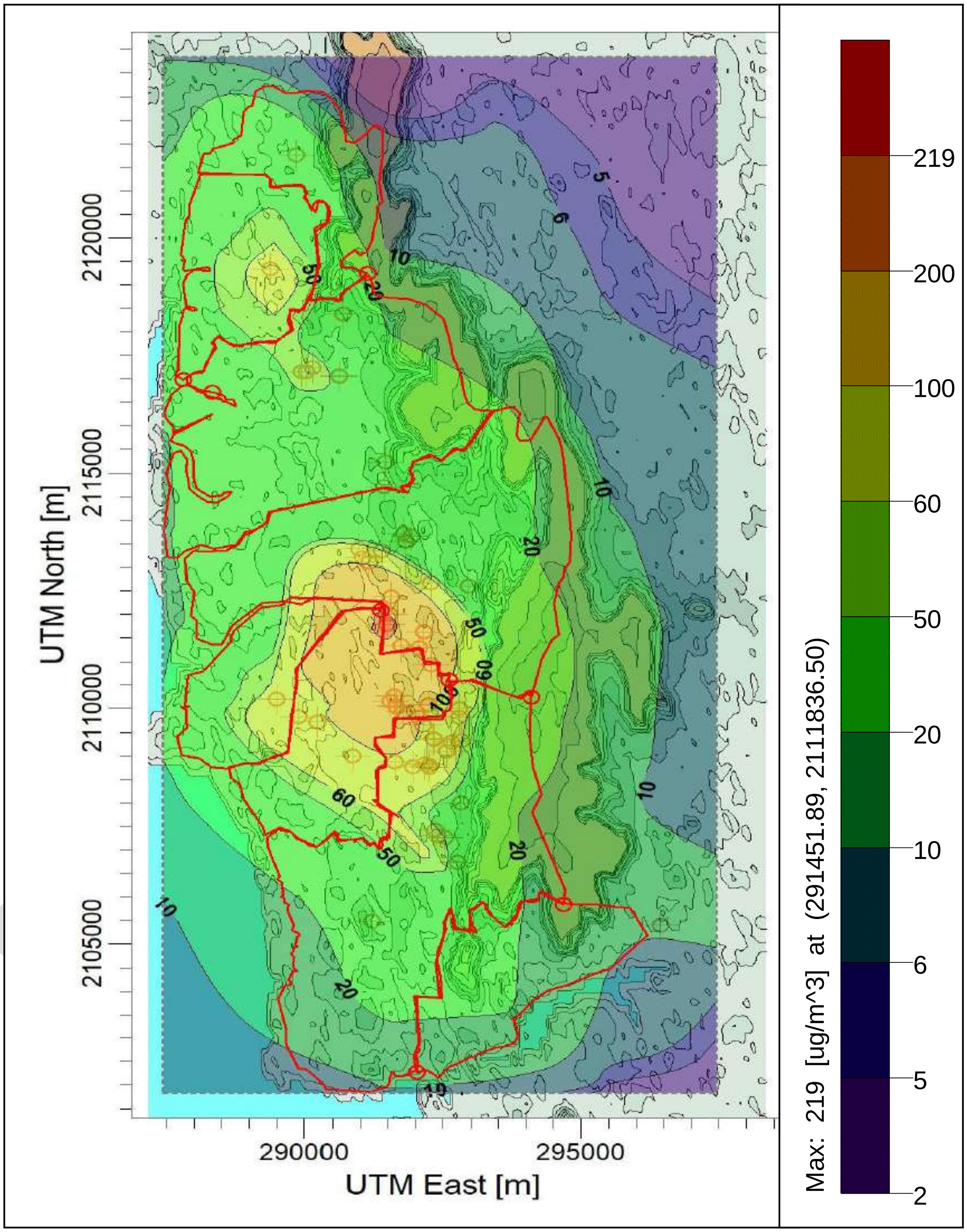

Figure 8.5 : Isopleths of NOx Due to All Source– BaU 2020 (Navi Mumbai City)

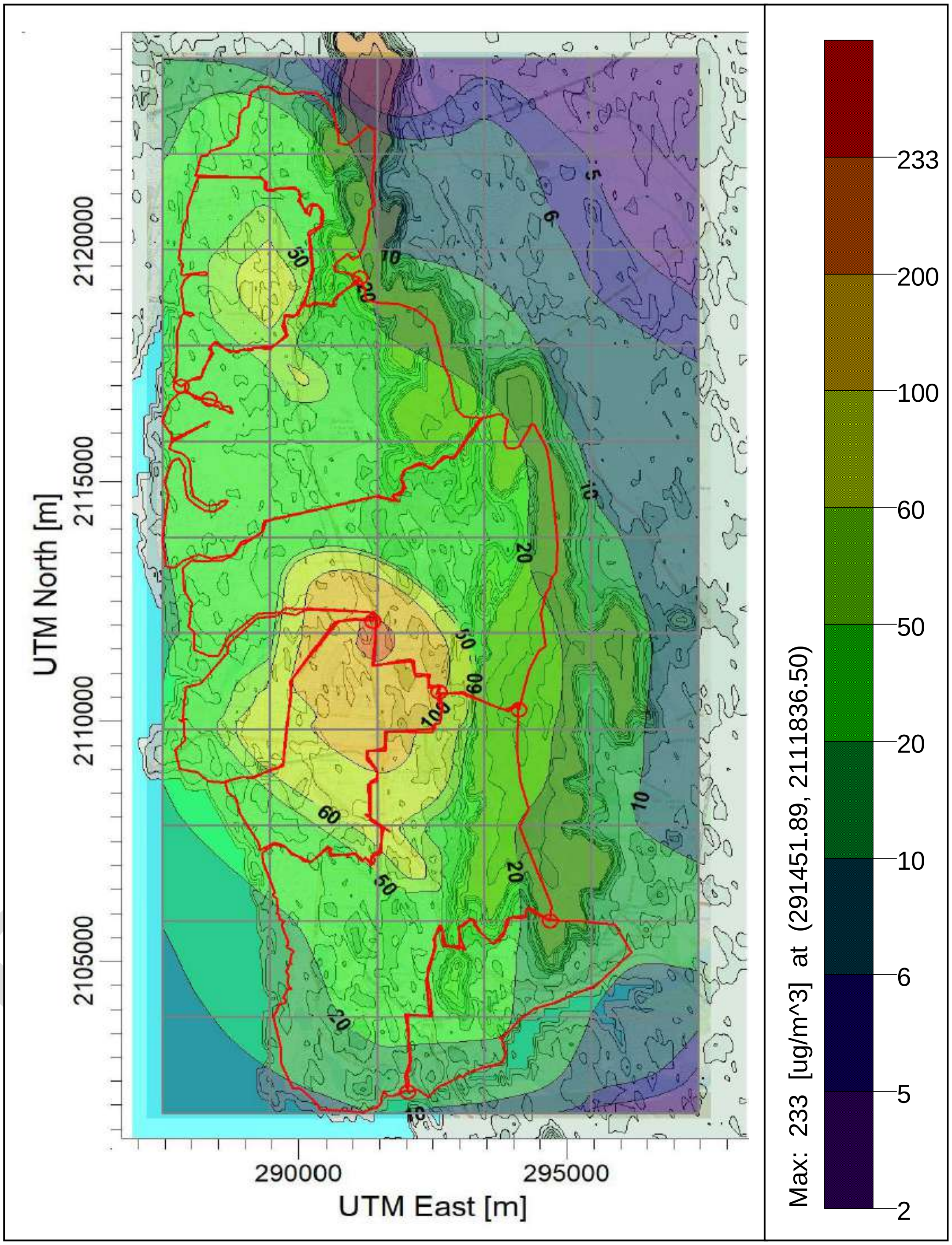

Figure 8.6 : Isopleths of NOx Due to All Source– BaU 2025 (Navi Mumbai City)

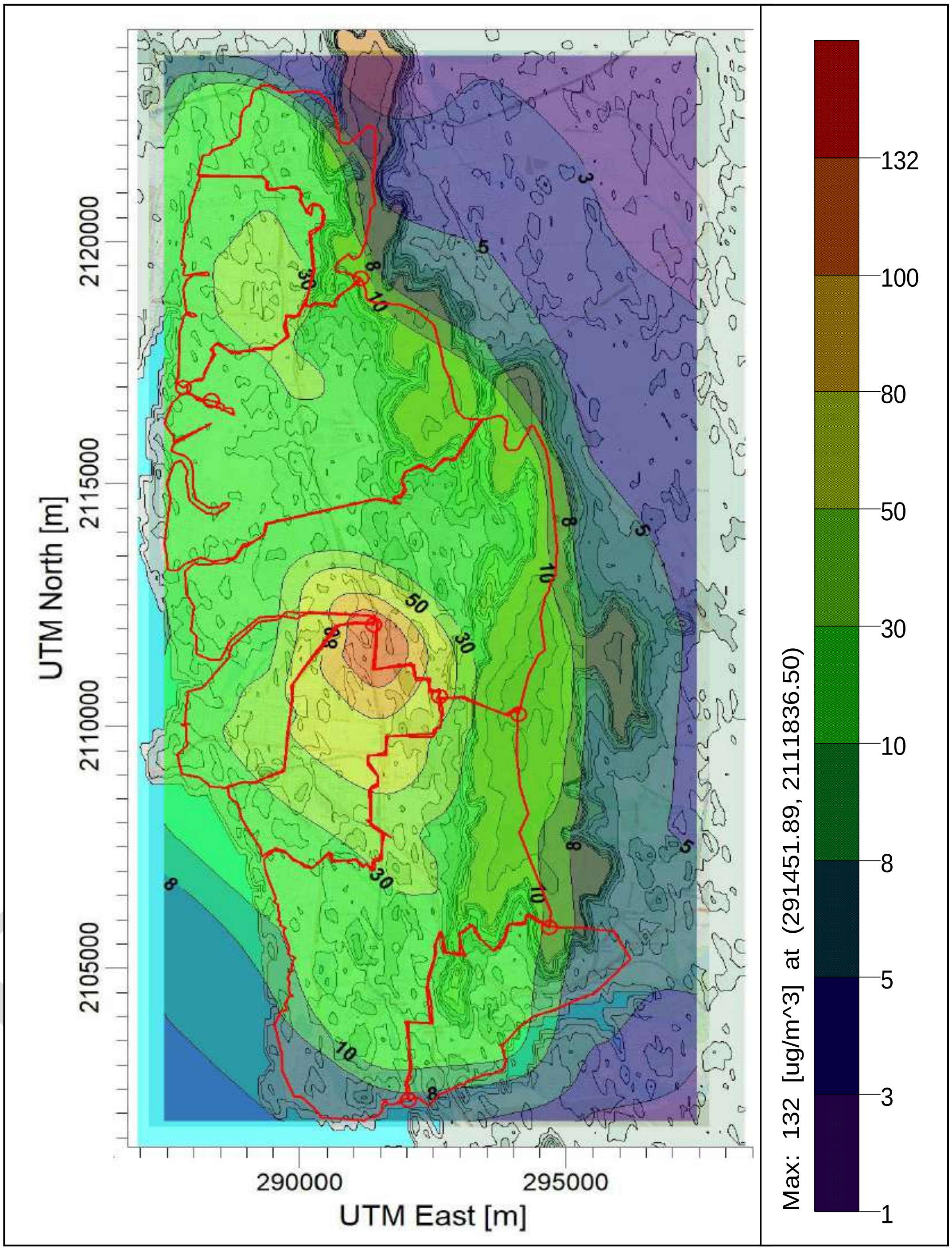

Figure 8.7 : Isopleths of NOx Due to All Source– Preferred Options I - 2020 (Navi Mumbai City)

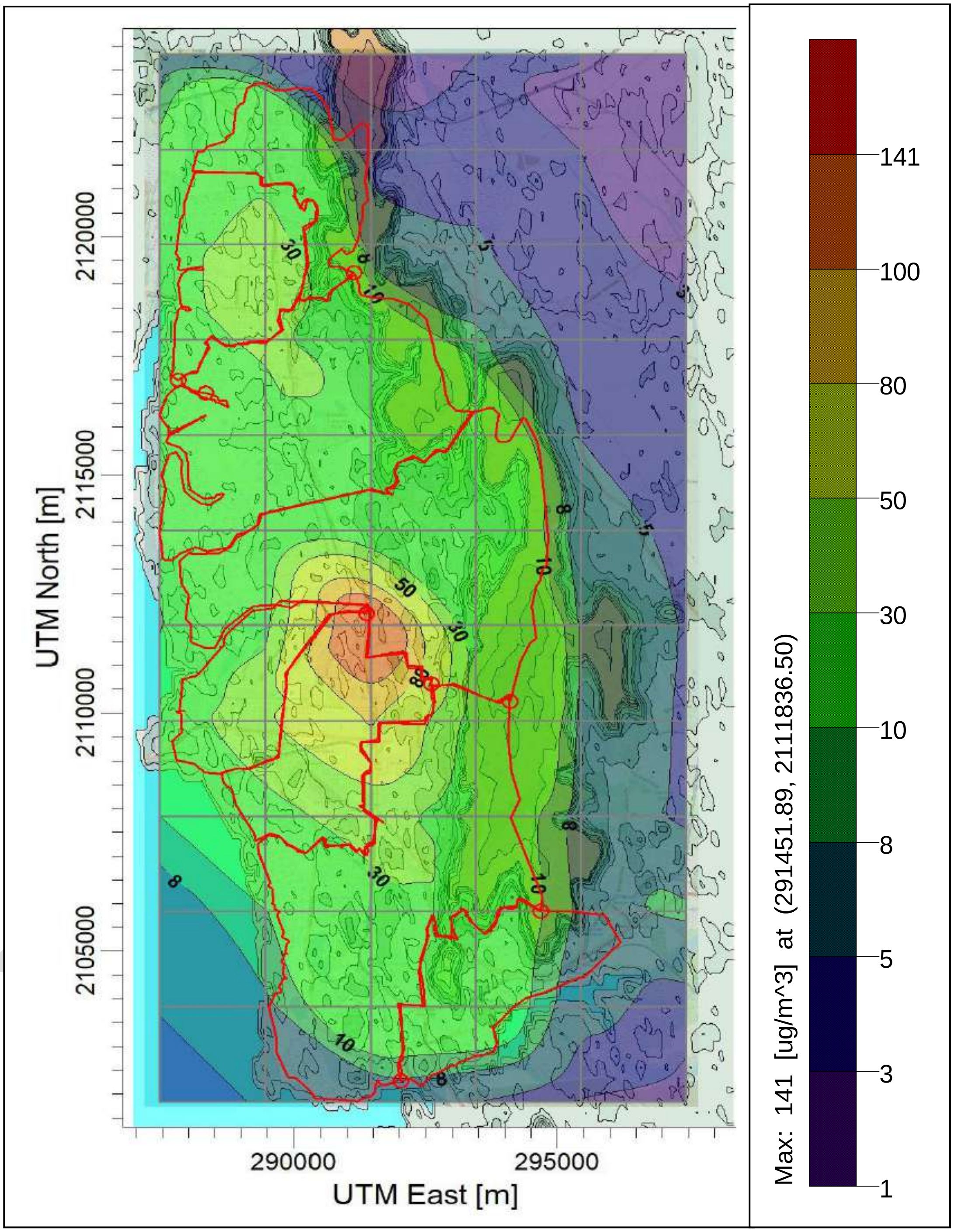

Figure 8.8 : Isopleths of NOx Due to All Source– Preferred Options II - 2025 (Navi Mumbai City)

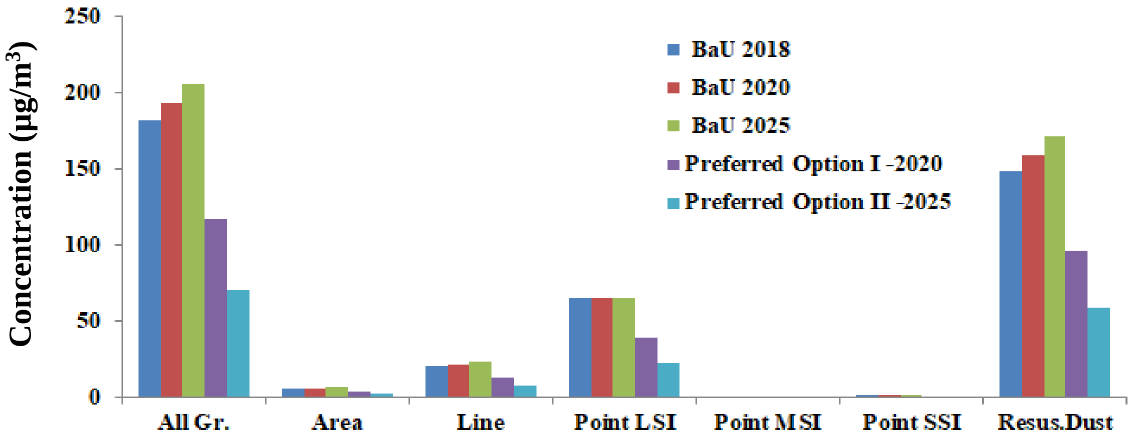

Figure 8.9 : PM Scenario Compared with BaU of 2018 for Preferred Option I (2020) and Preferred Option II (2025)

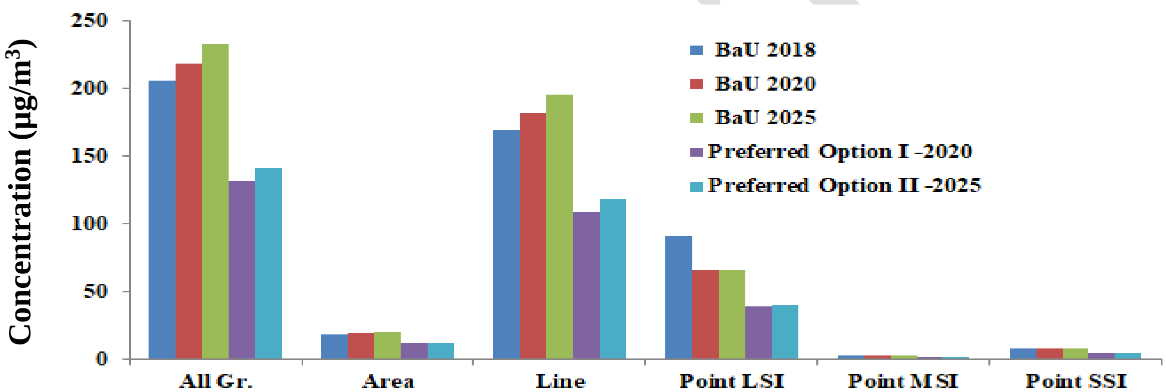

Figure 8.10 : NOx Scenario Compared with BaU of 2018 for Preferred Option I (2020) and Preferred Option II (2025)

If we compared with the all source group for BaU 2018, the concentrations of PM range around182.4 µg/m^3 and that will increase upto 193.8 µg/m^3 in 2020 and 206.3 µg/m^3 in 2025, if the growth factor is liner. However, the Preferred Option I is applied (control measures for area, industrial source and vehicles 1 to 6 scenarios) the predicted concentrations will be coming down to 117.3 µg/m^3, whereas for Preferred Option II (all vehicles scenarios 1 to 11; industrial and area sources) it is coming around 70.6 µg/m^3. That means the reduction can be observed upto 36% in short term and 61% in long term as per dispersion modeling, which is also coming line with reduction option calculation without modeling upto 40% in short term and 50% long term as discussed earlier in reduction strategies for control option chapter.

The other source contributions such as area source increases from 5.7 to 6.5 µg/m^3 from 2018 to 2025 as liner growth, after control option implementation, as preferred option I (2020) and II (2025) it will decreases from 3.7 µg/m^3 to 2.2 µg/m^3 in 2020 and 2025 respectively. Line source also decreases from 20.4 µg/m^3 to 13.3 µg/m^3 in 2020 and 8.1 µg/m^3 in 2025, and if we not considered any preferred option the BaU 2025 concentration may reaches upto 23.6 µg/m^3 for line source. The both dispersion modeling and reduction control option for line source gives the reduction upto 30% to 50% in short and long term respectively. The pockets of high concentration are observed close to major traffic junctions in central part city i.e near Vashi and Pawane area, where major interlinkages or roads viz. Thane Belapur and Sion Panvel Highway exist. Due to APMC market and industrial connectivity, approx 2148235 VKT movement was observed for Heavy Duty Vehicles. Amongst the total emission of PM from vehicular sector, 25.67% of emissions are from Ward C-Vashi, contributing 838.4 Kg/day of PM. The Heavy Duty vehicles contribute 12.8% of the total PM load. At discrete cartesian location at highest concentrations reported at Vashi area and Pawane area.

The industrial source will not give any impact as there is no growth scenario in the city of Navi Mumbai, the concentrations of is coming around 65.2 µg/m^3 which will further, reduces upto 39.5 µg/m^3 in 2020 and 22.3 µg/m^3 in 2025, if we shifting fuel quality from fossil fuel to NG. The dispersion modeling for preferred options gives reduction upto 40% in 2020 and 66% in 2025, whereas without dispersion modeling reduction option calculations gives 54% in short term and 94% in long term for industrial source.

As we are observed from emission inventory 50% contribution is from resuspension of dust i.e. (39% Unpaved and 16% Paved), which is also reflected in dispersion modeling for BaU 2018 and gives concentration of 148.3 µg/m^3 out of 182.4 µg/m^3 from all source group. If we considered the preferred options I and II (i.e. pavement and widening of unpaved roads, vehicular resupension, controlling road constructions and building activities) it will bring down the concentrations upto 96.6 µg/m^3 in short term and 58.7 µg/m^3 in long term, which will reduce the concentrations upto 30% to 50% as per dispersion modeling, similar percent is noticed without the dispersion modeling calculations.

In current scenario, the concentrations of emission is exceeding the CPCB standard i.e. 100 µg/m^3 for PM, is mainly due to resuspension of dust. We compare the standard with individual sources (area, point and line) then preferred option will definitely reduce the emission below the CPCB standard, as also the respension of dust will be reduce. Anthropogenic activities like construction, vehicular resupension will be managed, but natural dust remains and concentrations will be noticed above the standard.

In case of NOx the predicted ground level concentrations for all source group for BaU 2018, the concentrations of NOx range around 206.2 µg/m^3 and that will increase upto 218.9 µg/m^3 in 2020 and 233 µg/m^3 in 2025, if the growth factor is liner. After running the Preferred Option I and II the predicted concentrations goes down upto 131.6 µg/m^3 and 141.3 µg/m^3 in short and long term respectively. The reduction is not substantial it is coming upto 31 -36% in both the cases.

The other source contributions for NOx will also decrease viz. area source i.e. 18.5 µg/m^3 (2018) to 11.7 to 12.6 µg/m^3 in 2020 and 2025. Vehicular source is the major contributor, out of 206.2 µg/m^3 from all sources, the line source share 80% i.e. 169 µg/m^3. Predicted line source also decreases from 169 µg/m^3 to 109.2 µg/m^3 in 2020 and 118.4 µg/m^3 in 2025; and if we not considered any preferred option the concentration may reaches upto 181.7 to 195.2 µg/m^3 for line source in BaU 2020 and BaU 2025 respectively. The both dispersion modeling and reduction control option for line source gives the reduction upto 30% to 40% in short and long term respectively. If rigorous BS-VI scenario will be implemented then NOx reduction can be achieved upto 91%. The hotspot for major traffic junctions will not change the concentrations range which is in between 40 to 195 µg/m^3.

The industry will also share the major role in NOx, out of 206.2 µg/m^3 the point source gives (65.91) µg/m^3 i.e. (31)% in BaU 2018, conversion of fuels to NG will increase the NOx emission. With no growth scenario and partly shifting of fuel the concentration of 2020 and 2025 will comes around 65.9 µg/m^3, and if the preferred option I and II considered the concentrations decreases upto 39.6 to 39.9 µg/m^3. The dispersion modeling for preferred options gives the reduction upto 40% in short term and long term, whereas without dispersion modeling reduction would 8 to 9% for the both the years for industrial source. The all group annual impact of NOx concentrations shows that, it is exceeding the CPCB 24 hourly standard of 80 µg/m^3 among all the sources vehicular source is highest.

8.2 Prioritizing Technical Measures

Based on the framework of each sector delineated in possible action plan has been discussed in respect to their effectiveness, barriers to implementation and administrative issues. These options have also been considered for their co-benefits with regard to other pollutants adding values to the action planned. Navi Mumbai city specific measures at national as well as local levels have also been finalized after interactions in various meetings. Implementing agencies roles and responsibilities finally take the process further. These agencies are likely to have direct and indirect role in implementation. **Table 8.4** presents the considerations in prioritizing various measures for vehicular, industrial and area sources, respectively.

Table 8.4 : Considerations in Prioritizing Technical Measures for Addressing Urban Air Pollution - Vehicles

Actions	Technical Issue	Effectiveness for Pollution reduction	Barriers to implementation	Administrative /regulatory	Qualifiers (Co-Benefit)	Local/ National Stakeholders
Strategy : Vehicles: Emission Reduction per unit Fuel Used						
S reduction in diesel	Technically feasible and being implemented	Moderate. Reported elsewhere 2000 to 300 ppm reduction in S leads to 2.5- 13% reduction in PM #	High cost. Being planned by Refineries as per the Auto Fuel Policy. The cost is in the range of 15000/35000 crores based on the levels of S	Improvement in emission standards as well as legislation for stringent fuel standards for S, Phasing out the subsidies on diesel. Bringing diesel cost at par in a state/centre	The S reduction will not only reduce the PM but also lead to correspondingly lower SO_2 emission leading to lower ambient SO_2 and sulphate. It will also allow better functioning of exhaust after treatment devices.	Oil companies, Ministry of Petroleum, vehicle manufacturer
Reduce fuel adulteration	Better quality fuel by adopting stricter fuel supply and dispensing system (e.g. Pure for Sure etc.) Chemical marker system	Reduced adulteration will lead to reduced PM (difficult to quantify). Effectiveness is moderate as marker system has not been seen as a primary means to reduce PM	Present system of Anti Adulteration cell function needs major improvement in terms of higher manpower and spread. Presently one office at Mumbai looks after three states of western region. Success of marker system shall be highly dependent upon the joint working relation of Oil companies and AAC.	The current fuel specifications are too broad and therefore checking of conventional parameters such as density etc. does not reflect the adulteration. Finer fuel specifications are needed for implementation. Oil companies themselves can be proactive in proposing these values, which can be checked easily in any laboratory. They also need to be more accountable.	One of biggest advantage of non-adulteration shall be longer engine life besides the emission reduction for PM as well as CO and HC. The catalytic converter shall be active for its entire lifetime.	Anti-Adulteration Cell, Oil Companies, Vehicle owners

 # Source (Air Quality Monitoring, Emission Inventory and Source Apportionment Studies for Indian Cities, February, 2011, CPCB, and Air pollution from motor vehicles, Faiz Asif, Weaver C.S. and Walsh M.P., The World Bank, Washington, D.C., 1996)

Table 8.4 (Contd..) : Considerations in Prioritizing Technical Measures for Addressing Urban Air Pollution - Vehicles

Actions	**Technical Issue**	**Effectiveness for Pollution reduction**	**Barriers to implementation**	**Administrative /regulatory**	**Qualifiers (Co-Benefit)**	**Local/ National Stakeholders**
Strategy : Vehicles: Emission Reduction per unit Fuel Used						
Alternative fuels	Technical infrastructure in Navi Mumbai for dispensing CNG/LPG is fairly good and is improving	High, more than 90% reduction in PM can be achieved compared to diesel [#]	Can be applicable mainly for vehicles, which are supposed to ply within the city. Applicable to only local public transport, Buses /taxies, auto etc.	Incentive by the government authorities to private vehicle owners to shift to CNG/LPG.	Will lead to substantial reduction in CO and HC emission, however, NOx values may go up	Mahanagar Gas, Oil Companies marketing LPG, Local Government
Phase out of grossly polluting vehicles	No major technical problem	High, Estimate suggest 25% of these vehicle may contribute 75% of total emission $	Poor Inspection system both for emission as well as vehicle. New legislation may require changes in Motor Vehicles Act	New legislation needed for improved Inspection certification system, better testing facility.	Better compliance will lead to reduction of other pollutants as well. It will also lead to less pressure on complying vehicles	Transport Commissioner Office, Ministry of Road Transport and Highway

Source (Air pollution from motor vehicles, Faiz Asif, Weaver C.S. and Walsh M.P., The World Bank, Washington, D.C., 1996)
$ Source (Impact of Better Traffic Management, South Asia Urban Air Quality Management, Briefing Note No. 5, ESMAP, The World Bank, 2002)

Table 8.4 (Contd...) : Considerations in Prioritizing Technical Measures for Addressing Urban Air Pollution - Vehicles

Actions	Technical Issue	Effectiveness for Pollution reduction	Barriers to implementation	Administrative /regulatory	Qualifiers (Co-Benefit)	Local/ National Stakeholders
Strategy : Vehicles: Emission Reduction per unit distance travelled						
Congestion reduction	Improvement of roads, new roads, scientifically planned traffic management Connectivity of nodes to major highways, intercity transport	High emission due to fuel burning at idle or slow moving traffic	Road quality improvement is a matter of technology and quality of work carried out. Inter disciplinary approach within nodal agencies for future expansion of city.	Better planning and training in traffic management Road construction norms to be evolved and implemented	It will reduce traffic junction hotspot of all the pollutants It will also reduce continuous source of dust	NMMC, MMRDA, MMRCL, CIDCO, MSRDC, State Government Transport police, other agencies.
Standards for new and In-use vehicles	No technical issue with new vehicles. For in-use old vehicles, technical feasibility needs to be established	Implementation of BSIV- BSVI norms- vehicles emission reduction can be substantial	The process of in-use vehicles standards may take time as they need to be revised at central level. Inadequate infrastructure and manpower at local levels could be other major barriers.	After the legislation is in place, provision of strict penalty leading to cancellation of vehicle registration.	As the old vehicle population is substantial, the standards will bring in the much needed control on emissions of all types	MoRTH, Transport Office Govt. Maharashtra, Automobile Companies & Fuel Suppliers
Introduction of new technology vehicles	New technology based vehicles emit less per unit distance travelled Electric and Hybrid vehicles	High compared to grossly polluting, moderate with respect to in-use vehicles. It can be mostly use for Public transport	Emphasis to allow only a type of technology to be permitted may meet with resistance from manufacturer as well as buyer. (e.g. rule to allow only 4 stroke vehicle to be registered)	This needs to be backed with proper legislation. Else charge higher registration fee or subject them to carry out more frequent I&C test. Electric vehicles for grossly polluting high VKT vehicles are a good option. It needs regulatory push	It will lead to better compliance from on-road emission test and overall improvement in emission of all the pollutants. Electric vehicles provide localized benefits of no air pollution	MNRE, MoRTH, Transport Office Govt. Maharashtra, Automobile Companies

Table 8.4 (Contd...) : Considerations in Prioritizing Technical Measures for Addressing Urban Air Pollution - Vehicles

Actions	Technical Issue	Effectiveness for Pollution reduction	Barriers to implementation	Administrative /regulatory	Qualifiers (Co-Benefit)	Local/ National Stakeholders
Strategy : Vehicles: Emission Reduction per unit distance travelled						
Retrofitment of new engine/ Emission control device	Experience of other countries suggests that it can be feasible. However, in Indian scenario, a pilot retrofit programme to evaluate the efficacy needs to be undertaken. A pilot project was conducted in Pune with USEPA, USTDA and NEERI	Engine replacement could lead to major reduction of PM. Emission control devices available (DPF, DOC) can remove PM upto 90%	Availability of new engines for retrofit. Vehicle manufacturers need to come forward. For Emission control devices, there are innumerable agencies. Govt initiative for cost sharing for its implementation.	Presently no legislation. Need to frame one including a mechanism by which the system can be evaluated by an appropriate agency.	All the heavy duty in-use vehicles. The APC market movements of truck entering into the city boundary will restricted, if control measures are not taken. High levels of compliance expected.	Truck Association, Transport Office Govt. Maharashtra, vehicle manufacturer, MoRTH, MSRDC
Higher usage of Public Transport	Dedicated bus lane, better buses, low cost of travel, faster travel etc. Inter-linkages of nodes development with surrounding cities.	Effectiveness is high as less and less road space will be occupied by private vehicles, faster movement of public transport in comfort shall lead to low emissions	Feasibility to be established for bus lane. Finances for better buses Measures to reduce the cost of travel by way of cross financing.	Local level planning in coordination with all the authorities involved in MUTP, CIDCO, Urban Planners, and City Development Planers, Metro Rail Corporation.	Future growth of the city will entirely depend upon the levels of public transport availability. Cheaper and faster mode of public transport will lead to higher per capita efficiency.	NMMT, BEST, KDMT , KMT NMMC, MMRDA, MSRDC, MMRCL, Transport Office Govt. Maharashtra,

Table 8.4 (Contd...) : Considerations in Prioritizing Technical Measures for Addressing Urban Air Pollution - Vehicles

Actions	Technical Issue	Effectiveness for Pollution reduction	Barriers to implementation	Administrative /regulatory	Qualifiers (Co-Benefit)	Local/ National Stakeholders
Strategy : Vehicles: Emission Reduction per unit distance travelled						
Decrease Private vehicles on Road	Vehicle manufactures and holding of private ownership vehicle is the major issue	Less private vehicles on road, high road space utilization	Awareness matched with better public transport. Need for barriers for buying a car	Higher parking charges, high registration fees, higher car user charges, sale linked with parking availability.	Private vehicles owners should must own their own garages, less parking on the roads, less congestion	Transport Office Govt. Maharashtra, RTO, NMMC, MMRDA
Strategy : Vehicles: Emission Reduction -Awareness						
Training and Awareness programme for car owners, public transport operators, drivers and mechanics	On use of alternative fuel, Inspection and certification, adulteration of fuels, use of public transport, less usage of private vehicles	May lead to 5-10% reduction of emission.	Resources for awareness and training, bringing the different groups together	Structure for such programme should be developed and integrated into legislation.	Savings by way of improved vehicle maintenance and operation	RTO, Transport Commissioner Off., NMMC, MMRDA, CIDO, Other institutions/ NGO involved in awareness campaign

Table 8.4 (Contd..) : Considerations in Prioritizing Technical Measures for Addressing Urban Air Pollution - Industries

Actions	**Technical Issue**	**Effectiveness for Pollution reduction**	**Barriers to implementation**	**Administrative /regulatory**	**Qualifiers] (Co-Benefit)**	**Local/ National Stakeholders**
Strategy : Industries: Emission Reduction per unit Fuel Used						
S reduction in fuel	This process is currently on, however, the fuel S reduction is mainly for Medium and Small Scale industries	Many industries are shifting fuel from fossil fuel to NG, PNG, CNG Bigger industries needs to take care for Coal, HSD, LSHS, and FO	Industrial growth is not progressive in Navi Mumbai, the Medium and Small Scale LSI, Orange industries need to be pressed upon	MPCB can specify the S levels for the fuel being used	Implementation of barriers viz. bag filters, industrial scrubbers, electro static precipitator, use of low sulphur fuel oil will leads to control PM, SOx and pollutants	MPCB, Industries
Combustion Processes	Change in combustion technology will be needed for shifting from coal/oil to natural gas	Moderate	Finances to change the process technology.	Administrative and regulatory incentive and tax rebate for changing technology.	It will lead to lower emission of CO and HC	MPCB, Industries
Alternate Fuel	Large no of industries are using NG and LPG	The higher percentage of use of cleaner fuel has already resulted in better air quality in the city	Easy availability and infrastructural improvement	More allocation of NG/LPG to the industrial sector through MGL/GAIL/ Govt. of India	Better air quality in terms of SO_2, CO and HC will be achieved.	Mahanagar Gas, MPCB

Table 8.4 (Contd..) : Considerations in Prioritizing Technical Measures for Addressing Urban Air Pollution - Industries

Actions	Technical Issue	Effectiveness for Pollution reduction	Barriers to implementation	Administrative /regulatory	Qualifiers (Co-Benefit)	Local/ National Stakeholders
Strategy : Industries: Emission Reduction by Industrial Policy and Standards						
Promoting Cleaner Industries	Use of cleaner production processes	Large scale shift shall result in major PM reduction	Finances to carry out these changes	State as well as central government can provide incentives to carry out the necessary change	It will lead to sustainable existence of industries within the city. Also lead to other pollutants reduction High level emission shall have lower PM and other gaseous pollutants	MoEF, CPCB, MPCB, MNRE Pharmaceutical, Refineries,
Fugitive Emission control	Industrial process improvement better operation and maintenance	For localized region, very effective, particularly for industries with fine particles raw material or products. High efficiencies can be achieved for quarries.	Monitored data is scarce and therefore how and where to undertake the action will be limited	MPCB can work on the identification of hotspots, standards and compliance system should be developed for fugitive emission	Local area air quality improvement could be highly effective.	MPCB, Industries, CPCB

Table 8.4 (Contd..) : Considerations in Prioritizing Technical Measures for Addressing Urban Air Pollution – Area Source

Actions	Technical Issue	Effectiveness for Pollution reduction	Barriers to implementation	Administrative /regulatory	Qualifiers (Co-Benefit)	Local/ National Stakeholders
Strategy : Area Sources: Mixed sources and varied strategies						
Improve fuel used for domestic purposes	LPG/PNG major domestic fuel, however kerosene is still a major source in low income group/ better stoves or change in fuel to LPG	Likely to improve indoor air quality	Lack of finance to low income group, particularly in slums	Administrative mechanism to be evolved to provide low cost clean fuel to slum dwellers	It would alleviate large section of population with high indoor pollution of other sources leading to lower disease burden and better quality of life	Central and State Govt., MoPNG, Mahanagar Gas
Bakeries /crematoria	Electric/LPG source based bakeries needing changes in design. Many crematoria have electric system, but need to convert all the other into electric system	Local grid based PM can be reduced.	Awareness to bakeries that the quality can still be maintained with electric or LPG ovens. Similarly, despite electric crematoria being available, people prefer using wood based pyres	Strict monitoring of emissions from bakeries and crematoria, Stack monitoring	Reduction in PM as well as odour will take place and is likely to improve the local air quality	MMRDA, NMMC and MPCB
Biomass/trash burning, landfill waste burning	Better control on collection and disposal at the respective sites. Landfill waste burning needs proper technology driven site management	Local area can have substantial reduction in PM. Very high effectiveness to adjoining grids	Awareness and local control. Apathy to take urgent action. No burning day vow to be taken by NMMC	NMMC needs to address this issues	High level improvement in local area ambient air quality not only for PM but other pollutants	NMMC, MPCB, MMRDA

Table 8.4 (Contd..) : Considerations in Prioritizing Technical Measures for Addressing Urban Air Pollution – Area Source

Actions	Technical Issue	Effectiveness for Pollution reduction	Barriers to implementation	Administrative /regulatory	Qualifiers (Co-Benefit)	Local/ National Stakeholders
Strategy : Area Sources: Mixed sources and varied strategies						
Resuspension	Vehicle movement related resuspension can be reduced by having better paved roads, regular sweeping and spray of water.	Highly effective for kerb-side air quality	Awareness and will to implement	Norms for road construction to be framed and implemented	Roadside as well population within the distance of about 200-300 m from the road will have low exposure of PM leading to better sense of well being	NMMC, CIDCO, MSRDC, MMRDA
Illegal SSI	Level of problem not well known. Need to understand what are the levels of operation and their contribution in each of the grids in the city	Local area improvement can be moderately good	Knowledge of the problem	Need for strict rules of such units and identification by MPCB/DIC and BMC	It will lead to large scale reduction of fire accidents as well as minimization of wastewater problem	MPCB, DIC, NMMC
Construction	Construction activities which involve demolition, digging, construction, vehicle movement etc. need information on how to minimize the dust	Large scale improvement in local area is expected.	Emphasis on better construction practices and management plan for air emission and its control by the implementing agencies	Penalty system to be employed by the local authorities for violating the best construction practices for air pollution control.	Spillage on road and further re-suspension of dust can be minimized	NMMC, MMRDA, CIDCO Builders Association

The options discussed are also detailed with regard to action to be taken up at city, state or central levels. The **Table 8.5** delineate the prioritize action plan components with ranking for vehicles, industries and area sources.

Table 8.5 : Prioritization of Action Components for Ranking

Types	Components
Vehicular Sector	
Fuel Related	1. Alternative Fuel CNG/LPG 2. Sulphur reduction 3. Prevent fuel adulteration
Vehicle Technology related	1. Stringent Emission standards for new vehicles (Bharat IV and VI) 2. Electric vehicles for high VKT vehicles 3. Conversion of private diesel cars to CNG/LPG 4. Fuel Efficiency standards 5. Replacement of commercial diesel vehicles to CNG/LPG 6. Retrofitment of catalytic converter & diesel oxidation catalyst -older vehicles 7. Phase out of older vehicles 8. Retrofitment of older vehicles with Bharat Stage III engines with DOC
In-Use vehicle	1. Improvement and compliance system in existing PUC 2. Inspection and identification of highly polluting vehicles 3. Augmentation of manpower and related infrastructure for Inspection and Certification
Policy and Public Processes	1. Prioritization of public transport on roads (bus lanes, better buses, low cost of travel, faster travel, accessibility of transport). 2. Affordable public transport (cross-support from charges collected for higher car use charges, higher parking charges, higher registration costs, higher taxes on private mode of transport, low fuel cost for public transport 3. Incentive/subsidy for voluntary inspection and maintenance of vehicles 4. Incentive/subsidy to phase out grossly polluting vehicles 5. Drivers and Mechanics Training programmes 6. Public awareness on use of alternate fuel (CNG/LPG), adulteration of fuels, benefits of various maintenance measures.
Road and Traffic Control	1. Improvement of roads 2. Transportation planning and better road maintenance 3. Pavement improvement and better sweeping for less resuspension 4. Road Congestion –encroachment etc. 5. Traffic Management: signal synchronization, one way, pedestrian plaza

Table 8.5 (Contd..) : Prioritization of Action Components for Ranking

Types	Components
Industrial Sector	
Fuel Related	1. Change of coal to NG 2. Change of LSHS to LDO
Technology related	1. Clean combustion technology 2. High efficiency control technology 3. Clean process technology
Fugitive and other emissions	1. Industry specific plans 2. Compliance monitoring design for fugitive emissions
Area Sector	
Fuel Related	1. LPG/ CNG & Low sulfur fuel for bakeries, crematoria 2. PNG/ LPG for domestic fuel in place of kerosene
Biomass /landfill burning	1. Open burning to be stopped 2. Landfill burning management 3. Open eatout burning of coal /kerosene to be regulated
Construction / demolition of buildings	1. Norms for building construction / demolitions 2. Regulation and compliance monitoring 3. Material movement control 4. Construction machineries use and its management
Road Construction/ Repairs	1. Road quality norms to be revisited (Refer : UTTIPEC design manual created by Delhi Development Authority for uniform roadside, drains, footpath and related design) 2. Use road repair technologies and consider life of road warranties 3. Stoppage of wood burning for tar melting or re-surfacing of the road
Public Awareness	1. Public awareness programme to empower citizens to report small sources but highly prevalent 2. Inclusion of road construction related burning in rules

All the above actions have been rated on the basis four criteria viz.

- Effectiveness - Ease of implementation - Cost implications - Time frame

These criteria should not be considered as firm numbers as many of these cannot be easily quantified. The ranking carried out here therefore is of subjective in nature; however, these are based on relevant facts and analysis of their effectiveness. For example an action plan with "low cost" in Fuel Related category may not be same as in Technology Related "low cost".

The prioritization of various options in all three categories have addressed mostly all the major reduction in the overall pollutants load reduction combined with ambient air quality improvement. However, many of these measures still may not lead to resolving very small area high concentration points which could be due to short term but high emission or high activity for a limited period and limited area. Such hot spots in the city of Navi Mumbai could exist when a local road is dug up and/or being repaired, construction and demolition of buildings, biomass and refuse burning, industries short term emissions etc. All of such activities can be controlled and regulated through local efforts and constant vigil on the part of citizen, pollution control agency and respective responsible implementing agency.

One of the biggest issues for large metro city is land use pattern, which indirectly drives the growth pattern of the city and consequent vehicle increase. Frequent change in floor space index (allowing more built up per unit area) leads to large scale increase in vehicle ownership and their presence on road. Better air quality planning for the city also needs appropriate transport planning which is linked with land use.

All reductions planned will only reduce emissions from manmade sources; however, natural background and dust would continue to remain in the atmosphere.

The benefits computed in the process described above will not only yield PM and NOx related pollution reduction but also co benefit of other pollutants (SO_2, VOCs, HC, CO etc) reductions as well. One of the other major co-benefits of these options (adoption of mass transport, use of cleaner fuel, efficient combustion etc) will provide large scale green house gas reduction. Navi Mumbai as growing metro city will provide the impetus of overall mitigation of GHG. The benefits of air quality improvement plan suggested and delineated above again will not yield desired results if the adjoining urban centers do not adopt measures suggested, as the objectives of clean air cannot be kept limited to the political boundary of Navi Mumbai, when it is in close proximity of major urban centers.

ANNEXURE - 1

Emission Factors

(Area, Line and Point Sources)

Annexure 1

Emission Factors

A) Area Source

Bakery

Emission Factor for Wood Burning (kg/t)
PM_{10} = 17.3, SO_2 = 0.2, NOx = 1.3, CO =126.3, HC = 114.5 (VOC as HC)
*$PM_{2.5}$ /PM_{10} ratio considered was =0.68
http://www.epa.gov/ttn/chief/ap42/index.html (Sec. 1.9, pp. 1.10.4, Table 1.9.1)
(Rakesh Kumar and Abba Elizabeth., 2003), VOC to HC - lb/ton - kg/ton*
Emission Factor for Diesel Burning (kg/kiloliters)
SPM= 0.25, PM_{10} =60% of SPM, $PM_{2.5}$ =40% of SPM, CO= 0.63, SO_2 =17.25S, NOx = 2.75, HC = 0.12, (Sulfur content = 0.35%) - automobile euro norms
(TERI, Environmental Effects of Energy Production Transportation and Consumption in NCR, New Delhi, 1992)

Crematoria

Emission factors for wood burning (kg/t)
PM_{10}=17.3, SO_2 = 0.2, NOx 1.3, CO =126.3, HC =114.5 (VOC as HC)
*$PM_{2.5}$ /PM_{10} ratio considered was =0.68
http://www.epa.gov/ttn/chief/ap42/index.html (Sec. 1.9, pp. 1.10.4, Table 1.9.1)
Emission Factor Kerosene (kg/t)
SPM =1.95, PM_{10} =0.61, SO_2 =4, NOx =2.5, CO=62, HC =19
URBAIR, Working Group 1992 - Kerosene, Residential Emission Factor - Electric (kg/ body)
Emission Factor Electric (kg/body)
PM_{10} =0.000025, SO_2 = 0.0544, NOx =0.308, CO =0.141, NVOC =0.013
*$PM_{2.5}$ /PM_{10} ratio considered was =0.68
http://www.naei.org.uk/emissions/selection.php
Body burning was separately calculated based on emission factor electric crematoria

Open Eat Outs

Emission factor for LPG
PM_{10} =2.10, SO_2 = 0.40, NOx = 1.8, CO= 0.25, HC as VOC=0.07
Assessment of Sources of Air, Water and Land Pollution – A Guide to Rapid Source Inventory Techniques and their Use in Formulating Environmental Control Strategies – Part one – Rapid Inventory Techniques in Environmental Pollution by A.P. Economopolous, WHO, Geneva, 1993
Particulate emission LPG considered as $PM_{2.5}$
Emission factor for Kerosene : SPM=0.06, PM_{10}=0.61, SO_2 =4, NOx =2.5, CO = 62
Urban Air Quality Management Strategy in Asia – Greater Mumbai Report edited by Jitendra J. Shah and Tanvi Nagpal, World Bank Technical Paper No. 381, 1997
Emission factor for Coal : SPM =20, SO_2 = 13.3, NOx =3.99, CO=24.92, HC =0.5
Environmental effects of energy production, transformation and consumption in the National Capital Region submitted to the Ministry of Environment & Forest, by Tata Energy Research Institute (TERI), New Delhi, February 1992

Domestic Cooking
<u>Emission Factor for LPG</u> : PM=2.1, CO =0.252, SO_2 = 0.4, NOx = 1.8, VOC = 0.072
<u>Emission Factor for Kerosene</u> : PM_{10}=0.61, SO_2 =4, NOx =2.5, CO = 62
Assessment of Sources of Air, Water and Land Pollution – A Guide to Rapid Source Inventory Techniques and their Use in Formulating Environmental Control Strategies – Part one – Rapid Inventory Techniques in Environmental Pollution by A.P. Economopolous, WHO, Geneva, 1993

Hotels & Restaurants
<u>Emission factor for LPG</u>
PM_{10} =2.10, SO_2 = 0.40, NOx = 1.8, CO= 0.25, HC as VOC=0.07
Assessment of Sources of Air, Water and Land Pollution – A Guide to Rapid Source Inventory Techniques and their Use in Formulating Environmental Control Strategies – Part one – Rapid Inventory Techniques in Environmental Pollution by A.P. Economopolous, WHO, Geneva, 1993
Particulate emission LPG considered as PM2.5
<u>Emission factor for Coal</u> : SPM =20, SO_2 = 13.3, NOx =3.99, CO=24.92, HC =0.5
Environmental effects of energy production, transformation and consumption in the National Capital Region submitted to the Ministry of Environment & Forest, by Tata Energy Research Institute (TERI), New Delhi, February 1992

Open Burning
Emission Factor (kg/MT) PM_{10} = 8, $PM_{2.5}$ =5.44, CO=42, SO_2=0.5000,NOx= 3, VOC= 21.5
A Guide to Rapid Source Inventory Techniques and their Use in Formulating Environmental Control Strategies – Part one – Rapid Inventory Techniques in Environmental Pollution by A.P. Economopolous, WHO, Geneva, 1993

Aircrafts
Emission factor domestic flight
PM10=0.99*, CO =11.8, SOx =0.8, NOx =8.3, VOC=0.5
Emission factor international flight
PM10=0.99*, CO =6.1, SOx =1.6, NOx =26, VOC=0.2
** A Guide to Rapid Source Inventory Techniques and their Use in Formulating Environmental Control Strategies – Part one – Rapid Inventory Techniques in Environmental Pollution by A.P. Economopolous, WHO, Geneva, 1993*
Other emission factors are taken from
www.ecotourism.org/onlineLib/Uploaded/ … Airplanes emissions. PDF
PM2.5/PM10 = 0.92
Preparation of Fine Particulate Emission Inventories -Student Manual, APTI Course 419B, Sec. 4.2.1, pg-4.7

Marine Vessels
Emission factors *(kg/t fuel consumed)*: PM_{10} =1.03, CO =1.85, SO_2 =11, NOx= 10, VOC as HC = 0.83, Density of diesel = 0.86 (HSD) *UK-Shipping international-Fuel oil*

Paved & Unpaved Dust
Paved Road Dust : $PM_{2.5}$ = 0.39, PM_{10}= 1.93
** Strengthening Environmental Management at the State Level (Cluster) Component E- Strengthening Environmental Management at West Bengal Pollution Control Board, TA No. 3423-IND, Asian Development Bank, Nov. 2005 (Table 12, Page 23) USEPA AP42 Paved, Section 13.2.1.4 Motor Transport Statistics, Transport Commissioner Office, Mumbai* Silt loading estimate -0.531 gm/m2 (*Kolkata ADB report –Table 13, page 23) Break and tire wear correction – (USEPA AP42 Paved, Section 13.2.1.4, Table 13.2.1.2) Wet days = 120, (IMD, Mumbai)

Emission factor for industrial and vehicular sources are given in respective chapters

B) Line (Vehicular) Source

Emission Factors Calculated by Automotive Research Association of India (ARAI)

Vehicular Emission Factors (Gm/Km)	Car Petrol Post 2005 Fuel BSII	Car Diesel Post 2005 Fuel BSII	Car CNG Post 2000, Fuel BSII	Two Wheeler Post 2005 4 Stroke Fuel BS II	Three Wheeler CNG Retro 25 Post 2000 Fuel BS II	CNG Buses Post 2000 Fuel BS II	Trucks Diesel Post 2000 Fuel BSII
PM	0.002	0.015	0.006	0.013	0.118	0.044	1.240
NOx	0.090	0.280	0.740	0.150	0.190	6.210	9.300
CO	0.840	0.060	0.060	0.720	0.690	3.720	6.000
HC	0.12	0.080	0.460	0.520	2.06	3.750	0.370

Factors used for emission load calculation Source: Air Quality Monitoring Project-Indian Clean Air Programme (ICAP), The Automotive Research Association of India, 08, 2007

* Emission Factors for BS IV and BS VI are given below :

Emission Factors for BS IV and BS VI

Emission Factor for BS IV fuel	PM	NO_x	CO	HC
Car Petrol Car	0.002	0.08	1	0.1
Car Diesel Car	0.025	0.25	0.5	0.3
CNG Car/Taxi (LMV)	0.006	0.08	1	0.1
Two wheeler	0.013	0.79	1.403	0.39
Three wheeler	0.0425	0.38	0.38	2.06
Heavy Duty Diesel Vehicles	0.02	3.5	1.5	0.46

Emission Factor for BS VI fuel	PM	NO_x	CO	HC
Car Petrol Car	0.005	0.06	1	0.1
Car Diesel Car	0.005	0.08	0.5	0.17
CNG Car/Taxi (LMV)	0.005	0.06	1	0.1
Two wheeler	0.0045	0.06	1	0.1
Three wheeler	0.025	0.1	0.22	0.1
CNG Buses	0.01	0.46	4	0.16
Heavy Duty Diesel Vehicles	0.01	0.4	1.5	0.13

* Values in g/km Source: *https://www.transportpolicy.net/region/asia/india/*

TransportPolicy.net is collaboration between the International Council on Clean Transportation and DieselNet. On 19 Feb 2016, the Ministry of Road Transport and Highways (MoRTH) issued a draft notification of Bharat Stage (BS) VI emission standards. The standards, as proposed, will take effect throughout the country for all light-duty and heavy-duty vehicles as well as two and three wheelers manufactured on or after 1 Apr 2020. The draft proposal specifies mass emission standards, type approval requirements, and on-board diagnostic (OBD) system and durability levels for each vehicle category.

Additional provisions in the draft proposal include:

- Adoption of more stringent WHSC and WHTC test cycles
- Off-cycle emissions testing requirements and in-service conformity testing for type approval
- Specifications for Portable Emissions Measurement System (PEMS) demonstration testing at type approval. The proposed BS VI regulation establishes an important precedent for leap frogging from Euro IV-equivalent directly to Euro VI-equivalent motor vehicle emissions standards.

The World Harmonized Transient Cycle (WHTC) test is a transient engine dynamometer schedule defined by the proposed global technical regulation (GTR) developed by the UN ECE GRPE group. The GTR is covering a world-wide harmonized heavy-duty certification (WHDC) procedure for engine exhaust emissions. The proposed regulation is based on the world-wide pattern of real heavy commercial vehicle use.

a. test is performed on an engine dynamometer operated through a sequence of 13 speed and load conditions
b. a hot start steady state test cycle
c. transient test cycle with both cold and hot start requirements

Prior to 2010, emissions were tested using the ECE R49[a] test cycle. After 2010, for Bharat III and IV, the ESC (European Stationary Cycle) and ETC (European Transient Cycle) test cycles were used. BS VI will require the application of WHSC[b] (World Harmonized Stationary Cycle) and WHTC[c] (World Harmonized Transient Cycle) test cycles.

C) Point (Industry) Source

Emission Factors applied for Industrial Emissions

S. No.	Type of Fuel	Unit	S	Emission Factors (Kg/Unit)					
				TSP	SO_2	NO_x	HC	CO	Ash
1.	LSHS	KL	0.45	1.25*S + 0.38	19.25* S	7.5	0.12	0.63	
2.	FO	KL	4.0	1.25*S + 0.38	19.25* S	7.5	0.12	0.63	
3.	LDO	KL	1.8	0.25	17.25* S	2.75	0.12	0.63	
4.	HSD	KL	1.0	0.25	17.25* S	2.75	0.12	0.63	
5.	LPG/FG[$$]	KL	0.02	0.072	0.01*S	2.52	0.07	0.43	
6.	NG	m^3	-	160 E-06	9.6 E-06	2800 E-06	48 E-06	272 E-06	
7.	Coal /Coke	MT	0.5*	6.5*A	19S	7.5	0.5	1.0	45
8.	Kerosene[##]	Kg/t	0.25	0.06	17S	2.5	--	--	--
For Power Plant**									
1.	LSHS	KL	0.45	1.25*S + 0.38	19.25* S	6.25	0.12	0.63	
2.	NG	m^3	-	160 E-06	9.6 E-06	2800 E-06	48 E-06	272 E-06	
3.	Coal	MT	0.15	6.5*A	19*S	7.5	0.5	1	6

Source: URBAIR Report, Bombay, 1992
A: Percentage ash in coal = 45% and S: Percentage Sulphur
Other than Power Plant, efficiency of Cyclone considered as 75%
* *Power plant
[$$]Emission Factors for LPG from Revised AP-42 (Ref. PMRAP, NEERI, 2003 (Table 3.2)
Π Coal
A - % Ash: 2- 10% Avg. 6%, S - % Sulphur: 0.1 – 0.2%, Avg. 0.15%
ESP Eff. : 99.5%, FGD Eff. : 99%
Π LSHS Sulphur: 0.45%
Source:
a. Environmental effects of energy production, transformation and consumption in the National Capital Region submitted to the Ministry of Environment & Forest, by Tata Energy Research Institute (TERI), New Delhi, February 1992
b. Indian Oil Corporation Ltd, Vadodara

Density[b] of Fuels (Kg/m^3)

LSHS	943
FO	943
LDO	860
LPG	504
HSD	860

Baggase : Emission Factor Documentation for AP-42 Section 1.8, Bagasse Combustion in Sugar Mills, April, 1993 [PM10- 4.6, SO2-0.18, NO2-0.275, HC-0.0002515, CO - 390 (g/km)]

ANNEXURE - 2

ISOPLETS OF PM :

All Categories- (a)Area, (b) Line, (c) Resuspension of Dust, (d) Point –LSI, MSI & SSI

&

For All Season (Summer, Post Monsoon, Winter and Annual)

(Navi Mumbai City)

A) AREA SOURCE – ALL (PM)

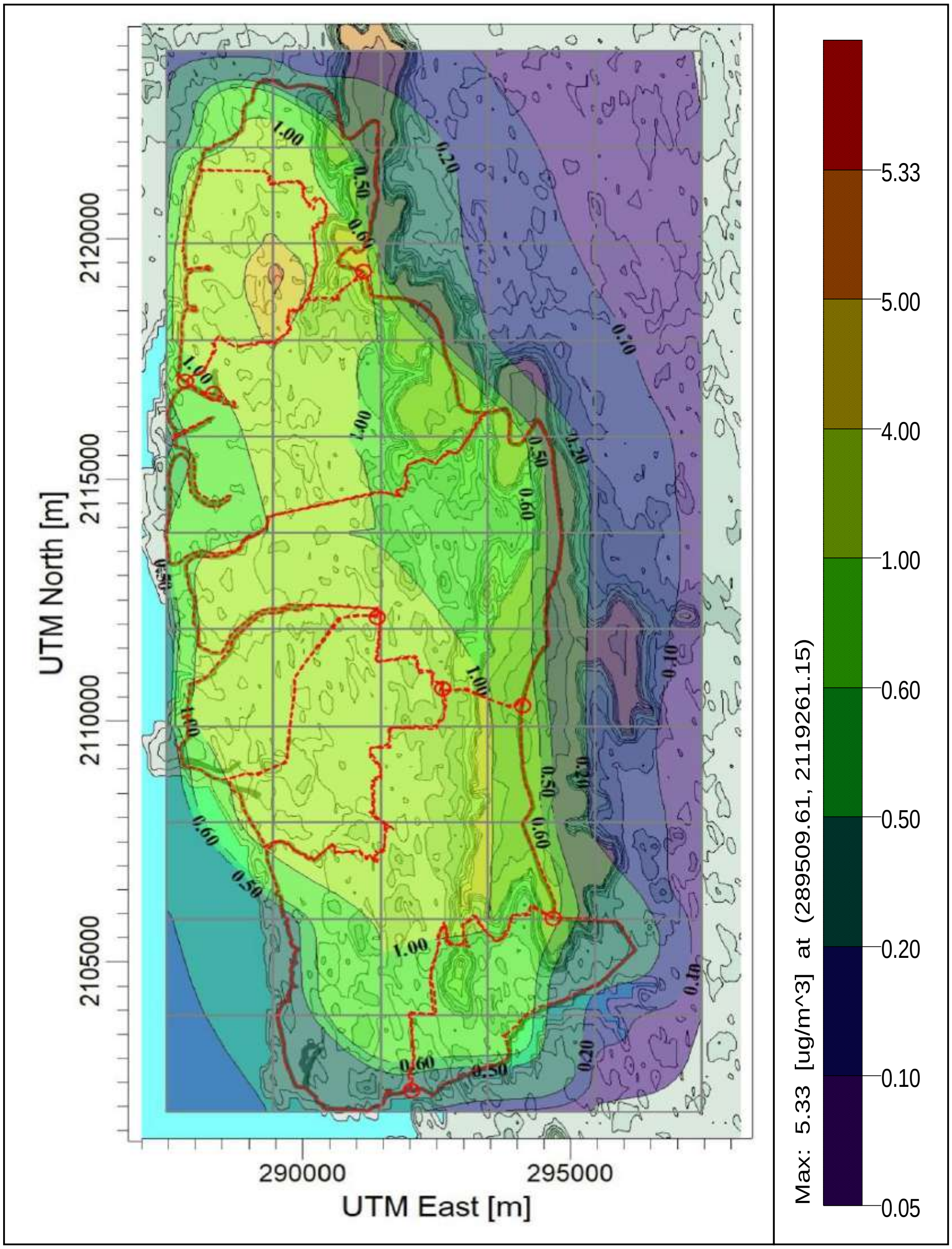

Figure P1: Isopleths of PM Due to Area Sources – Summer Season (Navi Mumbai City)

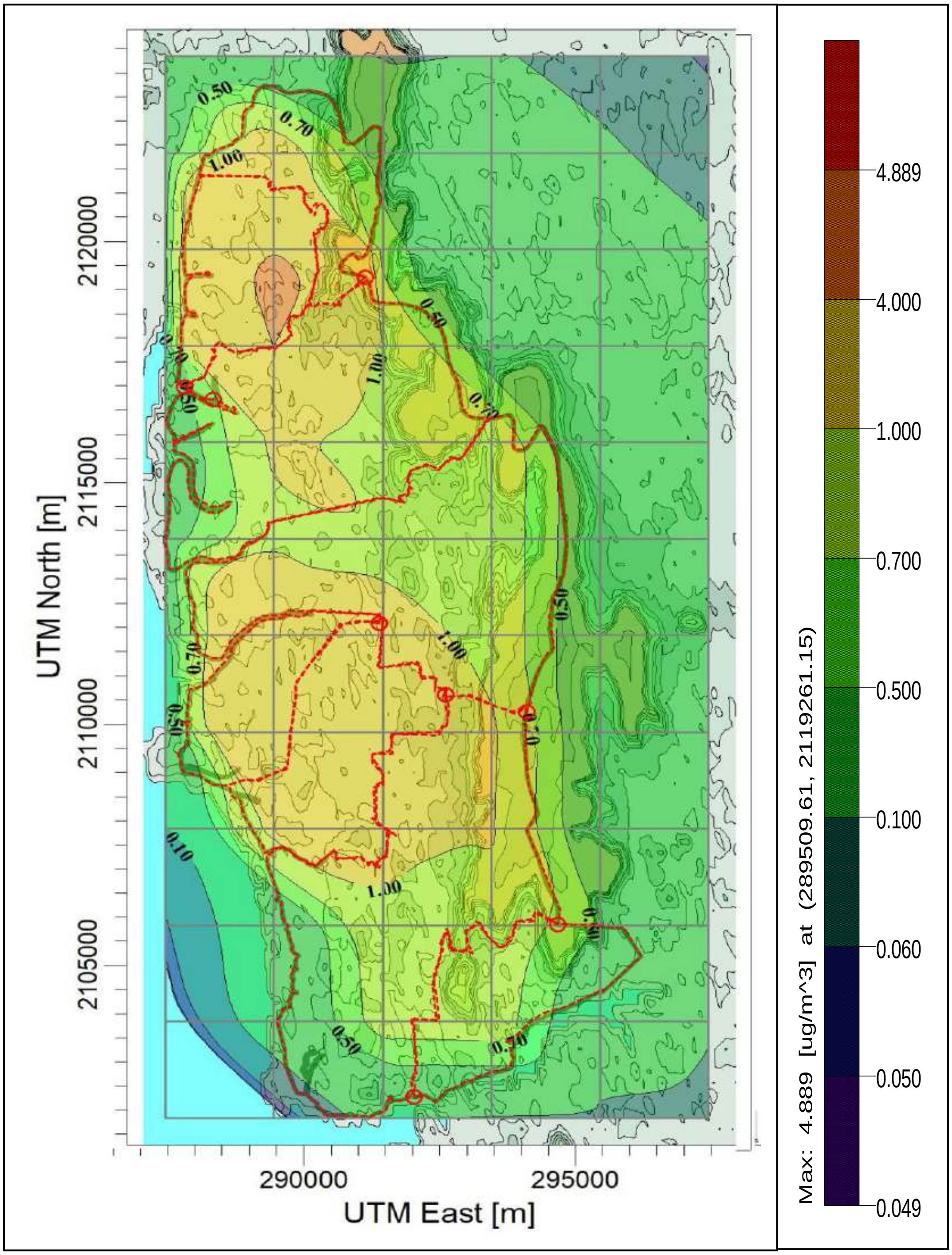

Figure P2 : Isopleths of PM Due to Area Sources – Post Monsoon Season (Navi Mumbai City)

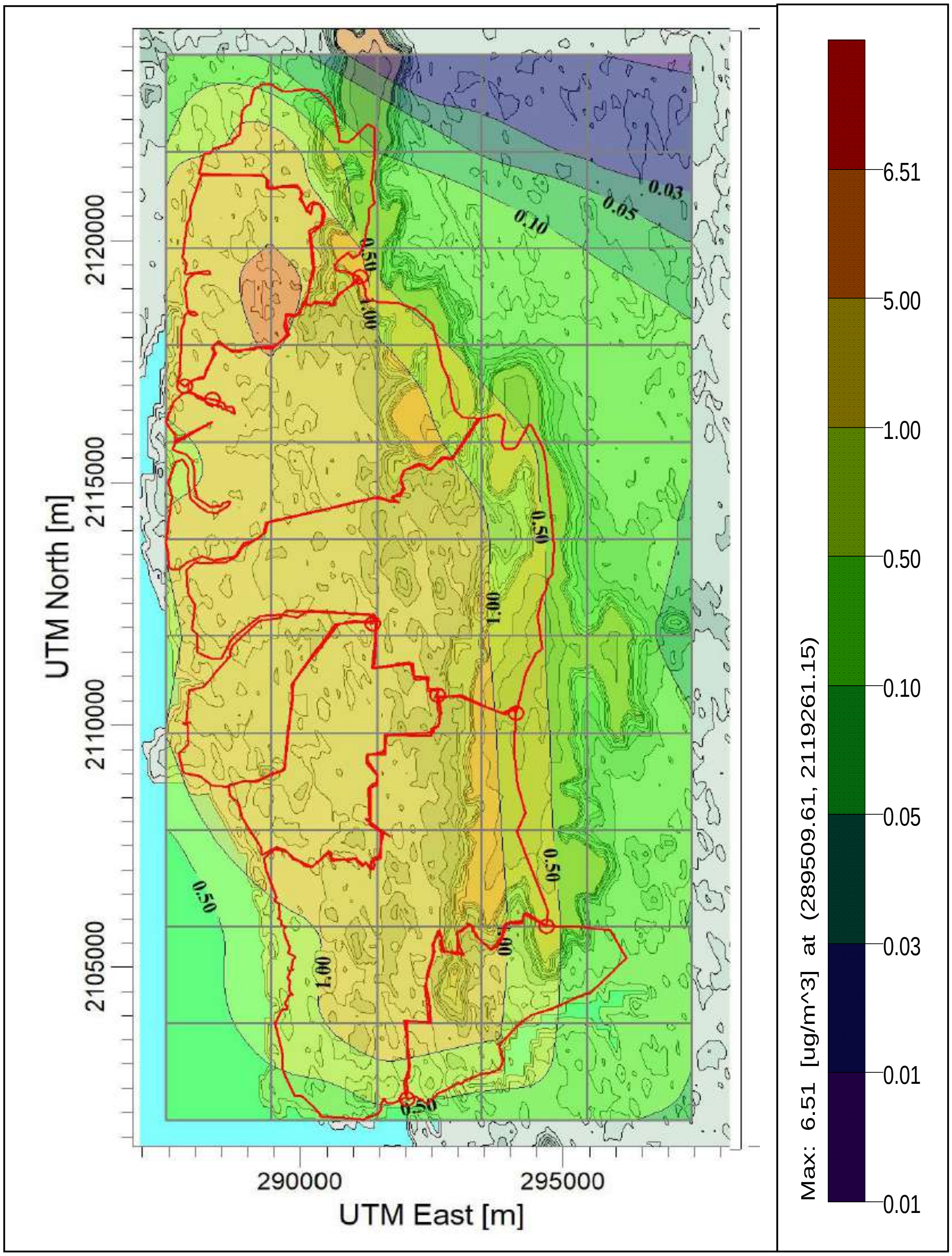

Figure P3 : Isopleths of PM Due to Area Sources – Winter Season (Navi Mumbai City)

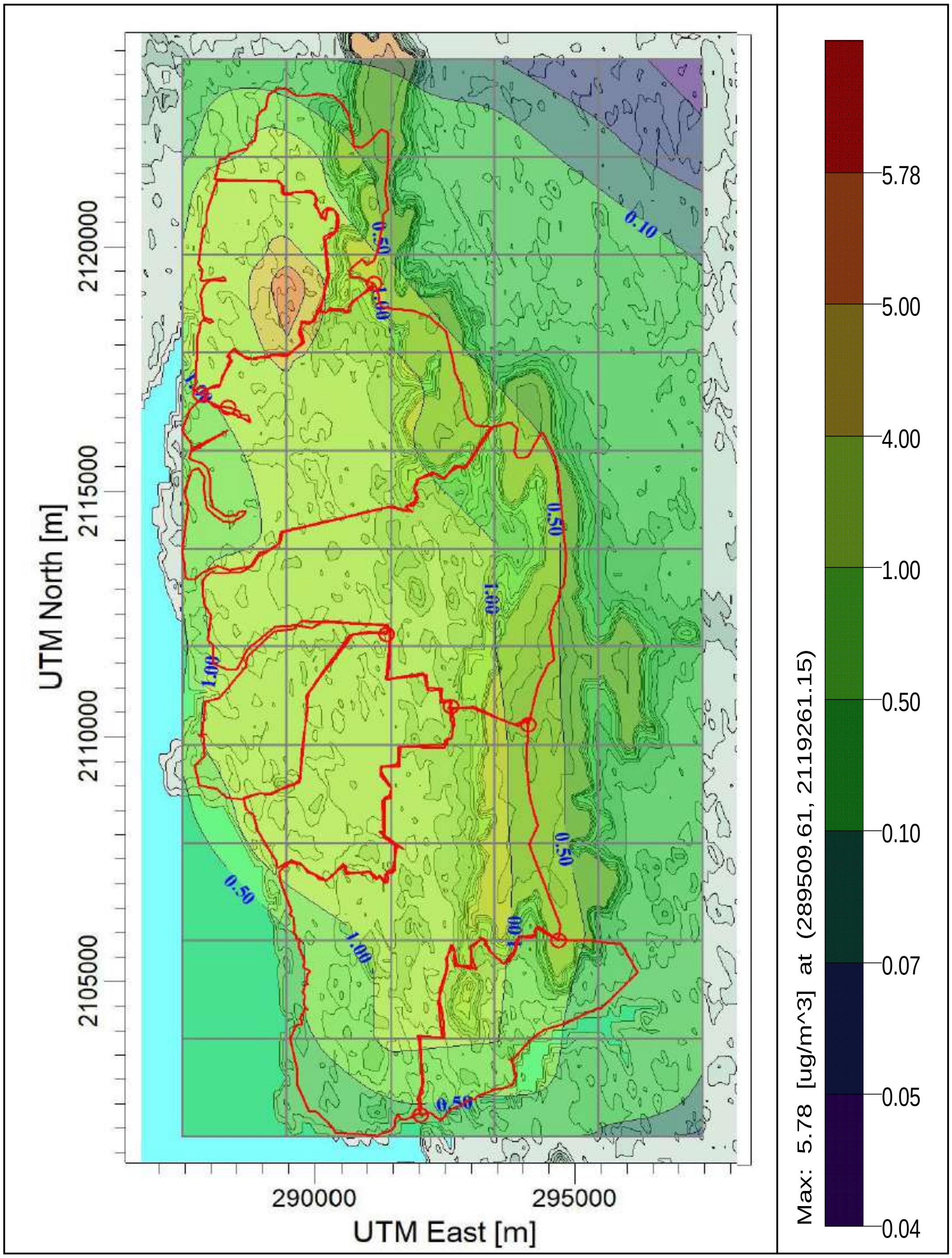

Figure P4 : Isopleths of PM Due to Area Sources – Annual (Navi Mumbai City)

B) LINE SOURCE – ALL (PM)

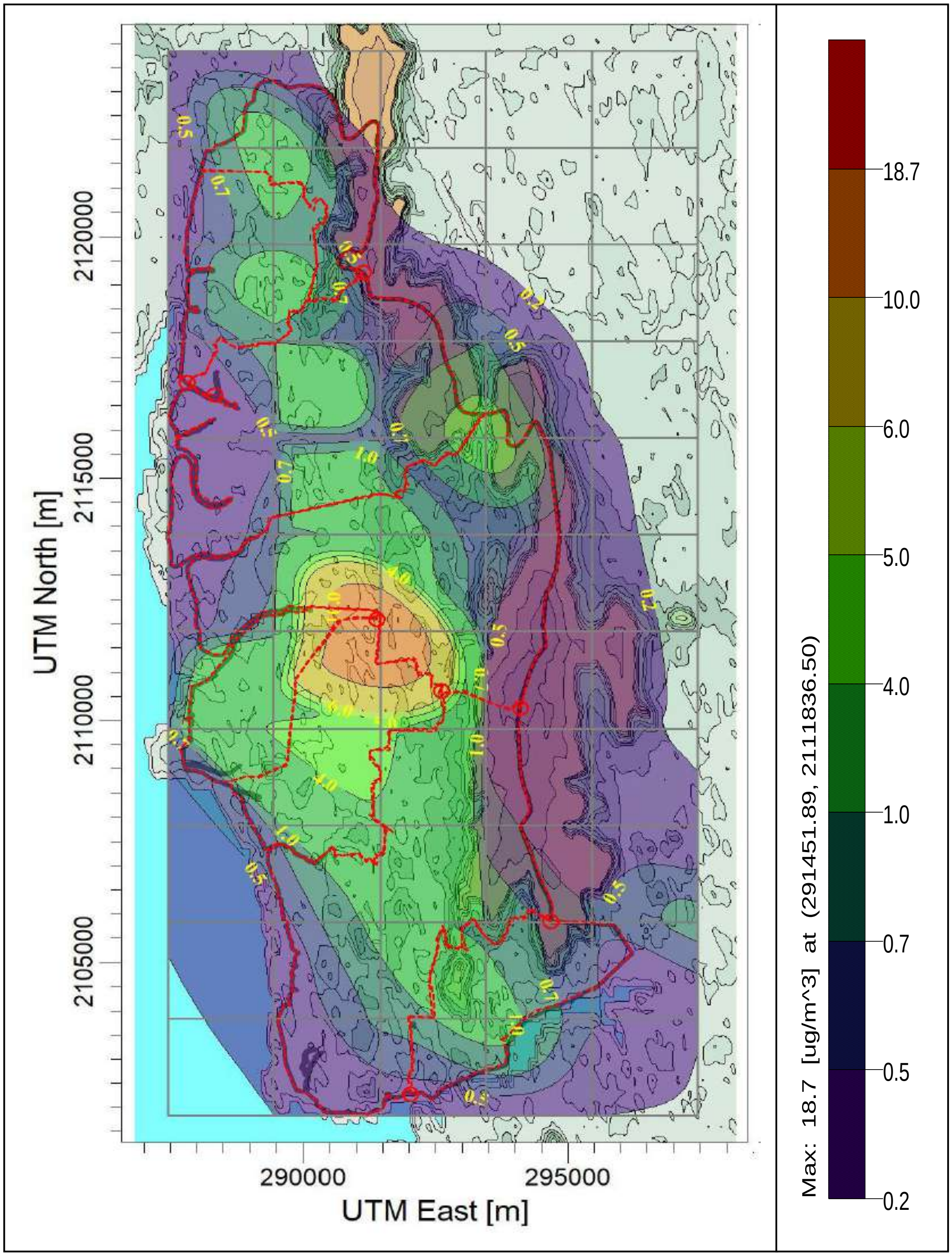

Figure P5 : Isopleths of PM Due to Line Sources – Summer Season (Navi Mumbai City)

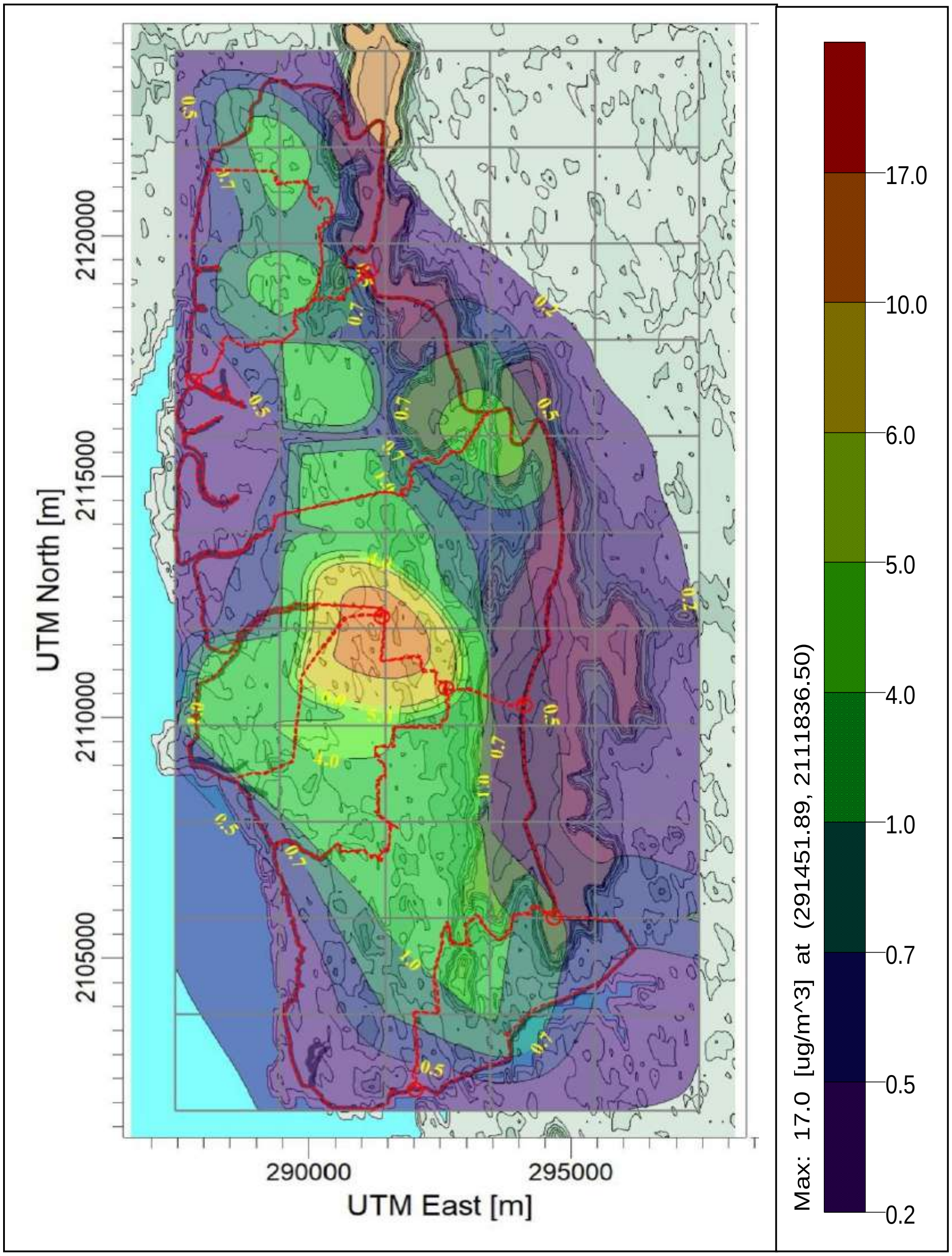

Figure P6 : Isopleths of PM Due to Line Sources – Post Monsoon Season (Navi Mumbai City)

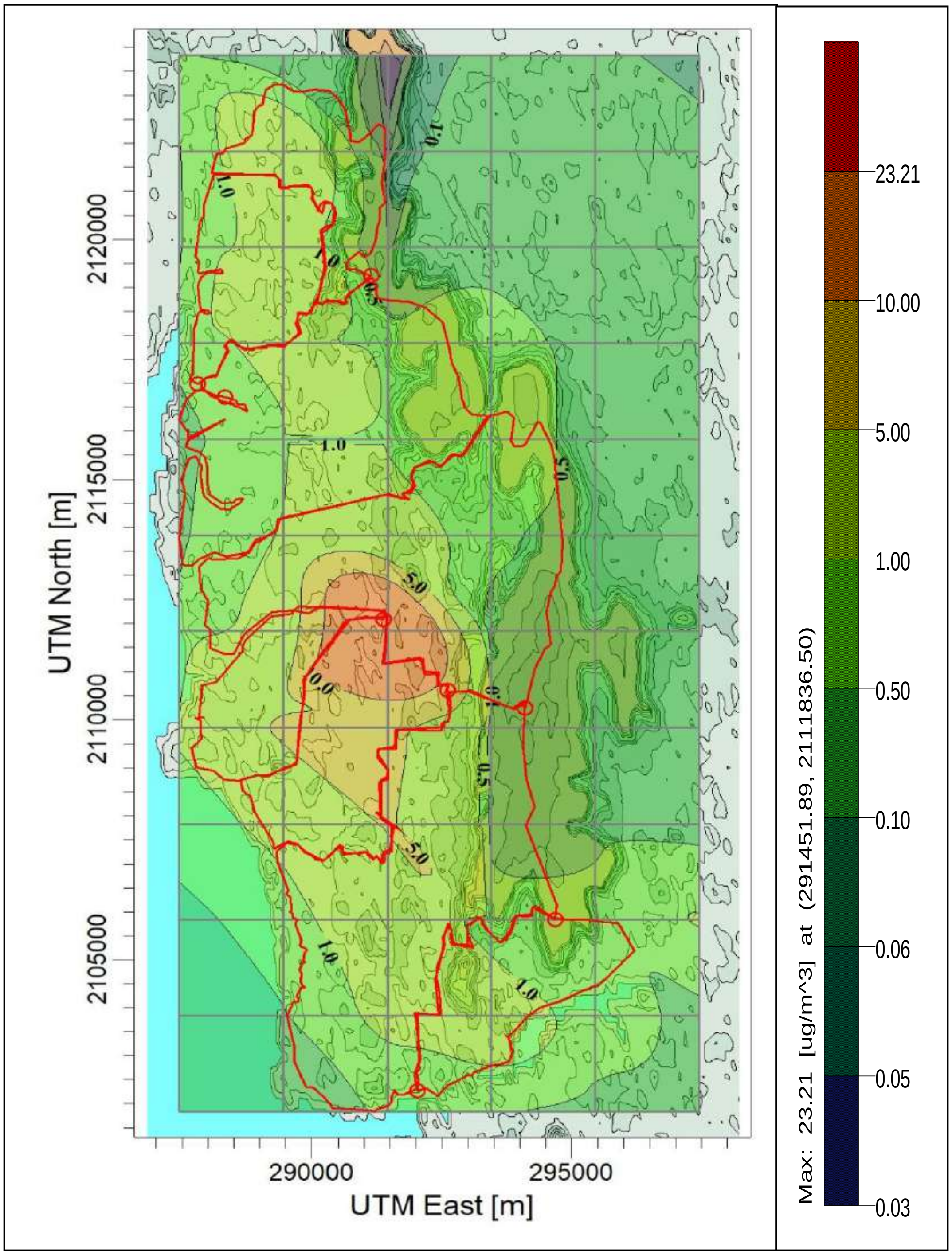

Figure P7 : Isopleths of PM Due to Line Sources – Winter Season (Navi Mumbai City)

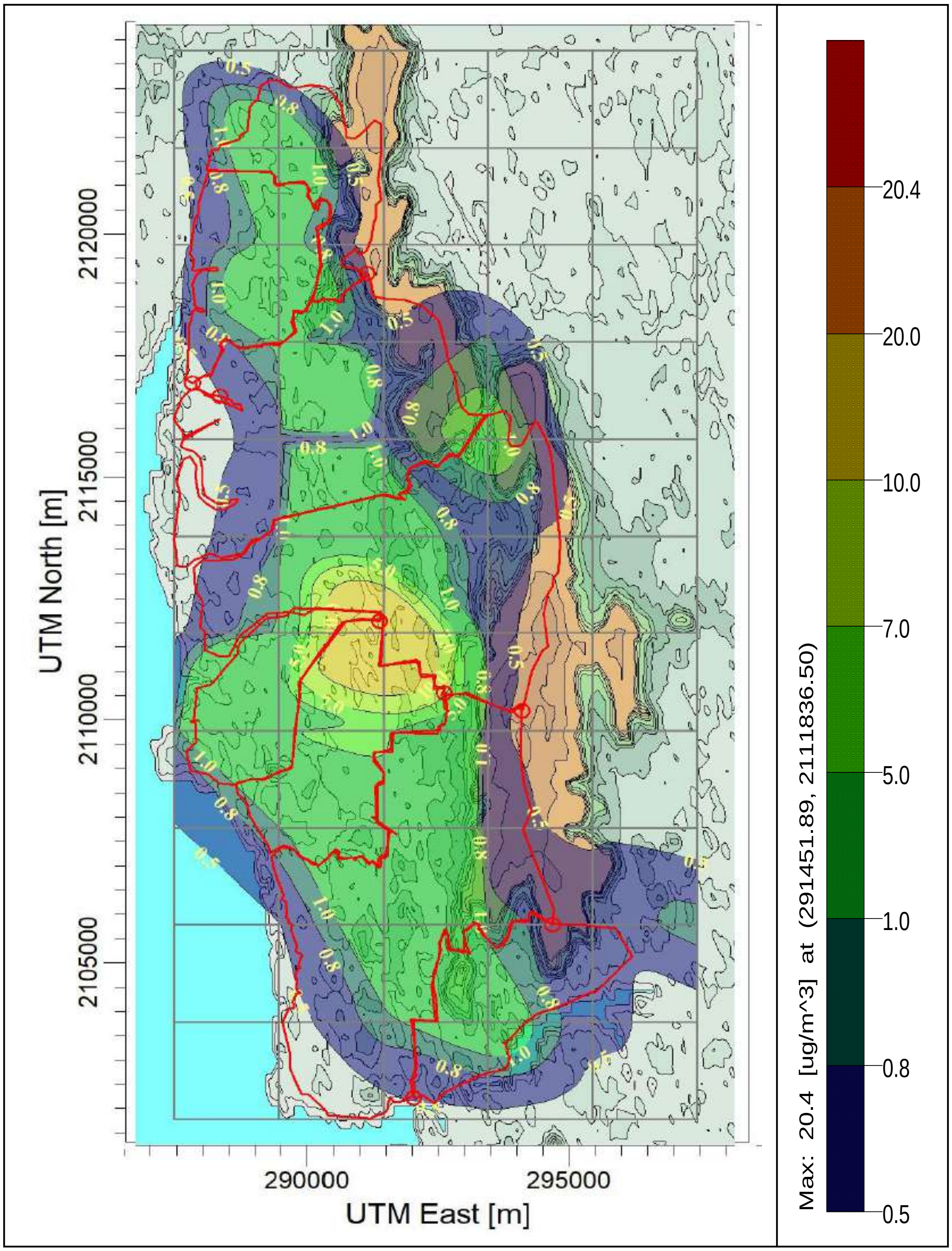

Figure P8 : Isopleths of PM Due to Line Sources – Annual (Navi Mumbai City)

C) RESUSPENSION DUST– ALL (PM)

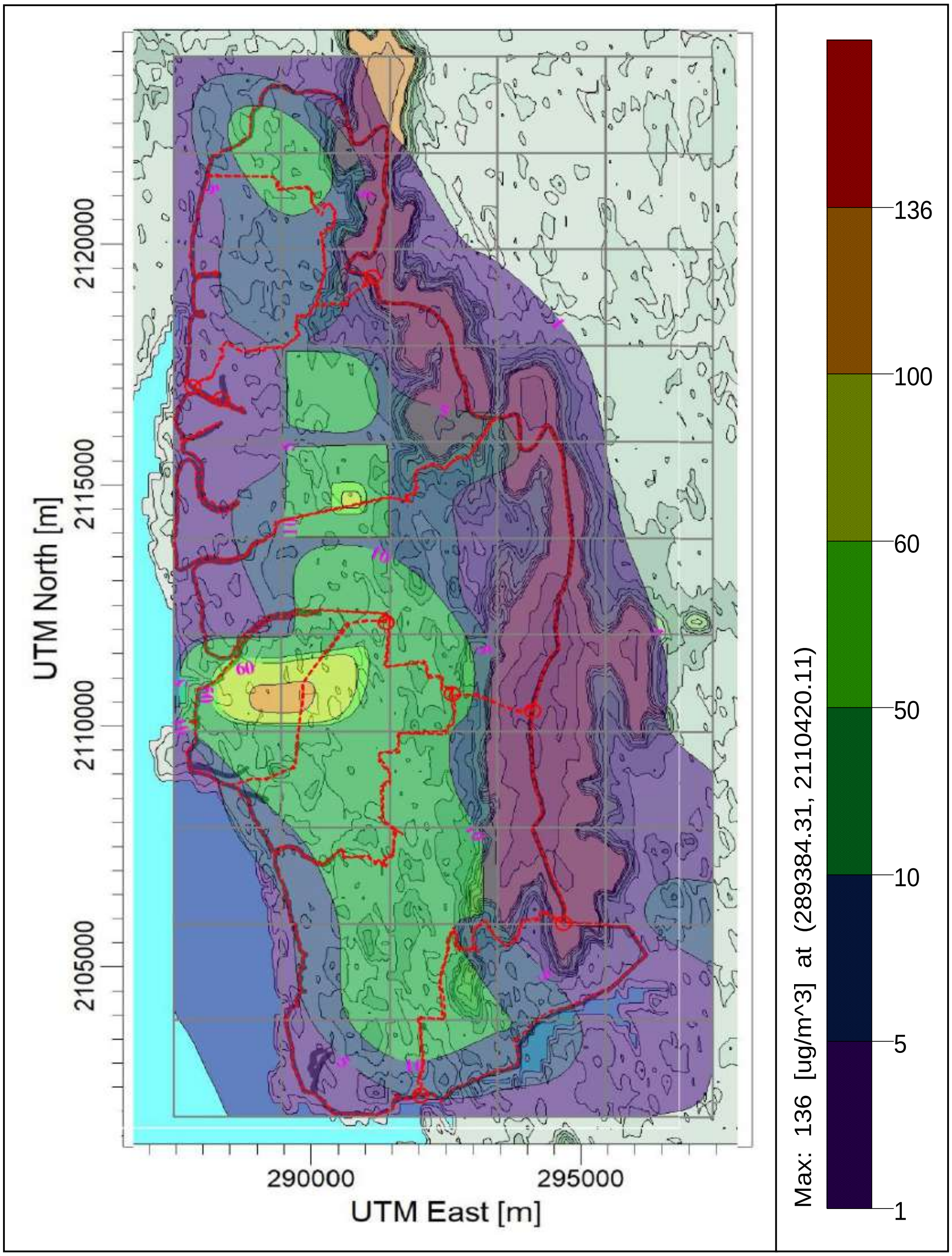

Figure P9 : Isopleths of PM Due to Resuspension Dust– Summer Season (Navi Mumbai City)

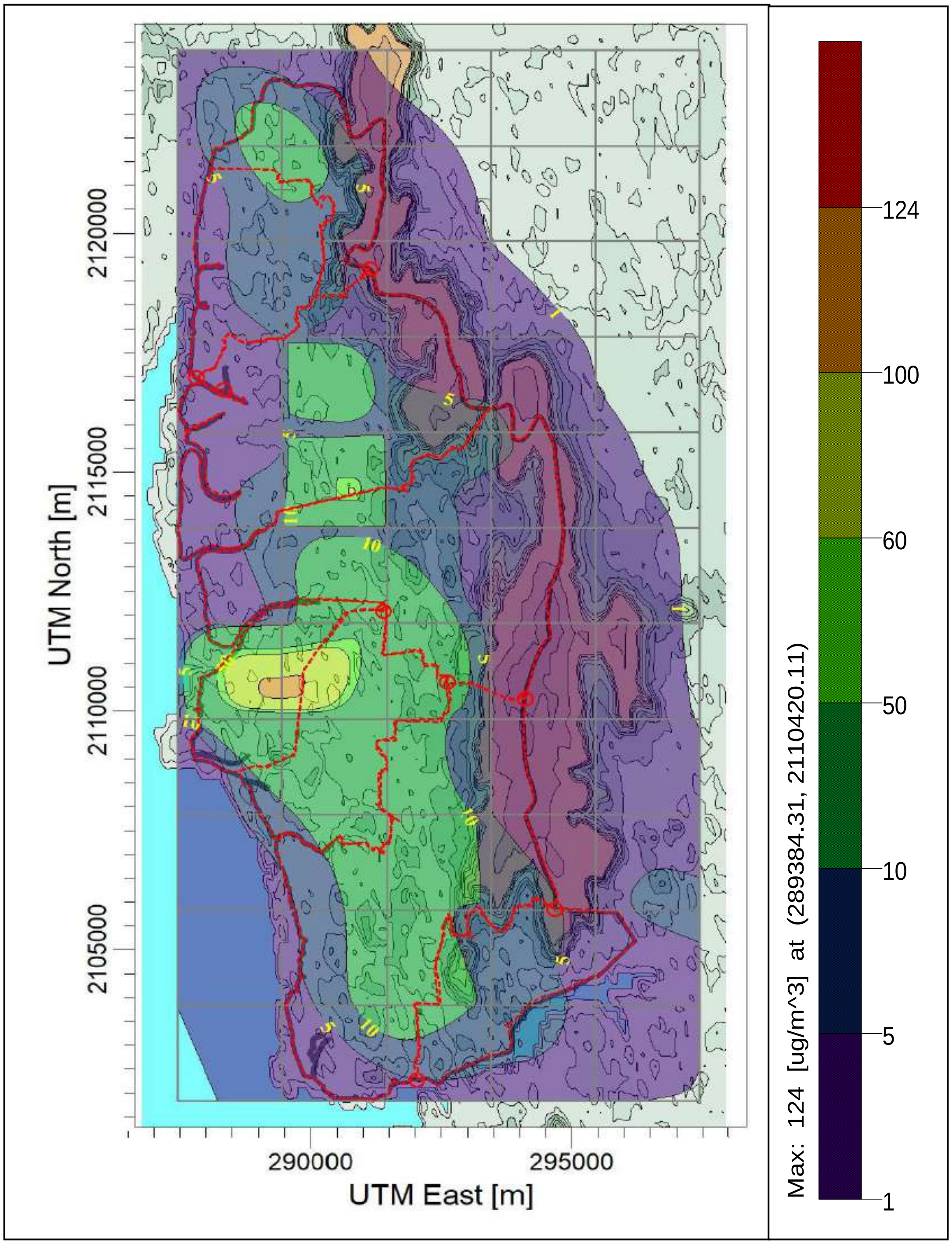

Figure P10 : Isopleths of PM Due to Resuspension Dust– Post Monsoon Season (Navi Mumbai City)

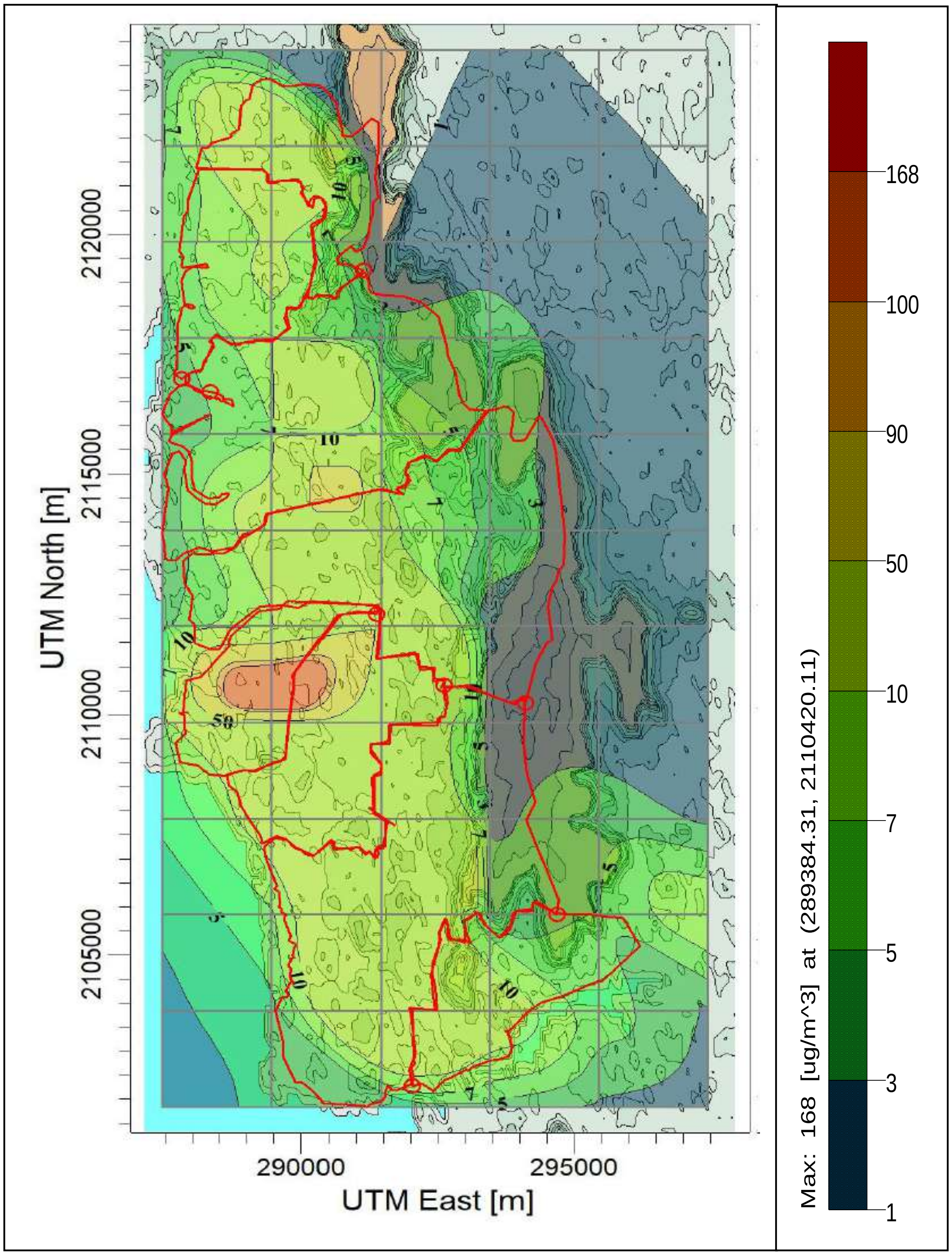

Figure P11 : Isopleths of PM Due to Resuspension Dust– Winter Season (Navi Mumbai City)

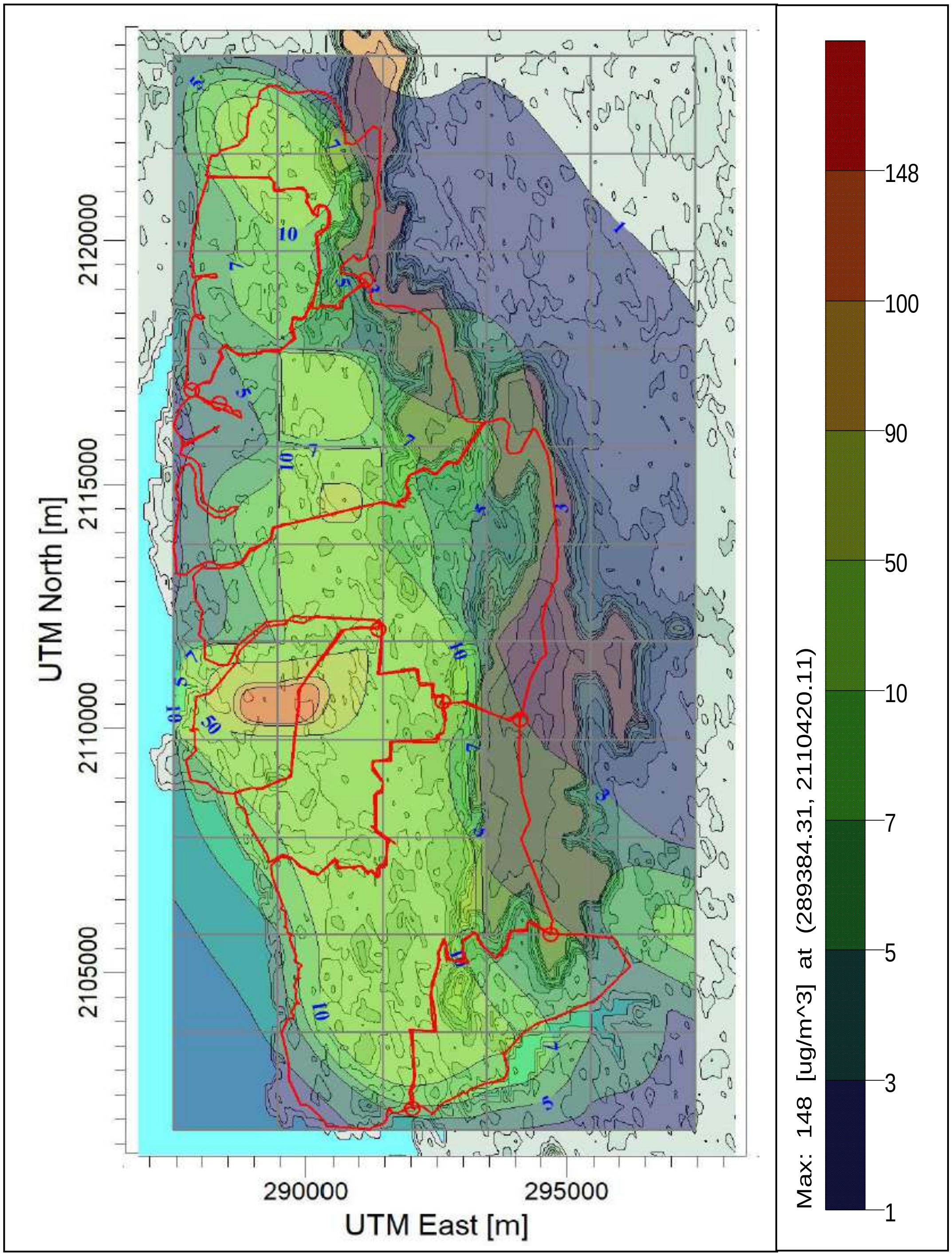

Figure P12 : Isopleths of PM Due to Resuspension Dust– Annual (Navi Mumbai City)

D) POINT SOURCE – LSI (PM)

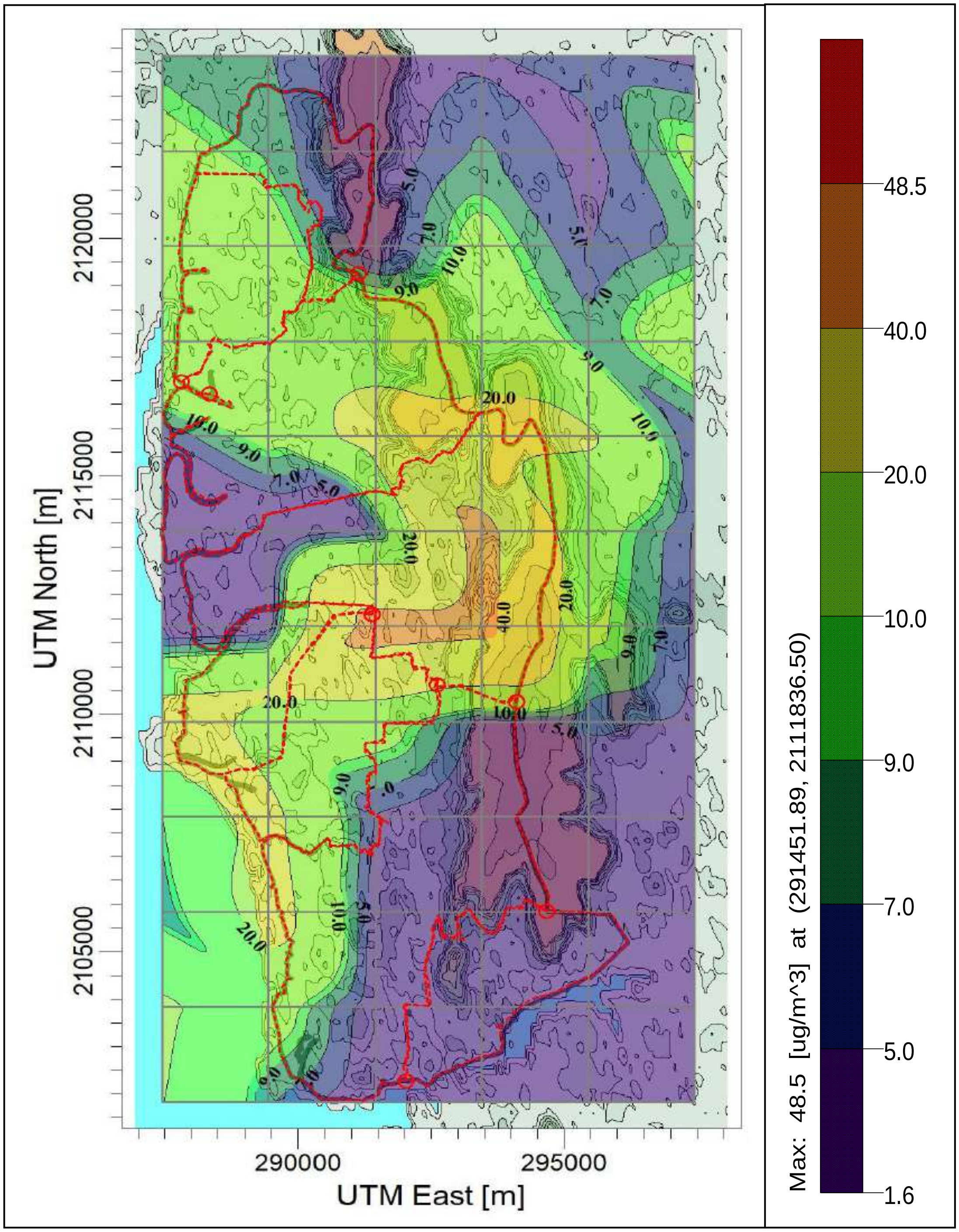

Figure P13 : Isopleths of PM Due to Point Sources (LSI) – Summer Season (Navi Mumbai City)

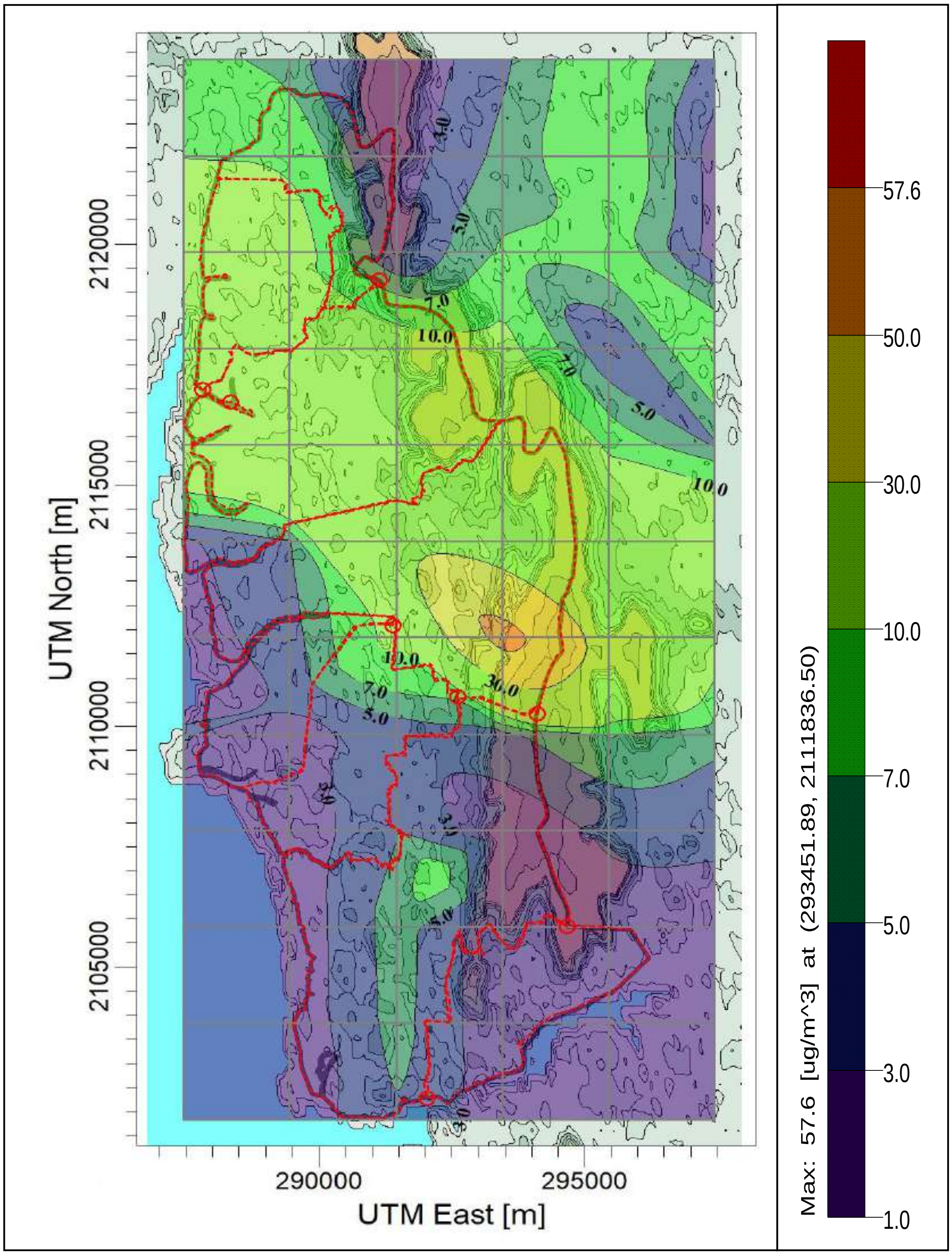

Figure P14 : Isopleths of PM Due to Point Sources (LSI) – Post Monsoon Season (Navi Mumbai City)

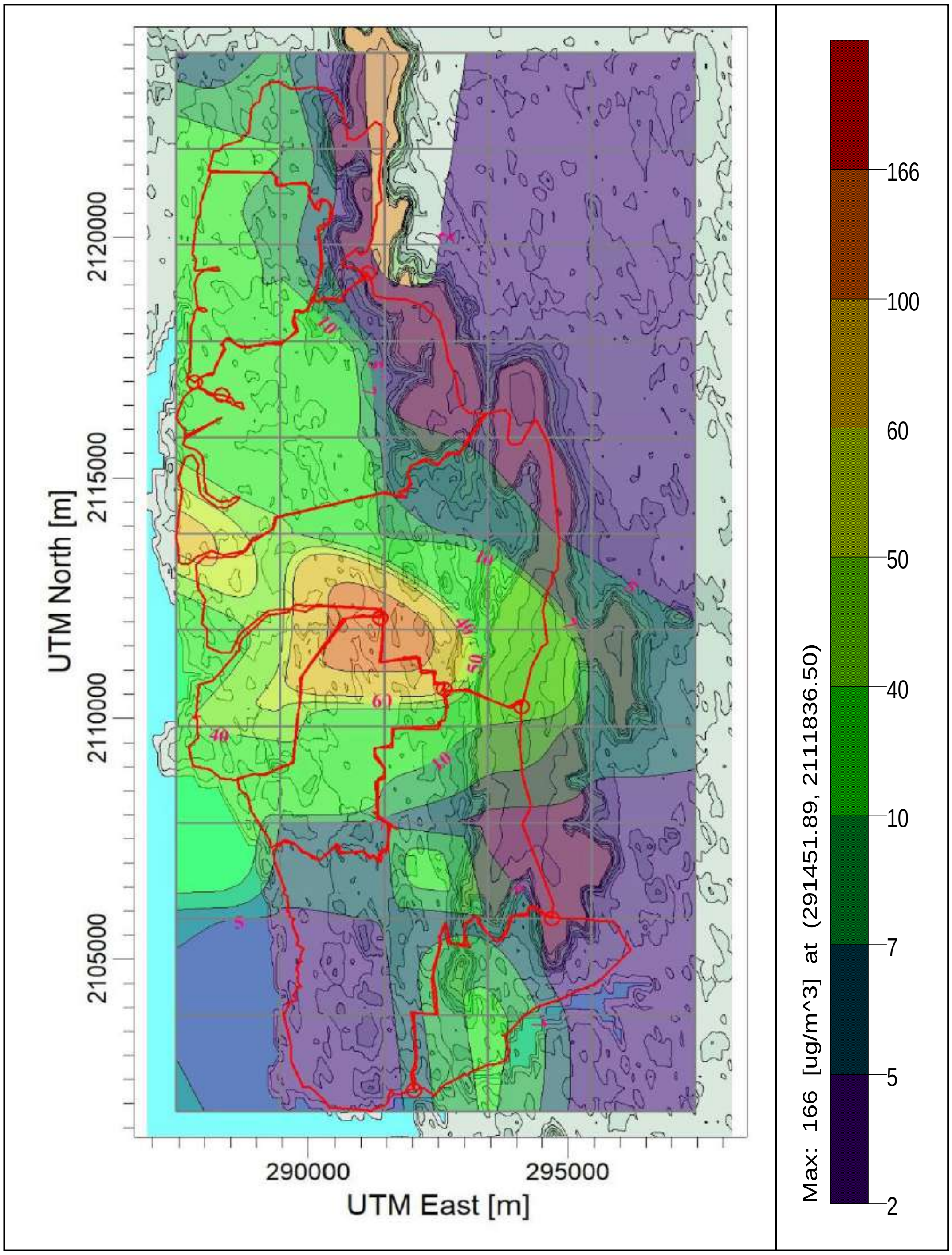

Figure P15 : Isopleths of PM Due to Point Sources (LSI) – Winter Season (Navi Mumbai City)

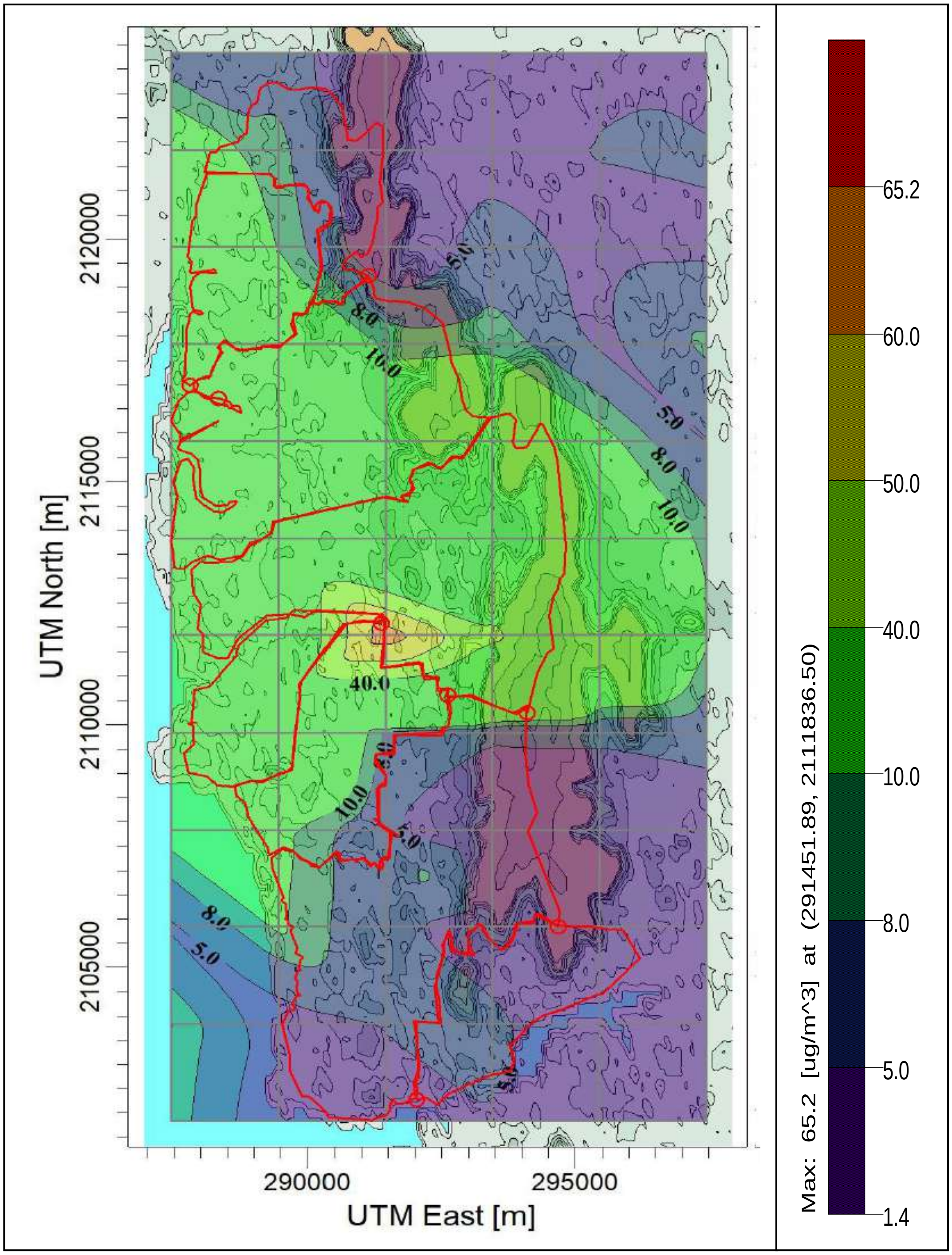

Figure P16 : Isopleths of PM Due to Point Sources (LSI) – Annual (Navi Mumbai City)

E) POINT SOURCE – MSI (PM)

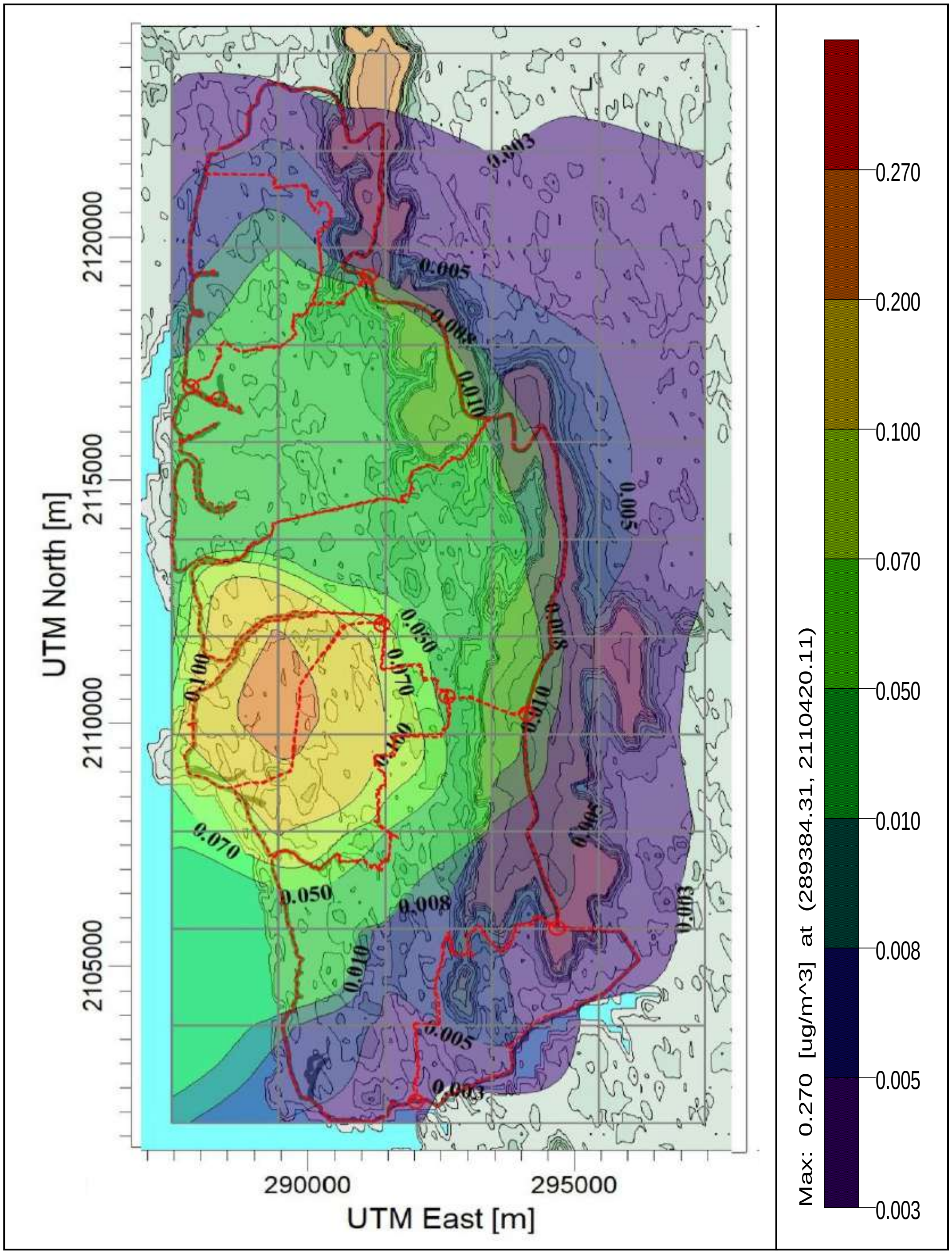

Figure P17 : Isopleths of PM Due to Point Sources (MSI)– Summer Season (Navi Mumbai City)

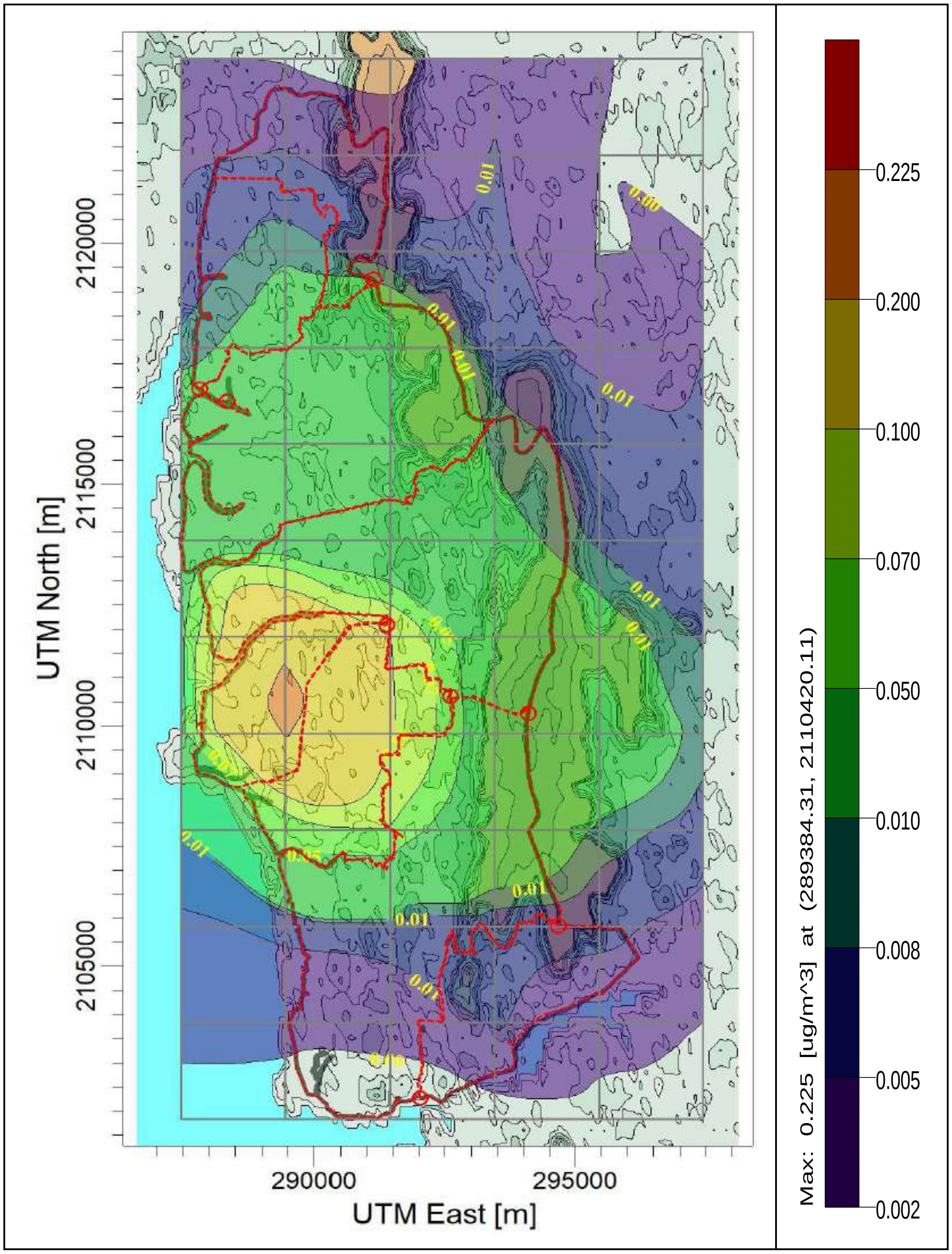

Figure P18 : Isopleths of PM Due to Point Sources (MSI)– Post Monsoon Season (Navi Mumbai City)

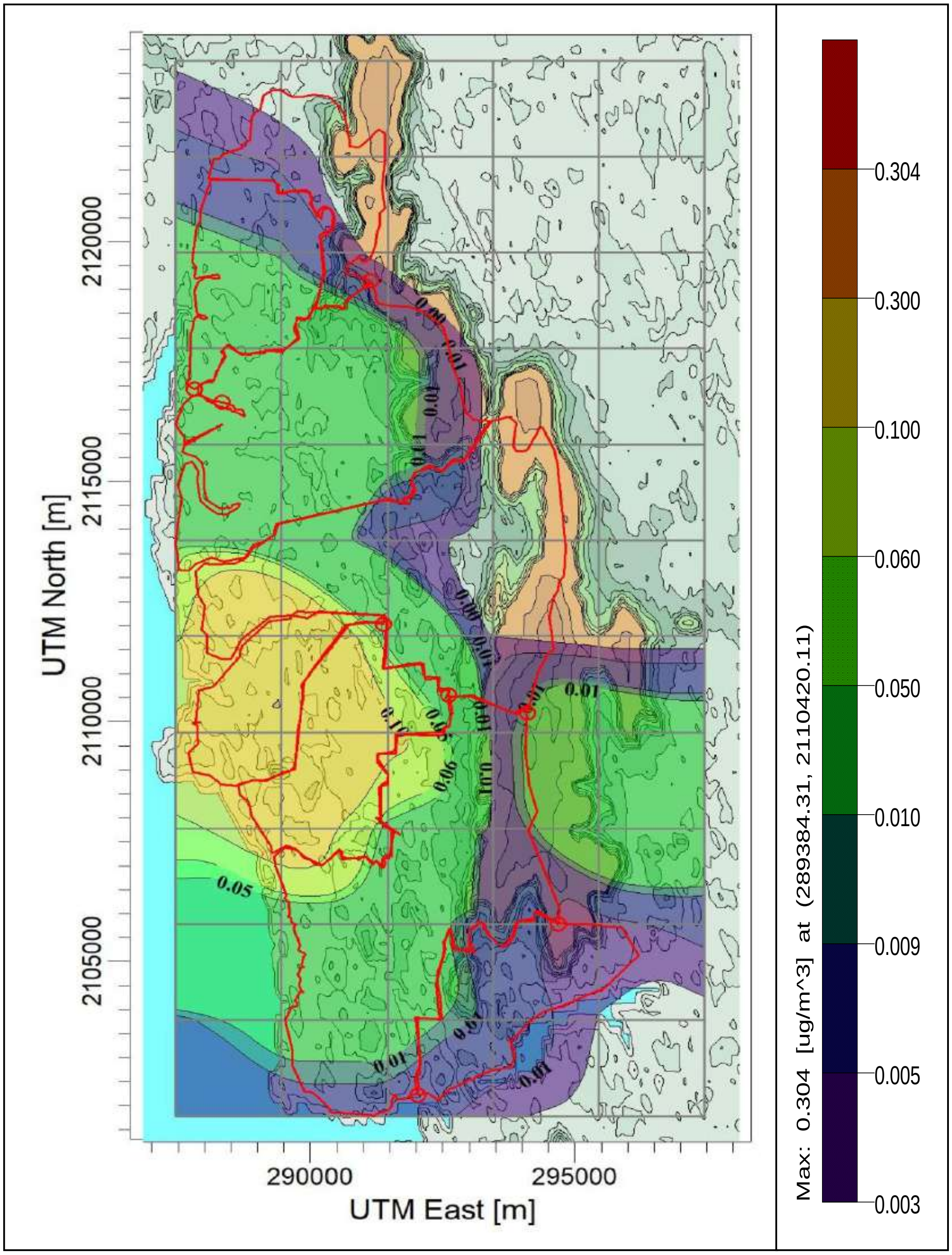

Figure P19 : Isopleths of PM Due to Point Sources (MSI) – Winter Season (Navi Mumbai City)

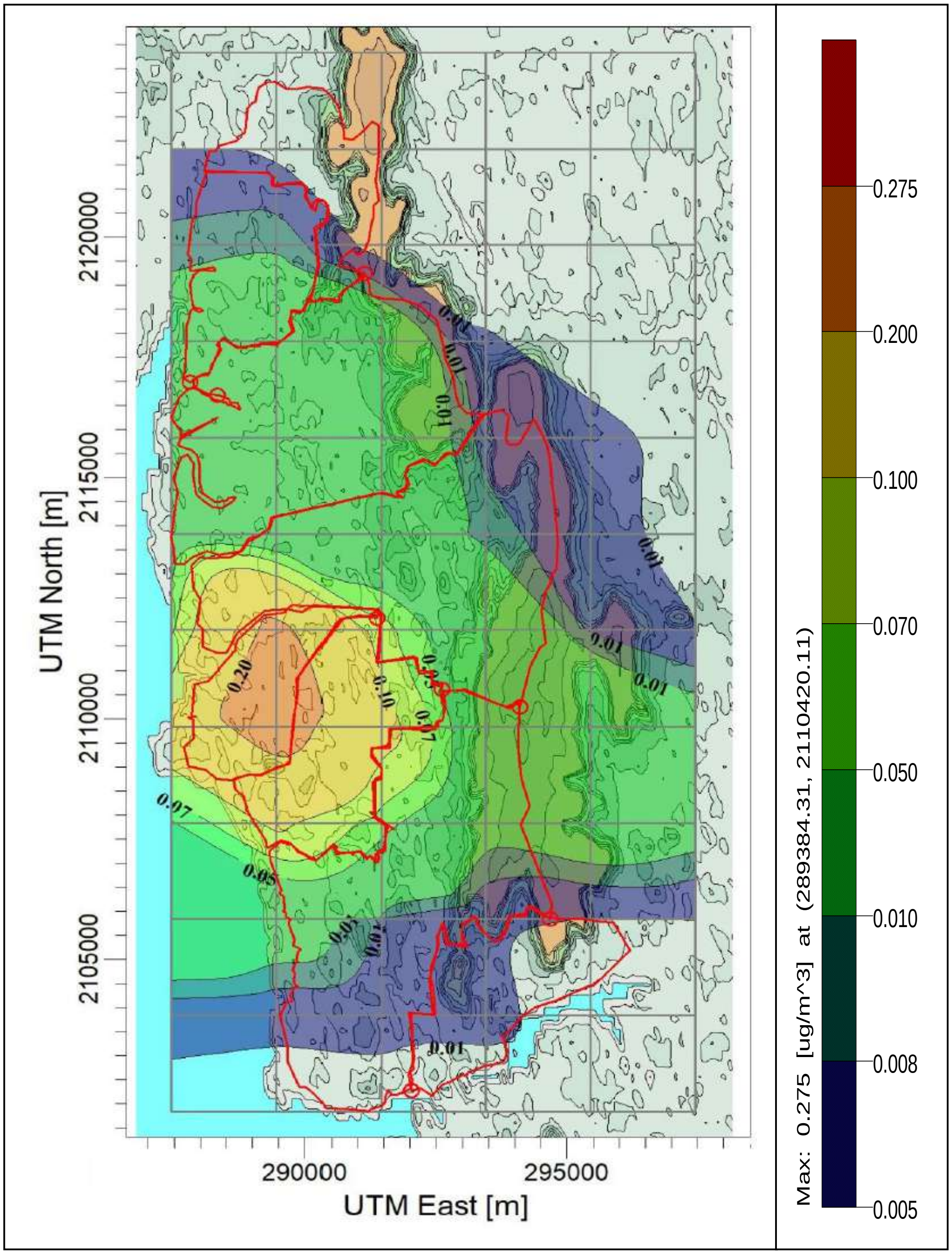

Figure P20 : Isopleths of PM Due to Point Sources (MSI) – Annual (Navi Mumbai City)

F) POINT SOURCE – SSI (PM)

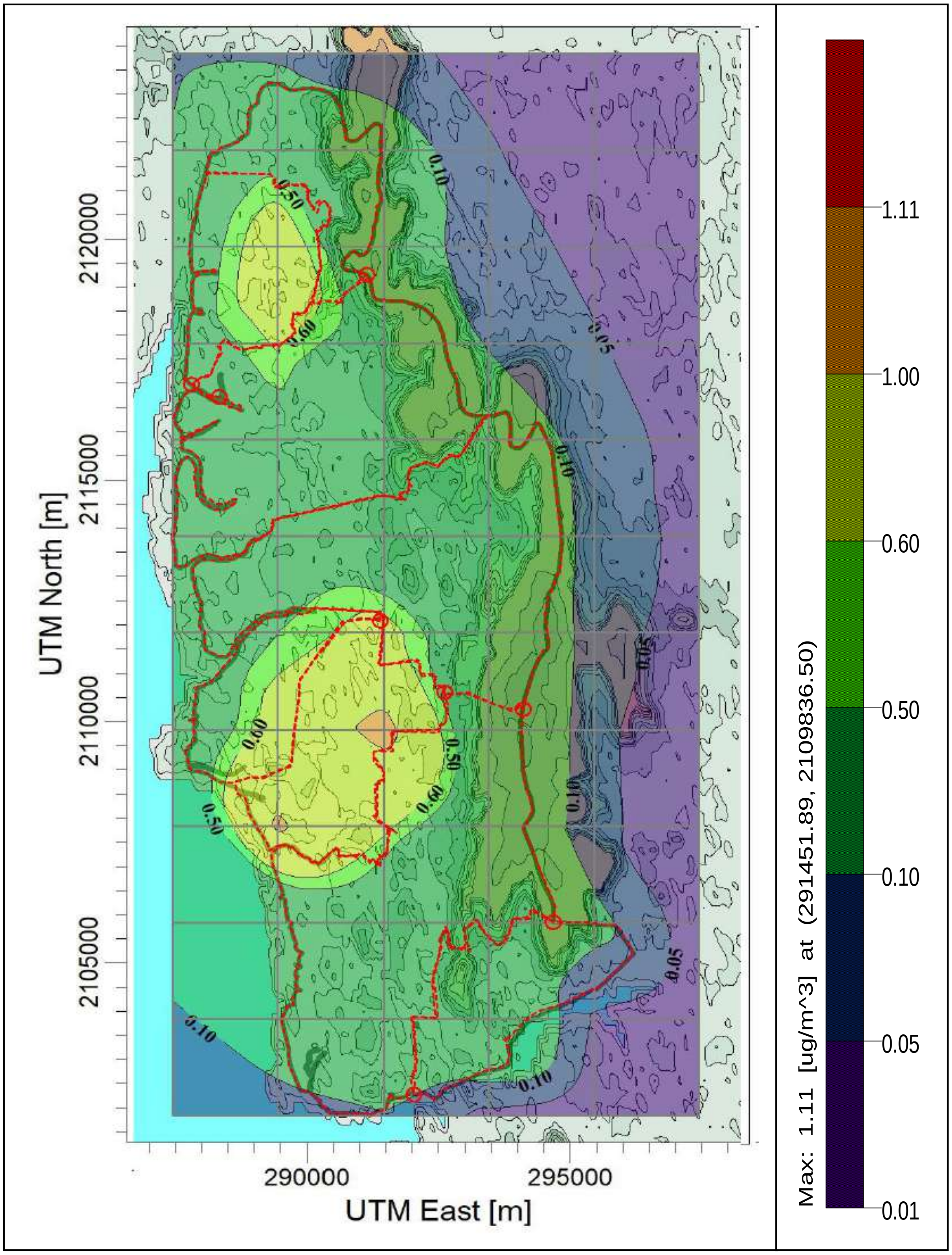

Figure P21 : Isopleths of PM Due to Point Sources (SSI) – Summer Season (Navi Mumbai City)

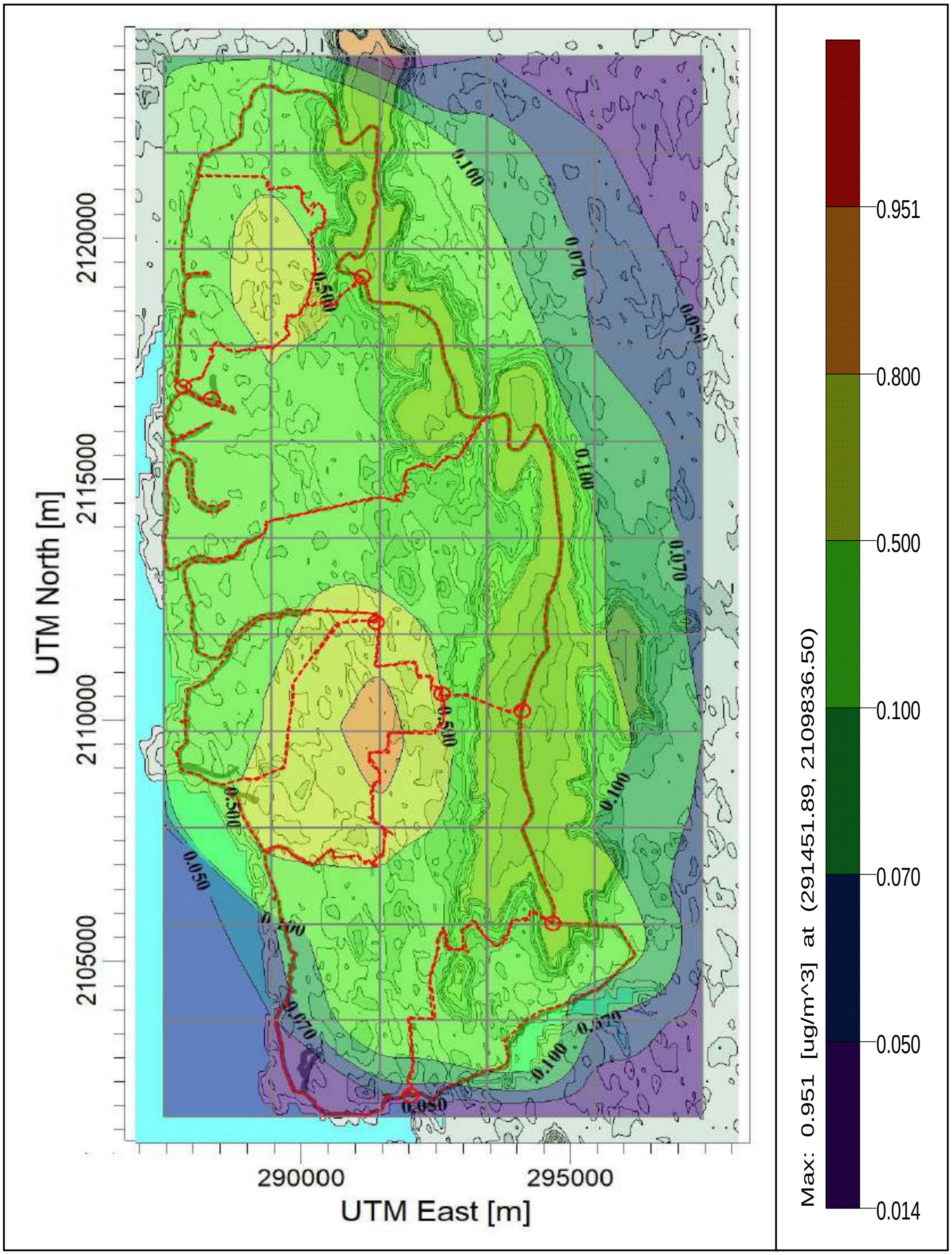

Figure P22 : Isopleths of PM Due to Point Sources (SSI) – Post Monsoon Season (Navi Mumbai City)

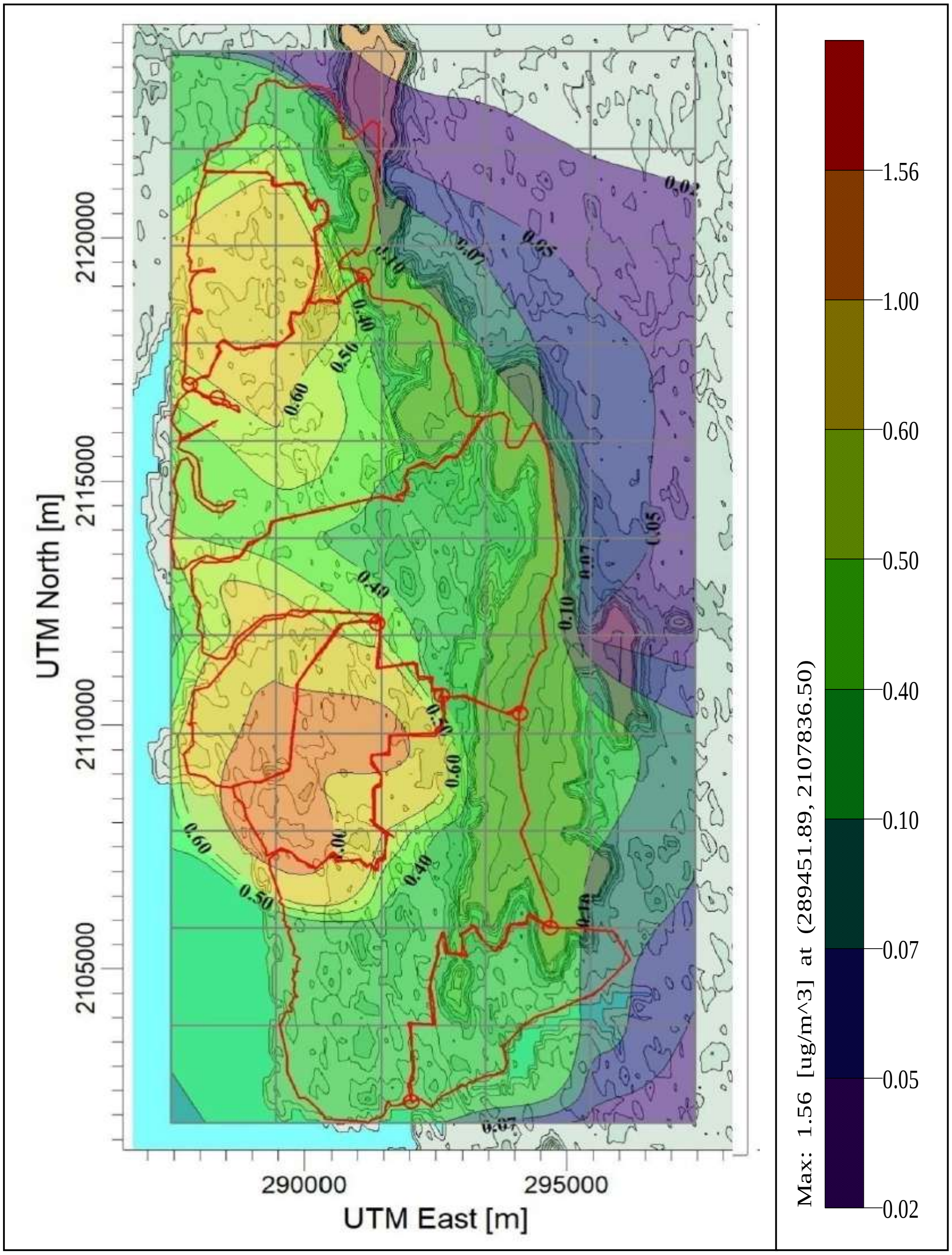

Figure P23 : Isopleths of PM Due to Point Sources (SSI) – Winter Season (Navi Mumbai City)

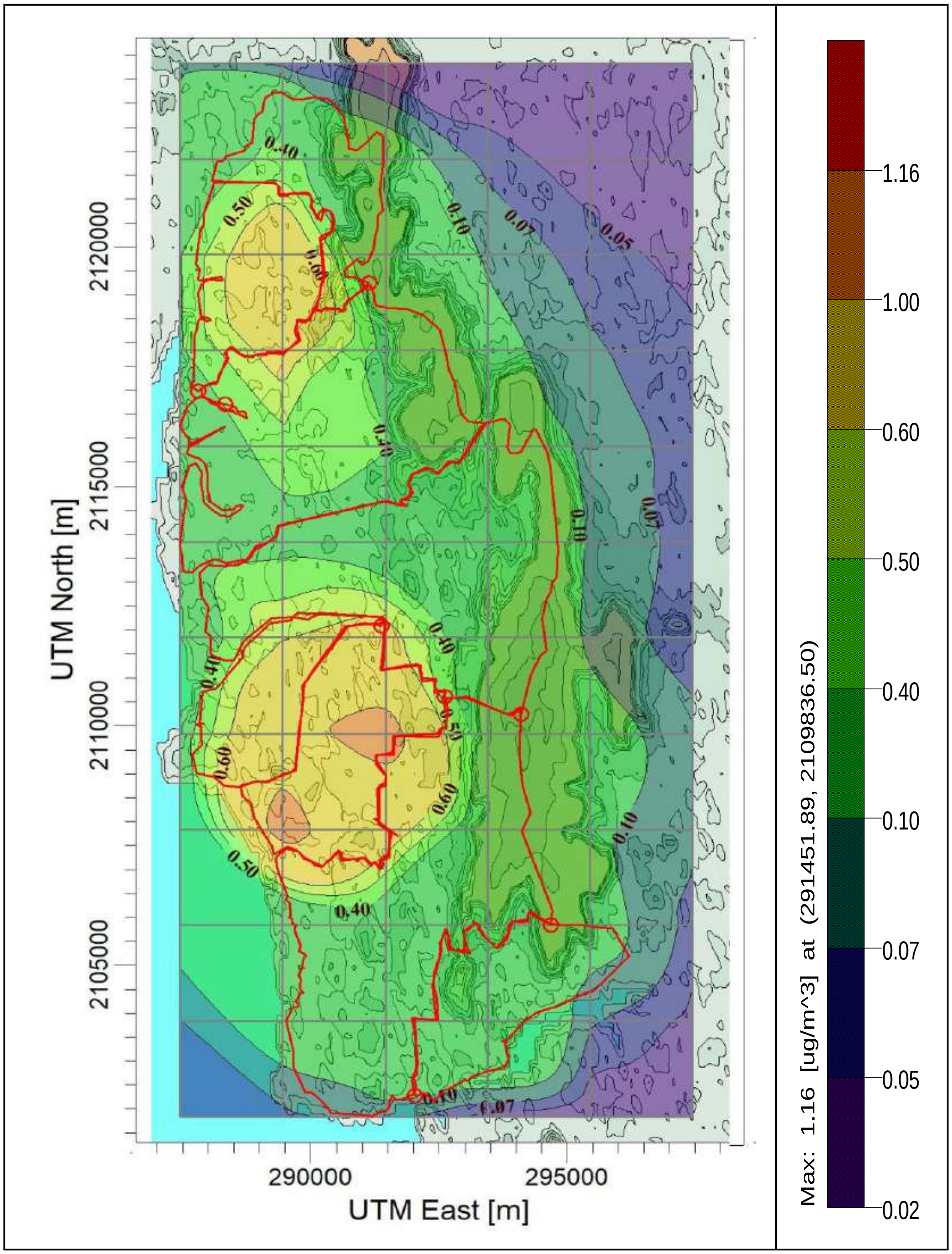

Figure P24 : Isopleths of PM Due to Point Sources (SSI) – Annual (Navi Mumbai City)

ANNEXURE – 3

Maximum Ten Concentrations of PM_{10} (Annual) BaU 2018, 2020, 2025 and Preferred Option I -2020, Preferred Option II – 2025

Navi Mumbai City

Annexure 3

A) Maximum Ten Occurrences of PM_{10} Concentrations in BaU 2018 at Navi Mumbai City (Annual)

Annual - All Source – BaU 2018			
	X length,m	Y length,m	Concentration µg/m³
1st	289384.31	2110420.11	403.85
2nd	289384.31	2110420.11	362.90
3rd	289384.31	2110420.11	288.79
4th	289384.31	2110420.11	268.29
5th	289384.31	2110420.11	217.17
6th	289384.31	2110420.11	216.81
7th	289384.31	2110420.11	208.22
8th	289384.31	2110420.11	189.61
9th	289384.31	2110420.11	167.45
10th	289384.31	2110420.11	148.81
Avg.	289384.31	2110420.11	182.25

Annual - Area Source – BaU 2018			
	X length,m	Y length,m	Concentration µg/m³
1st	289509.61	2119261.15	11.76
2nd	289509.61	2119261.15	10.66
3rd	289509.61	2119261.15	9.01
4th	289509.61	2119261.15	7.54
5th	289509.61	2119261.15	7.17
6th	289509.61	2119261.15	7.07
7th	289509.61	2119261.15	6.27
8th	289509.61	2119261.15	5.61
9th	289509.61	2119261.15	5.24
10th	289509.61	2119261.15	4.71
Avg.	289509.61	2119261.15	5.78

Annual – Point Source (LSI) – BaU 2018			
	X length,m	Y length,m	Concentration µg/m³
1st	291451.89	2111836.50	389.65
2nd	287451.89	2113836.50	192.65
3rd	291451.89	2111836.50	174.99
4th	291451.89	2111836.50	115.07
5th	293451.89	2111836.50	76.83
6th	291451.89	2111836.50	72.51
7th	293451.89	2111836.50	58.97
8th	293451.89	2111836.50	35.51
9th	293451.89	2111836.50	34.38
10th	293451.89	2111836.50	29.26
All Avg.	291451.89	2111836.50	65.22

Annual – Point Source (MSI) – BaU 2018			
	X length,m	Y length,m	Concentration µg/m³
1st	289384.31	2110420.11	0.64
2nd	289384.31	2110420.11	0.49
3rd	289384.31	2110420.11	0.41
4th	289384.31	2110420.11	0.40
5th	289384.31	2110420.11	0.39
6th	289384.31	2110420.11	0.35
7th	289384.31	2110420.11	0.33
8th	289384.31	2110420.11	0.27
9th	289384.31	2110420.11	0.25
10th	289384.31	2110420.11	0.24
Avg.	289384.31	2110420.11	0.28

Annual – Point Source (SSI) – BaU 2018			
	X length,m	Y length,m	Concentration µg/m³
1st	289451.89	2107836.50	3.25
2nd	289451.89	2109836.50	2.21
3rd	289451.89	2107836.50	1.90
4th	289451.89	2107836.50	1.90
5th	289451.89	2107836.50	1.84
6th	289451.89	2107836.50	1.74
7th	289451.89	2107836.50	1.34
8th	291451.89	2109836.50	1.23
9th	291451.89	2109836.50	1.11
10th	291451.89	2109836.50	0.94
Avg.	291451.89	2109836.50	1.16

A) Maximum Ten Occurrences of PM_{10} Concentrations in BaU 2018 at Navi Mumbai City (Annual) (Contd..)

Annual – Line Source – BaU 2018			
	X length,m	Y length,m	Concentration µg/m^3
1st	291451.89	2111836.50	42.07
2nd	291451.89	2111836.50	36.96
3rd	291451.89	2111836.50	31.81
4th	291451.89	2111836.50	26.89
5th	291451.89	2111836.50	26.86
6th	291451.89	2111836.50	24.68
7th	291451.89	2111836.50	22.90
8th	291451.89	2111836.50	19.24
9th	291451.89	2111836.50	19.11
10th	291451.89	2111836.50	16.20
Avg.	291451.89	2111836.50	20.44

Annual – Resuspended Dust– BaU 2018			
	X length,m	Y length,m	Concentration µg/m^3
1st	289384.31	2110420.11	304.78
2nd	289384.31	2110420.11	271.87
3rd	289384.31	2110420.11	229.92
4th	289384.31	2110420.11	196.30
5th	289384.31	2110420.11	192.45
6th	289384.31	2110420.11	178.75
7th	289384.31	2110420.11	163.65
8th	289384.31	2110420.11	140.36
9th	289384.31	2110420.11	137.53
10th	289384.31	2110420.11	118.39
Avg.	289384.31	2110420.11	148.49

B) Maximum Ten Occurrences of PM_{10} Concentrations in BaU 2020 at Navi Mumbai City (Annual)

Annual - All Source – BaU 2020			
	X length,m	Y length,m	Concentration µg/m³
1st	291451.89	2111836.50	433.72
2nd	289384.31	2110420.11	386.73
3rd	289384.31	2110420.11	306.78
4th	289384.31	2110420.11	276.00
5th	289384.31	2110420.11	232.47
6th	289384.31	2110420.11	231.80
7th	289384.31	2110420.11	220.96
8th	289384.31	2110420.11	203.52
9th	289384.31	2110420.11	178.16
10th	289384.31	2110420.11	159.73
Avg.	289384.31	2110420.11	193.82

Annual - Area Source – BaU 2020			
	X length,m	Y length,m	Concentration µg/m³
1st	289509.61	2119261.15	12.41
2nd	289509.61	2119261.15	11.25
3rd	289509.61	2119261.15	9.51
4th	289509.61	2119261.15	7.96
5th	289509.61	2119261.15	7.57
6th	289509.61	2119261.15	7.45
7th	289509.61	2119261.15	6.62
8th	289509.61	2119261.15	5.92
9th	289509.61	2119261.15	5.53
10th	289509.61	2119261.15	4.97
Avg.	289509.61	2119261.15	6.10

Annual – Point Source (LSI) – BaU 2020			
	X length,m	Y length,m	Concentration µg/m³
1st	291451.89	2111836.50	389.65
2nd	287451.89	2113836.50	192.65
3rd	291451.89	2111836.50	174.99
4th	291451.89	2111836.50	115.07
5th	293451.89	2111836.50	76.83
6th	291451.89	2111836.50	72.51
7th	293451.89	2111836.50	58.97
8th	293451.89	2111836.50	35.51
9th	293451.89	2111836.50	34.38
10th	293451.89	2111836.50	29.26
All Avg.	291451.89	2111836.50	65.22

Annual – Point Source (MSI) – BaU 2020			
	X length,m	Y length,m	Concentration µg/m³
1st	289384.31	2110420.11	0.64
2nd	289384.31	2110420.11	0.49
3rd	289384.31	2110420.11	0.41
4th	289384.31	2110420.11	0.40
5th	289384.31	2110420.11	0.39
6th	289384.31	2110420.11	0.35
7th	289384.31	2110420.11	0.33
8th	289384.31	2110420.11	0.27
9th	289384.31	2110420.11	0.25
10th	289384.31	2110420.11	0.24
Avg.	289384.31	2110420.11	0.28

Annual – Point Source (SSI) – BaU 2020			
	X length,m	Y length,m	Concentration µg/m³
1st	289451.89	2107836.50	3.25
2nd	289451.89	2109836.50	2.21
3rd	289451.89	2107836.50	1.90
4th	289451.89	2107836.50	1.90
5th	289451.89	2107836.50	1.84
6th	289451.89	2107836.50	1.74
7th	289451.89	2107836.50	1.34
8th	291451.89	2109836.50	1.23
9th	291451.89	2109836.50	1.11
10th	291451.89	2109836.50	0.94
Avg.	291451.89	2109836.50	1.16

B) Maximum Ten Occurrences of PM_{10} Concentrations in BaU 2020 at Navi Mumbai City (Annual) (Contd..)

Annual – Line Source – BaU 2020			
	X length,m	Y length,m	Concentration µg/m^3
1st	291451.89	2111836.50	45.23
2nd	291451.89	2111836.50	39.73
3rd	291451.89	2111836.50	34.20
4th	291451.89	2111836.50	28.90
5th	291451.89	2111836.50	28.88
6th	291451.89	2111836.50	26.53
7th	291451.89	2111836.50	24.62
8th	291451.89	2111836.50	20.68
9th	291451.89	2111836.50	20.54
10th	291451.89	2111836.50	17.42
Avg.	291451.89	2111836.50	21.98

Annual – Resuspended Dust– BaU 2020			
	X length,m	Y length,m	Concentration µg/m^3
1st	289384.31	2110420.11	327.64
2nd	289384.31	2110420.11	292.27
3rd	289384.31	2110420.11	247.17
4th	289384.31	2110420.11	211.03
5th	289384.31	2110420.11	206.88
6th	289384.31	2110420.11	192.15
7th	289384.31	2110420.11	175.92
8th	289384.31	2110420.11	150.89
9th	289384.31	2110420.11	147.84
10th	289384.31	2110420.11	127.27
Avg.	289384.31	2110420.11	159.63

C) Maximum Ten Occurrences of PM_{10} Concentrations in BaU 2025 at Navi Mumbai City (Annual)

Annual - All Source – BaU 2025			
	X length,m	Y length,m	Concentration µg/m³
1st	289384.31	2110420.11	448.06
2nd	289384.31	2110420.11	412.46
3rd	289384.31	2110420.11	326.18
4th	289384.31	2110420.11	284.32
5th	289384.31	2110420.11	248.98
6th	289384.31	2110420.11	247.96
7th	289384.31	2110420.11	234.71
8th	289384.31	2110420.11	218.54
9th	289384.31	2110420.11	189.71
10th	289384.31	2110420.11	171.51
Avg.	289384.31	2110420.11	206.31

Annual - Area Source – BaU 2025			
	X length,m	Y length,m	Concentration µg/m³
1st	289509.61	2119261.15	13.28
2nd	289509.61	2119261.15	12.03
3rd	289509.61	2119261.15	10.17
4th	289509.61	2119261.15	8.51
5th	289509.61	2119261.15	8.10
6th	289509.61	2119261.15	7.98
7th	289509.61	2119261.15	7.08
8th	289509.61	2119261.15	6.33
9th	289509.61	2119261.15	5.92
10th	289509.61	2119261.15	5.31
Avg.	289509.61	2119261.15	6.53

Annual – Point Source (LSI) – BaU 2025			
	X length,m	Y length,m	Concentration µg/m³
1st	291451.89	2111836.50	389.65
2nd	287451.89	2113836.50	192.65
3rd	291451.89	2111836.50	174.99
4th	291451.89	2111836.50	115.07
5th	293451.89	2111836.50	76.83
6th	291451.89	2111836.50	72.51
7th	293451.89	2111836.50	58.97
8th	293451.89	2111836.50	35.51
9th	293451.89	2111836.50	34.38
10th	293451.89	2111836.50	29.26
All Avg.	291451.89	2111836.50	65.22

Annual – Point Source (MSI) – BaU 2025			
	X length,m	Y length,m	Concentration µg/m³
1st	289384.31	2110420.11	0.64
2nd	289384.31	2110420.11	0.49
3rd	289384.31	2110420.11	0.41
4th	289384.31	2110420.11	0.40
5th	289384.31	2110420.11	0.39
6th	289384.31	2110420.11	0.35
7th	289384.31	2110420.11	0.33
8th	289384.31	2110420.11	0.27
9th	289384.31	2110420.11	0.25
10th	289384.31	2110420.11	0.24
Avg.	289384.31	2110420.11	0.28

Annual – Point Source (SSI) – BaU 2025			
	X length,m	Y length,m	Concentration µg/m³
1st	289451.89	2107836.50	3.25
2nd	289451.89	2109836.50	2.21
3rd	289451.89	2107836.50	1.90
4th	289451.89	2107836.50	1.90
5th	289451.89	2107836.50	1.84
6th	289451.89	2107836.50	1.74
7th	289451.89	2107836.50	1.34
8th	291451.89	2109836.50	1.23
9th	291451.89	2109836.50	1.11
10th	291451.89	2109836.50	0.94
Avg.	291451.89	2109836.50	1.16

C) Maximum Ten Occurrences of PM_{10} Concentrations in BaU 2025 at Navi Mumbai City (Annual) (Contd..)

Annual – Line Source – BaU 2025			
	X length,m	Y length,m	Concentration µg/m³
1st	291451.89	2111836.50	48.62
2nd	291451.89	2111836.50	42.71
3rd	291451.89	2111836.50	36.76
4th	291451.89	2111836.50	31.07
5th	291451.89	2111836.50	31.05
6th	291451.89	2111836.50	28.52
7th	291451.89	2111836.50	26.47
8th	291451.89	2111836.50	22.23
9th	291451.89	2111836.50	22.08
10th	291451.89	2111836.50	18.72
Avg.	291451.89	2111836.50	23.62

Annual – Resuspended Dust– BaU 2025			
	X length,m	Y length,m	Concentration µg/m³
1st	289384.31	2110420.11	352.21
2nd	289384.31	2110420.11	314.19
3rd	289384.31	2110420.11	265.70
4th	289384.31	2110420.11	226.85
5th	289384.31	2110420.11	222.40
6th	289384.31	2110420.11	206.56
7th	289384.31	2110420.11	189.11
8th	289384.31	2110420.11	162.20
9th	289384.31	2110420.11	158.93
10th	289384.31	2110420.11	136.81
Avg.	289384.31	2110420.11	171.60

D) Maximum Ten Occurrences of PM_{10} Concentrations after Implementation of Control Options (Preferred Option I -2020) at Navi Mumbai City (Annual)

Annual All Source Preferred Option I -2020			
	X length,m	Y length,m	Concentration µg/m³
1st	291451.89	2111836.50	262.60
2nd	289384.31	2110420.11	234.15
3rd	289384.31	2110420.11	185.74
4th	289384.31	2110420.11	167.10
5th	289384.31	2110420.11	140.75
6th	289384.31	2110420.11	140.34
7th	289384.31	2110420.11	133.78
8th	289384.31	2110420.11	123.22
9th	289384.31	2110420.11	107.86
10th	289384.31	2110420.11	96.71
Avg.	289384.31	2110420.11	117.35

Annual Area Source Preferred Option I -2020			
	X length,m	Y length,m	Concentration µg/m³
1st	289509.61	2119261.15	7.51
2nd	289509.61	2119261.15	6.81
3rd	289509.61	2119261.15	5.76
4th	289509.61	2119261.15	4.82
5th	289509.61	2119261.15	4.58
6th	289509.61	2119261.15	4.51
7th	289509.61	2119261.15	4.01
8th	289509.61	2119261.15	3.58
9th	289509.61	2119261.15	3.35
10th	289509.61	2119261.15	3.01
Avg.	289509.61	2119261.15	3.69

Annual Point Source (LSI) Preferred Option I -2020			
	X length,m	Y length,m	Concentration µg/m³
1st	291451.89	2111836.50	235.92
2nd	287451.89	2113836.50	116.64
3rd	291451.89	2111836.50	105.95
4th	291451.89	2111836.50	69.67
5th	293451.89	2111836.50	46.52
6th	291451.89	2111836.50	43.90
7th	293451.89	2111836.50	35.70
8th	293451.89	2111836.50	21.50
9th	293451.89	2111836.50	20.82
10th	293451.89	2111836.50	17.72
All Avg.	291451.89	2111836.50	39.49

Annual Point Source (MSI) Preferred Option I -2020			
	X length,m	Y length,m	Concentration µg/m³
1st	289384.31	2110420.11	0.38
2nd	289384.31	2110420.11	0.29
3rd	289384.31	2110420.11	0.25
4th	289384.31	2110420.11	0.24
5th	289384.31	2110420.11	0.24
6th	289384.31	2110420.11	0.21
7th	289384.31	2110420.11	0.20
8th	289384.31	2110420.11	0.17
9th	289384.31	2110420.11	0.15
10th	289384.31	2110420.11	0.14
Avg.	289384.31	2110420.11	0.17

Annual Point Source (SSI) Preferred Option I -2020			
	X length,m	Y length,m	Concentration µg/m³
1st	289451.89	2107836.50	1.97
2nd	289451.89	2109836.50	1.34
3rd	289451.89	2107836.50	1.15
4th	289451.89	2107836.50	1.15
5th	289451.89	2107836.50	1.11
6th	289451.89	2107836.50	1.05
7th	289451.89	2107836.50	0.81
8th	291451.89	2109836.50	0.75
9th	291451.89	2109836.50	0.67
10th	291451.89	2109836.50	0.57
Avg.	291451.89	2109836.50	0.71

D) Maximum Ten Occurrences of PM_{10} Concentrations after Implementation of Control Options (Preferred Option I -2020) at Mumbai City (Annual) (Contd..)

Annual Line Source Preferred Option I -2020			
	X length,m	Y length,m	Concentration $\mu g/m^3$
1st	291451.89	2111836.50	27.38
2nd	291451.89	2111836.50	24.06
3rd	291451.89	2111836.50	20.70
4th	291451.89	2111836.50	17.50
5th	291451.89	2111836.50	17.49
6th	291451.89	2111836.50	16.06
7th	291451.89	2111836.50	14.91
8th	291451.89	2111836.50	12.52
9th	291451.89	2111836.50	12.44
10th	291451.89	2111836.50	10.55
Avg.	291451.89	2111836.50	13.31

Annual Resuspended Dust Preferred Option I -2020			
	X length,m	Y length,m	Concentration $\mu g/m^3$
1st	289384.31	2110420.11	198.37
2nd	289384.31	2110420.11	176.95
3rd	289384.31	2110420.11	149.65
4th	289384.31	2110420.11	127.77
5th	289384.31	2110420.11	125.26
6th	289384.31	2110420.11	116.34
7th	289384.31	2110420.11	106.51
8th	289384.31	2110420.11	91.35
9th	289384.31	2110420.11	89.51
10th	289384.31	2110420.11	77.05
Avg.	289384.31	2110420.11	96.65

E) Maximum Ten Occurrences of PM_{10} Concentrations after Implementation of Control Options (Preferred Option II -2025) at Mumbai City (Annual)

Annual All Source Preferred Option II -2025			
	X length,m	Y length,m	Concentration µg/m³
1st	289384.31	2110420.11	153.24
2nd	289384.31	2110420.11	141.06
3rd	289384.31	2110420.11	111.56
4th	289384.31	2110420.11	97.24
5th	289384.31	2110420.11	85.15
6th	289384.31	2110420.11	84.80
7th	289384.31	2110420.11	80.27
8th	289384.31	2110420.11	74.74
9th	289384.31	2110420.11	64.88
10th	289384.31	2110420.11	58.66
Avg.	289384.31	2110420.11	70.56

Annual Area Source Preferred Option II -2025			
	X length,m	Y length,m	Concentration µg/m³
1st	289509.61	2119261.15	4.54
2nd	289509.61	2119261.15	4.12
3rd	289509.61	2119261.15	3.48
4th	289509.61	2119261.15	2.91
5th	289509.61	2119261.15	2.77
6th	289509.61	2119261.15	2.73
7th	289509.61	2119261.15	2.42
8th	289509.61	2119261.15	2.16
9th	289509.61	2119261.15	2.02
10th	289509.61	2119261.15	1.82
Avg.	289509.61	2119261.15	2.23

Annual Point Source (LSI) Preferred Option II -2025			
	X length,m	Y length,m	Concentration µg/m³
1st	291451.89	2111836.50	133.26
2nd	287451.89	2113836.50	65.89
3rd	291451.89	2111836.50	59.85
4th	291451.89	2111836.50	39.36
5th	293451.89	2111836.50	26.28
6th	291451.89	2111836.50	24.80
7th	293451.89	2111836.50	20.17
8th	293451.89	2111836.50	12.14
9th	293451.89	2111836.50	11.76
10th	293451.89	2111836.50	10.01
All Avg.	291451.89	2111836.50	22.30

Annual Point Source (MSI) Preferred Option II -2025			
	X length,m	Y length,m	Concentration µg/m³
1st	289384.31	2110420.11	0.22
2nd	289384.31	2110420.11	0.17
3rd	289384.31	2110420.11	0.14
4th	289384.31	2110420.11	0.14
5th	289384.31	2110420.11	0.13
6th	289384.31	2110420.11	0.12
7th	289384.31	2110420.11	0.11
8th	289384.31	2110420.11	0.09
9th	289384.31	2110420.11	0.08
10th	289384.31	2110420.11	0.08
Avg.	289384.31	2110420.11	0.09

Annual Point Source (SSI) Preferred Option II -2025			
	X length,m	Y length,m	Concentration µg/m³
1st	289451.89	2107836.50	1.11
2nd	289451.89	2109836.50	0.76
3rd	289451.89	2107836.50	0.65
4th	289451.89	2107836.50	0.65
5th	289451.89	2107836.50	0.63
6th	289451.89	2107836.50	0.59
7th	289451.89	2107836.50	0.46
8th	291451.89	2109836.50	0.42
9th	291451.89	2109836.50	0.38
10th	291451.89	2109836.50	0.32
Avg.	291451.89	2109836.50	0.40

E) Maximum Ten Occurrences of PM_{10} Concentrations after Implementation of Control Options (Preferred Option II -2025) at Mumbai City (Annual) (Contd..)

Annual Line Source Preferred Option II -2025			
	X length,m	Y length,m	Concentration $\mu g/m^3$
1st	291451.89	2111836.50	16.63
2nd	291451.89	2111836.50	14.61
3rd	291451.89	2111836.50	12.57
4th	291451.89	2111836.50	10.63
5th	291451.89	2111836.50	10.62
6th	291451.89	2111836.50	9.75
7th	291451.89	2111836.50	9.05
8th	291451.89	2111836.50	7.60
9th	291451.89	2111836.50	7.55
10th	291451.89	2111836.50	6.40
Avg.	291451.89	2111836.50	8.08

Annual Resuspended Dust Preferred Option II -2025			
	X length,m	Y length,m	Concentration $\mu g/m^3$
1st	289384.31	2110420.11	120.46
2nd	289384.31	2110420.11	107.45
3rd	289384.31	2110420.11	90.87
4th	289384.31	2110420.11	77.58
5th	289384.31	2110420.11	76.06
6th	289384.31	2110420.11	70.64
7th	289384.31	2110420.11	64.68
8th	289384.31	2110420.11	55.47
9th	289384.31	2110420.11	54.35
10th	289384.31	2110420.11	46.79
Avg.	289384.31	2110420.11	58.69

ANNEXURE - 4

ISOPLETS OF NOx :

All Categories- (a)Area, (b) Line, (c) Resuspension of Dust, (d) Point –LSI, MSI & SSI

&

For All Season (Summer, Post Monsoon, Winter and Annual)

(Navi Mumbai City)

A) AREA SOURCE – ALL (NOx)

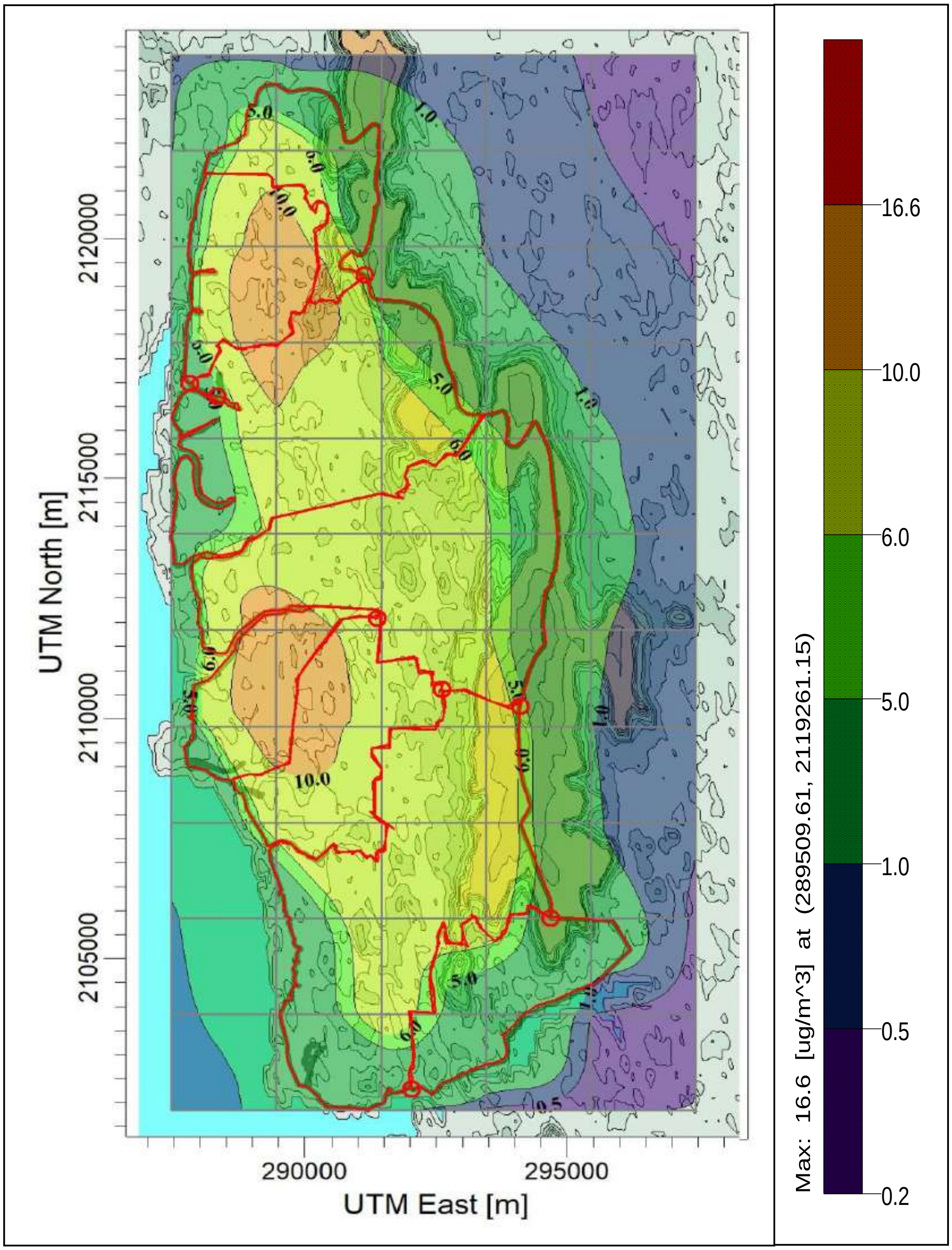

Figure N1: Isopleths of NOx Due to Area Sources – Summer Season (Navi Mumbai City)

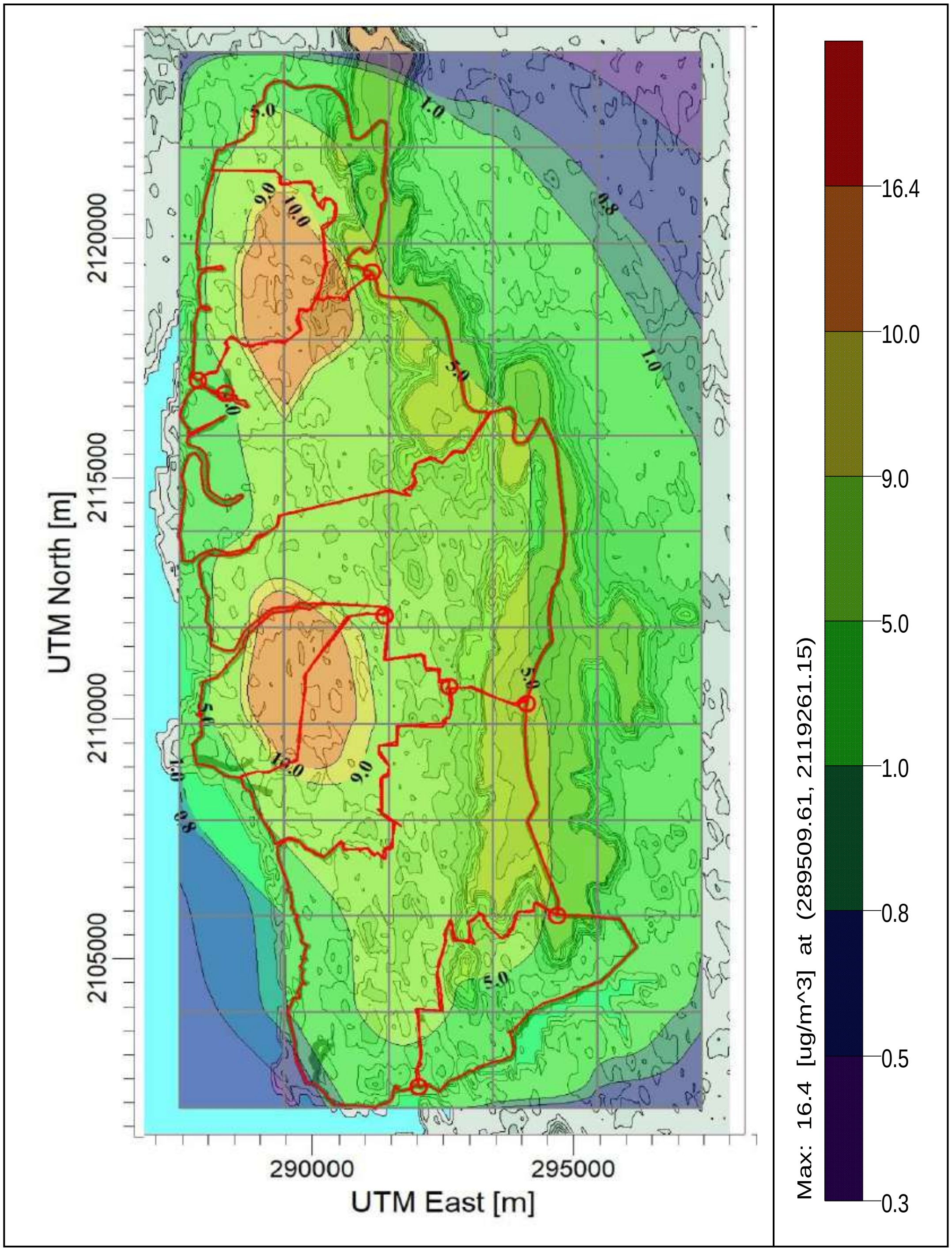

Figure N2 : Isopleths of NOx Due to Area Sources – Post Monsoon Season (Navi Mumbai City)

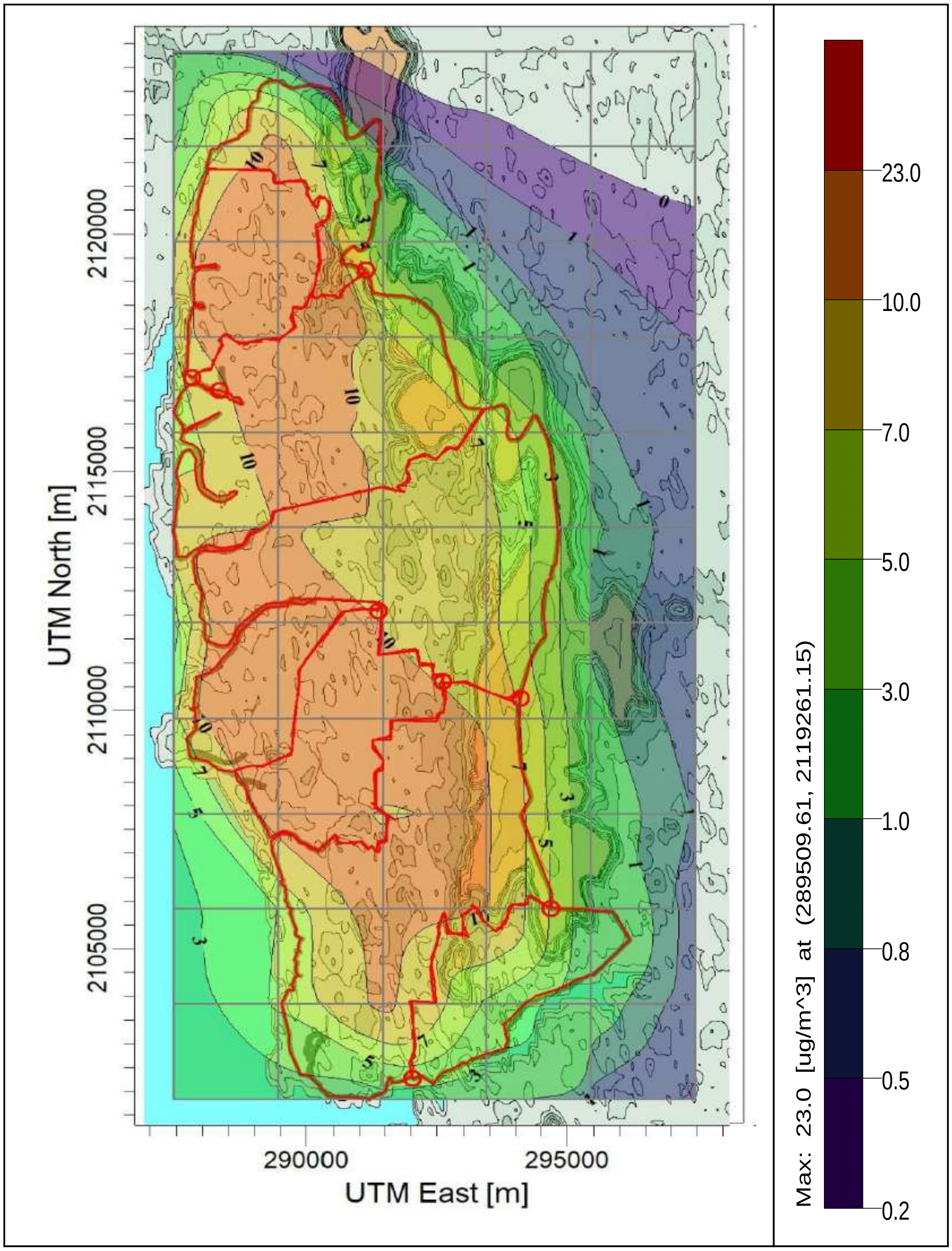

Figure N3 : Isopleths of NOx Due to Area Sources – Winter Season (Navi Mumbai City)

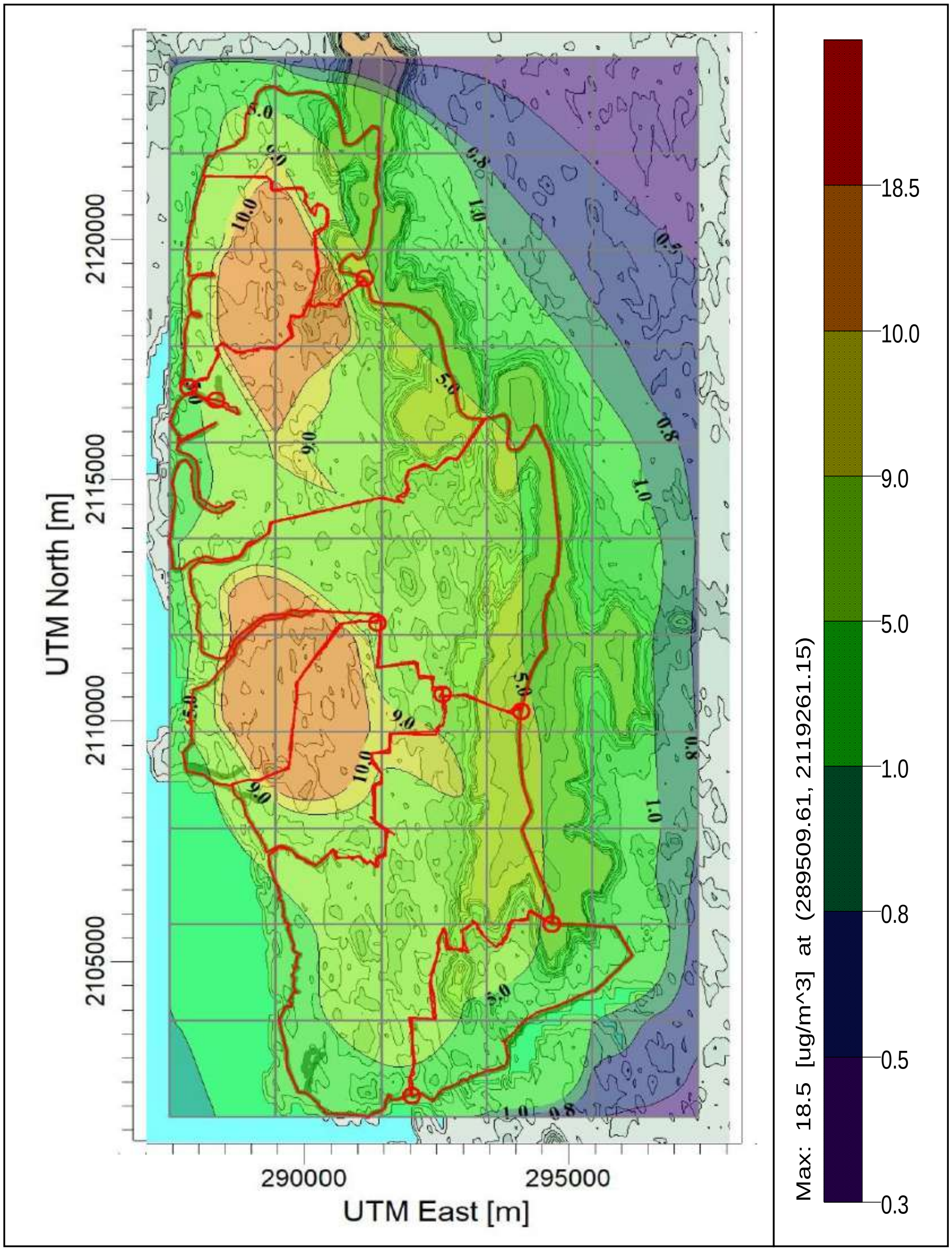

Figure N4 : Isopleths of NOx Due to Area Sources – Annual (Navi Mumbai City)

B) LINE SOURCE – ALL (NOx)

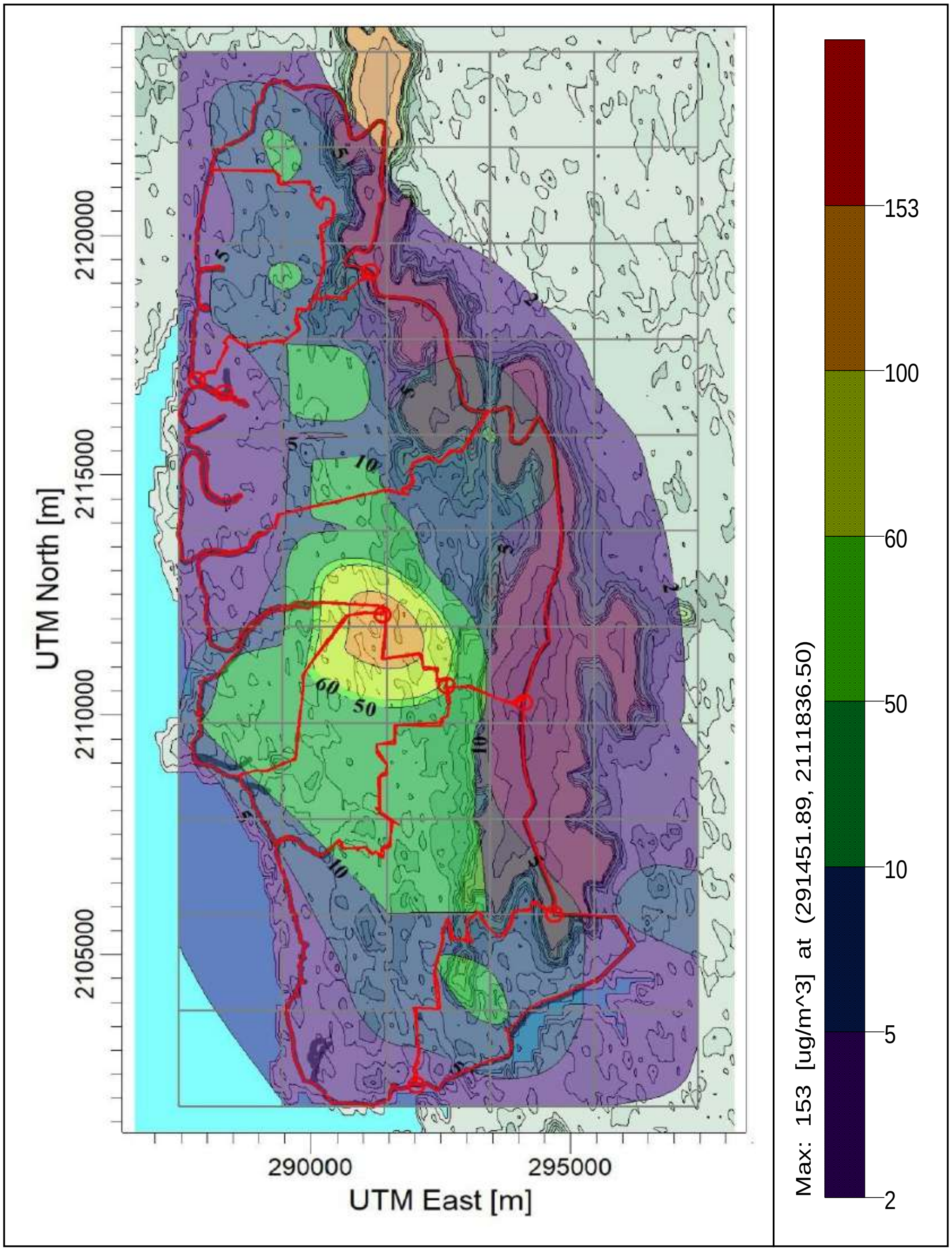

Figure N5 : Isopleths of NOx Due to Line Sources – Summer Season (Navi Mumbai City)

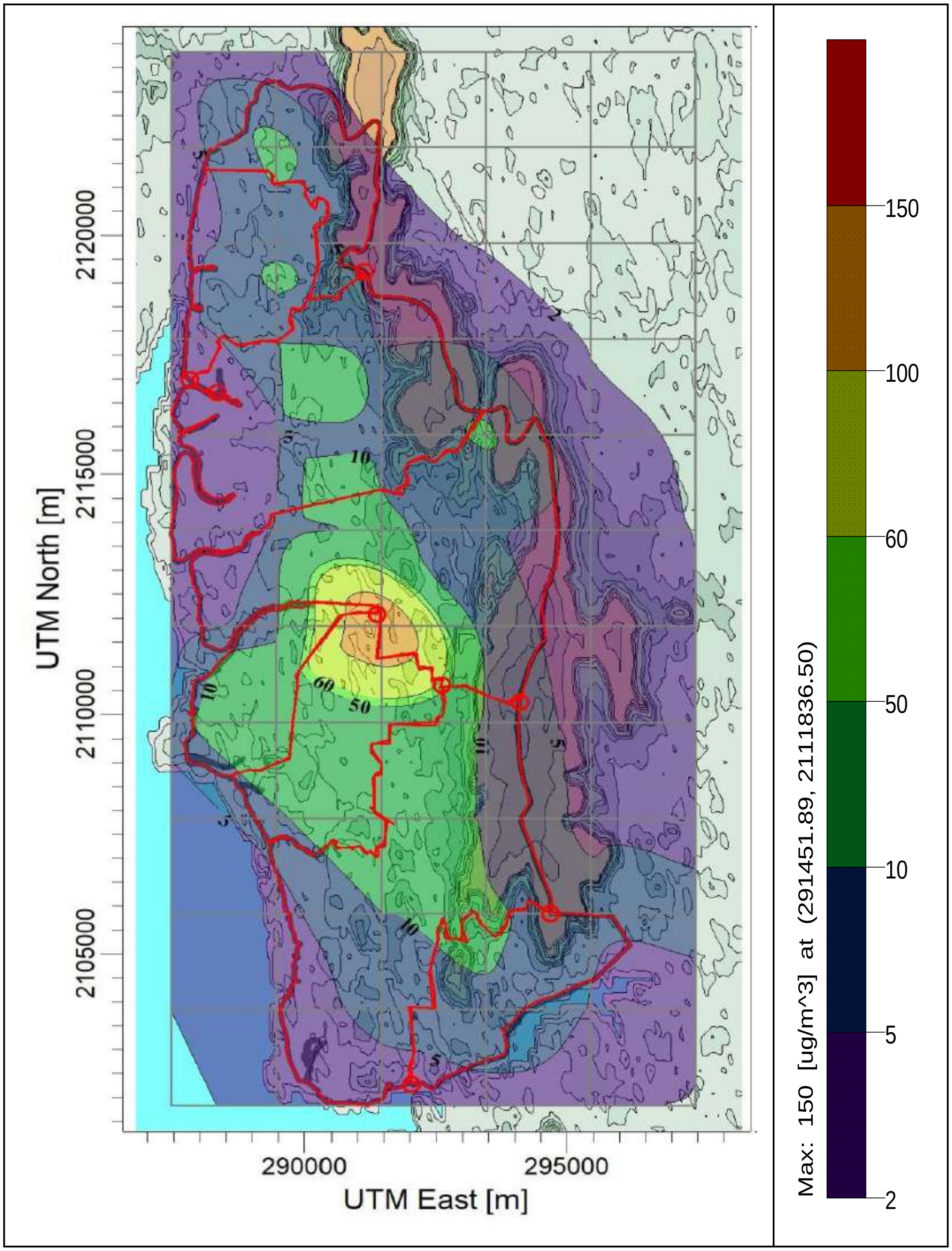

Figure N6 : Isopleths of NOx Due to Line Sources – Post Monsoon Season (Navi Mumbai City)

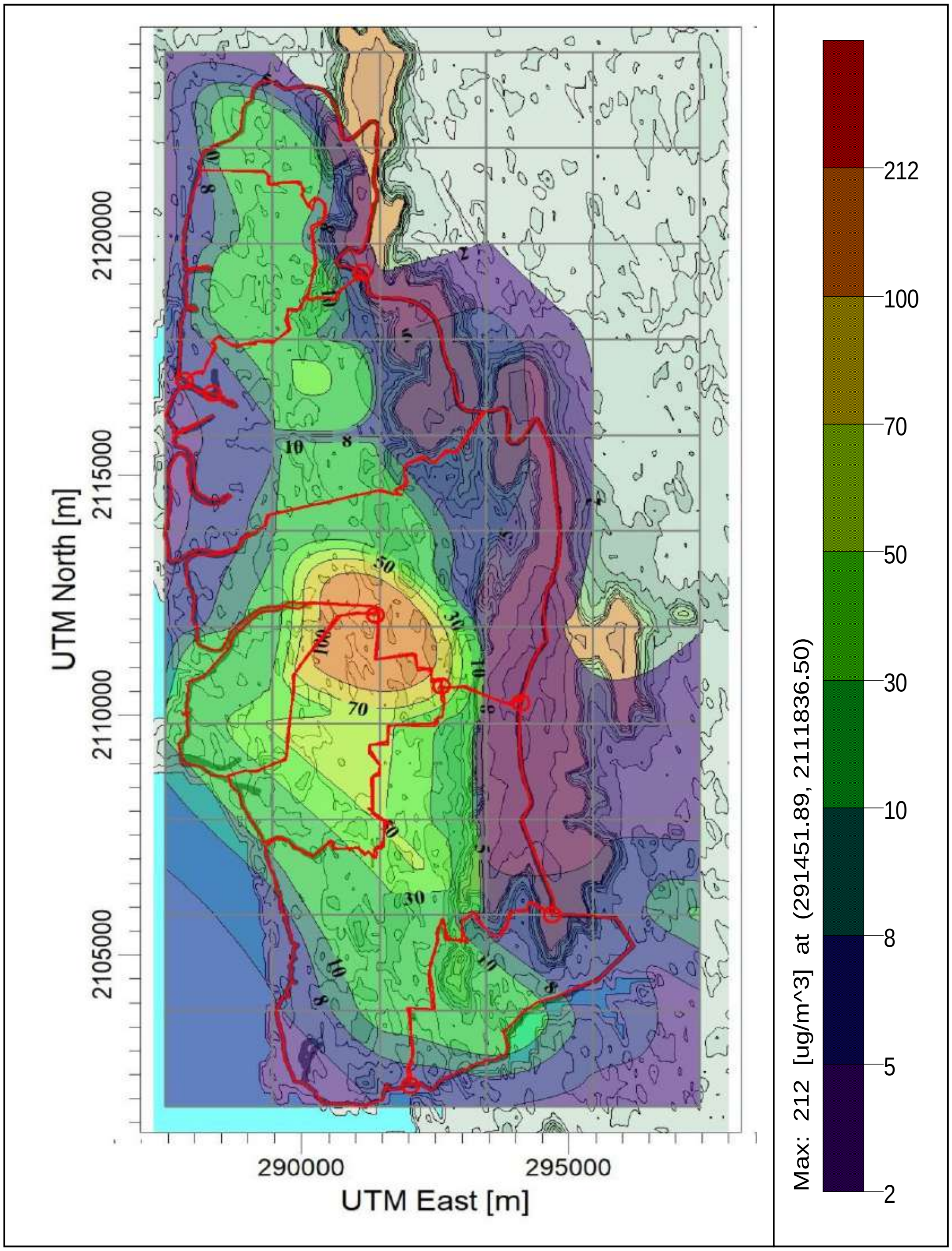

Figure N7 : Isopleths of NOx Due to Line Sources – Winter Season (Navi Mumbai City)

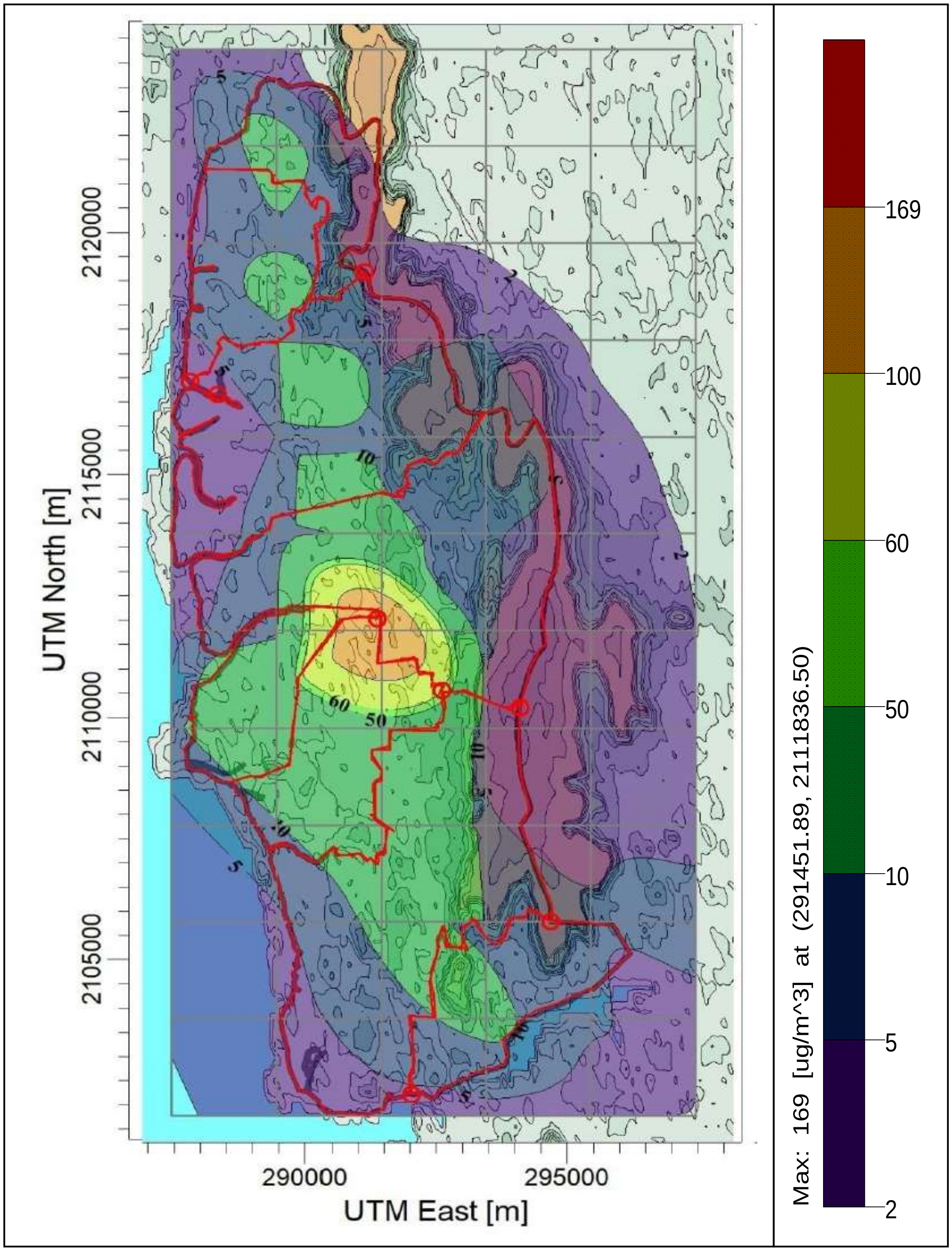

Figure N8 : Isopleths of NOx Due to Line Sources – Annual (Navi Mumbai City)

C) POINT SOURCE – LSI (NOx)

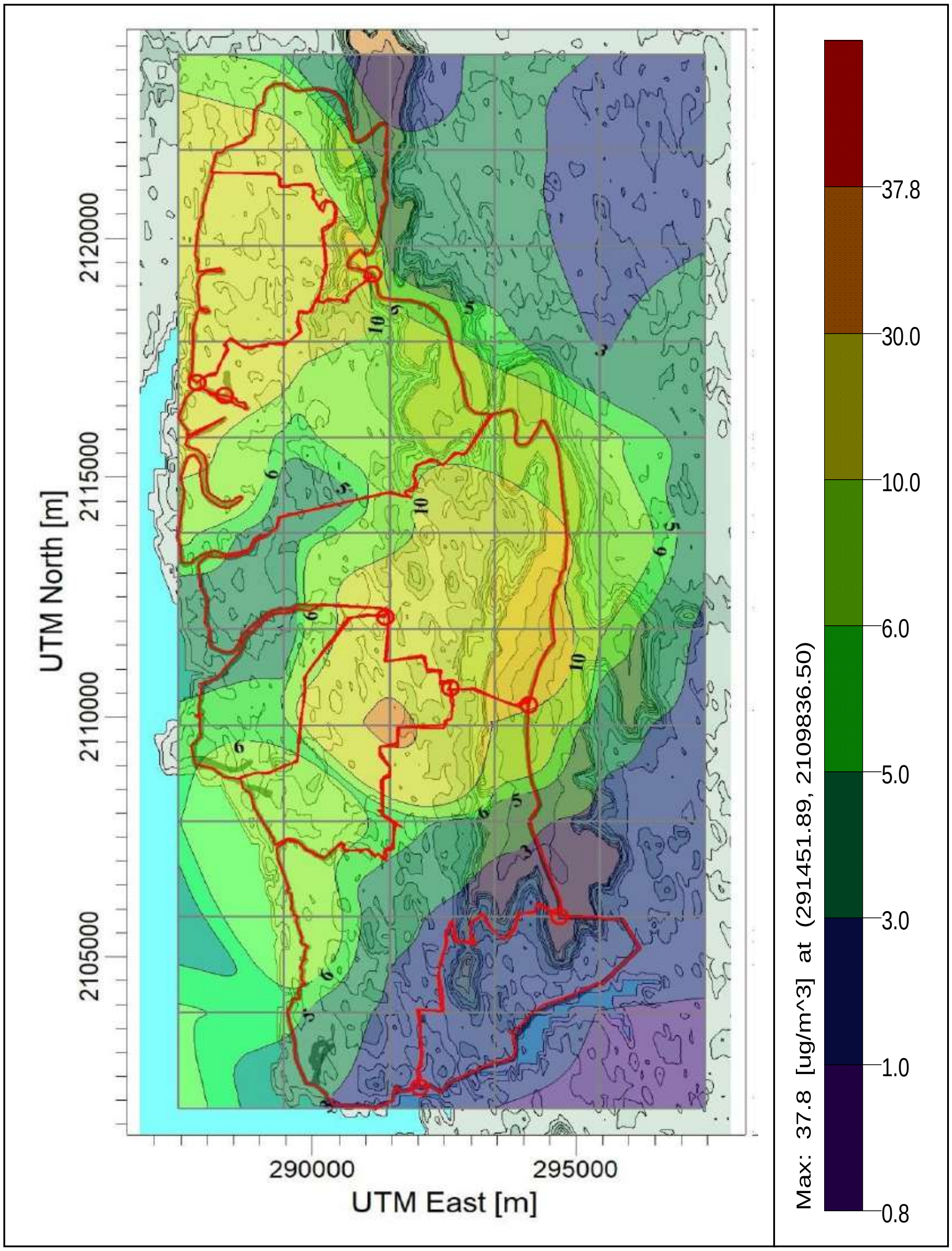

Figure N9 : Isopleths of NOx Due to Point Sources (LSI) – Summer Season (Navi Mumbai City)

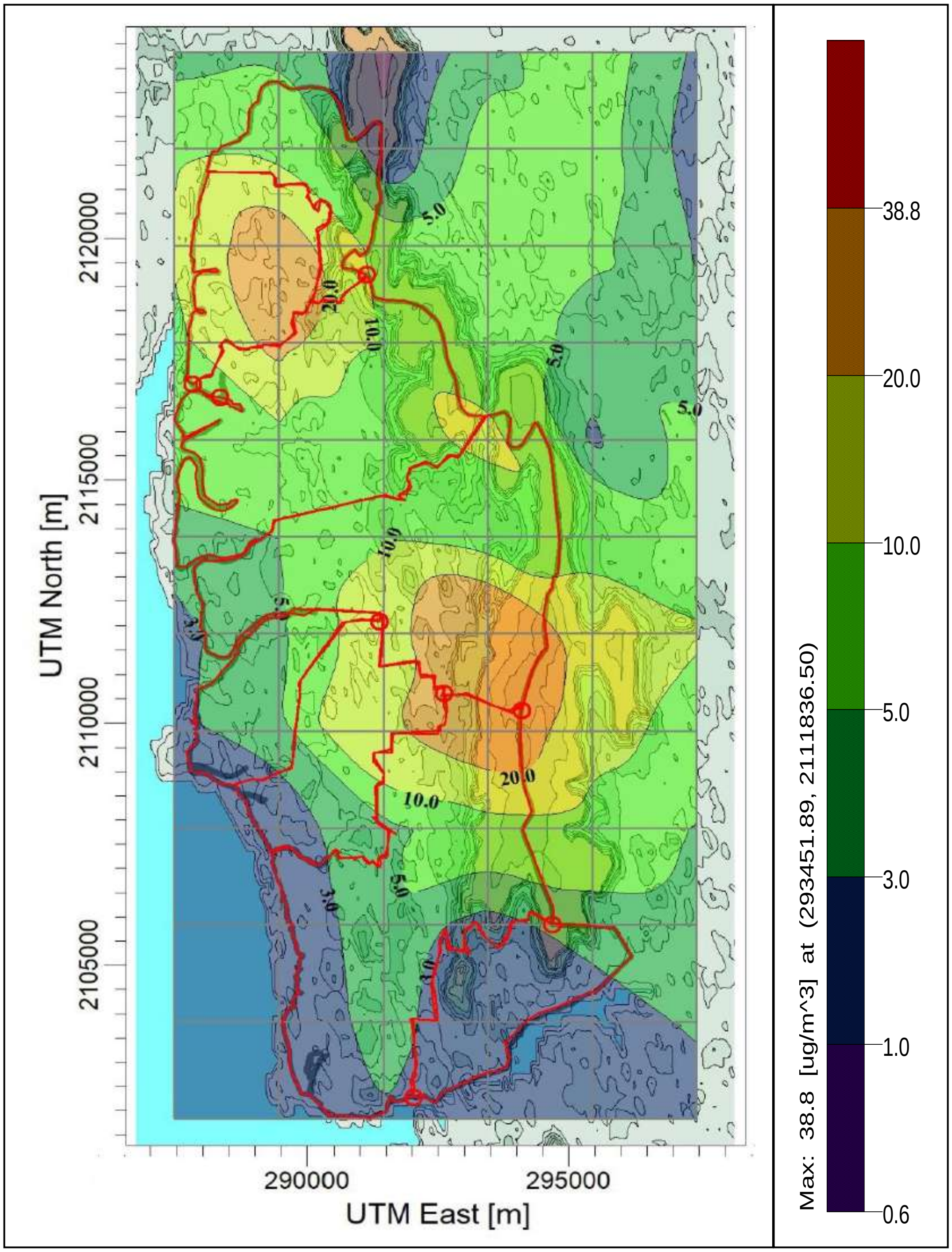

Figure N10 : Isopleths of NOx Due to Point Sources (LSI) – Post Monsoon Season (Navi Mumbai City)

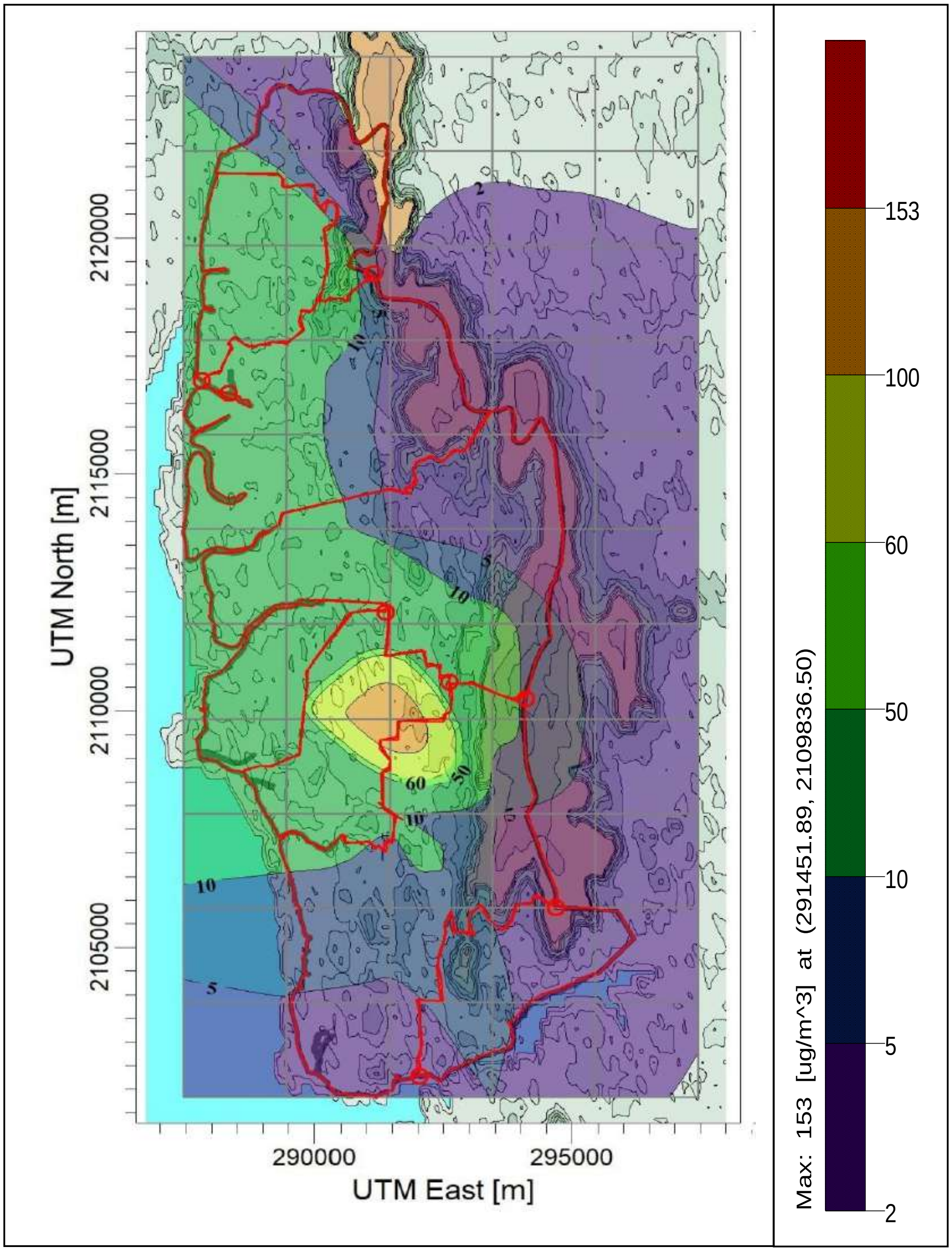

Figure N11 : Isopleths of NOx Due to Point Sources (LSI) – Winter Season (Navi Mumbai City)

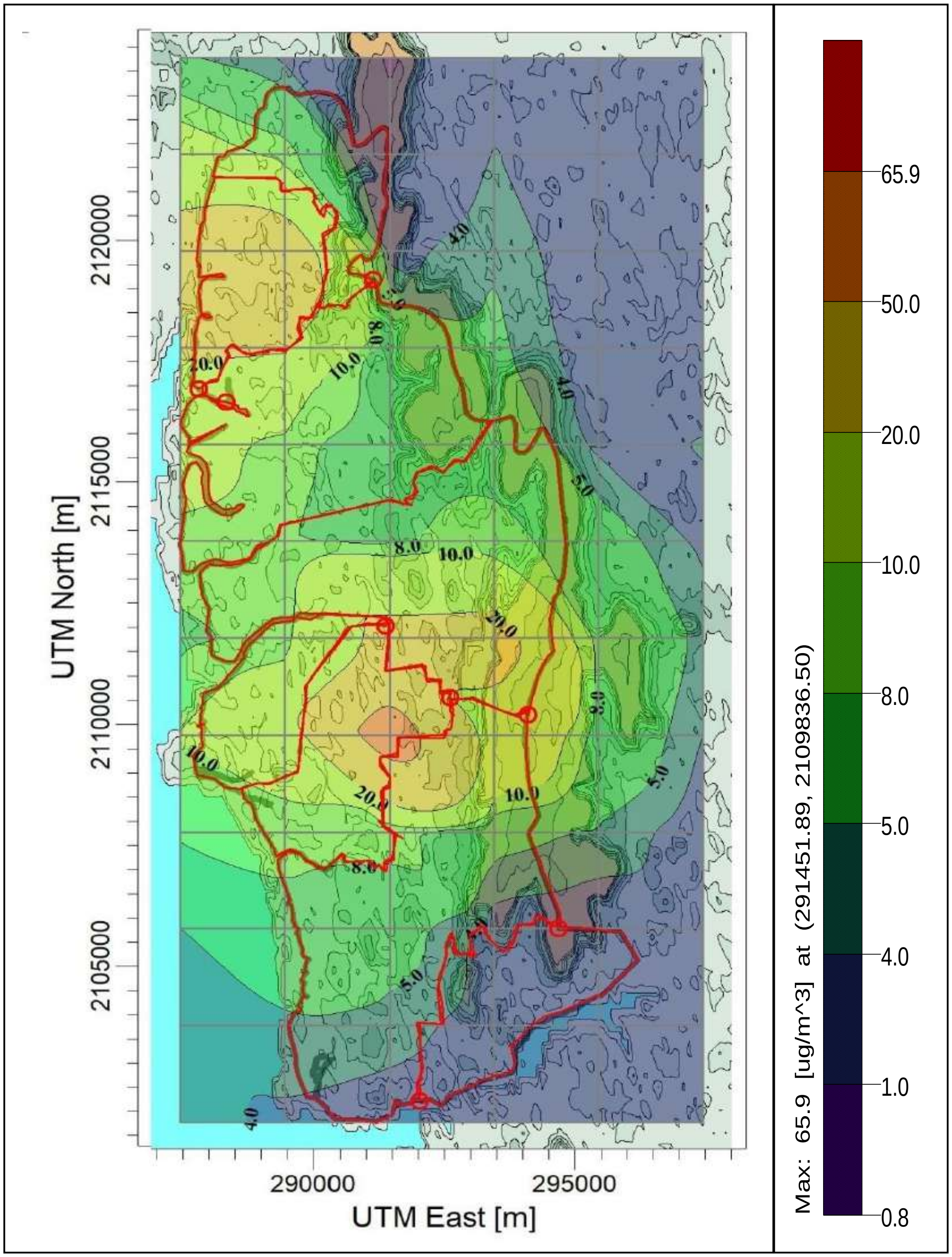

Figure N12 : Isopleths of NOx Due to Point Sources (LSI) – Annual (Navi Mumbai City)

E) POINT SOURCE – MSI (NOx)

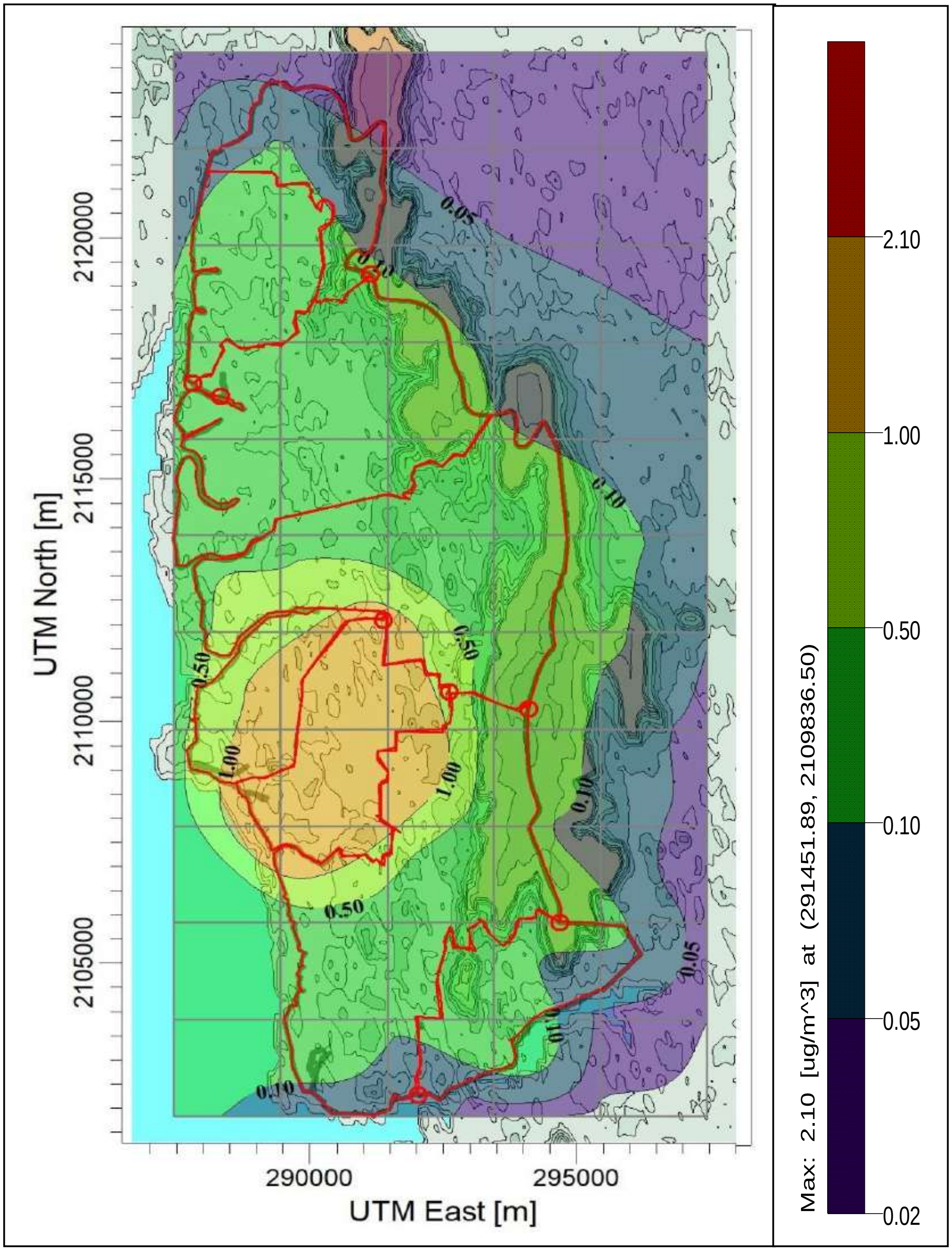

Figure N13 : Isopleths of NOx Due to Point Sources (MSI)– Summer Season (Navi Mumbai City)

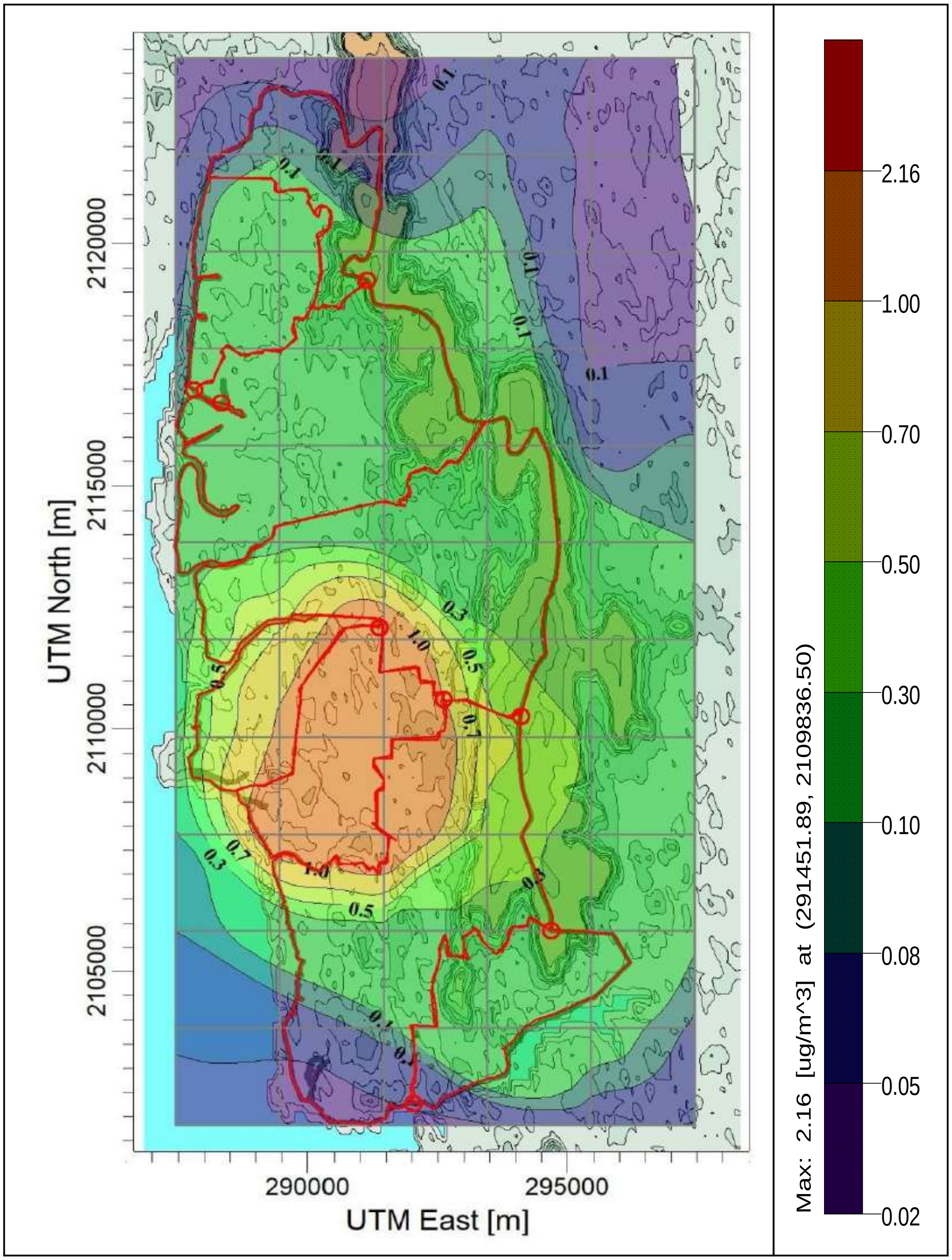

Figure N14 : Isopleths of NOx Due to Point Sources (MSI)– Post Monsoon Season (Navi Mumbai City)

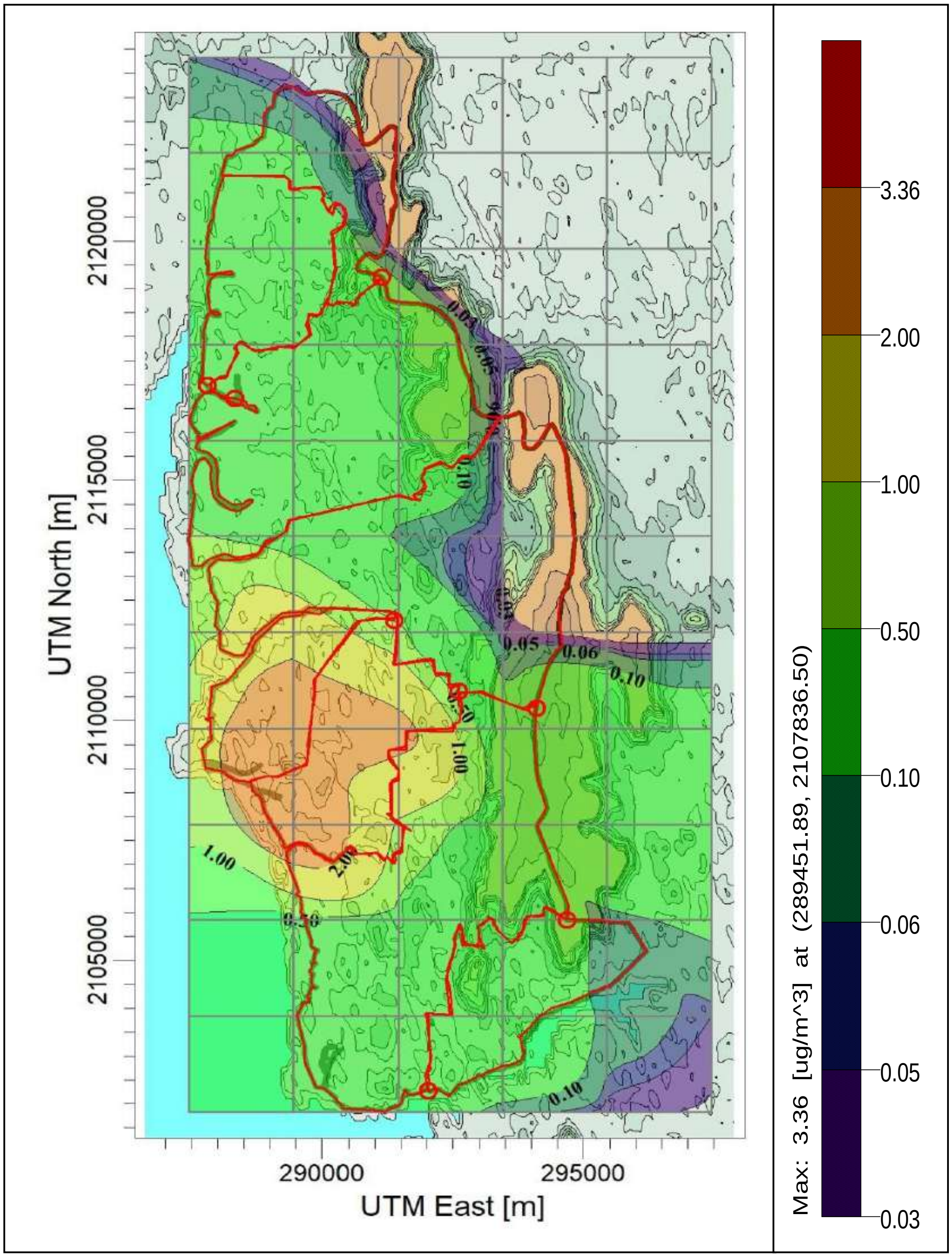

Figure N15 : Isopleths of NOx Due to Point Sources (MSI) – Winter Season (Navi Mumbai City)

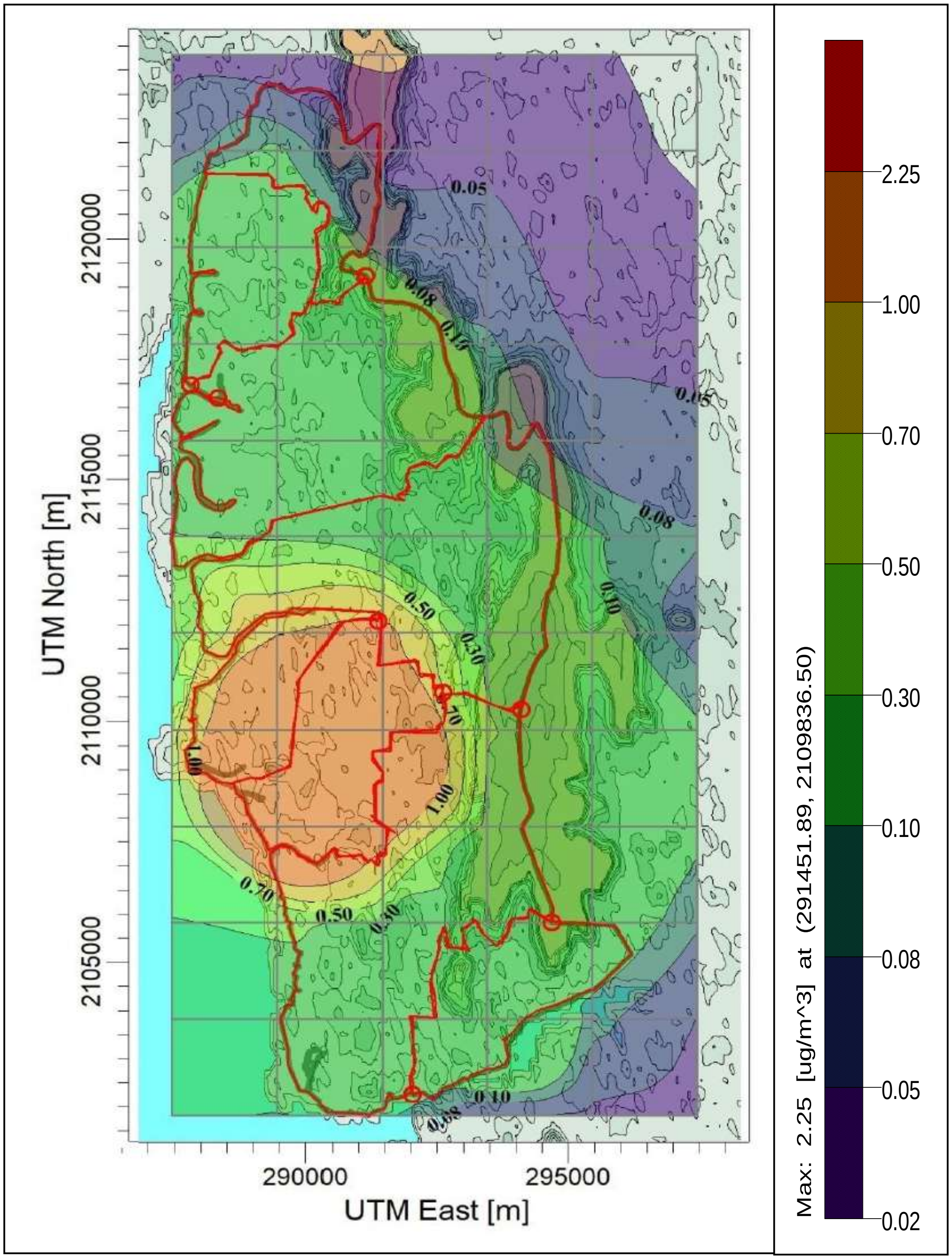

Figure N16 : Isopleths of NOx Due to Point Sources (MSI) – Annual (Navi Mumbai City)

F) POINT SOURCE – SSI (NOx)

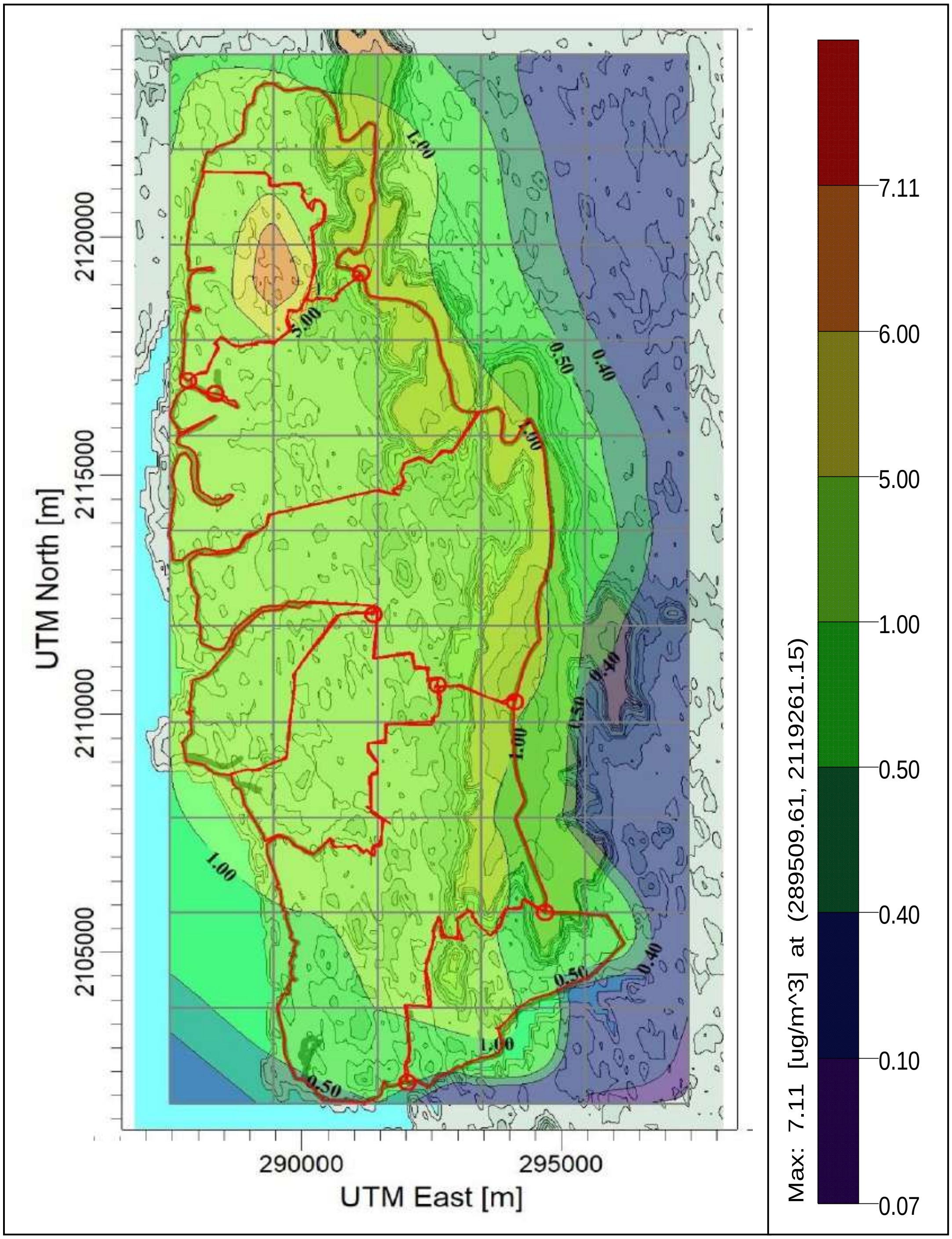

Figure N17 : Isopleths of NOx Due to Point Sources (SSI) – Summer Season (Navi Mumbai City)

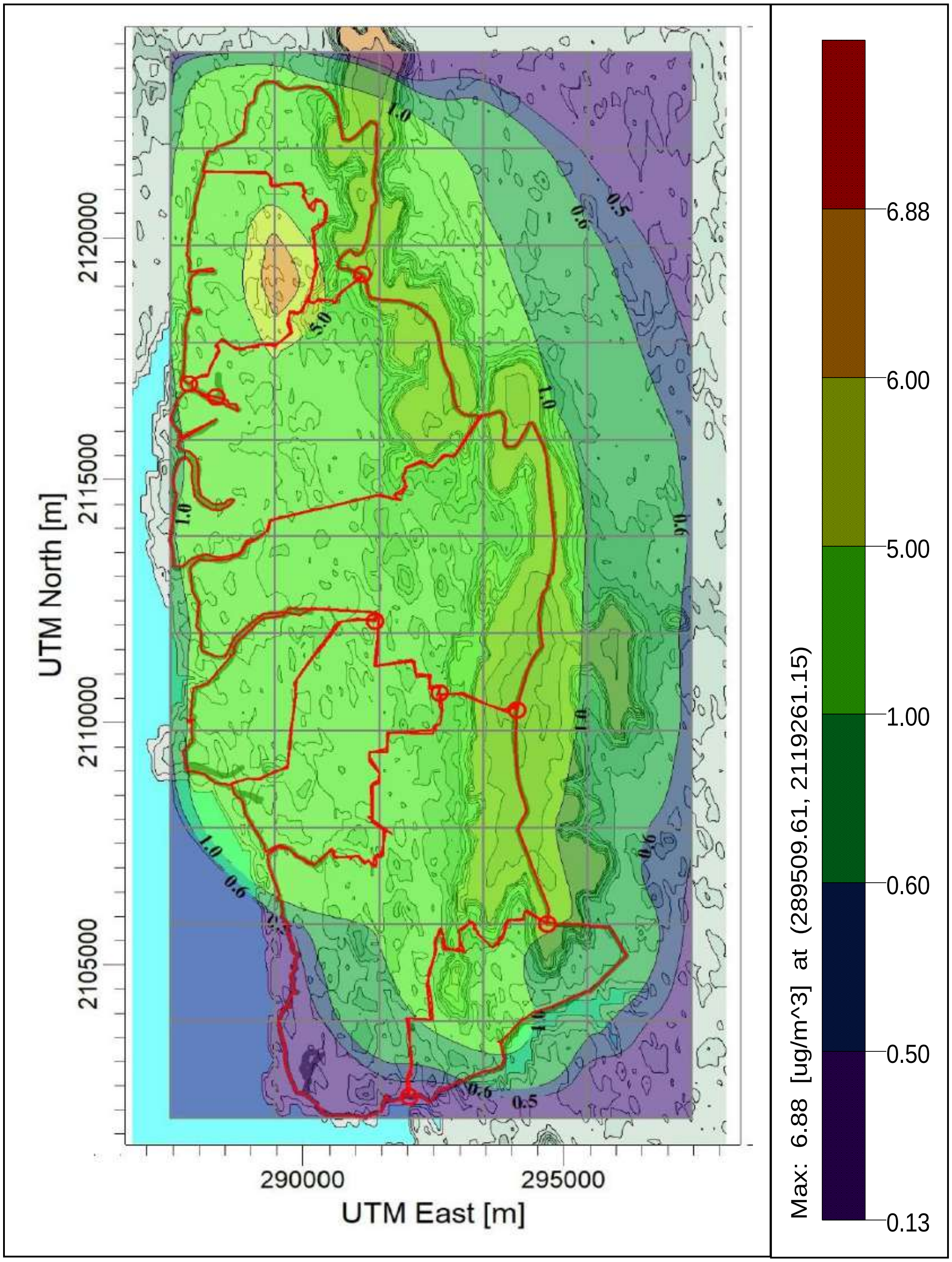

Figure N18 : Isopleths of NOx Due to Point Sources (SSI) – Post Monsoon Season (Navi Mumbai City)

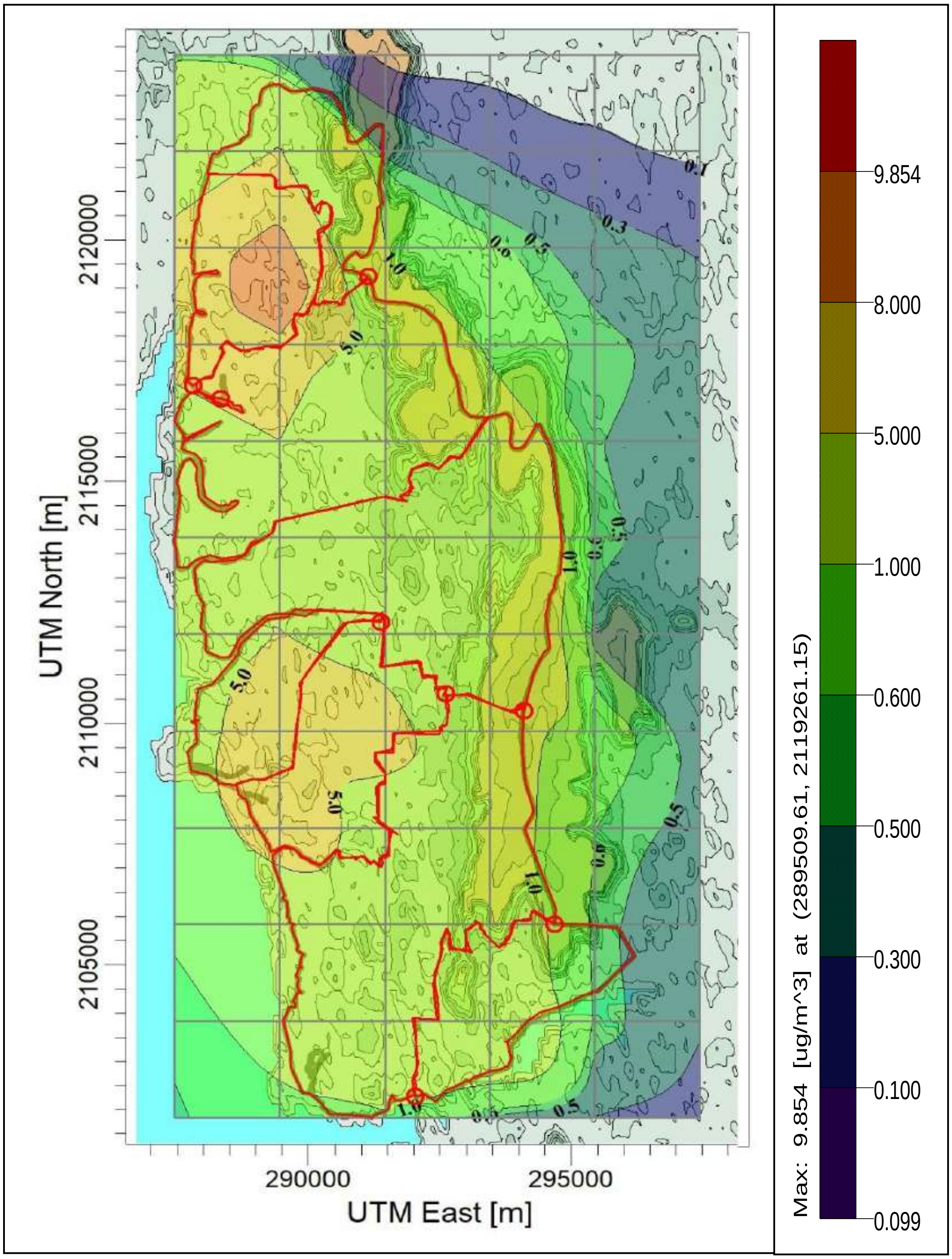

Figure N19 : Isopleths of NOx Due to Point Sources (SSI) – Winter Season (Navi Mumbai City)

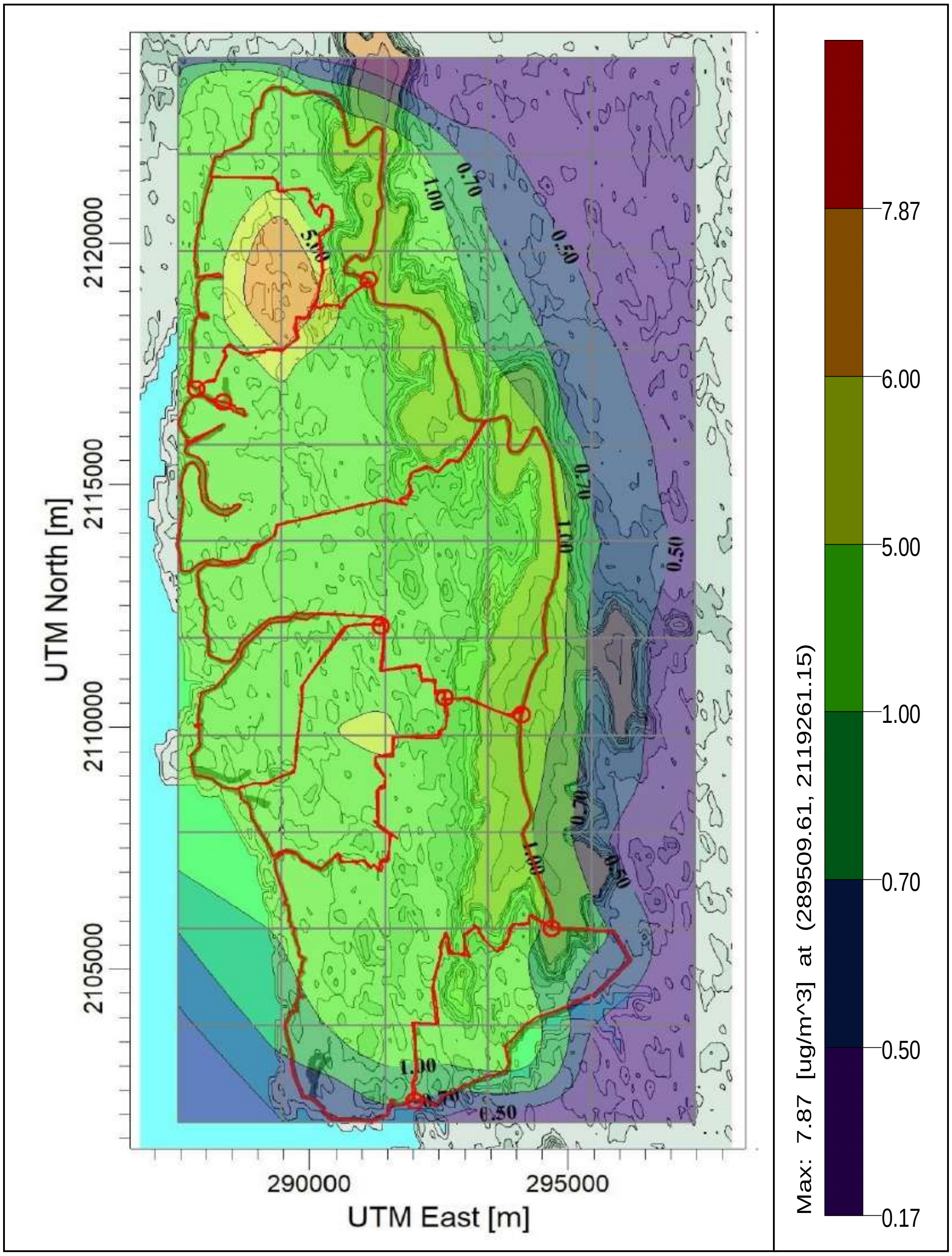

Figure N20 : Isopleths of NOx Due to Point Sources (SSI) – Annual (Navi Mumbai City)

ANNEXURE – 5

Maximum Ten Concentrations of NOx (Annual) BaU 2018, 2020, 2025 and Preferred Option I -2020, Preferred Option II – 2025

Navi Mumbai City

Annexure 5

A) Maximum Ten Occurrences of NO_X Concentrations in BaU 2018 at Navi Mumbai City (Annual)

Annual - All Source – BaU 2018			
	X length,m	Y length,m	Concentration µg/m³
1st	291451.89	2111836.50	445.34
2nd	291451.89	2111836.50	382.18
3rd	291451.89	2111836.50	339.60
4th	291451.89	2111836.50	300.60
5th	291451.89	2111836.50	289.41
6th	291451.89	2111836.50	275.71
7th	291451.89	2111836.50	262.86
8th	291451.89	2111836.50	262.63
9th	291451.89	2111836.50	247.88
10th	291451.89	2111836.50	234.51
Avg.	291451.89	2111836.50	205.75

Annual - Area Source – BaU 2018			
	X length,m	Y length,m	Concentration µg/m³
1st	289509.61	2119261.15	42.84
2nd	289509.61	2119261.15	36.88
3rd	289509.61	2119261.15	33.00
4th	289509.61	2119261.15	26.53
5th	289509.61	2119261.15	25.17
6th	289509.61	2119261.15	25.07
7th	289509.61	2119261.15	23.59
8th	289509.61	2119261.15	23.04
9th	289509.61	2119261.15	22.57
10th	289509.61	2119261.15	22.43
Avg.	289509.61	2119261.15	18.45

Annual – Line Source – BaU 2018			
	X length,m	Y length,m	Concentration µg/m³
1st	291451.89	2111836.50	384.83
2nd	291451.89	2111836.50	337.85
3rd	291451.89	2111836.50	291.13
4th	291451.89	2111836.50	246.02
5th	291451.89	2111836.50	245.80
6th	291451.89	2111836.50	225.91
7th	291451.89	2111836.50	212.38
8th	291451.89	2111836.50	210.56
9th	291451.89	2111836.50	209.57
10th	291451.89	2111836.50	202.65
Avg.	291451.89	2111836.50	168.98

Annual - Point Source (LSI)– BaU 2018			
	X length,m	Y length,m	Concentration µg/m³
1st	287451.89	2119836.50	354.35
2nd	287451.89	2119836.50	282.48
3rd	287451.89	2119836.50	251.58
4th	287451.89	2119836.50	232.89
5th	287451.89	2119836.50	129.48
6th	287451.89	2119836.50	126.84
7th	287451.89	2117836.50	110.97
8th	287451.89	2117836.50	86.00
9th	287451.89	2117836.50	75.71
10th	287451.89	2117836.50	35.33
Avg.	289509.61	2119261.15	65.91

Annual – Point Source (MSI) – BaU 2018			
	X length,m	Y length,m	Concentration µg/m³
1st	289451.89	2107836.50	7.08
2nd	289451.89	2109836.50	5.62
3rd	289451.89	2107836.50	4.58
4th	289451.89	2107836.50	4.39
5th	289451.89	2107836.50	4.37
6th	289451.89	2107836.50	4.17
7th	289451.89	2107836.50	4.05
8th	289451.89	2107836.50	3.92
9th	289451.89	2107836.50	3.81
10th	289451.89	2107836.50	3.04
Avg.	291451.89	2109836.50	2.25

Annual – Point Source (SSI) – BaU 2018			
	X length,m	Y length,m	Concentration µg/m³
1st	289509.61	2119261.15	20.28
2nd	289509.61	2119261.15	15.54
3rd	289509.61	2119261.15	16.25
4th	289509.61	2119261.15	12.78
5th	289509.61	2119261.15	12.48
6th	289509.61	2119261.15	9.81
7th	289509.61	2119261.15	10.70
8th	289509.61	2119261.15	10.28
9th	289509.61	2119261.15	10.14
10th	289509.61	2119261.15	10.12
Avg.	289509.61	2119261.15	7.86

B) Maximum Ten Occurrences of NO_X Concentrations in BaU 2020 at Navi Mumbai City (Annual)

Annual - All Source – BaU 2020			
	X length,m	Y length,m	Concentration µg/m^3
1st	291451.89	2111836.50	475.24
2nd	291451.89	2111836.50	408.47
3rd	291451.89	2111836.50	362.19
4th	291451.89	2111836.50	319.62
5th	291451.89	2111836.50	308.42
6th	291451.89	2111836.50	292.05
7th	291451.89	2111836.50	280.38
8th	291451.89	2111836.50	278.83
9th	291451.89	2111836.50	264.32
10th	291451.89	2111836.50	250.30
Avg.	291451.89	2111836.50	218.87

Annual - Area Source – BaU 2020			
	X length,m	Y length,m	Concentration µg/m^3
1st	289509.61	2119261.15	45.19
2nd	289509.61	2119261.15	38.91
3rd	289509.61	2119261.15	34.81
4th	289509.61	2119261.15	27.99
5th	289509.61	2119261.15	26.55
6th	289509.61	2119261.15	26.45
7th	289509.61	2119261.15	24.88
8th	289509.61	2119261.15	24.31
9th	289509.61	2119261.15	23.82
10th	289509.61	2119261.15	23.67
Avg.	289509.61	2119261.15	19.47

Annual – Line Source – BaU 2020			
	X length,m	Y length,m	Concentration µg/m^3
1st	291451.89	2111836.50	413.70
2nd	291451.89	2111836.50	363.19
3rd	291451.89	2111836.50	312.97
4th	291451.89	2111836.50	264.48
5th	291451.89	2111836.50	264.24
6th	291451.89	2111836.50	242.85
7th	291451.89	2111836.50	228.31
8th	291451.89	2111836.50	226.35
9th	291451.89	2111836.50	225.29
10th	291451.89	2111836.50	217.85
Avg.	291451.89	2111836.50	181.66

Annual - Point Source (LSI)– BaU 2020			
	X length,m	Y length,m	Concentration µg/m^3
1st	291451.89	2109836.50	356.35
2nd	291451.89	2109836.50	284.48
3rd	291451.89	2109836.50	252.58
4th	291451.89	2109836.50	233.89
5th	291451.89	2109836.50	130.48
6th	291451.89	2109836.50	127.84
7th	291451.89	2109836.50	111.97
8th	291451.89	2109836.50	87.00
9th	291451.89	2109836.50	76.71
10th	291451.89	2109836.50	36.33
Avg.	291451.89	2109836.50	65.91

Annual – Point Source (MSI) – BaU 2020			
	X length,m	Y length,m	Concentration µg/m^3
1st	289451.89	2107836.50	7.08
2nd	289451.89	2109836.50	5.62
3rd	289451.89	2107836.50	4.58
4th	289451.89	2107836.50	4.39
5th	289451.89	2107836.50	4.37
6th	289451.89	2107836.50	4.17
7th	289451.89	2107836.50	4.05
8th	289451.89	2107836.50	3.92
9th	289451.89	2107836.50	3.81
10th	289451.89	2107836.50	3.04
Avg.	291451.89	2109836.50	2.25

Annual – Point Source (SSI) – BaU 2020			
	X length,m	Y length,m	Concentration µg/m^3
1st	289509.61	2119261.15	20.25
2nd	289509.61	2119261.15	15.53
3rd	289509.61	2119261.15	15.25
4th	289509.61	2119261.15	11.78
5th	289509.61	2119261.15	11.48
6th	289509.61	2119261.15	10.81
7th	289509.61	2119261.15	10.70
8th	289509.61	2119261.15	10.48
9th	289509.61	2119261.15	10.44
10th	289509.61	2119261.15	10.42
Avg.	289509.61	2119261.15	7.87

C) Maximum Ten Occurrences of NO_X Concentrations in BaU 2025 at Navi Mumbai City (Annual)

Annual - All Source – BaU 2025			
	X length,m	Y length,m	Concentration µg/m^3
1st	291451.89	2111836.50	507.66
2nd	291451.89	2111836.50	436.99
3rd	291451.89	2111836.50	386.67
4th	291451.89	2111836.50	340.21
5th	291451.89	2111836.50	329.00
6th	291451.89	2111836.50	309.76
7th	291451.89	2111836.50	299.37
8th	291451.89	2111836.50	296.38
9th	291451.89	2111836.50	282.14
10th	291451.89	2111836.50	267.42
Avg.	291451.89	2111836.50	233.09

Annual - Area Source – BaU 2025			
	X length,m	Y length,m	Concentration µg/m^3
1st	289509.61	2119261.15	48.36
2nd	289509.61	2119261.15	41.64
3rd	289509.61	2119261.15	37.25
4th	289509.61	2119261.15	29.95
5th	289509.61	2119261.15	28.41
6th	289509.61	2119261.15	28.30
7th	289509.61	2119261.15	26.63
8th	289509.61	2119261.15	26.01
9th	289509.61	2119261.15	25.48
10th	289509.61	2119261.15	25.33
Avg.	289509.61	2119261.15	20.83

Annual – Line Source – BaU 2025			
	X length,m	Y length,m	Concentration µg/m^3
1st	291451.89	2111836.50	444.72
2nd	291451.89	2111836.50	390.43
3rd	291451.89	2111836.50	336.44
4th	291451.89	2111836.50	284.31
5th	291451.89	2111836.50	284.06
6th	291451.89	2111836.50	261.07
7th	291451.89	2111836.50	245.43
8th	291451.89	2111836.50	243.33
9th	291451.89	2111836.50	242.19
10th	291451.89	2111836.50	234.19
Avg.	291451.89	2111836.50	195.28

Annual - Point Source (LSI)– BaU 2025			
	X length,m	Y length,m	Concentration µg/m^3
1st	291451.89	2109836.50	356.35
2nd	291451.89	2109836.50	284.48
3rd	291451.89	2109836.50	252.58
4th	291451.89	2109836.50	233.89
5th	291451.89	2109836.50	130.48
6th	291451.89	2109836.50	127.84
7th	291451.89	2109836.50	111.97
8th	291451.89	2109836.50	87.00
9th	291451.89	2109836.50	76.71
10th	291451.89	2109836.50	36.33
Avg.	291451.89	2109836.50	65.91

Annual – Point Source (MSI) – BaU 2025			
	X length,m	Y length,m	Concentration µg/m^3
1st	289451.89	2107836.50	7.00
2nd	289451.89	2109836.50	4.95
3rd	289451.89	2107836.50	4.49
4th	289451.89	2107836.50	4.33
5th	289451.89	2107836.50	4.20
6th	289451.89	2107836.50	4.14
7th	289451.89	2107836.50	4.05
8th	289451.89	2107836.50	3.92
9th	289451.89	2107836.50	3.71
10th	289451.89	2107836.50	2.97
Avg.	291451.89	2109836.50	2.19

Annual – Point Source (SSI) – BaU 2025			
	X length,m	Y length,m	Concentration µg/m^3
1st	289509.61	2119261.15	20.25
2nd	289509.61	2119261.15	15.53
3rd	289509.61	2119261.15	15.25
4th	289509.61	2119261.15	11.78
5th	289509.61	2119261.15	11.48
6th	289509.61	2119261.15	10.81
7th	289509.61	2119261.15	10.70
8th	289509.61	2119261.15	10.48
9th	289509.61	2119261.15	10.44
10th	289509.61	2119261.15	10.42
Avg.	289509.61	2119261.15	7.87

D) Maximum Ten Occurrences of NO_X Concentrations after Implementation of Control Options (Preferred Option I -2020) at Mumbai City (Annual)

Annual - All Source Preferred Option I -2020			
	X length,m	Y length,m	Concentration μg/m^3
1st	291451.89	2111836.50	285.73
2nd	291451.89	2111836.50	245.59
3rd	291451.89	2111836.50	217.76
4th	291451.89	2111836.50	192.16
5th	291451.89	2111836.50	185.43
6th	291451.89	2111836.50	175.59
7th	291451.89	2111836.50	168.57
8th	291451.89	2111836.50	167.64
9th	291451.89	2111836.50	158.92
10th	291451.89	2111836.50	150.49
Avg.	291451.89	2111836.50	131.59

Annual - Area Source Preferred Option I -2020			
	X length,m	Y length,m	Concentration μg/m^3
1st	289509.61	2119261.15	27.17
2nd	289509.61	2119261.15	23.39
3rd	289509.61	2119261.15	20.93
4th	289509.61	2119261.15	16.83
5th	289509.61	2119261.15	15.96
6th	289509.61	2119261.15	15.90
7th	289509.61	2119261.15	14.96
8th	289509.61	2119261.15	14.62
9th	289509.61	2119261.15	14.32
10th	289509.61	2119261.15	14.23
Avg.	289509.61	2119261.15	11.71

Annual – Line Source Preferred Option I -2020			
	X length,m	Y length,m	Concentration μg/m^3
1st	291451.89	2111836.50	248.73
2nd	291451.89	2111836.50	218.36
3rd	291451.89	2111836.50	188.17
4th	291451.89	2111836.50	159.01
5th	291451.89	2111836.50	158.87
6th	291451.89	2111836.50	146.01
7th	291451.89	2111836.50	137.27
8th	291451.89	2111836.50	136.09
9th	291451.89	2111836.50	135.45
10th	291451.89	2111836.50	130.98
Avg.	291451.89	2111836.50	109.22

Annual Point Source (LSI) Preferred Option I -2020			
	X length,m	Y length,m	Concentration μg/m^3
1st	291451.89	2109836.50	214.25
2nd	291451.89	2109836.50	171.04
3rd	291451.89	2109836.50	151.86
4th	291451.89	2109836.50	140.62
5th	291451.89	2109836.50	78.45
6th	291451.89	2109836.50	76.86
7th	291451.89	2109836.50	67.32
8th	291451.89	2109836.50	52.30
9th	291451.89	2109836.50	46.12
10th	291451.89	2109836.50	21.84
Avg.	291451.89	2109836.50	39.62

Annual Point Source (MSI) Preferred Option I-2020			
	X length,m	Y length,m	Concentration μg/m^3
1st	289451.89	2107836.50	4.25
2nd	289451.89	2109836.50	3.38
3rd	289451.89	2107836.50	2.76
4th	289451.89	2107836.50	2.64
5th	289451.89	2107836.50	2.63
6th	289451.89	2107836.50	2.51
7th	289451.89	2107836.50	2.43
8th	289451.89	2107836.50	2.36
9th	289451.89	2107836.50	2.29
10th	289451.89	2107836.50	1.83
Avg.	291451.89	2109836.50	1.35

Annual Point Source (SSI) Preferred Option I-2020			
	X length,m	Y length,m	Concentration μg/m^3
1st	289509.61	2119261.15	12.17
2nd	289509.61	2119261.15	9.34
3rd	289509.61	2119261.15	9.17
4th	289509.61	2119261.15	7.08
5th	289509.61	2119261.15	6.90
6th	289509.61	2119261.15	6.50
7th	289509.61	2119261.15	6.43
8th	289509.61	2119261.15	6.30
9th	289509.61	2119261.15	6.28
10th	289509.61	2119261.15	6.27
Avg.	289509.61	2119261.15	4.73

E) Maximum Ten Occurrences of NO_X Concentrations after Implementation of Control Options (Preferred Option II -2025) at Mumbai City (Annual)

Annual - All Source Preferred Option II -2025			
	X length,m	Y length,m	Concentration µg/m^3
1st	291451.89	2111836.50	307.73
2nd	291451.89	2111836.50	264.89
3rd	291451.89	2111836.50	234.39
4th	291451.89	2111836.50	206.23
5th	291451.89	2111836.50	199.43
6th	291451.89	2111836.50	187.77
7th	291451.89	2111836.50	181.47
8th	291451.89	2111836.50	179.65
9th	291451.89	2111836.50	171.02
10th	291451.89	2111836.50	162.10
Avg.	291451.89	2111836.50	141.29

Annual - Area Source Preferred Option II -2025			
	X length,m	Y length,m	Concentration µg/m^3
1st	289509.61	2119261.15	29.31
2nd	289509.61	2119261.15	25.24
3rd	289509.61	2119261.15	22.58
4th	289509.61	2119261.15	18.16
5th	289509.61	2119261.15	17.22
6th	289509.61	2119261.15	17.15
7th	289509.61	2119261.15	16.14
8th	289509.61	2119261.15	15.77
9th	289509.61	2119261.15	15.45
10th	289509.61	2119261.15	15.35
Avg.	289509.61	2119261.15	12.63

Annual – Line Source Preferred Option II -2025			
	X length,m	Y length,m	Concentration µg/m^3
1st	291451.89	2111836.50	269.58
2nd	291451.89	2111836.50	236.67
3rd	291451.89	2111836.50	203.94
4th	291451.89	2111836.50	172.34
5th	291451.89	2111836.50	172.19
6th	291451.89	2111836.50	158.25
7th	291451.89	2111836.50	148.77
8th	291451.89	2111836.50	147.50
9th	291451.89	2111836.50	146.81
10th	291451.89	2111836.50	141.96
Avg.	291451.89	2111836.50	118.37

Annual Point Source (LSI) Preferred Option II-2025			
	X length,m	Y length,m	Concentration µg/m^3
1st	291451.89	2109836.50	216.01
2nd	291451.89	2109836.50	172.44
3rd	291451.89	2109836.50	153.11
4th	291451.89	2109836.50	141.78
5th	291451.89	2109836.50	79.10
6th	291451.89	2109836.50	77.49
7th	291451.89	2109836.50	67.88
8th	291451.89	2109836.50	52.73
9th	291451.89	2109836.50	46.50
10th	291451.89	2109836.50	22.02
Avg.	291451.89	2109836.50	39.95

Annual Point Source (MSI) Preferred Option II-2025			
	X length,m	Y length,m	Concentration µg/m^3
1st	289451.89	2107836.50	4.29
2nd	289451.89	2109836.50	3.41
3rd	289451.89	2107836.50	2.78
4th	289451.89	2107836.50	2.66
5th	289451.89	2107836.50	2.65
6th	289451.89	2107836.50	2.53
7th	289451.89	2107836.50	2.45
8th	289451.89	2107836.50	2.38
9th	289451.89	2107836.50	2.31
10th	289451.89	2107836.50	1.84
Avg.	291451.89	2109836.50	1.37

Annual Point Source (SSI) Preferred Option II-2025			
	X length,m	Y length,m	Concentration µg/m^3
1st	289509.61	2119261.15	12.27
2nd	289509.61	2119261.15	9.42
3rd	289509.61	2119261.15	9.24
4th	289509.61	2119261.15	7.14
5th	289509.61	2119261.15	6.96
6th	289509.61	2119261.15	6.55
7th	289509.61	2119261.15	6.49
8th	289509.61	2119261.15	6.35
9th	289509.61	2119261.15	6.33
10th	289509.61	2119261.15	6.32
Avg.	289509.61	2119261.15	4.77

Annexure-III

Groslly polluted Industries , TTC MIDC Navi Mumbai.

Sr. No.	Name of Industry	Scale	MPCB ID	Category	OCEMS Status
1	M/s. Zydus Takeda healthcare, Plot No C-4, TTc MIDC Pawane, Navi Mumbai.	LSI	site_440	17 Category	Connected
2	M/s. RPG Life science 25 MIDC Land, thane Belapur road, Pawane, Navi Mumbai.	LSI	-	17 Category	Connected
3	M/s. Piramal pharma PVt. LTD. Plot No. C 43/46, TTC MIDC Navi Mumbai.	LSI	site_785	17 Category	Connected
4	M/s. Gramercy trade industries Pvt. LTd. GEN-2/1/A MIDC Road, D Block, Turbhe MIDC, TTC Industrial Area, Navi Mumbai-400705	LSI	site_631	17 Category	Connected
5	M/s. Reliane Life Science Pvt. Ltd. , Plot No. R-282, TTC Industrial area MIDC Rabale, Navi Mumbai.	LSI	-	17 Category	Connected
6	M/s. Lubrizol India Pvt. Ltd, Turbhe, TTC MIDC Navi Mumbai.	LSI	-	GPI	Connected
7	M/s. Amines and plasticizers Pvt. Ltd. Plot No. D-21/21A, TTC Industrial area, MIDC Turbhe, Navi Mumbai.	LSI	site_841	GPI	Connected
8	M/S BASF India Ltd., Plot No.12/13, Thane Belapur Road, TTC area, Turbhe, Navi mumbai	LSI	-	GPI	Connected
9	Croda India Company Pvt. Ltd., Plot No. 1/1, TTC MIDC Navi Mumbai.	LSI	-	GPI	Connected
10	Henkel Adhesive Technologies India Pvt. Ltd., Plot No. P-1/1 Pt-II, TTC MIDC Navi Mumbai.	LSI	-	GPI	Connected
11	M/s. Savita oil technology Pvt. Lt. Plot No. 17/17A, Thane Belapur Road Vashi, Navi Mumbai.	LSI	site_1700	GPI	Connected
12	M/s. Kolhapur Zillha sahakari dudh utpadak, Plot No. 40/4-5, Mafco yard, Turbhe, Navi Mumbai.	LSI	-	GPI	Connected
13	M/s Nocil Ltd, Plot No. C 37, TTC Industrial area, MIDC Pawane, navi Mumbai.	LSI	-	GPI	Connected

Annexure-IV

Navi Mumbai Muncipal Corporation (STP) -- Sanpada Sector 20
OUTLETS

SR. NO.	Parameters	Standards	Unit	04.01.2024	21.02.2024	01.03.2024	29.04.2024	29.05.2024	04.06.2024	04.07.2024	06.08.2024	03.09.2024	03.10.2024
				BR-0063527	BR-0067175	BR-0067788	BR-0071576	BR-0073554	BR-0074047	BR-0076359	BR-0078348	BR-0079847	BR-0082959
1	PH	6.5-9.0		7.5	7	7.5	7.6	7.2	7.6	7.8	7.7	7.9	7.9
2	Suspended Solid	Not to Exceed 20	mg/l	10	10	6	8	10	10	14	8	8	10
3	Ammonical Nitrogen	Not to Exceed 05	mg/l	**6.38**	0.56	0.55	0.58	0.67	0.49	BDL	0.03	0.05	0.08
4	Biological Oxygen Demand (BOD)	Not to Exceed 10	mg/l	9	6	3	3	6	2.4	4	2	4	BDL
5	ml	Not to Exceed 50	mg/l	**64**	21.3	10.6	12.6	22	5.2	8	4	8	BDL
6	Nitrate Nitrogen	Not to Exceed 10	mg/l	9.42	9.03	0.13	0.1	0.66	0.38	0.52	5.2	1.3	0.5

Navi Mumbai Municipal Corporation (STP) -- Vashi Sector 18
OUTLETS

SR. NO.	Parameters	Standards	Unit	04.01.2024	21.02.2024	01.03.2024	29.04.2024	29.05.2024	04.06.2024	04.07.2024	06.08.2024	03.09.2024	03.10.2024
				BR-0063529	BR-0067177	BR-0067790	BR-0071579	BR-0073556	BR-0074049	BR-0076361	BR-0078350	BR-0079849	BR-0082963
1	PH	6.5-9.0		7.5	7.2	7.8	7.2	7.5	7.4	7.5	7.8	8.3	7.9
2	Suspended Solid	Not to Exceed 20	mg/l	11	16	8	8	10	12	16	6	8	10
3	Ammonical Nitrogen	Not to Exceed 05	mg/l	**9.24**	1.64	1.14	0.58	0.57	0.8	BDL	BDL	0.16	0.22
4	Biological Oxygen Demand (BOD)	Not to Exceed 10	mg/l	7	15	2.26	6	4	10	4	BDL	6	BDL
5	Chemical Oxygen Demand (COD)	Not to Exceed 50	mg/l	**56**	**58.8**	7.9	24	11.2	38.2	8	BDL	24	BDL
7	Nitrate Nitrogen	Not to Exceed 10	mg/l	8.9	2.48	BDL	0.16	0.11	0.96	0.21	2.8	1.1	0.52

Navi Mumbai Muncipal Corporation (STP) -- Nerul Sector- 50
OUTLETS

SR. NO.	Parameters	Standards	Unit	04.01.2024	21.02.2024	01.03.2024	29.04.2024	29.05.2024	04.06.2024	04.07.2024	06.08.2024	03.09.2024	03.10.2024
				BR-0063525	BR-0067173	BR-0067786	BR-0071574	BR-0073552	BR-0074045	BR-0076357	BR-0078346	BR-0079845	BR-0082961
1	PH	6.5-9.0		7.3	7.6	7.9	7.3	7.6	7.7	7.4	7.8	7.9	7.9
2	Suspended Solid	Not to Exceed 20	mg/l	9	8	6	8	10	10	12	6	10	8
3	Ammonical Nitrogen	Not to Exceed 05	mg/l	0.35	0.25	0.76	2.71	1.58	0.62	BDL	0.03	0.03	0.61
4	Biological Oxygen Demand (BOD)	Not to Exceed 10	mg/l	7	3	2.8	5	**20**	6	4	2	2	BDL
5	Chemical Oxygen Demand (COD)	Not to Exceed 50	mg/l	44	11.8	7.9	22.8	**96.4**	14.3	12	4	4	BDL
7	Nitrate Nitrogen	Not to Exceed 10	mg/l	4.96	0.47	BDL	0.17	0.2	0.44	0.19	1.6	1.2	0.49

Navi Mumbai Muncipal Corporation (STP) -- CBD Belapur Sector 12
OUTLETS

SR. NO.	Parameters		Unit	04.01.2024	21.02.2024	01.03.2024	29.04.2024	29.05.2024	04.06.2024	04.07.2024	06.08.2024	03.09.2024	03.10.2024
				BR-0063523	BR-0067171	BR-0067784	BR-0071572	BR-0073550	BR-0074043	BR-0076355	BR-0078344	BR-0079843	BR-0082957
1	PH	6.5-9.0		7.3	7.2	7.3	7.3	7.6	7.3	7.7	7.8	8.2	7.9
2	Suspended Solid	Not to Exceed 20	mg/l	11	8	8	8	10	12	10	8	8	10
3	Ammonical Nitrogen	Not to Exceed 05	mg/l	0.41	13.8	117.8	2.11	0.91	9.1	0.92	0.03	0.06	0.48
4	Biological Oxygen Demand (BOD)	Not to Exceed 10	mg/l	6	6	22	3	14	**20**	4	2	4	BDL
5	Chemical Oxygen Demand (COD)	Not to Exceed 50	mg/l	40	26	**76.9**	14.1	**54.8**	39.4	8	4	8	BDL
7	Nitrate Nitrogen	Not to Exceed 10	mg/l	5.01	1.08	3.3	0.18	0.21	0.56	0.18	1.5	2.1	0.46

STP Airoli

SR. NO.	Parameters/ Date	Limit	30/01/2024	22/02/2024	30/04/2024	29/05/2024	27/06/2024	31/07/2024	03/09/2024
1	pH	6.5 to 9.0	7.3	7.2	7.7	7.5	7.9	7.7	7.5
2	BOD	10 Mg/l	6.0	7.0	2.0	6.0	5.0	7.0	9.0
3	COD	50 Mg/l	44.0	28.8	7.9	21.2	18.8	28.0	32.0
4	Suspended Solids	10 Mg/l	8.0	8.0	10.0	12.0	12.0	18.0	6.0
5	Nitrate Nitrogen	-	2.00	0.63	0.79	0.47	2.53	6.90	1.37
6	Ammonical Nitrogen	-	1.62	0.56	0.45	0.59	0.61	0.21	6.26

STP Ghansoli

SR. NO.	Parameters/ Date	Limit	30/01/2024	22/02/2024	30/04/2024	29/05/2024	27/06/2024	31/07/2024	3/9/2024
1	pH	6.5 to 9.0	7.3	7.1	7.7	7.7	7.8	7.5	7.8
2	BOD	10 Mg/l	7.0	10.0	5.0	3.6	BDL	4.0	2.0
3	COD	50 Mg/l	36.0	34.0	34.2	10.4	4.8	12.0	4.0
4	Suspended Solids	10 Mg/l	8.0	8.0	10.0	10.0	10.0	8.0	6.0
5	Nitrate Nitrogen	-	2.02	1.00	0.10	0.20	1.43	1.20	3.41
6	Phosphate (total)	-	-	-	-		-		-
7	Ammonical Nitrogen	-	1.62	1.1	0.58	3.72	0.64	0.12	1.77

STP Koperkhairne

SR. NO.	Parameters/ Date	Limit	30/01/2024	22/02/2024	30/04/2024	29/05/2024	27/06/2024	31/07/2024	03/09/2024	
1	pH	6.5 to 9.0	7.3	7.1	7.6	7.5	7.7	7.7	7.2	
2	BOD	10 Mg/l	7.0	8.0	4.0	7.0	BDL	7.0	4.0	
3	COD	50 Mg/l	36.0	30.4	24.4	26.8	1.2	28.0	20.0	
4	Suspended Solids	10 Mg/l	8.0	10.0	10.0	10.0	14.0	24.0	8.0	
5	Nitrate Nitrogen	-	2.10	2.70	0.81	0.44	0.06	11.68	3.77	
6	Ammonical Nitrogen	-	1.74	0.58	0.47	0.56	0.64	0.18	1.77	

Annexure-V

List of Industries switched over to PNG

S. No.	Name	Address
1	M/S M. J. Coaters Pvt. Ltd.	Plot No. A-471, ,
2	M/S Zenco Metal Finishers	R-714, ,
3	M/S Crish Metal Works Pvt. Ltd.	A-429, TTC Industrial Area, ,
4	M/S Indo Allied Protein Foods P LTD.	A-586,MIDC, TTC Ind. Area, Mahape ,
5	M/S KANTILAL DAMODAR MITHAIWALA LLP	Plot No: Rabale , Plot no-R-377 ,
6	M/S SUDHIR DAIRY & SWEETS PVT LTD	Plot No A-258 ,
7	M/S SWAN AGRI PRODUCTS PVT. LTD.	Plot No: Rabale , R-871, ,
8	M/S Suwinka Engineers	R-971, TTC Ind Area, MIDC Rabale ,
9	M/S Jem Industries	R- 641, TTC, MIDC, Rabale ,
10	M/S Tip Top Foods	R-577, TTC, MIDC, Rabale ,
11	M/S Sudha Metal Printers Pvt Ltd	Plot No: Rabale , R 605, TTC MIDC ,
12	M/S WELFINISH METAL PROCESSOR P.LTD.	Plot No: R-563 , MIDC RABALE,THANE BELAPUR RD. ,
13	M/S Hylite Electroplaters Pvt. Ltd.	A-129, TTC Industrial Area ,
14	M/S Sharp Batteries & Allied Industries Ltd.	C-331, ,
15	M/S Anand & Company (Gr. Floor)	Plot. No. A-760, ,
16	M/S Anand & Company (First Floor)	Plot No. A-760, ,
17	M/S Syndicate Wiper Systems Pvt. Ltd.	A-125, TTC IND. Estate, ,
18	M/S Lotus Enterprise	Plot No. C/21/7, ,
19	M/S Avarya Retail Private Limited	Plot No. EL-223, ,
20	M/S Zenith Industries	W-128, MIDC , ,
21	M/S Brightwell Industries	A 28 TTC Industrial Estate, MIDC ,
22	M/S ALMA SPECIALITY CHEMICALS PVT LTD	Plot No: Khairne , A-688 ,
23	M/S MAHAVIR BULLION & REFINERY PVT LTD	Plot No: Pawne , W-154, ,
24	M/S SYMATIC ENGINEERING PVT LTD	Plot No: MAHAPE , Plot no- EL-127/128, MIDC ,
25	M/S ALPHA CARBONLESS PAPER MGF CO.PVT.LTD	Plot No: Plot-C101 , TTC industrial area Pawane ,
26	M/S Brite Coatings Pvt.Ltd.	Plot No: Pawane , Plot No. C - 352 ,
27	M/S Parker Hannifin India Pvt.Ltd.	Plot No: Mahape , Plot No. EL - 26 ,
28	M/S Ennovative Wash Care	Plot: A-146/1 TTC, MIDC , Khairne ,
29	M/S Shree Enterprises	W 186, TTC, MIDC Pawane ,
30	M/S Chhaparia Industries Private Limited	A 41, TTC Indl Area, MIDC Pawane ,
31	M/S AMPORIOS VENTURES PVT LTD	Plot No. D-183/4 ,
32	M/S ORO PRECIOUSMETALS PRIVATE LIMITED	Plot No: TURBHE , C-67, ,
33	M/S Paras Organics Pvt Ltd	D-119, TTC,MIDC, Shiravane,PO Nerul ,

34	M/S Shri Dutt India Private Limited	D 57, MIDC TTC. ,
35	M/S JHS CHEMI PHARMA PRIVATE LIMITED	Plot R-69, TTC, Rabale, MIDC ,
36	M/S MOTACHIPS	W104 D, TTC INDUSTRIAL AREA ,
37	M/S Amines & Plasticizers Limited	Plot No: Turbhe , Plot No.D 21/21 A ,
38	M/S VIPUL CHEMICALS INDIA PVT LTD	Plot No: Turbhe , Plot No-C-53&C53/1, industrial area ,
39	M/S Heat Well	Plot No: R-48 , TTC Ind Area, Rable Village ,
40	M/S GODFREY PHILLIPS (I) LTD	Plot No: R-19 , T.T.C.INDS. AREA,OPP RABALE STATION ,
41	M/S Pradeep Metals Limited	R-205,206,207/1, Rabale ,
42	M/S PSA Engineering Works Pvt. Ltd.	Plot no 13, Kalwa, TTC, Digha, MIDC ,
43	M/S Bharat Bijlee Limited	Plot No.-2, MIDC, Airoli ,
44	M/S RPG Life Sciences Ltd.	PLOT NO 25,MIDC,Thane-Belapur Road,Pawane ,
45	M/S Sandoz Private Limited (Unit: Kalwe)	Pl. No 8A/2 & 8B, Kalwe, Village Dighe ,
46	M/S SAVITA ENTERPRISES	PLOT R 803/1,TTC INDUS AREA,RABALE ,
47	M/S Apar Industries Limited	Plot No: Rabale , Building: Plot No.Gen -18 & Gen-18/1 , TTC ,MIDC Industrial Area ,
48	M/S SANDOZ PRIVATE LIMITED	MIDC PLOT NO. 8-A/1/1 ,
49	M/S VIJAY CHEMICAL INDUSTRIES	Plot No: Rabale , R-422/1 ,
50	M/S KWALITY CHEMICAL INDUSTRIES PVT. LTD.	Plot No: A-742 , M.I.D.C. Kopar Khairane ,
51	M/S Angre Chemicals Pvt.Ltd.	Plot No: Khairne , Plot No. A - 737/4 ,
52	M/S MAKHARIA INDUSTRIAL GASES PVT LTD	A-670, TTC , PAWNE ,
53	M/S NEOGEN CHEMICALS LIMITED	43, TTC, OPP EL ZONE, MIDC, MAHPE ,
54	M/S Mehk Chemicals Private Limited	W-6, TTC Ind Area, MIDC Pawane ,
55	M/S FAZLANI EXPORTS PRIVATE LIMITED	A-32,TTC Ind Area, MIDC Mahape ,
56	M/S Darshan Chemicals	A-39, TTC, MIDC, Pawane ,
57	M/S Sigma Galvanizing Pvt Ltd	C-532,TTC MIDC Ind Area,Pawane ,
58	M/S ALOK INDUSTRIES LIMITED	Plot No: C-16/2 , T.T.C. INDUSTRIAL AREA ,
59	M/S TYTAN ORGANICS PVT. LTD.	Plot No: C-146 , TTC IND. AREA, THANE BELAPUR RD ,
60	M/S NOCIL LIMITED	C-37,TTC Ind Area,MIDC,Pawane ,
61	M/S HINDUSTAN PLATINUM Pvt. Ltd.	Plot No: C-122 , TTC IND. AREA,PAWNE ,
62	M/S Croda India Company Private Limited.	Plot No: PL-1/1 , KOPARKHAIRNE,TTC AREA, ,
63	M/S B R Steel Products Pvt Ltd	Plot No: C-39 , TTC Industrial Area ,
64	M/S USV PRIVATE LIMITED	D-115 ,
65	M/S Darshan Chemicals - Unit 2	Plot No: Turbhe , Plot No. D - 29/3 ,

66	M/S Mack Springs Pvt.Ltd.	Plot No: Turbhe , Plot No. C - 66 ,
67	M/S ARKEMA CHEMICALS INDIA PVT LTD	D-43(1), M.I.D.C SHIRVANE, NERUL ,
68	M/S Sandoz Private Limited	D-31/32 TTC Ind Area, MIDC, Turbhe ,
69	M/S Sunfresh Agro Industries Private Limited	D37/4, TTC Ind Area, MIDC, Turbhe ,
70	M/S Prabhat Nutritious & Frozen Food Ind	D37/4, TTC Ind Area, MIDC, Turbhe ,
71	M/S LUBRIZOL INDIA PVT. LTD.	9/3 THANE BELAPUR RD ,
72	M/S BASF India Limited	Plot No: Plot No:12 , TTC Industrial Area ,
73	M/S Henkel Adhesives Technologies India Pvt. Ltd	Plot No: TTC Ind , D-73/2, D-74/2 & D-74/6 ,
74	M/S Kubo Combustion Efficiency Chemicals	Plot No: C-359 , TTC, Pawane Village ,
75	M/S HI-TECH ENGINEERS	Plot No: C-240 , TTC Ind Area, Village pawane ,
76	M/S Mazda Colours Ltd	Plot No: D-51 , TTC Ind Area, Turbhe ,
77	M/S ALUMINA CHEMICALS & CASTABLES	Plot No: RABALE , PLOT NO. R-32, ,
78	M/S BRITEX ENGINEERING WORKS	Plot No: Rabale , PLOT NO. R-209, ,
79	M/S GULRAJ HOTELS PRIVATE LIMITED	Plot No: MAHAPE , PLOT X-5/2, ,
80	M/S GHOSH NIHARA PROCESSOR	Plot No: Rabale , PLOT NO. R445/1 ,
81	M/S OM LAUNDRY SERVICES PVT LTD	Plot No: Rabale , R704 ,
82	M/S KRUPA PHARMACEUTICALS	Plot No: MAHAPE , PLOT NO. A-405 ,
83	M/S CHERYL LABORATORIES PVT. LTD.	Plot No: MAHAPE , PLOT NO. A/328/329/330 ,
84	M/S GOPALDAS VISRAM & CO. LTD.	Plot No: MAHAPE , PLOT NO. A327 ,
85	M/S GOPALDAS VISRAM & CO. LTD.	Plot No: MAHAPE , PLOT NO. A590/591 ,
86	M/S SYNDICATE WIPER SYSTEMS PVT. LTD.	A-416 ,
87	M/S CRISH METAL WORKS PRIVATE LIMITED	PLOT NO. A489/902 ,
88	M/S M J ENTERPRISES	Plot No: MAHAPE , PLOT NO. A-448 ,
89	M/S M J COATERS PRIVATE LIMITED	Plot No: MAHAP , PLOT NO. A-474 ,
90	M/S Sunraj Corrugators unit 2	Plot No: Rabale , Plot No. R- 433/1 & R-420 ,
91	M/S Par Formulations Pvt.Ltd.	Plot No: Digha , Plot No.8 - A/1,2, ,
92	M/S Blue Remix	Plot No: Mahape , Plot No. A - 368 ,
93	M/S NEO WHEELS LTD	Plot No: R-202 , MIDC ,
94	M/S Sunraj Corrugators (UniT 2)	Plot No: Rabale , R/956 MIDC Thane belapur Rd ,
95	M/S Print House India Pvt Ltd	R-847/2, MIDC, TTC Ind Area, Rabale ,
96	M/S Hawa Valves (India) Pvt Ltd	Plot No: Rabale , R-954, TTC Industrial Area, Thane Belapur road ,

97	M/S Jay Industries	Plot No: Rabale , Plot No-R - 947,TTC Ind.Area ,MIDC ,
98	M/S Yaashkrishni Food Science Ltd	Plot No: Rabale , Plot No: R-267 ,
99	M/S Cen Mech Industries	Plot No: Rabale , Plot No - R- 398 ,
100	M/S Wash N Wear Apparels Processors	Plot No: Khairne , Plot No.A-679 ,
101	M/S Pratap Organics Pvt Ltd	Plot No: Pawane , Plot No.C-492 ,
102	M/S TopNotch Chemicals Pvt.Ltd.	Plot No: Pawane , Plot No.C - 116 ,
103	M/S NGL Fine-Chem Ltd.	Plot No: Pawane , Plot No.W-142/C ,
104	M/S Hi - Tech Engineers - unit 2	Plot No: Khairane , Plot No. A - 173/6 ,
105	M/S G.M. Chemie Pvt.Ltd.	Plot No: Pawane , Plot No. C- 467/468 ,
106	M/S SKC Chemie Pvt.Ltd.	Plot No: Khairane , Plot No. A-85 ,
107	M/S Laxmi Industries	Plot No: Khairane , Plot No. A - 823 ,
108	M/S Swastik Chemicals	Plot No: Pawane , Plot No.W/155 ,
109	M/S Vaishnavi Esters Pvt.Ltd.	Plot No: Mahape , Plot No. A - 689 ,
110	M/S FAZLANI EXPORTS PVT. LTD.	GEN 56 ,
111	M/S CANDOR FOODS PVT. LTD.	Plot No: KHAIRANE , PLOT NO. W 202 (A) ,
112	M/S BEETACHEM INDUSTRIES	Plot No: PAWNE , PLOT NO. W-176 ,
113	M/S PACOPACK INDUSTRIES	Plot No: PAWANE , PLOT NO. C-26, ,
114	M/S PRATAP ORGANICS PRIVATE LIMITED	Plot No: PAWANE , PLOT NO. C-481/4,5,6 ,
115	M/S MADHURAM APPARELS PVT.LTD.	Plot No: A-29 , MIDC,TTC INDUSTRIAL AREA ,
116	Company Shree Shyam Engg Industries	A 41, TTC Indl Area, MIDC Pawane ,
117	M/S WellChem Laboratories	W 183, MIDC Pawane ,
118	M/S Beetachem Industries	W 177, TTC, MIDC, Pawane ,
119	M/S Raigad Chemicals Pvt Ltd	W-181, TTC Ind Area, Pawne ,
120	M/S Eco Friend Industries	A 205, TTC, MIDC, Pawane ,
121	M/S SWANI SPICE MILLS PVT LTD	Plot No: Navi Mumba , A-819,Khairne ,
122	M/S Mehk Chemicals Pvt Ltd (Unit-II)	C-159, TTC Industrial Area ,
123	M/S Amruta Industries	Plot No: Pawane , A-824/5, MIDC, TTC Industrial Area ,
124	M/S J K COATING CENTRE	Plot No: TURBHE , PLOT NO D-13/1, ,
125	M/S G.M. Chemical	Plot No: Pawane , Plot No-C-233/234 ,
126	M/S Pushpam Chemical Pvt. Ltd.	Plot No: Pawane , Plot No-C-348 ,
127	M/S Turbhe chemicals pvt. ltd.	Plot No: Turbhe , plot no. D-89/4,5 ,
128	M/S Shree Warana Sahakari Dudhutpadak Prakriya Sangh Ltd.	PLOT NO.D-139 ,
129	M/S Vaishnavi Global Private Limited	Plot No. C-237, TTC Industrial Area ,
130	M/S Privi Biotechnologies Pvt Ltd	Plot No: Nerul , Plot No.D-122 ,
131	M/S Merwans Confectioners Pvt Ltd	Plot No C-47, TTC , MIDC, Mahape ,
132	M/S GOPINATH DAIRY PRODUCTS PVT LTD	D-14/2,MIDC TTC Ind. Area , Turbhe ,
133	M/S D. H. Exports Pvt Ltd	C-41, TTC Ind Area, MIDC Pawane ,
134	M/S Hemmo Pharmaceuticals Pvt Ltd	C-43, TTC, MIDC, Turbhe ,

135	M/S BHARKEN RUBBER WORKS PVT. LTD. (Prop. of Indocap Metal Printers)	Plot No: C-237 , TTC INDUS. AREA, PAWNE VILLAGE ,
136	M/S Silver Techno Pvt. Ltd.	A-256, ,
137	M/S New India Manufacturing Co.	Plot No. A-357, ,
138	M/S RAJOG ENTERPRISES	Plot No: MIDC , Plot No-413/2 ,
139	M/S Aayas Global LLP	Plot No. EL- 185 ,
140	M/S Fattesingrao Naik(Appa) Saha.D.U.S. Ltd.	Plot No. EL-230, ,
141	M/S Brijwasi Kashinath Chhotalal	D-165, TTC Industrial Area, ,
142	M/S Osnar Chemical Pvt. Ltd.	Plot No. C-28, ,
143	M/S Bloom Energy India Pvt. Ltd	IT Incubation Centre ,
144	M/S G.B.GALVANIZER	Plot No: pawane , W-464,MIDC AREA ,
145	M/S Reliance Life Sciences Pvt. Ltd.	R-282, ,
146	M/S Mukand Limited	Thane Belapur Road, ,
147	Gokul Dairy	Plot no 40/4-5, MAFCO
148	Modern LED	PAP A 254/255, Mahape MIDC
149	Raj Packaging	A-301, MIDC Mahape
150	Tricon Polymers	A-356, MIDC Mahape

Annexure-VI

Trade effluent generating Industries			
Sr. No.	Name of Industry	Address	Scale
1	Lubrizol India Pvt. Ltd.	Plot No. 9/3	LSI
2	Mazda Colours Ltd.	D - 51	MSI
3	Sitec Labs Ltd.	G - 40	MSI
4	SI-Group India Ltd.	D-2/1	LSI
5	Arkema Chemicals India P. Ltd.	D-43/1	LSI
6	RPG Life Science Ltd.	P-25	MSI
7	MODICON Pvt. Ltd.	D-40/2	MSI
8	Allana Cold Storage P. Ltd.	D-38	MSI
9	Sky Industries Pvt. Ltd.	C-58	MSI
10	Croda India Company Pvt. Ltd.	Plot NO. 1/1	MSI
11	NOCIL LTD.	C-37	LSI
12	Henkel Adhesive Technologies India Pvt. Ltd.	P-1/1 Pt-II	MSI
13	Indoco Remedies Pvt. Ltd.	R-104	MSI
14	Hemmo pharmaceuticals Pvt. Ltd.	C-43	LSI
15	Seasaga Enterprises Pvt. Ltd.	R-25&26	MSI
16	Anthea Aromatics Pvt. Ltd.	R-81/82	MSI
17	Godfrey Phillips India Ltd.	Plot nO.19	MSI
18	Beekalene Fabrics Pvt. Ltd.	C-1/1	MSI
19	Amines & Plasticizers Ltd.	D-21/21A	LSI
20	Hindustan Platinum Pvt. Ltd.	C-122	LSI
21	Hyva (India) Pvt. Ltd.	EL-215	MSI
22	Expanded Polymer Systems Pvt. Ltd.	C-44/1&2	MSI
23	Akzonobel India Limited	P-1/1	MSI
24	Bennett & Coleman & Co. Ltd. (Times of India)	Plot-4	MSI
25	Fazlani Export Pvt. Ltd.	Gen. - 56	MSI
26	Kansai Nerolac Paints LTD.	W-188/189	LSI
27	Akash Fabrics Pvt. Ltd	P-63	MSI
28	BASF India Ltd.	D-12	LSI
29	Savita Oil Technologies Ltd.	Plot-17	LSI
30	Balmar Lawrie - Van Lee Ltd.	D - 195/2	LSI
31	USV Pvt. Ltd.	D - 115	LSI
32	Sunfresh Agro Inds. Pvt. Ltd.	D-37/4	MSI
33	Aarti Industries Limited	A-94/1	MSI
34	Zydus Takeda Healthcare Pvt. Ltd	C-4	LSI
35	Total Oil India Pvt. Ltd	P-26	MSI
36	P P G Asian Paints	C-52	MSI
37	Soujanya Colour Pvt. Ltd	C-35/36	MSI
38	Zoetis Pharmaceutical Research Pvt. Ltd.	P-16	MSI
39	Yashraj Biotechnology Ltd	C-232/2	MSI
40	Aarav Fragrances & Flavours Pvt Ltd	C-61	MSI
41	Suditi Industries	C-253	MSI
42	Sandoz Private Limited	D-31/32	MSI
43	Paras Organics	D-119	LSI
44	Asian Paints Ltd	C-3 B/1	LSI
45	Sandoz Private Limited	P-8A/2 & 8B	MSI
46	Shirdi Chemicals Pvt Ltd	C-118	LSI
47	Vipul Chemicals India Pvt. Ltd.	C-53, C-53/1	LSI
48	Supra Chemicals	W-58	MSI

Zero Liquid Discharge Industries in TTC MIDC

Sr No.	Name of Industry	Plot No.	Category	Scale	Consent validity	Consent issued by Board for manufacture of ….	Effluent Quantity (CMD)	Effluent Treatment facililty provided
Zero Liquid Discharge Industries (SRO Navi Mumbai-1)								
1	MODICON PRIVATE LIMITED Plot no. D-40/2, TTC Ind area, Turbhe MIDC.	D-40/2	RED	MSI	31.01.2023	elecrical contact& rivets	6	ZLD
2	M/s. Altim Metals Pvt. Ltd Plot No. D-193/D-193 Pt., TTC Indl. Area, MIDC Shirwane, Navi Mumbai.	D-193	RED	SSI	31.05.2025	Refining / Extraction of Gold and Silver & Jewellry	0.5	ZLD
3	M/s Vijay Plastic Products Plot No W-119, TTC MIDC Thane Belapur Road Khairane navi Mumbai 400709,navi Mumbai,Navi Mumbai	W-119	RED	SSI	Established (applied for operate)	Anodizing & powder coating	-	ZLD
4	Vivaan Group of Industries Plot No. A-6/1, TTC, MIDC, Pawane, Navi Mumbai.	A-6/1	Green	SSI	Established	Anodizing & powder coating	0	ZLD
5	M/s. G. M. Chemicals Plot No. C-233,234, TTC MIDC Pawane Navi Mumabi	C-233,234	RED	LSI	31.12.2025	Basic organic chemicals like Acetate, Cellulose, Phthalate	108	ZLD
6	M/s. Connell Bros. Co. (India) Pvt. Ltd. Plot No. C-56/1(part), Gala No. 201 & 230, Turbhe Industrial Park, TTC Indl. Area, MIDC Turbhe, Tal-Navi Mumbai, Dist-Thane.	C-56	Orange	LSI	31.10.2030	cosmatic products and store handling testing samples of raw material	0.045	ZLD
7	M/s. VARSHA TEJ TEXO CHEM LLP Plot No. A-751/1, TTC INDUSTRIAL AREA NAVI MUMBAI.	A-751/1	Orange	SSI	30.06.2032	REPAIR OF ELECTRIC MOTORS	1	ZLD
8	M/s.JMD Marketing Pvt. Ltd Plot NO. D-151, TTC Industrial area, navi Mumabi.	D-151	Orange	SSI	30.11.2025	Servicing, Repairing& painting of light motor vihicales	1	ZLD
9	M/s. Chain N Chains Jewels Ltd. Plot No.D-175, TTC Indl. Area, MIDC Shirwane, Navi Mumbai	D-175	RED	SSI	Established (applied for operate)	Ornaments with Rhodium plating activity..	0.5	ZLD
10	M/s. CU INSPECTIONS AND CERTIFICATION INDIA PRIVATE LIMITED, Plot No. C-56/1Gala NO 403, MIDC Turbhe Navi Mumbai	C-56/1	Orange	SSI	30.06.2023	Reserch center of internal use of Agro Product.	0.08	ZLD
11	M/s. Lupin Healthcare Ltd, C-533, Industrial area, pawane navi Mumbai	C-533	Orange	LSI	31.10.2022	Diagnostics Lab (Non - Beded)	-	ZLD
12	M/s. Western Super Fresh Stores Pvt.Ltd. Plot No. 24,25,26 & 27 Mahadev Services Inustrial Estate , Ghoteghar, Shil Phata, Navi Mumbai	Plot No. 24,25,26 &27	Orange	M.S.I	31.05.2026	Washing and Cold Storage for fruits, vegitables, chiken and all types of sea foods atoms/ cold starage for ice-cream and spices	12	

Annexure-VII

CETP Monthly Average Results Year 2022 to 2024

Outlet Average (Jan to December- 2022)													
Outlet	Limit	Jan	Feb	March	April	May	June	July	August	September	October	November	December
		Average	Average	Average	Average	Average	Average	Average	Average	Average	Average	Average	Average
BOD	100	43	58	58	133	104	71	35	35	49	45		66
COD	250	174	193	204	358	317	216	156	141	181	130	143	193
O&G	20	BDL	BDL	BDL	BDL	BDL	BDL	1	BDL	BDL	BDL	BDL	BDL
pH	5.5-9.0	6.7	6.9	7.5	7.6	7.5	7.5	7.4	7	7.2	6.9	7.1	7.4
SS	100	95	59	49	84	113	54	47	52	38	31	30	63
TDS	2100	2173	1735	1862	2781	3245	2367	2490	2205	2281	2435	1834	1104

Except pH all values are in mg/lit

Outlet Average (Jan to December- 2023)													
Outlet	Limit	Jan	Feb	March	April	May	June	July	August	September	October	November	December
		Average	Average	Average	Average	Average	Average	Average	Average	Average	Average	Average	Average
pH	5.5-9.0 (mg/l)	7.54	7.5	7.5	7.65	7.6	7.65	7.68	7.55	7.55	7.6	7.4	7.2
SS	100 (mg/l)	53	35	23	30	15	35	53	29	38	37	124	33
TAN	50 (mg/l)	104	180	179	215	193	217	139	119	115	107	102	103
BOD	100 (mg/l)	56	54.5	68	72	61	NA	45	95	33	47	90	43
COD	250 (mg/l)	157	193	221	229	184	207	145	321	119	170	308	168
TDS	2100 (mg/l)	1502	1593	1740	1760	2065	2075	1698	2736	1507	1753	1818	1520

Except pH all values are in mg/lit

Outlet Average (Jan to December- 2024)										
Outlet	Limit	Jan	Feb	March	April	May	June	July	August	September
		Average	Average	Average	Average	Average	Average	Average	Average	Average
pH	5.5-9.0 (mg/l)	7.2	7.4	7.4	7.3	7.3	7.1	7.2	7.2	7.7
SS	100 (mg/l)	30	48	49	56	51	50	64	18	20
TAN	50 (mg/l)	137	112	126	163	107	63	60	0.8	195
BOD	100 (mg/l)	68	53	20	40	45	87	31	33	34
COD	250 (mg/l)	253	228	201	204	154	180	104	117	126
TDS	2100 (mg/l)	1577	1638	1951	2584	1589	1657	1424	1666	1610

Except pH all values are in mg/lit

1353 **Annexure-VIII**

	नवी मुंबई महानगरपालीका.	NAVI MUMBAI MUNICIPAL CORPORATION
नवी मुंबई महानगरपालिका	आरोग्य विभाग, नवीन मुख्यालय ईमारत, तीसरा माळा, किल्लेगावठाण समोर, भुखंड क्र. १, से. १५ए,सी.बी.डी. बेलापूर. नवी मुंबई – ४००६१४. दुरध्वनी क्र: ०२२-२७५६७२६१	HEALTH DEPARTMENT, 3rd floor, plot no 1, OppKillegaothan, Sect - 15A, CBD BELAPUR NAVI MUMBAI - 400 614 TELIPHONE NO. - 022-27567261

जा.क्र.नमुंमपा/आरोग्य/ ६२९८ /२०२४
दिनांक -२८/१० /२०२४

प्रति
क्षेत्र अधिकारी
महाराष्ट्र प्रदूषण नियंत्रण मंडळ
प्रादेशिक अधिकारी (मुख्यालय)

विषय– महाराष्ट्र प्रदूषण नियत्रण मंडळ वायुप्रदूषण मुद्दा क्र. ५ बाबत
संदर्भ- महाराष्ट्र प्रदूषण नियत्रण मंडळ प्रादेशिक अधिकारी (मुख्यालय) विभाग २४/१०/२०२४ प्राप्त मेल.

उपरोक्त संदर्भीय विषयान्वये महाराष्ट्र प्रदूषण नियत्रण मंडळ प्रादेशिक अधिकारी मुख्यालय) विभाग प्राप्त मेल नुसार मुद्दा क्र. ५ ची आरोग्य विभागाची माहिती खालील प्रमाणे आहे.

Month	Total No of emegrgencies reported to ED	Total No of Acute respiratory illness Repited	Cases required Nebulisation	Cases Required admission	Cases Requirednon invasive ventilation	Cases Requiored invasive Ventilation	Recovered Cases	Casuality
Jan2021 to Dec 2021	739	394	168	265	2	16	0	0
Jan2022 to Dec 2022	1452	1021	764	471	51	38	1021	0
Jan2023 to Dec 2023	7743	2251	1723	1198	57	4	2251	0
Jan2024 to October 2024	15254	1279	992	723	23	0	1279	0

डॉ. प्रशांत जवादे
वैद्यकिय आरोग्य अधिकारी
नवी मुंबई महानगरपालिका

प्रत -: 1.मा.अतिरिक्त शहर अभियंता,नमुंमपा यांना महितीस्तव
2.कार्यकारी अभियंता, पर्यावरण विभाग, नमुंमपा महितीस्तव

List of Spent Solvent Distilation Industries

Sr. No.	Name of the industries
1	M/s. Darshan Chemicals Plot No. A-38/39, MIDC Pawane, Thane Belapur Road, Navi Mumbai 400705
2	M/s. Beetachem Industries, W-177, TTC MIDC, Pawane, Thane Belapur Road, Navi Mumbai 400710
3	M/s. Darshan Chemicals Plot No. D-29/3, MIDC Turbhe, Navi Mumbai 400705
4	M/s. Jyoti Dye Chem Pvt. Ltd. Plot No. D-76/1, TTC MIDC, Turbhe, Navi Mumbai
5	Rajput Organics Pvt. Ltd.,D-206, TTC, MIDC Turbhe, Navi Mumbai
6	M/s. Shri Gajanan Industries, Plot No. W-299, TTC Industrial Area, MIDC, Rabale, Navi Mumbai.
7	M/s. Praktan Industries Plot No. W 298 T T C Industrial Area Rabale MIDC Navi Mumbai
8	M/s. ROMEL HOLDINGS PVT. LTD., Plot No. W-292, TTC Indl. Area, M.I.D.C., Rabale, Navi Mumbai
9	M/s.Sujan Chemoplast Pvt Ltd, Plot No.A -697,TTC Industrial Area,MIDC Mahape,Navi Mumbai
10	M/s. Mayur Chemicals, Plot No. A-724, TTC MIDC Area, MIDC Mahape, Navi Mumbai
11	M/s. JHS chemipharma Pvt. Ltd. Plot No. R-69, MIDC Rabale, TTC Industrial area, Navi Mumbai.

List of Industries Chemical and solvent. Annexure-X

Sr. No.	Name and Adddress
1	M/s. Beetachem Industries Pvt Ltd, Plot no. D-177, MIDC Turbhe, Nm
2	M/s. Darshan Chemicals, Plot No.A-38, MIDC Turbhe, NM
3	M/s. Raigad Chemicals Pvt Ltd, Plot no. W-181, MIDC Turbhe, Nm
4	M/s. Darshan Chemicals, Plot No. D-29/3, MIDC Turbhe, NM
5	M/s. Maha recyclon Industries Plot No. W-278 A, MIDC Rabale, navi Mumbai.
6	M/s. Amines & Plasticizers Limited, Plot no. D-21/21A, MIDC Turbhe, Nm
7	M/s. Arkema Chemicals India Pvt Ltd. Plot no. D-43(1), D-43(5), MIDC Shiravane
8	M/s. Gramercy Trade Industries Pvt Ltd, Plot No. D-2/1, MIDC turbhe
9	M/s. Korde Chemicals Pvt Ltd, Plow No. W-13, MIDC Pawne, Nm
10	M/s. Mehk Chemicasl Pvt Ltd, Plot No. C-159, MIDC Pawne, NM
11	M/s. NOCIL Ltd, Plot No. C-37, MIDC Pawne, Navi Mumbai.
12	M/s. N.S. Chemicals Pvt Ltd, Shed No. W-3 & 4, MIDC Pawne
13	M/s. Paras Organics Pvt Ltd, Plot No. D-119, MIDC Shiravane, Nm
14	M/s. Esters and Solvents, Plot No. W-180, MIDC Pawne, Nm
15	M/s. Piramal Pharma Ltd (Hemmo Pharmaceturicals Pvt Ltd), Plot no. C-43, MIDC Pawne
16	M/s. Precise Biopharma Pvt Ltd, Plot No. C-384, MIDC Turbhe, NM
17	M/s. Precise Chemipharma Pvt Ltd, Plot No. D-90/3, MIDC Turbhe
18	M/s. RPG Life Science Limited, Plot no. 25, MIDC Pawane, Nm
19	M/s. Shridi Chemicals Pvt Ltd, Plot No. C-118, MIDC Pawne, NM
20	M/s. Zydus Takeda Healthcare Pvt Ltd, Plot No. C-4, MIDC Pawne, NM

MAHARASHTRA POLLUTION CONTROL BOARD

Regional Office, Navi-Mumbai

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e-mail :ronavimumbai@mpcb.gov.in

Raigad Bhavan, 7th floor,
Sec-11, C.B.D.Belapur,
Navi Mumbai- 400 614.

No: MPCB/RONM/ 23 12280003

Date: - 28 **/12/2023**

To,
M/s. Beetachem Industries Pvt Ltd,
Plot No. W-177, MIDC Turbhe,
TTC Industrial Area, Behind MTNL,
Navi Mumbai.

Sub : Direction under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, Air (Prevention & Control of Pollution) Act, 1981 and Hazardous & Other Waste (Management and Trans-boundary Movement) Rules 2016

Ref :
1. Consent to Operate granted to your unit by MPC board.
2. Hon'ble, NGT, WB, Pune in respect of
3. CPCB mitigation plan for odour and air pollution industries source in this area.
4. Legal Action Proposal vide no. MPCB-LEGAL_ACTIONS- 271223004

....

WHEREAS, you are operating your industry in Water & Air pollution prevention area declared under Water (P & CP) Act, 1974 Air (P & CP) Act, 1981 and Hazardous & Other Waste (Management & Transboundary Movement) Rules, 2016.

AND WHEREAS, Board has granted conditional Consent to Operate u/s. 26 of Water (P & CP) Act, 1974; u/s 21 of Air (P & CP) Act, 1981 and u/s 6 of Hazardous & Other Waste (Management & Transboundry Movement) Rules, 2016 with certain terms & conditions and it is mandatory on your part to comply all the conditions stipulated in the consent to operate.

AND WHEREAS, it is obligatory on your part to provide necessary water & air pollution control devices and operate them continuously and efficiently so as to meet the standards prescribed by the Board at all times. Also comply with the provisions of Hazardous & Other Waste (Management & Transboundry Movement) Rules, 2016.

AND WHEREAS, MPC Board is receiving frequent complaints from surrounding area regarding Air Pollution Problem due to operation of units in Thane Belapur Industrial Area.

AND WHEREAS, Hon'ble National Green Tribunal, Western Bench, Pune has admitted SUMOTO case No. 197 of 2023.

AND WHEREAS, CPCB has submitted specific mitigation plan for odour and air pollution industries source in Thane Belapur Industrial Area.

AND WHERAS, considering the measures proposed by Regional Director, Central Pollution Contro Board, Pune and curb the pollution issue in surrounding area, in exercise of the powers conferred upon me by the Board u/s. 33A of the Water (Prevention & Control of Pollution) Act, 1974 and u/s. 31A of Air (P&CP) Act, 1981, you are hereby directed to:

1. Identifying the odour causing sources.
2. Compliance of CPCB SOP prepared under Rule-9 of HOW (M & TM) Rules 2016 for solvent recovery.
3. Transfer of solvents (spent and recovered) should be carried by connecting vents through condenser and of closed pipelines.
4. Process vents to be connected through double condenser.
5. Process vents of condenser should be adequate height.
6. Process vents of condenser should pass through absorption media like activated carbon.
7. Pumps shall be provided with mechanical seals to prevent leakages.
8. Regular monitoring of VOCs shall be carried out in the work zone area and ambient air.
9. Implementation of LDAR (Leakage Detection and Repair) to control VOCs emissions.
10. Total losses of solvent should not be more than 5%.
11. Condenser system for control of VOC emission at the vents of all the potential storage tanks.

Long term (1 year and above)

a. Installation of floating roof tanks for solvent (spent and recovered) storage to minimize fugitive emission.

Your reply along with time bound action plan shall reach this office within a period of 15 days from date of receipt of this notice. In case, you fail to comply with the above directions, the Board will have no option than to initiate appropriate legal action including issuance of final directions and filing of prosecution as per the provisions of Water (Prevention & Control of Pollution) Act, 1974 and Air (Prevention & Control of Pollution) Act, 1981 respectively, which may please be noted.

(Satish H Padwal)
Regional Officer, Navi Mumbai

Copy submitted to:

1. The Joint Director (WPC), M.P.C. Board, Sion, Mumbai.
2. Legal Division

Copy to:-

Sub-Regional Officer, Navi Mumbai-I - He is directed to serve these directions to industry.

MAHARASHTRA POLLUTION CONTROL BOARD

Regional Office, Navi-Mumbai

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Raigad Bhavan, 7th floor,
Sec-11, C.B.D.Belapur,
Navi Mumbai- 400 614.

No: MPCB/RONM/23122800002 Date: - 28 /12/2023

To,
M/s. Darshan Chemicals Pvt Ltd,
Plot No. A-38, MIDC Pawne,
TTC Industrial Area, Behind MTNL,
Navi Mumbai.

Sub : Direction under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, Air (Prevention & Control of Pollution) Act, 1981 and Hazardous & Other Waste (Management and Trans-boundary Movement) Rules 2016

Ref :
1. Consent to Operate granted to your unit by MPC board.
2. Hon'ble, NGT, WB, Pune in respect of
3. CPCB mitigation plan for odour and air pollution industries source in this area.
4. Legal Action Proposal vide no. MPCB-LEGAL_ACTIONS- 271223003

……………………………

WHEREAS, you are operating your industry in Water & Air pollution prevention area declared under Water (P & CP) Act, 1974 Air (P & CP) Act, 1981 and Hazardous & Other Waste (Management & Transboundary Movement) Rules, 2016.

AND WHEREAS, Board has granted conditional Consent to Operate u/s. 26 of Water (P & CP) Act, 1974; u/s 21 of Air (P & CP) Act, 1981 and u/s 6 of Hazardous & Other Waste (Management & Transboundry Movement) Rules, 2016 with certain terms & conditions and it is mandatory on your part to comply all the conditions stipulated in the consent to operate.

AND WHEREAS, it is obligatory on your part to provide necessary water & air pollution control devices and operate them continuously and efficiently so as to meet the standards prescribed by the Board at all times. Also comply with the provisions of Hazardous & Other Waste (Management & Transboundry Movement) Rules, 2016.

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AND WHERAS, considering the measures proposed by Regional Director, Central Pollution Control Board, Pune and curb the pollution issue in surrounding area, in exercise of the powers conferred upon me by the Board u/s. 33A of the Water (Prevention & Control of Pollution) Act, 1974 and u/s. 31A of Air (P&CP) Act, 1981, you are hereby directed to:

1. Identifying the odour causing sources.
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9. Implementation of LDAR (Leakage Detection and Repair) to control VOCs emissions.
10. Total losses of solvent should not be more than 5%.
11. Condenser system for control of VOC emission at the vents of all the potential storage tanks.

Long term (1 year and above)

a. Installation of floating roof tanks for solvent (spent and recovered) storage to minimize fugitive emission.

Your reply along with time bound action plan shall reach this office within a period of 15 days from date of receipt of this notice. In case, you fail to comply with the above directions, the Board will have no option than to initiate appropriate legal action including issuance of final directions and filing of prosecution as per the provisions of Water (Prevention & Control of Pollution) Act, 1974 and Air (Prevention & Control of Pollution) Act, 1981 respectively, which may please be noted.

(Satish H Padwal)
Regional Officer, Navi Mumbai

Copy submitted to:

1. The Joint Director (WPC), M.PC. Board, Sion, Mumbai.
2. Legal Division

Copy to:-

Sub-Regional Officer, Navi Mumbai-I - He is directed to serve these directions to industry.

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Raigad Bhavan, 7th floor,
Sec-11, C.B.D.Belapur,
Navi Mumbai- 400 614.

No: MPCB/RONM/ 2312280005 Date: -28 /12/2023

To,
M/s. Raigad Chemicals Pvt Ltd,
Plot No. W-182, MIDC Turbhe,
TTC Industrial Area, Behind MTNL,
Navi Mumbai.

Sub : Direction under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, Air (Prevention & Control of Pollution) Act, 1981 and Hazardous & Other Waste (Management and Trans-boundary Movement) Rules 2016

Ref :
1. Consent to Operate granted to your unit by MPC board.
2. Hon'ble, NGT, WB, Pune in respect of
3. CPCB mitigation plan for odour and air pollution industries source in this area.
4. Legal Action Proposal vide no. MPCB-LEGAL_ACTIONS- 271223005

....

WHEREAS, you are operating your industry in Water & Air pollution prevention area declared under Water (P & CP) Act, 1974 Air (P & CP) Act, 1981 and Hazardous & Other Waste (Management & Transboundary Movement) Rules, 2016.

AND WHEREAS, Board has granted conditional Consent to Operate u/s. 26 of Water (P & CP) Act, 1974; u/s 21 of Air (P & CP) Act, 1981 and u/s 6 of Hazardous & Other Waste (Management & Transboundry Movement) Rules, 2016 with certain terms & conditions and it is mandatory on your part to comply all the conditions stipulated in the consent to operate.

AND WHEREAS, it is obligatory on your part to provide necessary water & air pollution control devices and operate them continuously and efficiently so as to meet the standards prescribed by the Board at all times. Also comply with the provisions of Hazardous & Other Waste (Management & Transboundry Movement) Rules, 2016.

AND WHEREAS, MPC Board is receiving frequent complaints from surrounding area regarding Air Pollution Problem due to operation of units in Thane Belapur Industrial Area.

AND WHEREAS, Hon'ble National Green Tribunal, Western Bench, Pune has admitted SUMOTO case No. 197 of 2023.

AND WHEREAS, CPCB has submitted specific mitigation plan for odour and air pollution industries source in Thane Belapur Industrial Area.

AND WHERAS, considering the measures proposed by Regional Director, Central Pollution Contro Board, Pune and curb the pollution issue in surrounding area, in exercise of the powers conferred upon m by the Board u/s. 33A of the Water (Prevention & Control of Pollution) Act, 1974 and u/s. 31A of Air (P&CP Act, 1981, you are hereby directed to:

1. Identifying the odour causing sources.
2. Compliance of CPCB SOP prepared under Rule-9 of HOW (M & TM) Rules 2016 for solvent recovery
3. Transfer of solvents (spent and recovered) should be carried by connecting vents through condenser and of closed pipelines.
4. Process vents to be connected through double condenser.
5. Process vents of condenser should be adequate height.
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7. Pumps shall be provided with mechanical seals to prevent leakages.
8. Regular monitoring of VOCs shall be carried out in the work zone area and ambient air.
9. Implementation of LDAR (Leakage Detection and Repair) to control VOCs emissions.
10. Total losses of solvent should not be more than 5%.
11. Condenser system for control of VOC emission at the vents of all the potential storage tanks.

Long term (1 year and above)

a. Installation of floating roof tanks for solvent (spent and recovered) storage to minimize fugitive emission.

Your reply along with time bound action plan shall reach this office within a period of 15 days from date of receipt of this notice. In case, you fail to comply with the above directions, the Board will have no option than to initiate appropriate legal action including issuance of final directions and filing of prosecution as per the provisions of Water (Prevention & Control of Pollution) Act, 1974 and Air (Prevention & Control of Pollution) Act, 1981 respectively, which may please be noted.

(Satish H Padwal)
Regional Officer, Navi Mumbai

Copy submitted to:

1. The Joint Director (WPC), M.PC. Board, Sion, Mumbai.
2. Legal Division

Copy to:-

Sub-Regional Officer, Navi Mumbai-I - He is directed to serve these directions to industry.

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Raigad Bhavan, 7th floor,
Sec-11, C.B.D.Belapur,
Navi Mumbai- 400 614.

No: MPCB/RONM/ 23122800007

Date: - 28/12/2023

To,
M/s. Darshan Chemicals,
Plot No. D-29/3, MIDC Turbhe,
TTC Industrial Area, Behind MTNL,
Navi Mumbai.

Sub : Direction under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, Air (Prevention & Control of Pollution) Act, 1981 and Hazardous & Other Waste (Management and Trans-boundary Movement) Rules 2016

Ref :
1. Consent to Operate granted to your unit by MPC board.
2. Hon'ble, NGT, WB, Pune in respect of
3. CPCB mitigation plan for odour and air pollution industries source in this area.
4. Legal Action Proposal vide no. MPCB-LEGAL_ACTIONS- 261223028

....

WHEREAS, you are operating your industry in Water & Air pollution prevention area declared under Water (P & CP) Act, 1974 Air (P & CP) Act, 1981 and Hazardous & Other Waste (Management & Transboundary Movement) Rules, 2016.

AND WHEREAS, Board has granted conditional Consent to Operate u/s. 26 of Water (P & CP) Act, 1974; u/s 21 of Air (P & CP) Act, 1981 and u/s 6 of Hazardous & Other Waste (Management & Transboundry Movement) Rules, 2016 with certain terms & conditions and it is mandatory on your part to comply all the conditions stipulated in the consent to operate.

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a. Installation of floating roof tanks for solvent (spent and recovered) storage to minimize fugitive emission.

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(Satish H Padwal)
Regional Officer, Navi Mumbai

Copy submitted to:

1. The Joint Director (WPC), M.P.C. Board, Sion, Mumbai.
2. Legal Division

Copy to:-

Sub-Regional Officer, Navi Mumbai-I - He is directed to serve these directions to industry.

MAHARASHTRA POLLUTION CONTROL BOARD

Regional Office, Navi-Mumbai

Ph.:- (022)- 2757 2740
Fax Ph. :- (022)- 2757 1586
Visit us at :- htpp//mpcb.gov.in
e-mail :ronavimumbai@mpcb.gov.in

Raigad Bhavan, 7th floor,
Sec-11, C.B.D.Belapur,
Navi Mumbai- 400 614.

No: MPCB/RONM/2401150005 Date:- 15/01/2024

To,
M/s. Maha Recyclochem Industries,
Plot No. W-278 A, MIDC Rabale,
Navi Mumbai.

Sub : Direction under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, Air (Prevention & Control of Pollution) Act, 1981 and Hazardous & Other Waste (Management and Trans-boundary Movement) Rules 2016

Ref :
1. Consent to Operate granted to your unit by MPC board.
2. Hon'ble, NGT, WB, Pune in respect of
3. CPCB mitigation plan for odour and air pollution industries source in this area.
4. Legal Action Proposal vide no. MPCB-LEGAL_ACTIONS- 120422002

....

WHEREAS, you are operating your industry in Water & Air pollution prevention area declared under Water (P & CP) Act, 1974 Air (P & CP) Act, 1981 and Hazardous & Other Waste (Management & Transboundary Movement) Rules, 2016.

AND WHEREAS, Board has granted conditional Consent to Operate u/s. 26 of Water (P & CP) Act, 1974; u/s 21 of Air (P & CP) Act, 1981 and u/s 6 of Hazardous & Other Waste (Management & Transboundry Movement) Rules, 2016 with certain terms & conditions and it is mandatory on your part to comply all the conditions stipulated in the consent to operate.

AND WHEREAS, it is obligatory on your part to provide necessary water & air pollution control devices and operate them continuously and efficiently so as to meet the standards prescribed by the Board at all times. Also comply with the provisions of Hazardous & Other Waste (Management & Transboundry Movement) Rules, 2016.

AND WHEREAS, MPC Board is receiving frequent complaints from surrounding area regarding Air Pollution Problem due to operation of units in Thane Belapur Industrial Area.

AND WHEREAS, Hon'ble National Green Tribunal, Western Bench, Pune has admitted SUMOTO case No. 197 of 2023.

AND WHEREAS, CPCB has submitted specific mitigation plan for odour and air pollution industries source in Thane Belapur Industrial Area.

AND WHERAS, considering the measures proposed by Regional Director, Central Pollution Control Board, Pune and curb the pollution issue in surrounding area, in exercise of the powers conferred upon me by the Board u/s. 33A of the Water (Prevention & Control of Pollution) Act, 1974 and u/s. 31A of Air (P&CP) Act, 1981, you are hereby directed to:

1. Identifying the odour causing sources.
2. Compliance of CPCB SOP prepared under Rule-9 of HOW (M & TM) Rules 2016 for solvent recovery.
3. Transfer of solvents (spent and recovered) should be carried by connecting vents through condenser and of closed pipelines.
4. Process vents to be connected through double condenser.
5. Process vents of condenser should be adequate height.
6. Process vents of condenser should pass through absorption media like activated carbon.
7. Pumps shall be provided with mechanical seals to prevent leakages.
8. Regular monitoring of VOCs shall be carried out in the work zone area and ambient air.
9. Implementation of LDAR (Leakage Detection and Repair) to control VOCs emissions.
10. Total losses of solvent should not be more than 5%.
11. Condenser system for control of VOC emission at the vents of all the potential storage tanks.

Long term (1 year and above)

a. Installation of floating roof tanks for solvent (spent and recovered) storage to minimize fugitive emission.

Your reply along with time bound action plan shall reach this office within a period of 15 days from date of receipt of this notice. In case, you fail to comply with the above directions, the Board will have no option than to initiate appropriate legal action including issuance of final directions and filing of prosecution as per the provisions of Water (Prevention & Control of Pollution) Act, 1974 and Air (Prevention & Control of Pollution) Act, 1981 respectively, which may please be noted.

(Satish H Padwal)
Regional Officer, Navi Mumbai

Copy submitted to:

1. The Joint Director (WPC), M.PC. Board, Sion, Mumbai.
2. Legal Division

Copy to:-

Sub-Regional Officer, Navi Mumbai-II - He is directed to serve these directions to industry.

MAHARASHTRA POLLUTION CONTROL BOARD

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Raigad Bhavan, 7th floor,
Sec-11, C.B.D.Belapur,
Navi Mumbai- 400 614.

No: MPCB/RONM/ 2401120003

Date: - 12/01/2024

To,
M/s. Amines & Plasticizers Limited.
Plot No. D-21/21A,
MIDC Turbhe, Navi Mumbai.

Sub : Direction under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, Air (Prevention & Control of Pollution) Act, 1981 and Hazardous & Other Waste (Management and Trans-boundary Movement) Rules 2016

Ref :
1. Consent to Operate granted to your unit by MPC board.
2. Hon'ble, NGT, WB, Pune in respect of
3. CPCB mitigation plan for odour and air pollution industries source in this area.
4. Legal Action Proposal vide no. MPCB-LEGAL_ACTIONS- 100124022

…………………………………

WHEREAS, you are operating your industry in Water & Air pollution prevention area declared under Water (P & CP) Act, 1974 Air (P & CP) Act, 1981 and Hazardous & Other Waste (Management & Transboundary Movement) Rules, 2016.

AND WHEREAS, Board has granted conditional Consent to Operate u/s. 26 of Water (P & CP) Act, 1974; u/s 21 of Air (P & CP) Act, 1981 and u/s 6 of Hazardous & Other Waste (Management & Transboundry Movement) Rules, 2016 with certain terms & conditions and it is mandatory on your part to comply all the conditions stipulated in the consent to operate.

AND WHEREAS, it is obligatory on your part to provide necessary water & air pollution control devices and operate them continuously and efficiently so as to meet the standards prescribed by the Board at all times. Also comply with the provisions of Hazardous & Other Waste (Management & Transboundry Movement) Rules, 2016.

AND WHEREAS, MPC Board is receiving frequent complaints from surrounding area regarding Air Pollution Problem due to operation of units in Thane Belapur Industrial Area.

AND WHEREAS, Hon'ble National Green Tribunal, Western Bench, Pune has admitted SUMOTO case No. 197 of 2023.

AND WHEREAS, CPCB has submitted specific mitigation plan for odour and air pollution industries source in Thane Belapur Industrial Area.

AND WHERAS, considering the measures proposed by Regional Director, Central Pollution Control Board, Pune and curb the pollution issue in surrounding area, in exercise of the powers conferred upon me by the Board u/s. 33A of the Water (Prevention & Control of Pollution) Act, 1974 and u/s. 31A of Air (P&CP) Act, 1981, you are hereby directed to:

Short Term (Less than 1 year)

1. Process vents to be connected through double condenser.
2. Process vents of condenser should be of adequate height.
3. Process vents of condenser should pass through absorption media like activated carbon.
4. Pumps shall be provided with mechanical seals to prevent leakages.
5. Implementation of LDAR to control NH3 emissions.
6. Removal of VOCs by air stripping before equalization tank.
7. Odours wastewater stream shall be handled in closed system from the source to primary treatment stages.
8. Removal of VOCs by competing mechanisms of air stripping and adsorption on solids in aeration tank.
9. Aqueous activated sludge diffusion, by sparging the collected odor emissions into aeration tanks of CETP, a typical liquid-based odor control system.
10. Regular O&M of sludge thickeners i.e. treating the sludge with lime or iron salts to encourage thickening and reduce the degassing of sulfurous compounds (H2S, organic sulphides, organosulphur based compounds etc) and ammonia.

Long term (1 year and above)

Capping of various open-air treatment systems (collection tanks, equalization tanks) and venting with appropriate VOC traps/media based scrubbers.

Your reply along with time bound action plan shall reach this office within a period of 15 days from date of receipt of this notice. In case, you fail to comply with the above directions, the Board will have no option than to initiate appropriate legal action including issuance of final directions and filing of prosecution as per the provisions of Water (Prevention & Control of Pollution) Act, 1974 and Air (Prevention & Control of Pollution) Act, 1981 respectively, which may please be noted.

(Satish H Padwal)
Regional Officer, Navi Mumbai

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Raigad Bhavan, 7th floor,
Sec-11, C.B.D.Belapur,
Navi Mumbai- 400 614.

No: MPCB/RONM/240112000 5 **Date: -** 12**/01/2024**

To,
M/s. Arkema Chemicals India Pvt Ltd.
Plot No. D-43(1), D-43(5), MIDC Shiravne,
Navi Mumbai.

Sub : Direction under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, Air (Prevention & Control of Pollution) Act, 1981 and Hazardous & Other Waste (Management and Trans-boundary Movement) Rules 2016

Ref :
1. Consent to Operate granted to your unit by MPC board.
2. Hon'ble, NGT, WB, Pune in respect of
3. CPCB mitigation plan for odour and air pollution industries source in this area.
4. Legal Action Proposal vide no. MPCB-LEGAL_ACTIONS- 100124024

....

WHEREAS, you are operating your industry in Water & Air pollution prevention area declared under Water (P & CP) Act, 1974 Air (P & CP) Act, 1981 and Hazardous & Other Waste (Management & Transboundary Movement) Rules, 2016.

AND WHEREAS, Board has granted conditional Consent to Operate u/s. 26 of Water (P & CP) Act, 1974; u/s 21 of Air (P & CP) Act, 1981 and u/s 6 of Hazardous & Other Waste (Management & Transboundry Movement) Rules, 2016 with certain terms & conditions and it is mandatory on your part to comply all the conditions stipulated in the consent to operate.

AND WHEREAS, it is obligatory on your part to provide necessary water & air pollution control devices and operate them continuously and efficiently so as to meet the standards prescribed by the Board at all times. Also comply with the provisions of Hazardous & Other Waste (Management & Transboundry Movement) Rules, 2016.

AND WHEREAS, MPC Board is receiving frequent complaints from surrounding area regarding Air Pollution Problem due to operation of units in Thane Belapur Industrial Area.

AND WHEREAS, Hon'ble National Green Tribunal, Western Bench, Pune has admitted SUMOTO case No. 197 of 2023.

AND WHEREAS, CPCB has submitted specific mitigation plan for odour and air pollution industries source in Thane Belapur Industrial Area.

AND WHERAS, considering the measures proposed by Regional Director, Central Pollution Con Board, Pune and curb the pollution issue in surrounding area, in exercise of the powers conferred upon by the Board u/s. 33A of the Water (Prevention & Control of Pollution) Act, 1974 and u/s. 31A of Air (P& Act, 1981, you are hereby directed to:

Short Term (Less than 1 year)

1. Process vents to be connected through double condenser.
2. Process vents of condenser should be of adequate height.
3. Process vents of condenser should pass through absorption media like activated carbon.
4. Pumps shall be provided with mechanical seals to prevent leakages.
5. Implementation of LDAR to control NH3 emissions.
6. Removal of VOCs by air stripping before equalization tank.
7. Odours wastewater stream shall be handled in closed system from the source to primai treatment stages.
8. Removal of VOCs by competing mechanisms of air stripping and adsorption on solids in aeratio tank.
9. Aqueous activated sludge diffusion, by sparging the collected odor emissions into aeration tank of CETP, a typical liquid-based odor control system.
10. Regular O&M of sludge thickeners i.e. treating the sludge with lime or iron salts to encourag thickening and reduce the degassing of sulfurous compounds (H2S, organic sulphides organosulphur based compounds etc) and ammonia.

Long term (1 year and above)

Capping of various open-air treatment systems (collection tanks, equalization tanks) and venting with appropriate VOC traps/media based scrubbers.

Your reply along with time bound action plan shall reach this office within a period of 15 days from date of receipt of this notice. In case, you fail to comply with the above directions, the Board will have no option than to initiate appropriate legal action including issuance of final directions and filing of prosecution as per the provisions of Water (Prevention & Control of Pollution) Act, 1974 and Air (Prevention & Control of Pollution) Act, 1981 respectively, which may please be noted.

(Satish H Padwal)
Regional Officer, Navi Mumbai

Copy submitted to:

1. The Joint Director (WPC), M.P.C. Board, Sion, Mumbai.
2. Legal Division

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Sub-Regional Officer, Navi Mumbai-I - He is directed to serve these directions to industry.

MAHARASHTRA POLLUTION CONTROL BOARD

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Raigad Bhavan, 7th floor,
Sec-11, C.B.D.Belapur,
Navi Mumbai- 400 614.

No: MPCB/RONM/23122290004 Date: - 29/12/2023

To,
M/s. Gramercy Trade Industries Pvt Ltd,
Plot No. D-2/1, TTC Indl Area,
Thane Belapur Road, MIDC Turbhe,
Navi Mumbai.

Sub : Direction under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, Air (Prevention & Control of Pollution) Act, 1981 and Hazardous & Other Waste (Management and Trans-boundary Movement) Rules 2016

Ref :
1. Consent to Operate granted to your unit by MPC board.
2. Hon'ble, NGT, WB, Pune in respect of
3. CPCB mitigation plan for odour and air pollution industries source in this area.
4. Legal Action Proposal vide no. MPCB-LEGAL_ACTIONS- 271223013

....

WHEREAS, you are operating your industry in Water & Air pollution prevention area declared under Water (P & CP) Act, 1974 Air (P & CP) Act, 1981 and Hazardous & Other Waste (Management & Transboundary Movement) Rules, 2016.

AND WHEREAS, Board has granted conditional Consent to Operate u/s. 26 of Water (P & CP) Act, 1974; u/s 21 of Air (P & CP) Act, 1981 and u/s 6 of Hazardous & Other Waste (Management & Transboundry Movement) Rules, 2016 with certain terms & conditions and it is mandatory on your part to comply all the conditions stipulated in the consent to operate.

AND WHEREAS, it is obligatory on your part to provide necessary water & air pollution control devices and operate them continuously and efficiently so as to meet the standards prescribed by the Board at all times. Also comply with the provisions of Hazardous & Other Waste (Management & Transboundry Movement) Rules, 2016.

AND WHEREAS, MPC Board is receiving frequent complaints from surrounding area regarding Air Pollution Problem due to operation of units in Thane Belapur Industrial Area.

AND WHEREAS, Hon'ble National Green Tribunal, Western Bench, Pune has admitted SUMOTO case No. 197 of 2023.

AND WHEREAS, CPCB has submitted specific mitigation plan for odour and air pollution industries source in Thane Belapur Industrial Area.

AND WHERAS, considering the measures proposed by Regional Director, Central Pollution Control Board, Pune and curb the pollution issue in surrounding area, in exercise of the powers conferred upon me by the Board u/s. 33A of the Water (Prevention & Control of Pollution) Act, 1974 and u/s. 31A of Air (P&CP) Act, 1981, you are hereby directed to:

Short Term (Less than 1 year)

1. Process vents to be connected through double condenser.
2. Process vents of condenser should be of adequate height.
3. Process vents of condenser should pass through absorption media like activated carbon.
4. Pumps shall be provided with mechanical seals to prevent leakages.
5. Implementation of LDAR to control NH3 emissions.
6. Removal of VOCs by air stripping before equalization tank.
7. Odours wastewater stream shall be handled in closed system from the source to primary treatment stages.
8. Removal of VOCs by competing mechanisms of air stripping and adsorption on solids in aeration tank.
9. Aqueous activated sludge diffusion, by sparging the collected odor emissions into aeration tanks of CETP, a typical liquid-based odor control system.
10. Regular O&M of sludge thickeners i.e. treating the sludge with lime or iron salts to encourage thickening and reduce the degassing of sulfurous compounds (H2S, organic sulphides, organosulphur based compounds etc) and ammonia.

Long term (1 year and above)

Capping of various open-air treatment systems (collection tanks, equalization tanks) and venting with appropriate VOC traps/media based scrubbers.

Your reply along with time bound action plan shall reach this office within a period of 15 days from date of receipt of this notice. In case, you fail to comply with the above directions, the Board will have no option than to initiate appropriate legal action including issuance of final directions and filing of prosecution as per the provisions of Water (Prevention & Control of Pollution) Act, 1974 and Air (Prevention & Control of Pollution) Act, 1981 respectively, which may please be noted.

(Satish H Padwal)
Regional Officer, Navi Mumbai

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MAHARASHTRA POLLUTION CONTROL BOARD

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Raigad Bhavan, 7th floor,
Sec-11, C.B.D.Belapur,
Navi Mumbai- 400 614.

No: MPCB/RONM/ 23|2290007 **Date: - 29/12/2023**

To,
M/s. Korde Chemicals Pvt Ltd,
Plot No. W-13, TTC Indl Area,
MIDC Pawne, Navi Mumbai.

Sub : Direction under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, Air (Prevention & Control of Pollution) Act, 1981 and Hazardous & Other Waste (Management and Trans-boundary Movement) Rules 2016

Ref :
1. Consent to Operate granted to your unit by MPC board.
2. Hon'ble, NGT, WB, Pune in respect of
3. CPCB mitigation plan for odour and air pollution industries source in this area.
4. Legal Action Proposal vide no. MPCB-LEGAL_ACTIONS- 271223011

....

WHEREAS, you are operating your industry in Water & Air pollution prevention area declared under Water (P & CP) Act, 1974 Air (P & CP) Act, 1981 and Hazardous & Other Waste (Management & Transboundary Movement) Rules, 2016.

AND WHEREAS, Board has granted conditional Consent to Operate u/s. 26 of Water (P & CP) Act, 1974; u/s 21 of Air (P & CP) Act, 1981 and u/s 6 of Hazardous & Other Waste (Management & Transboundry Movement) Rules, 2016 with certain terms & conditions and it is mandatory on your part to comply all the conditions stipulated in the consent to operate.

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AND WHEREAS, MPC Board is receiving frequent complaints from surrounding area regarding Air Pollution Problem due to operation of units in Thane Belapur Industrial Area.

AND WHEREAS, Hon'ble National Green Tribunal, Western Bench, Pune has admitted SUMOTO case No. 197 of 2023.

AND WHEREAS, CPCB has submitted specific mitigation plan for odour and air pollution industries source in Thane Belapur Industrial Area.

AND WHERAS, considering the measures proposed by Regional Director, Central Pollution Contro Board, Pune and curb the pollution issue in surrounding area, in exercise of the powers conferred upon m by the Board u/s. 33A of the Water (Prevention & Control of Pollution) Act, 1974 and u/s. 31A of Air (P&CP Act, 1981, you are hereby directed to:

Short Term (Less than 1 year)

1. Process vents to be connected through double condenser.
2. Process vents of condenser should be of adequate height.
3. Process vents of condenser should pass through absorption media like activated carbon.
4. Pumps shall be provided with mechanical seals to prevent leakages.
5. Implementation of LDAR to control NH_3 emissions.
6. Removal of VOCs by air stripping before equalization tank.
7. Odours wastewater stream shall be handled in closed system from the source to primary treatment stages.
8. Removal of VOCs by competing mechanisms of air stripping and adsorption on solids in aeration tank.
9. Aqueous activated sludge diffusion, by sparging the collected odor emissions into aeration tanks of CETP, a typical liquid-based odor control system.
10. Regular O&M of sludge thickeners i.e. treating the sludge with lime or iron salts to encourage thickening and reduce the degassing of sulfurous compounds (H_2S, organic sulphides, organosulphur based compounds etc) and ammonia.

Long term (1 year and above)

Capping of various open-air treatment systems (collection tanks, equalization tanks) and venting with appropriate VOC traps/media based scrubbers.

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(Satish H Padwal)
Regional Officer, Navi Mumbai

Copy submitted to:

1. The Joint Director (WPC), M.P.C. Board, Sion, Mumbai.
2. Legal Division

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Raigad Bhavan, 7th floor,
Sec-11, C.B.D.Belapur,
Navi Mumbai- 400 614.

No: MPCB/RONM/ 2312290006 Date: - 29/12/2023

To,
M/s. Mehk Chemicals Pvt Ltd,
Plot No.C-159, TTC Indl Area,
MIDC Pawne, Navi Mumbai.

Sub : Direction under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, Air (Prevention & Control of Pollution) Act, 1981 and Hazardous & Other Waste (Management and Trans-boundary Movement) Rules 2016

Ref :
1. Consent to Operate granted to your unit by MPC board.
2. Hon'ble, NGT, WB, Pune in respect of
3. CPCB mitigation plan for odour and air pollution industries source in this area.
4. Legal Action Proposal vide no. MPCB-LEGAL_ACTIONS- 271223012

………………………………

WHEREAS, you are operating your industry in Water & Air pollution prevention area declared under Water (P & CP) Act, 1974 Air (P & CP) Act, 1981 and Hazardous & Other Waste (Management & Transboundary Movement) Rules, 2016.

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Short Term (Less than 1 year)

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(Satish H Padwal)
Regional Officer, Navi Mumbai

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Raigad Bhavan, 7th floor,
Sec-11, C.B.D.Belapur,
Navi Mumbai- 400 614.

No: MPCB/RONM/2401040005 Date:- 04/01/2024

To,
M/s. NOCIL Ltd,
Plot No. C-37, TTC Indl Area,
MIDC Pawne, Navi Mumbai.

Sub : Direction under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, Air (Prevention & Control of Pollution) Act, 1981 and Hazardous & Other Waste (Management and Trans-boundary Movement) Rules 2016

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1. Consent to Operate granted to your unit by MPC board.
2. Hon'ble, NGT, WB, Pune in respect of
3. CPCB mitigation plan for odour and air pollution industries source in this area.
4. Legal Action Proposal vide no. MPCB-LEGAL_ACTIONS- 030124013

....

WHEREAS, you are operating your industry in Water & Air pollution prevention area declared under Water (P & CP) Act, 1974 Air (P & CP) Act, 1981 and Hazardous & Other Waste (Management & Transboundary Movement) Rules, 2016.

AND WHEREAS, Board has granted conditional Consent to Operate u/s. 26 of Water (P & CP) Act, 1974; u/s 21 of Air (P & CP) Act, 1981 and u/s 6 of Hazardous & Other Waste (Management & Transboundry Movement) Rules, 2016 with certain terms & conditions and it is mandatory on your part to comply all the conditions stipulated in the consent to operate.

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7. Odours wastewater stream shall be handled in closed system from the source to primary treatment stages.
8. Removal of VOCs by competing mechanisms of air stripping and adsorption on solids in aeration tank.
9. Aqueous activated sludge diffusion, by sparging the collected odor emissions into aeration tanks of CETP, a typical liquid-based odor control system.
10. Regular O&M of sludge thickeners i.e. treating the sludge with lime or iron salts to encourage thickening and reduce the degassing of sulfurous compounds (H2S, organic sulphides, organosulphur based compounds etc) and ammonia.

Long term (1 year and above)

Capping of various open-air treatment systems (collection tanks, equalization tanks) and venting with appropriate VOC traps/media based scrubbers.

Your reply along with time bound action plan shall reach this office within a period of 15 days from date of receipt of this notice. In case, you fail to comply with the above directions, the Board will have no option than to initiate appropriate legal action including issuance of final directions and filing of prosecution as per the provisions of Water (Prevention & Control of Pollution) Act, 1974 and Air (Prevention & Control of Pollution) Act, 1981 respectively, which may please be noted.

(Satish H Padwal)
Regional Officer, Navi Mumbai

Copy submitted to:

1. The Joint Director (WPC), M.P.C. Board, Sion, Mumbai.
2. Legal Division

Copy to:-

Sub-Regional Officer, Navi Mumbai-I - He is directed to serve these directions to industry.

MAHARASHTRA POLLUTION CONTROL BOARD

Regional Office, Navi-Mumbai

Ph.:- (022)- 2757 2740
Fax Ph. :- (022)- 2757 1586
Visit us at :- htpp//mpcb.gov.in
e-mail :ronavimumbai@mpcb.gov.in

Raigad Bhavan, 7th floor,
Sec-11, C.B.D.Belapur,
Navi Mumbai- 400 614.

No: MPCB/RONM/ 2312290008 **Date: - 29/12/2023**

To,
M/s. N. S. Chemical Pvt Ltd,
Shed No. W-3 and 4, TTC Indl Area,
MIDC Pawne, Navi Mumbai.

Sub : Direction under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, Air (Prevention & Control of Pollution) Act, 1981 and Hazardous & Other Waste (Management and Trans-boundary Movement) Rules 2016

Ref :
1. Consent to Operate granted to your unit by MPC board.
2. Hon'ble, NGT, WB, Pune in respect of
3. CPCB mitigation plan for odour and air pollution industries source in this area.
4. Legal Action Proposal vide no. MPCB-LEGAL_ACTIONS- 271223010

....

WHEREAS, you are operating your industry in Water & Air pollution prevention area declared under Water (P & CP) Act, 1974 Air (P & CP) Act, 1981 and Hazardous & Other Waste (Management & Transboundary Movement) Rules, 2016.

AND WHEREAS, Board has granted conditional Consent to Operate u/s. 26 of Water (P & CP) Act, 1974; u/s 21 of Air (P & CP) Act, 1981 and u/s 6 of Hazardous & Other Waste (Management & Transboundry Movement) Rules, 2016 with certain terms & conditions and it is mandatory on your part to comply all the conditions stipulated in the consent to operate.

AND WHEREAS, it is obligatory on your part to provide necessary water & air pollution control devices and operate them continuously and efficiently so as to meet the standards prescribed by the Board at all times. Also comply with the provisions of Hazardous & Other Waste (Management & Transboundry Movement) Rules, 2016.

AND WHEREAS, MPC Board is receiving frequent complaints from surrounding area regarding Air Pollution Problem due to operation of units in Thane Belapur Industrial Area.

AND WHEREAS, Hon'ble National Green Tribunal, Western Bench, Pune has admitted SUMOTO case No. 197 of 2023.

AND WHEREAS, CPCB has submitted specific mitigation plan for odour and air pollution industries source in Thane Belapur Industrial Area.

AND WHERAS, considering the measures proposed by Regional Director, Central Pollution Contro Board, Pune and curb the pollution issue in surrounding area, in exercise of the powers conferred upon me by the Board u/s. 33A of the Water (Prevention & Control of Pollution) Act, 1974 and u/s. 31A of Air (P&CP) Act, 1981, you are hereby directed to:

Short Term (Less than 1 year)

1. Process vents to be connected through double condenser.
2. Process vents of condenser should be of adequate height.
3. Process vents of condenser should pass through absorption media like activated carbon.
4. Pumps shall be provided with mechanical seals to prevent leakages.
5. Implementation of LDAR to control NH3 emissions.
6. Removal of VOCs by air stripping before equalization tank.
7. Odours wastewater stream shall be handled in closed system from the source to primary treatment stages.
8. Removal of VOCs by competing mechanisms of air stripping and adsorption on solids in aeration tank.
9. Aqueous activated sludge diffusion, by sparging the collected odor emissions into aeration tanks of CETP, a typical liquid-based odor control system.
10. Regular O&M of sludge thickeners i.e. treating the sludge with lime or iron salts to encourage thickening and reduce the degassing of sulfurous compounds (H2S, organic sulphides, organosulphur based compounds etc) and ammonia.

Long term (1 year and above)

Capping of various open-air treatment systems (collection tanks, equalization tanks) and venting with appropriate VOC traps/media based scrubbers.

Your reply along with time bound action plan shall reach this office within a period of 15 days from date of receipt of this notice. In case, you fail to comply with the above directions, the Board will have no option than to initiate appropriate legal action including issuance of final directions and filing of prosecution as per the provisions of Water (Prevention & Control of Pollution) Act, 1974 and Air (Prevention & Control of Pollution) Act, 1981 respectively, which may please be noted.

(Satish H Padwal)
Regional Officer, Navi Mumbai

Copy submitted to:

1. The Joint Director (WPC), M.P.C. Board, Sion, Mumbai.
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MAHARASHTRA POLLUTION CONTROL BOARD

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Raigad Bhavan, 7th floor,
Sec-11, C.B.D.Belapur,
Navi Mumbai- 400 614.

No: MPCB/RONM/2402230004 Date: - 23/02/2024

To,
M/s. Paras Organics Pvt Ltd.
Plot No. D-119, MIDC Shiravne,
Navi Mumbai.

Sub : Direction under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, Air (Prevention & Control of Pollution) Act, 1981 and Hazardous & Other Waste (Management and Trans-boundary Movement) Rules 2016

Ref :
1. Consent to Operate granted to your unit by MPC board.
2. Hon'ble, NGT, WB, Pune in respect of Sumoto Case No. 197/2023
3. CPCB mitigation plan for odour and air pollution industries source in this area.
4. Legal Action Proposal vide no. MPCB-LEGAL_ACTIONS- 160224012

……………………………..

WHEREAS, you are operating your industry in Water & Air pollution prevention area declared under Water (P & CP) Act, 1974 Air (P & CP) Act, 1981 and Hazardous & Other Waste (Management & Transboundary Movement) Rules, 2016.

AND WHEREAS, Board has granted conditional Consent to Operate u/s. 26 of Water (P & CP) Act, 1974; u/s 21 of Air (P & CP) Act, 1981 and u/s 6 of Hazardous & Other Waste (Management & Transboundry Movement) Rules, 2016 with certain terms & conditions and it is mandatory on your part to comply all the conditions stipulated in the consent to operate.

AND WHEREAS, it is obligatory on your part to provide necessary water & air pollution control devices and operate them continuously and efficiently so as to meet the standards prescribed by the Board at all times. Also comply with the provisions of Hazardous & Other Waste (Management & Transboundry Movement) Rules, 2016.

AND WHEREAS, MPC Board is receiving frequent complaints from surrounding area regarding Air Pollution Problem due to operation of units in Thane Belapur Industrial Area.

AND WHEREAS, Hon'ble National Green Tribunal, Western Bench, Pune has admitted SUMOTO case No. 197 of 2023.

AND WHEREAS, CPCB has submitted specific mitigation plan for odour and air pollution industries source in Thane Belapur Industrial Area.

AND WHERAS, considering the measures proposed by Regional Director, Central Pollution Control Board, Pune and curb the pollution issue in surrounding area, in exercise of the powers conferred upon me by the Board u/s. 33A of the Water (Prevention & Control of Pollution) Act, 1974 and u/s. 31A of Air (P&CP) Act, 1981, you are hereby directed to:

Short Term (Less than 1 year)

1. Process vents to be connected through double condenser.
2. Process vents of condenser should be of adequate height.
3. Process vents of condenser should pass through absorption media like activated carbon.
4. Pumps shall be provided with mechanical seals to prevent leakages.
5. Implementation of LDAR to control NH3 emissions.
6. Removal of VOCs by air stripping before equalization tank.
7. Odours wastewater stream shall be handled in closed system from the source to primary treatment stages.
8. Removal of VOCs by competing mechanisms of air stripping and adsorption on solids in aeration tank.
9. Aqueous activated sludge diffusion, by sparging the collected odor emissions into aeration tanks of CETP, a typical liquid-based odor control system.
10. Regular O&M of sludge thickeners i.e. treating the sludge with lime or iron salts to encourage thickening and reduce the degassing of sulfurous compounds (H2S, organic sulphides, organosulphur based compounds etc) and ammonia.

Long term (1 year and above)

Capping of various open-air treatment systems (collection tanks, equalization tanks) and venting with appropriate VOC traps/media based scrubbers.

Your reply along with time bound action plan shall reach this office within a period of 15 days from date of receipt of this notice. In case, you fail to comply with the above directions, the Board will have no option than to initiate appropriate legal action including issuance of final directions and filing of prosecution as per the provisions of Water (Prevention & Control of Pollution) Act, 1974 and Air (Prevention & Control of Pollution) Act, 1981 respectively, which may please be noted.

(Satish H Padwal)
Regional Officer, Navi Mumbai

Copy submitted to:

1. The Joint Director (WPC), M.PC. Board, Sion, Mumbai.
2. Law Officer (P&L Divn), MPCB, Mumbai.

Copy to:-

Sub-Regional Officer, Navi Mumbai-I - He is directed to serve these directions to industry.

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Raigad Bhavan, 7th floor,
Sec-11, C.B.D.Belapur,
Navi Mumbai- 400 614.

No: MPCB/RONM/ 2312290009 **Date: - 29/12/2023**

To,
M/s. Esters and Solvents,
Plot No. W-180, TTC Indl Area,
MIDC Pawne, Navi Mumbai.

Sub : Direction under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, Air (Prevention & Control of Pollution) Act, 1981 and Hazardous & Other Waste (Management and Trans-boundary Movement) Rules 2016

Ref :
1. Consent to Operate granted to your unit by MPC board.
2. Hon'ble, NGT, WB, Pune in respect of
3. CPCB mitigation plan for odour and air pollution industries source in this area.
4. Legal Action Proposal vide no. MPCB-LEGAL_ACTIONS- 271223009

………………………………

WHEREAS, you are operating your industry in Water & Air pollution prevention area declared under Water (P & CP) Act, 1974 Air (P & CP) Act, 1981 and Hazardous & Other Waste (Management & Transboundary Movement) Rules, 2016.

AND WHEREAS, Board has granted conditional Consent to Operate u/s. 26 of Water (P & CP) Act, 1974; u/s 21 of Air (P & CP) Act, 1981 and u/s 6 of Hazardous & Other Waste (Management & Transboundry Movement) Rules, 2016 with certain terms & conditions and it is mandatory on your part to comply all the conditions stipulated in the consent to operate.

AND WHEREAS, it is obligatory on your part to provide necessary water & air pollution control devices and operate them continuously and efficiently so as to meet the standards prescribed by the Board at all times. Also comply with the provisions of Hazardous & Other Waste (Management & Transboundry Movement) Rules, 2016.

AND WHEREAS, MPC Board is receiving frequent complaints from surrounding area regarding Air Pollution Problem due to operation of units in Thane Belapur Industrial Area.

AND WHEREAS, Hon'ble National Green Tribunal, Western Bench, Pune has admitted SUMOTO case No. 197 of 2023.

AND WHEREAS, CPCB has submitted specific mitigation plan for odour and air pollution industries source in Thane Belapur Industrial Area.

AND WHERAS, considering the measures proposed by Regional Director, Central Pollution Control Board, Pune and curb the pollution issue in surrounding area, in exercise of the powers conferred upon me by the Board u/s. 33A of the Water (Prevention & Control of Pollution) Act, 1974 and u/s. 31A of Air (P&CP) Act, 1981, you are hereby directed to:

Short Term (Less than 1 year)

1. Process vents to be connected through double condenser.
2. Process vents of condenser should be of adequate height.
3. Process vents of condenser should pass through absorption media like activated carbon.
4. Pumps shall be provided with mechanical seals to prevent leakages.
5. Implementation of LDAR to control NH3 emissions.
6. Removal of VOCs by air stripping before equalization tank.
7. Odours wastewater stream shall be handled in closed system from the source to primary treatment stages.
8. Removal of VOCs by competing mechanisms of air stripping and adsorption on solids in aeration tank.
9. Aqueous activated sludge diffusion, by sparging the collected odor emissions into aeration tanks of CETP, a typical liquid-based odor control system.
10. Regular O&M of sludge thickeners i.e. treating the sludge with lime or iron salts to encourage thickening and reduce the degassing of sulfurous compounds (H2S, organic sulphides, organosulphur based compounds etc) and ammonia.

Long term (1 year and above)

Capping of various open-air treatment systems (collection tanks, equalization tanks) and venting with appropriate VOC traps/media based scrubbers.

Your reply along with time bound action plan shall reach this office within a period of 15 days from date of receipt of this notice. In case, you fail to comply with the above directions, the Board will have no option than to initiate appropriate legal action including issuance of final directions and filing of prosecution as per the provisions of Water (Prevention & Control of Pollution) Act, 1974 and Air (Prevention & Control of Pollution) Act, 1981 respectively, which may please be noted.

(Satish H Padwal)
Regional Officer, Navi Mumbai

Copy submitted to:

1. The Joint Director (WPC), M.PC. Board, Sion, Mumbai.
2. Legal Division

Copy to:-

Sub-Regional Officer, Navi Mumbai-I - He is directed to serve these directions to industry.

MAHARASHTRA POLLUTION CONTROL BOARD

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Raigad Bhavan, 7th floor,
Sec-11, C.B.D.Belapur,
Navi Mumbai- 400 614.

No: MPCB/RONM/ 23122290003

Date: - 29/12/2023

To,
M/s. Hemmo Pharmaceuticals Pvt Ltd,
Plot No.C-43, TTC Indl Area,
MIDC Pawne, Navi Mumbai.

Sub : Direction under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, Air (Prevention & Control of Pollution) Act, 1981 and Hazardous & Other Waste (Management and Trans-boundary Movement) Rules 2016

Ref :
1. Consent to Operate granted to your unit by MPC board.
2. Hon'ble, NGT, WB, Pune in respect of
3. CPCB mitigation plan for odour and air pollution industries source in this area.
4. Legal Action Proposal vide no. MPCB-LEGAL_ACTIONS- 261223035

....

WHEREAS, you are operating your industry in Water & Air pollution prevention area declared under Water (P & CP) Act, 1974 Air (P & CP) Act, 1981 and Hazardous & Other Waste (Management & Transboundary Movement) Rules, 2016.

AND WHEREAS, Board has granted conditional Consent to Operate u/s. 26 of Water (P & CP) Act, 1974; u/s 21 of Air (P & CP) Act, 1981 and u/s 6 of Hazardous & Other Waste (Management & Transboundry Movement) Rules, 2016 with certain terms & conditions and it is mandatory on your part to comply all the conditions stipulated in the consent to operate.

AND WHEREAS, it is obligatory on your part to provide necessary water & air pollution control devices and operate them continuously and efficiently so as to meet the standards prescribed by the Board at all times. Also comply with the provisions of Hazardous & Other Waste (Management & Transboundry Movement) Rules, 2016.

AND WHEREAS, MPC Board is receiving frequent complaints from surrounding area regarding Air Pollution Problem due to operation of units in Thane Belapur Industrial Area.

AND WHEREAS, Hon'ble National Green Tribunal, Western Bench, Pune has admitted SUMOTO case No. 197 of 2023.

AND WHEREAS, CPCB has submitted specific mitigation plan for odour and air pollution industries source in Thane Belapur Industrial Area.

AND WHERAS, considering the measures proposed by Regional Director, Central Pollution Contro Board, Pune and curb the pollution issue in surrounding area, in exercise of the powers conferred upon me by the Board u/s. 33A of the Water (Prevention & Control of Pollution) Act, 1974 and u/s. 31A of Air (P&CP) Act, 1981, you are hereby directed to:

Short Term (Less than 1 year)

1. Process vents to be connected through double condenser.
2. Process vents of condenser should be of adequate height.
3. Process vents of condenser should pass through absorption media like activated carbon.
4. Pumps shall be provided with mechanical seals to prevent leakages.
5. Implementation of LDAR to control NH3 emissions.
6. Removal of VOCs by air stripping before equalization tank.
7. Odours wastewater stream shall be handled in closed system from the source to primary treatment stages.
8. Removal of VOCs by competing mechanisms of air stripping and adsorption on solids in aeration tank.
9. Aqueous activated sludge diffusion, by sparging the collected odor emissions into aeration tanks of CETP, a typical liquid-based odor control system.
10. Regular O&M of sludge thickeners i.e. treating the sludge with lime or iron salts to encourage thickening and reduce the degassing of sulfurous compounds (H2S, organic sulphides, organosulphur based compounds etc) and ammonia.

Long term (1 year and above)

Capping of various open-air treatment systems (collection tanks, equalization tanks) and venting with appropriate VOC traps/media based scrubbers.

Your reply along with time bound action plan shall reach this office within a period of 15 days from date of receipt of this notice. In case, you fail to comply with the above directions, the Board will have no option than to initiate appropriate legal action including issuance of final directions and filing of prosecution as per the provisions of Water (Prevention & Control of Pollution) Act, 1974 and Air (Prevention & Control of Pollution) Act, 1981 respectively, which may please be noted.

(Satish H Padwal)
Regional Officer, Navi Mumbai

Copy submitted to:

1. The Joint Director (WPC), M.PC. Board, Sion, Mumbai.
2. Legal Division

Copy to:-

Sub-Regional Officer, Navi Mumbai-I - He is directed to serve these directions to industry.

MAHARASHTRA POLLUTION CONTROL BOARD

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Raigad Bhavan, 7th floor,
Sec-11, C.B.D.Belapur,
Navi Mumbai- 400 614.

No: MPCB/RONM/2312290002 **Date: - 29/12/2023**

To,
M/s. Precise Biopharma Pvt Ltd,
Plot No.C-384, TTC Indl Area,
MIDC Turbhe, Navi Mumbai.

Sub : Direction under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, Air (Prevention & Control of Pollution) Act, 1981 and Hazardous & Other Waste (Management and Trans-boundary Movement) Rules 2016

Ref :
1. Consent to Operate granted to your unit by MPC board.
2. Hon'ble, NGT, WB, Pune in respect of Sumoto Case No. 197/2023
3. CPCB mitigation plan for odour and air pollution industries source in this area.
4. Legal Action Proposal vide no. MPCB-LEGAL_ACTIONS- 261223036

....

WHEREAS, you are operating your industry in Water & Air pollution prevention area declared under Water (P & CP) Act, 1974 Air (P & CP) Act, 1981 and Hazardous & Other Waste (Management & Transboundary Movement) Rules, 2016.

AND WHEREAS, Board has granted conditional Consent to Operate u/s. 26 of Water (P & CP) Act, 1974; u/s 21 of Air (P & CP) Act, 1981 and u/s 6 of Hazardous & Other Waste (Management & Transboundry Movement) Rules, 2016 with certain terms & conditions and it is mandatory on your part to comply all the conditions stipulated in the consent to operate.

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AND WHEREAS, MPC Board is receiving frequent complaints from surrounding area regarding Air Pollution Problem due to operation of units in Thane Belapur Industrial Area.

AND WHEREAS, Hon'ble National Green Tribunal, Western Bench, Pune has admitted SUMOTO case No. 197 of 2023.

AND WHEREAS, CPCB has submitted specific mitigation plan for odour and air pollution industries source in Thane Belapur Industrial Area.

AND WHERAS, considering the measures proposed by Regional Director, Central Pollution Control Board, Pune and curb the pollution issue in surrounding area, in exercise of the powers conferred upon me by the Board u/s. 33A of the Water (Prevention & Control of Pollution) Act, 1974 and u/s. 31A of Air (P&CP) Act, 1981, you are hereby directed to:

Short Term (Less than 1 year)

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3. Process vents of condenser should pass through absorption media like activated carbon.
4. Pumps shall be provided with mechanical seals to prevent leakages.
5. Implementation of LDAR to control NH3 emissions.
6. Removal of VOCs by air stripping before equalization tank.
7. Odours wastewater stream shall be handled in closed system from the source to primary treatment stages.
8. Removal of VOCs by competing mechanisms of air stripping and adsorption on solids in aeration tank.
9. Aqueous activated sludge diffusion, by sparging the collected odor emissions into aeration tanks of CETP, a typical liquid-based odor control system.
10. Regular O&M of sludge thickeners i.e. treating the sludge with lime or iron salts to encourage thickening and reduce the degassing of sulfurous compounds (H2S, organic sulphides, organosulphur based compounds etc) and ammonia.

Long term (1 year and above)

Capping of various open-air treatment systems (collection tanks, equalization tanks) and venting with appropriate VOC traps/media based scrubbers.

Your reply along with time bound action plan shall reach this office within a period of 15 days from date of receipt of this notice. In case, you fail to comply with the above directions, the Board will have no option than to initiate appropriate legal action including issuance of final directions and filing of prosecution as per the provisions of Water (Prevention & Control of Pollution) Act, 1974 and Air (Prevention & Control of Pollution) Act, 1981 respectively, which may please be noted.

(Satish H Padwal)
Regional Officer, Navi Mumbai

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2. Legal Division

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Raigad Bhavan, 7th floor,
Sec-11, C.B.D.Belapur,
Navi Mumbai- 400 614.

No: MPCB/RONM/2401120004 **Date: -**12 **/01/2024**

To,
M/s. Precise Chemipharma Pvt Ltd.
Plot No. D-90/3, MIDC Turbhe,
Navi Mumbai.

Sub : Direction under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, Air (Prevention & Control of Pollution) Act, 1981 and Hazardous & Other Waste (Management and Trans-boundary Movement) Rules 2016

Ref :
1. Consent to Operate granted to your unit by MPC board.
2. Hon'ble, NGT, WB, Pune in respect of
3. CPCB mitigation plan for odour and air pollution industries source in this area.
4. Legal Action Proposal vide no. MPCB-LEGAL_ACTIONS- 100124021

………………………………

WHEREAS, you are operating your industry in Water & Air pollution prevention area declared under Water (P & CP) Act, 1974 Air (P & CP) Act, 1981 and Hazardous & Other Waste (Management & Transboundary Movement) Rules, 2016.

AND WHEREAS, Board has granted conditional Consent to Operate u/s. 26 of Water (P & CP) Act, 1974; u/s 21 of Air (P & CP) Act, 1981 and u/s 6 of Hazardous & Other Waste (Management & Transboundry Movement) Rules, 2016 with certain terms & conditions and it is mandatory on your part to comply all the conditions stipulated in the consent to operate.

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AND WHEREAS, Hon'ble National Green Tribunal, Western Bench, Pune has admitted SUMOTO case No. 197 of 2023.

AND WHEREAS, CPCB has submitted specific mitigation plan for odour and air pollution industries source in Thane Belapur Industrial Area.

AND WHERAS, considering the measures proposed by Regional Director, Central Pollution Control Board, Pune and curb the pollution issue in surrounding area, in exercise of the powers conferred upon me by the Board u/s. 33A of the Water (Prevention & Control of Pollution) Act, 1974 and u/s. 31A of Air (P&CP) Act, 1981, you are hereby directed to:

Short Term (Less than 1 year)

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(Satish H Padwal)
Regional Officer, Navi Mumbai

Copy submitted to:

1. The Joint Director (WPC), M.P.C. Board, Sion, Mumbai.
2. Legal Division

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Sub-Regional Officer, Navi Mumbai-I - He is directed to serve these directions to industry.

MAHARASHTRA POLLUTION CONTROL BOARD

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Raigad Bhavan, 7th floor,
Sec-11, C.B.D.Belapur,
Navi Mumbai- 400 614.

No: MPCB/RONM/2312290010

Date: - 29/12/2023

To,
M/s. RPG Life Science Ltd,
Plot No. 25, MIDC Land, Thane Belapur Road,
MIDC Pawne, Navi Mumbai.

Sub : Direction under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, Air (Prevention & Control of Pollution) Act, 1981 and Hazardous & Other Waste (Management and Trans-boundary Movement) Rules 2016

Ref :
1. Consent to Operate granted to your unit by MPC board.
2. Hon'ble, NGT, WB, Pune in respect of
3. CPCB mitigation plan for odour and air pollution industries source in this area.
4. Legal Action Proposal vide no. MPCB-LEGAL_ACTIONS- 271223008

....

WHEREAS, you are operating your industry in Water & Air pollution prevention area declared under Water (P & CP) Act, 1974 Air (P & CP) Act, 1981 and Hazardous & Other Waste (Management & Transboundary Movement) Rules, 2016.

AND WHEREAS, Board has granted conditional Consent to Operate u/s. 26 of Water (P & CP) Act, 1974; u/s 21 of Air (P & CP) Act, 1981 and u/s 6 of Hazardous & Other Waste (Management & Transboundry Movement) Rules, 2016 with certain terms & conditions and it is mandatory on your part to comply all the conditions stipulated in the consent to operate.

AND WHEREAS, it is obligatory on your part to provide necessary water & air pollution control devices and operate them continuously and efficiently so as to meet the standards prescribed by the Board at all times. Also comply with the provisions of Hazardous & Other Waste (Management & Transboundry Movement) Rules, 2016.

AND WHEREAS, MPC Board is receiving frequent complaints from surrounding area regarding Air Pollution Problem due to operation of units in Thane Belapur Industrial Area.

AND WHEREAS, Hon'ble National Green Tribunal, Western Bench, Pune has admitted SUMOTO case No. 197 of 2023.

AND WHEREAS, CPCB has submitted specific mitigation plan for odour and air pollution industries source in Thane Belapur Industrial Area.

AND WHERAS, considering the measures proposed by Regional Director, Central Pollution Contro Board, Pune and curb the pollution issue in surrounding area, in exercise of the powers conferred upon m by the Board u/s. 33A of the Water (Prevention & Control of Pollution) Act, 1974 and u/s. 31A of Air (P&CP Act, 1981, you are hereby directed to:

Short Term (Less than 1 year)

1. Process vents to be connected through double condenser.
2. Process vents of condenser should be of adequate height.
3. Process vents of condenser should pass through absorption media like activated carbon.
4. Pumps shall be provided with mechanical seals to prevent leakages.
5. Implementation of LDAR to control NH3 emissions.
6. Removal of VOCs by air stripping before equalization tank.
7. Odours wastewater stream shall be handled in closed system from the source to primary treatment stages.
8. Removal of VOCs by competing mechanisms of air stripping and adsorption on solids in aeration tank.
9. Aqueous activated sludge diffusion, by sparging the collected odor emissions into aeration tanks of CETP, a typical liquid-based odor control system.
10. Regular O&M of sludge thickeners i.e. treating the sludge with lime or iron salts to encourage thickening and reduce the degassing of sulfurous compounds (H2S, organic sulphides, organosulphur based compounds etc) and ammonia.

Long term (1 year and above)

Capping of various open-air treatment systems (collection tanks, equalization tanks) and venting with appropriate VOC traps/media based scrubbers.

Your reply along with time bound action plan shall reach this office within a period of 15 days from date of receipt of this notice. In case, you fail to comply with the above directions, the Board will have no option than to initiate appropriate legal action including issuance of final directions and filing of prosecution as per the provisions of Water (Prevention & Control of Pollution) Act, 1974 and Air (Prevention & Control of Pollution) Act, 1981 respectively, which may please be noted.

(Satish H Padwal)
Regional Officer, Navi Mumbai

Copy submitted to:

1. The Joint Director (WPC), M.P.C. Board, Sion, Mumbai.
2. Legal Division

Copy to:-

Sub-Regional Officer, Navi Mumbai-I - He is directed to serve these directions to industry.

MAHARASHTRA POLLUTION CONTROL BOARD

Regional Office, Navi-Mumbai

Ph.:- (022)- 2757 2740
Fax Ph. :- (022)- 2757 1586
Visit us at :- htpp//mpcb.gov.in
e-mail :ronavimumbai@mpcb.gov.in

Raigad Bhavan, 7th floor,
Sec-11, C.B.D.Belapur,
Navi Mumbai- 400 614.

No: MPCB/RONM/2402010001 Date:- 1 /02/2024

To,
M/s. Shirdi Chemicals Pvt Ltd.
Plot No. C-118, MIDC Pawne,
Navi Mumbai.

Sub : Direction under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, Air (Prevention & Control of Pollution) Act, 1981 and Hazardous & Other Waste (Management and Trans-boundary Movement) Rules 2016

Ref :
1. Consent to Operate granted to your unit by MPC board.
2. Hon'ble, NGT, WB, Pune in respect of Sumoto Case No. 197/2023
3. CPCB mitigation plan for odour and air pollution industries source in this area.
4. Legal Action Proposal vide no. MPCB-LEGAL_ACTIONS- 290124003

....

WHEREAS, you are operating your industry in Water & Air pollution prevention area declared under Water (P & CP) Act, 1974 Air (P & CP) Act, 1981 and Hazardous & Other Waste (Management & Transboundary Movement) Rules, 2016.

AND WHEREAS, Board has granted conditional Consent to Operate u/s. 26 of Water (P & CP) Act, 1974; u/s 21 of Air (P & CP) Act, 1981 and u/s 6 of Hazardous & Other Waste (Management & Transboundry Movement) Rules, 2016 with certain terms & conditions and it is mandatory on your part to comply all the conditions stipulated in the consent to operate.

AND WHEREAS, it is obligatory on your part to provide necessary water & air pollution control devices and operate them continuously and efficiently so as to meet the standards prescribed by the Board at all times. Also comply with the provisions of Hazardous & Other Waste (Management & Transboundry Movement) Rules, 2016.

AND WHEREAS, MPC Board is receiving frequent complaints from surrounding area regarding Air Pollution Problem due to operation of units in Thane Belapur Industrial Area.

AND WHEREAS, Hon'ble National Green Tribunal, Western Bench, Pune has admitted SUMOTO case No. 197 of 2023.

AND WHEREAS, CPCB has submitted specific mitigation plan for odour and air pollution industries source in Thane Belapur Industrial Area.

AND WHERAS, considering the measures proposed by Regional Director, Central Pollution Contr Board, Pune and curb the pollution issue in surrounding area, in exercise of the powers conferred upon m by the Board u/s. 33A of the Water (Prevention & Control of Pollution) Act, 1974 and u/s. 31A of Air (P&CI Act, 1981, you are hereby directed to:

Short Term (Less than 1 year)

1. Process vents to be connected through double condenser.
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8. Removal of VOCs by competing mechanisms of air stripping and adsorption on solids in aeration tank.
9. Aqueous activated sludge diffusion, by sparging the collected odor emissions into aeration tanks of CETP, a typical liquid-based odor control system.
10. Regular O&M of sludge thickeners i.e. treating the sludge with lime or iron salts to encourage thickening and reduce the degassing of sulfurous compounds (H2S, organic sulphides, organosulphur based compounds etc) and ammonia.

Long term (1 year and above)

Capping of various open-air treatment systems (collection tanks, equalization tanks) and venting with appropriate VOC traps/media based scrubbers.

Your reply along with time bound action plan shall reach this office within a period of 15 days from date of receipt of this notice. In case, you fail to comply with the above directions, the Board will have no option than to initiate appropriate legal action including issuance of final directions and filing of prosecution as per the provisions of Water (Prevention & Control of Pollution) Act, 1974 and Air (Prevention & Control of Pollution) Act, 1981 respectively, which may please be noted.

(Satish H Padwal)
Regional Officer, Navi Mumbai

Copy submitted to:

1. The Joint Director (WPC), M.PC. Board, Sion, Mumbai.
2. Law Officer (P&L Divn), MPCB, Mumbai.

Copy to:-

Sub-Regional Officer, Navi Mumbai-I - He is directed to serve these directions to industry.

MAHARASHTRA POLLUTION CONTROL BOARD

Regional Office, Navi-Mumbai

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Raigad Bhavan, 7th floor,
Sec-11, C.B.D.Belapur,
Navi Mumbai- 400 614.

No: MPCB/RONM/ 2312290005 **Date: - 29/12/2023**

To,
M/s. Zydus Takeda Healthcare Pvt Ltd,
Plot No.C-4, TTC Indl Area,
MIDC Pawne, Navi Mumbai.

Sub : Direction under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, Air (Prevention & Control of Pollution) Act, 1981 and Hazardous & Other Waste (Management and Trans-boundary Movement) Rules 2016

Ref :
1. Consent to Operate granted to your unit by MPC board.
2. Hon'ble, NGT, WB, Pune in respect of
3. CPCB mitigation plan for odour and air pollution industries source in this area.
4. Legal Action Proposal vide no. MPCB-LEGAL_ACTIONS- 261223034

....

WHEREAS, you are operating your industry in Water & Air pollution prevention area declared under Water (P & CP) Act, 1974 Air (P & CP) Act, 1981 and Hazardous & Other Waste (Management & Transboundary Movement) Rules, 2016.

AND WHEREAS, Board has granted conditional Consent to Operate u/s. 26 of Water (P & CP) Act, 1974; u/s 21 of Air (P & CP) Act, 1981 and u/s 6 of Hazardous & Other Waste (Management & Transboundry Movement) Rules, 2016 with certain terms & conditions and it is mandatory on your part to comply all the conditions stipulated in the consent to operate.

AND WHEREAS, it is obligatory on your part to provide necessary water & air pollution control devices and operate them continuously and efficiently so as to meet the standards prescribed by the Board at all times. Also comply with the provisions of Hazardous & Other Waste (Management & Transboundry Movement) Rules, 2016.

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8. Removal of VOCs by competing mechanisms of air stripping and adsorption on solids in aeration tank.
9. Aqueous activated sludge diffusion, by sparging the collected odor emissions into aeration tanks of CETP, a typical liquid-based odor control system.
10. Regular O&M of sludge thickeners i.e. treating the sludge with lime or iron salts to encourage thickening and reduce the degassing of sulfurous compounds (H2S, organic sulphides, organosulphur based compounds etc) and ammonia.

Long term (1 year and above)

Capping of various open-air treatment systems (collection tanks, equalization tanks) and venting with appropriate VOC traps/media based scrubbers.

Your reply along with time bound action plan shall reach this office within a period of 15 days from date of receipt of this notice. In case, you fail to comply with the above directions, the Board will have no option than to initiate appropriate legal action including issuance of final directions and filing of prosecution as per the provisions of Water (Prevention & Control of Pollution) Act, 1974 and Air (Prevention & Control of Pollution) Act, 1981 respectively, which may please be noted.

(Satish H Padwal)
Regional Officer, Navi Mumbai

Copy submitted to:

1. The Joint Director (WPC), M.PC. Board, Sion, Mumbai.
2. Legal Division

Copy to:-

Sub-Regional Officer, Navi Mumbai-I - He is directed to serve these directions to industry.

Annexure X

Sr. No.	Name of Industry	odor reason	Direction issued on	Mitigation measures	compliance
1	M/s. Beetachem Industries Pvt Ltd, Plot no. W-177, MIDC Turbhe, Navi Mumbai.	1. Vapours of organic solvent during charging and discharging and process leakages. 2. Traces organic solvent from ETP. 3. Non operation of condenser.	28.12.2023	**Short term (1 year and above)-** 1. Identifying the odour causing sources. 2. Compliance of CPCB SOP prepared under Rule-9 of HOW (M & TM) Rules 2016 for solvent recovery. 3. Transfer of solvents (spent and recovered) should be carried by connecting vents through condenser and of closed pipelines. 4. Process vents to be connected through double condenser. 5. Process vents of condenser should be adequate height 6. Process vents of condenser should pass through absorption media like activated carbon. 7. Pumps shall be provided with mechanical seals to prevent leakages. 8. Regular monitoring of VOCs shall be carried out in the work zone area and ambient air. 9. Implementation of LDAR (Leakage Detection and Repair) to control VOCs emissions. 10. Total losses of solvent should not be more than 5%. 11. Condenser system for control of VOC emission at the vents of all the potential storage tanks. **Long term (1 year and above)** Installation of floating roof tanks for solvent (spent and recovered) storage to minimize fugitive emission	1. Yes 2. Yes 3. Yes 4. Yes 5. Yes 6.Yes 7. NA, as vaccum transfer provided. 8. Yes 9. Yes 10. Yes 11. Yes No. Underground tank provided.
2	M/s. Darshan Chemicals, Plot No.A-38, MIDC Turbhe, Navi Mumbai	1. Vapours of organic solvent during charging and discharging and process leakages. 2. Traces organic solvent from ETP. 3. Non operation of condenser.	28.12.2023	**Short term (1 year and above)-** 1. Identifying the odour causing sources. 2. Compliance of CPCB SOP prepared under Rule-9 of HOW (M & TM) Rules 2016 for solvent recovery. 3. Transfer of solvents (spent and recovered) should be carried by connecting vents through condenser and of closed pipelines. 4. Process vents to be connected through double condenser. 5. Process vents of condenser should be adequate height 6. Process vents of condenser should pass through absorption media like activated carbon. 7. Pumps shall be provided with mechanical seals to prevent leakages. 8. Regular monitoring of VOCs shall be carried out in the work zone area and ambient air. 9. Implementation of LDAR (Leakage Detection and Repair) to control VOCs emissions. 10. Total losses of solvent should not be more than 5%. 11. Condenser system for control of VOC emission at the vents of all the potential storage tanks. **Long term (1 year and above)** Installation of floating roof tanks for solvent (spent and recovered) storage to minimize fugitive emission	1. Yes 2. Yes 3. Yes 4. Yes 5. Yes 6. No 7. Yes 8. Yes 9. Yes 10. Yes 11. Yes No.

3	M/s. Raigad Chemicals Pvt Ltd, Plot no. W-181, MIDC Turbhe, Navi Mumbai	1. Vapours of organic solvent during charging and discharging and process leakages. 2. Traces organic solvent from ETP. 3. Non operation of condenser.	28.12.2023	**Short term (1 year and above)-** 1. Identifying the odour causing sources. 2. Compliance of CPCB SOP prepared under Rule-9 of HOW (M & TM) Rules 2016 for solvent recovery. 3. Transfer of solvents (spent and recovered) should be carried by connecting vents through condenser and of closed pipelines. 4. Process vents to be connected through double condenser. 5. Process vents of condenser should be adequate height 6. Process vents of condenser should pass through absorption media like activated carbon. 7. Pumps shall be provided with mechanical seals to prevent leakages. 8. Regular monitoring of VOCs shall be carried out in the work zone area and ambient air. 9. Implementation of LDAR (Leakage Detection and Repair) to control VOCs emissions. 10. Total losses of solvent should not be more than 5%. 11. Condenser system for control of VOC emission at the vents of all the potential storage tanks. **Long term (1 year and above)** Installation of floating roof tanks for solvent (spent and recovered) storage to minimize fugitive emission	As per reply received from industry dated 11.06.2024 against the directions issued by the Board, industry mentioned that industry has decided to remove the activity of technical distillation and rectification of solvents from point No. 3 of consent of M/s. Raigad Chemical Pvt. Ltd. Industry also mentioned that industry will not optained permission for distillation or rectificatio activity under Rule No. 9 of Hazardous and other waste (M&TM) Rules 2016.
4	M/s. Darshan Chemicals, Plot No. D-29/3, MIDC Turbhe, Navi Mumbai	1. Vapours of organic solvent during charging and discharging and process leakages. 2. Traces organic solvent from ETP. 3. Non operation of condenser.	28.12.2023	**Short term (1 year and above)-** 1. Identifying the odour causing sources. 2. Compliance of CPCB SOP prepared under Rule-9 of HOW (M & TM) Rules 2016 for solvent recovery. 3. Transfer of solvents (spent and recovered) should be carried by connecting vents through condenser and of closed pipelines. 4. Process vents to be connected through double condenser. 5. Process vents of condenser should be adequate height 6. Process vents of condenser should pass through absorption media like activated carbon. 7. Pumps shall be provided with mechanical seals to prevent leakages. 8. Regular monitoring of VOCs shall be carried out in the work zone area and ambient air. 9. Implementation of LDAR (Leakage Detection and Repair) to control VOCs emissions. 10. Total losses of solvent should not be more than 5%. 11. Condenser system for control of VOC emission at the vents of all the potential storage tanks. **Long term (1 year and above)** Installation of floating roof tanks for solvent (spent and recovered) storage to minimize fugitive emission	1. Yes 2. Yes 3. Yes 4. Yes 5. Yes 6.Yes 7. Yes. 8. Yes 9. Yes 10. Yes 11. Yes Yes

5	M/s. Maha recyclon Industries Plot No. W-278 A, MIDC Rabale, navi Mumbai.	1. Vapours of organic solvent during charging and discharging and process leakages. 2. Traces organic solvent from ETP. 3. Non operation of condenser.	15.01.2024	**Short term (1 year and above)** 1. Identifying the odour causing sources. 2. Compliance of CPCB SOP prepared under Rule-9 of HOW (M & TM) Rules 2016 for solvent recovery. 3. Transfer of solvents (spent and recovered) should be carried by connecting vents through condenser and of closed pipelines. 4. Process vents to be connected through double condenser. 5. Process vents of condenser should be adequate height 6. Process vents of condenser should pass through absorption media like activated carbon. 7. Pumps shall be provided with mechanical seals to prevent leakages. 8. Regular monitoring of VOCs shall be carried out in the work zone area and ambient air. 9. Implementation of LDAR (Leakage Detection and Repair) to control VOCs emissions. 10. Total losses of solvent should not be more than 5%. 11. Condenser system for control of VOC emission at the vents of all the potential storage tanks. **Long term (1 year and above)** Installation of floating roof tanks for solvent (spent and recovered) storage to minimize fugitive emission	1 to 10 -Complied 11 not complied. In under process
6	M/s. Amines & Plasticizers Limited, Plot no. D-21/21A, MIDC Turbhe, Navi Mumbai	1. Ammonia leakage from process. 2. Traces of organic chemicals in effluent vaporises during aeration.	12.01.2024	**Short Term (Less than 1 year)** 1. Process vents to be connected through double condenser. 2. Process vents of condenser should be of adequate height. 3. Process vents of condenser should pass through absorption media like activated carbon. 4. Pumps shall be provided with mechanical seals to prevent leakages. 5. Implementation of LDAR to control NH3 emissions. 6. Removal of VOCs by air stripping before equalization tank. 7. Odours wastewater stream shall be handled in closed system from the source to primary treatment stages 8. Removal of VOCs by competing mechanisms of air stripping and adsorption on solids in aeration tank. 9. Aqueous activated sludge diffusion, by sparging the collected odor emissions into aeration tanks of CETP, a typical liquid-based odor control system. 10. Regular O&M of sludge thickeners i.e. treating the sludge with lime or iron salts to encourage thickening and reduce the degassing of sulfurous compounds (H_2S, organic sulphides, organosulphur based compounds etc.) and ammonia. **Long term (1 year and above)** Capping of various open-air treatment systems (collection tanks, equalization tanks) and venting with appropriate VOC traps/media based scrubbers.	1.Yes 2.Yes 3.Yes 4.Yes 5.Yes 6.Yes 7.Yes 8.Yes 9.Yes 10. Yes Yes

7	M/s. Arkema Chemicals India Pvt Ltd. Plot no. D-43(1), D-43(5), MIDC Shiravane, Navi Mumbai	1. Ammonia leakage from process. 2. Traces of organic chemicals in effluent vaporises during aeration.	12.01.2024	**Short Term (Less than 1 year)** 1. Process vents to be connected through double condenser. 2. Process vents of condenser should be of adequate height. 3. Process vents of condenser should pass through absorption media like activated carbon. 4. Pumps shall be provided with mechanical seals to prevent leakages. 5. Implementation of LDAR to control NH3 emissions. 6. Removal of VOCs by air stripping before equalization tank. 7. Odours wastewater stream shall be handled in closed system from the source to primary treatment stages 8. Removal of VOCs by competing mechanisms of air stripping and adsorption on solids in aeration tank. 9. Aqueous activated sludge diffusion, by sparging the collected odor emissions into aeration tanks of CETP, a typical liquid-based odor control system. 10. Regular O&M of sludge thickeners i.e. treating the sludge with lime or iron salts to encourage thickening and reduce the degassing of sulfurous compounds (H_2S, organic sulphides, organosulphur based compounds etc.) and ammonia. **Long term (1 year and above)** Capping of various open-air treatment systems (collection tanks, equalization tanks) and venting with appropriate VOC traps/media based scrubbers.	1.Yes 2.Yes 3.Yes 4.Yes 5.NA 6.Yes 7.Yes 8.Yes 9.Yes 10. Yes Yes
8	M/s. Gramercy Trade Industries Pvt Ltd, Plot No. 2/1A, MIDC turbhe, Navi Mumbai.	1. Ammonia leakage from process. 2. Traces of organic chemicals in effluent vaporises during aeration.	29.12.2023	**Short Term (Less than 1 year)** 1. Process vents to be connected through double condenser. 2. Process vents of condenser should be of adequate height. 3. Process vents of condenser should pass through absorption media like activated carbon. 4. Pumps shall be provided with mechanical seals to prevent leakages. 5. Implementation of LDAR to control NH3 emissions. 6. Removal of VOCs by air stripping before equalization tank. 7. Odours wastewater stream shall be handled in closed system from the source to primary treatment stages 8. Removal of VOCs by competing mechanisms of air stripping and adsorption on solids in aeration tank. 9. Aqueous activated sludge diffusion, by sparging the collected odor emissions into aeration tanks of CETP, a typical liquid-based odor control system. 10. Regular O&M of sludge thickeners i.e. treating the sludge with lime or iron salts to encourage thickening and reduce the degassing of sulfurous compounds (H_2S, organic sulphides, organosulphur based compounds etc.) and ammonia. **Long term (1 year and above)** Capping of various open-air treatment systems (collection tanks, equalization tanks) and venting with appropriate VOC traps/media based scrubbers.	1.Yes 2.Yes 3.No, Process vents are connected to the flare. 4.Yes 5.NA 6.No 7.Yes 8.Yes 9.Yes 10. Yes VOC Monitoring started

9	M/s. Korde Chemicals Pvt Ltd, Plow No. W-13, MIDC Pawne, Navi Mumbai	1. Ammonia leakage from process. 2. Traces of organic chemicals in effluent vaporises during aeration.	29.12.2023	**Short Term (Less than 1 year)** 1. Process vents to be connected through double condenser. 2. Process vents of condenser should be of adequate height. 3. Process vents of condenser should pass through absorption media like activated carbon. 4. Pumps shall be provided with mechanical seals to prevent leakages. 5. Implementation of LDAR to control NH3 emissions. 6. Removal of VOCs by air stripping before equalization tank. 7. Odours wastewater stream shall be handled in closed system from the source to primary treatment stages 8. Removal of VOCs by competing mechanisms of air stripping and adsorption on solids in aeration tank. 9. Aqueous activated sludge diffusion, by sparging the collected odor emissions into aeration tanks of CETP, a typical liquid-based odor control system. 10. Regular O&M of sludge thickeners i.e. treating the sludge with lime or iron salts to encourage thickening and reduce the degassing of sulfurous compounds (H_2S, organic sulphides, organosulphur based compounds etc.) and ammonia. **Long term (1 year and above)** Capping of various open-air treatment systems (collection tanks, equalization tanks) and venting with appropriate VOC traps/media based scrubbers.	1.Yes 2.Yes 3.Yes 4.Yes 5.Yes 6.Yes 7.Yes 8.Yes 9.Yes 10. Yes Industry is in process of planning of the open air treatment system and appropriate venting via scrubber
10	M/s. Mehk Chemicasl Pvt Ltd, Plot No. C-159, TTC Industrial area, MIDC Pawne, Navi Mumbai	1. Ammonia leakage from process. 2. Traces of organic chemicals in effluent vaporises during aeration.	29.12.2023	**Short Term (Less than 1 year)** 1. Process vents to be connected through double condenser. 2. Process vents of condenser should be of adequate height. 3. Process vents of condenser should pass through absorption media like activated carbon. 4. Pumps shall be provided with mechanical seals to prevent leakages. 5. Implementation of LDAR to control NH3 emissions. 6. Removal of VOCs by air stripping before equalization tank. 7. Odours wastewater stream shall be handled in closed system from the source to primary treatment stages 8. Removal of VOCs by competing mechanisms of air stripping and adsorption on solids in aeration tank. 9. Aqueous activated sludge diffusion, by sparging the collected odor emissions into aeration tanks of CETP, a typical liquid-based odor control system. 10. Regular O&M of sludge thickeners i.e. treating the sludge with lime or iron salts to encourage thickening and reduce the degassing of sulfurous compounds (H_2S, organic sulphides, organosulphur based compounds etc.) and ammonia. **Long term (1 year and above)** Capping of various open-air treatment systems (collection tanks, equalization tanks) and venting with appropriate VOC traps/media based scrubbers.	1.Yes 2.Yes 3.In process 4.Yes 5.NA 6.In process 7.Closed Gutter provided 8.NA 9.NA 10. NA In process

11	M/s. Nocil Ltd, Plot No. C-37, MIDC Pawne, Navi Mumbai.	1. Ammonia leakage from process. 2. Traces of organic chemicals in effluent vaporises during aeration.	04.01.2024	**Short Term (Less than 1 year)** 1. Process vents to be connected through double condenser. 2. Process vents of condenser should be of adequate height. 3. Process vents of condenser should pass through absorption media like activated carbon. 4. Pumps shall be provided with mechanical seals to prevent leakages. 5. Implementation of LDAR to control NH3 emissions. 6. Removal of VOCs by air stripping before equalization tank. 7. Odours wastewater stream shall be handled in closed system from the source to primary treatment stages 8. Removal of VOCs by competing mechanisms of air stripping and adsorption on solids in aeration tank. 9. Aqueous activated sludge diffusion, by sparging the collected odor emissions into aeration tanks of CETP, a typical liquid-based odor control system. 10. Regular O&M of sludge thickeners i.e. treating the sludge with lime or iron salts to encourage thickening and reduce the degassing of sulfurous compounds (H_2S, organic sulphides, organosulphur based compounds etc.) and ammonia. **Long term (1 year and above)** Capping of various open-air treatment systems (collection tanks, equalization tanks) and venting with appropriate VOC traps/media based scrubbers.	1. Yes 2. Yes. 3.Yes . 4. Yes 5. Yes. 6. Yes 7. Yes, 8. Yes 9. Yes 10. Yes In Process
12	M/s. N.S. Chemicals Pvt Ltd, Shed No. W-3 & 4, MIDC Pawne, Navi Mumbai.	1. Ammonia leakage from process. 2. Traces of organic chemicals in effluent vaporises during aeration.	29.12.2023	**Short Term (Less than 1 year)** 1. Process vents to be connected through double condenser. 2. Process vents of condenser should be of adequate height. 3. Process vents of condenser should pass through absorption media like activated carbon. 4. Pumps shall be provided with mechanical seals to prevent leakages. 5. Implementation of LDAR to control NH3 emissions. 6. Removal of VOCs by air stripping before equalization tank. 7. Odours wastewater stream shall be handled in closed system from the source to primary treatment stages 8. Removal of VOCs by competing mechanisms of air stripping and adsorption on solids in aeration tank. 9. Aqueous activated sludge diffusion, by sparging the collected odor emissions into aeration tanks of CETP, a typical liquid-based odor control system. 10. Regular O&M of sludge thickeners i.e. treating the sludge with lime or iron salts to encourage thickening and reduce the degassing of sulfurous compounds (H_2S, organic sulphides, organosulphur based compounds etc.) and ammonia. **Long term (1 year and above)** Capping of various open-air treatment systems (collection tanks, equalization tanks) and venting with appropriate VOC traps/media based scrubbers.	1.Yes 2.Yes 3.NA 4.NA 5.NA 6. NA 7.Yes 8.NA 9.NA 10. No In process.

13	M/s. Paras Organics Pvt Ltd, Plot No. D-119, MIDC Shiravane, Navi Mumbai	1. Ammonia leakage from process. 2. Traces of organic chemicals in effluent vaporises during aeration.	23.02.2024	**Short Term (Less than 1 year)** 1. Process vents to be connected through double condenser. 2. Process vents of condenser should be of adequate height. 3. Process vents of condenser should pass through absorption media like activated carbon. 4. Pumps shall be provided with mechanical seals to prevent leakages. 5. Implementation of LDAR to control NH3 emissions. 6. Removal of VOCs by air stripping before equalization tank. 7. Odours wastewater stream shall be handled in closed system from the source to primary treatment stages 8. Removal of VOCs by competing mechanisms of air stripping and adsorption on solids in aeration tank. 9. Aqueous activated sludge diffusion, by sparging the collected odor emissions into aeration tanks of CETP, a typical liquid-based odor control system. 10. Regular O&M of sludge thickeners i.e. treating the sludge with lime or iron salts to encourage thickening and reduce the degassing of sulfurous compounds (H_2S, organic sulphides, organosulphur based compounds etc.) and ammonia. **Long term (1 year and above)** Capping of various open-air treatment systems (collection tanks, equalization tanks) and venting with appropriate VOC traps/media based scrubbers.	1.Yes 2.Yes 3.NA 4.Yes 5.NA 6.Yes 7.Yes 8.Yes 9.NA 10. Not use of sulfurous compounds and ammonia. Work in progress
14	M/s. Esters and Solvents, Plot No. W-180, MIDC Pawne, Navi Mumbai	1. Ammonia leakage from process. 2. Traces of organic chemicals in effluent vaporises during aeration.	29.12.2023	**Short Term (Less than 1 year)** 1. Process vents to be connected through double condenser. 2. Process vents of condenser should be of adequate height. 3. Process vents of condenser should pass through absorption media like activated carbon. 4. Pumps shall be provided with mechanical seals to prevent leakages. 5. Implementation of LDAR to control NH3 emissions. 6. Removal of VOCs by air stripping before equalization tank. 7. Odours wastewater stream shall be handled in closed system from the source to primary treatment stages 8. Removal of VOCs by competing mechanisms of air stripping and adsorption on solids in aeration tank. 9. Aqueous activated sludge diffusion, by sparging the collected odor emissions into aeration tanks of CETP, a typical liquid-based odor control system. 10. Regular O&M of sludge thickeners i.e. treating the sludge with lime or iron salts to encourage thickening and reduce the degassing of sulfurous compounds (H_2S, organic sulphides, organosulphur based compounds etc.) and ammonia. **Long term (1 year and above)** Capping of various open-air treatment systems (collection tanks, equalization tanks) and venting with appropriate VOC traps/media based scrubbers.	1.Yes 2.Yes 3.No, Connected to caustic scrubber 4.Yes 5.NA 6.In process 7.Yes 8.No 9.Yes 10. Yes In process.

15	M/s. Piramal Pharma Ltd (Hemmo Pharmaceturicals Pvt Ltd), Plot no. C-43, MIDC Pawne, Navi Mumbai	1. Ammonia leakage from process. 2. Traces of organic chemicals in effluent vaporises during aeration.	29.12.2023	**Short Term (Less than 1 year)** 1. Process vents to be connected through double condenser. 2. Process vents of condenser should be of adequate height. 3. Process vents of condenser should pass through absorption media like activated carbon. 4. Pumps shall be provided with mechanical seals to prevent leakages. 5. Implementation of LDAR to control NH3 emissions. 6. Removal of VOCs by air stripping before equalization tank. 7. Odours wastewater stream shall be handled in closed system from the source to primary treatment stages 8. Removal of VOCs by competing mechanisms of air stripping and adsorption on solids in aeration tank. 9. Aqueous activated sludge diffusion, by sparging the collected odor emissions into aeration tanks of CETP, a typical liquid-based odor control system. 10. Regular O&M of sludge thickeners i.e. treating the sludge with lime or iron salts to encourage thickening and reduce the degassing of sulfurous compounds (H_2S, organic sulphides, organosulphur based compounds etc.) and ammonia. **Long term (1 year and above)** Capping of various open-air treatment systems (collection tanks, equalization tanks) and venting with appropriate VOC traps/media based scrubbers.	1.Yes 2.Yes 3.Yes 4.Yes 5.Yes 6.No 7.Yes 8.NA 9.Not handling odorous chemical 10.Filter press provided In process
16	M/s. Precise Biopharma Pvt Ltd, Plot No. C-384, TTC Industrial Area, MIDC Pawane, Navi Mumbai.	1. Ammonia leakage from process. 2. Traces of organic chemicals in effluent vaporises during aeration.	29.12.2023	**Short Term (Less than 1 year)** 1. Process vents to be connected through double condenser. 2. Process vents of condenser should be of adequate height. 3. Process vents of condenser should pass through absorption media like activated carbon. 4. Pumps shall be provided with mechanical seals to prevent leakages. 5. Implementation of LDAR to control NH3 emissions. 6. Removal of VOCs by air stripping before equalization tank. 7. Odours wastewater stream shall be handled in closed system from the source to primary treatment stages 8. Removal of VOCs by competing mechanisms of air stripping and adsorption on solids in aeration tank. 9. Aqueous activated sludge diffusion, by sparging the collected odor emissions into aeration tanks of CETP, a typical liquid-based odor control system. 10. Regular O&M of sludge thickeners i.e. treating the sludge with lime or iron salts to encourage thickening and reduce the degassing of sulfurous compounds (H_2S, organic sulphides, organosulphur based compounds etc.) and ammonia. **Long term (1 year and above)** Capping of various open-air treatment systems (collection tanks, equalization tanks) and venting with appropriate VOC traps/media based scrubbers.	1.Yes 2.Yes 3.No(In process) 4.Yes 5.NA 6.Yes 7.Yes 8.Alum and Polyelectrolyte 9.No (Primary , Secondary and tertiary treatment) 10.Alum and poly treatment used to reduse degressing of sulphurous compound. In process

17	M/s. Precise Chemipharma Pvt Ltd, Plot No. D-90/3, MIDC Turbhe, Navi Mumbai.	1. Ammonia leakage from process. 2. Traces of organic chemicals in effluent vaporises during aeration.	12.01.2024	**Short Term (Less than 1 year)** 1. Process vents to be connected through double condenser. 2. Process vents of condenser should be of adequate height. 3. Process vents of condenser should pass through absorption media like activated carbon. 4. Pumps shall be provided with mechanical seals to prevent leakages. 5. Implementation of LDAR to control NH3 emissions. 6. Removal of VOCs by air stripping before equalization tank. 7. Odours wastewater stream shall be handled in closed system from the source to primary treatment stages 8. Removal of VOCs by competing mechanisms of air stripping and adsorption on solids in aeration tank. 9. Aqueous activated sludge diffusion, by sparging the collected odor emissions into aeration tanks of CETP, a typical liquid-based odor control system. 10. Regular O&M of sludge thickeners i.e. treating the sludge with lime or iron salts to encourage thickening and reduce the degassing of sulfurous compounds (H_2S, organic sulphides, organosulphur based compounds etc.) and ammonia. **Long term (1 year and above)** Capping of various open-air treatment systems (collection tanks, equalization tanks) and venting with appropriate VOC traps/media based scrubbers.	1.Yes 2.Yes 3.Work in progress. 4.Yes 5.Not any use of ammonia process. 6.Yes 7.Yes 8. Yes 9.Yes 10. Yes Work in progress
18	M/s. RPG Life Science Limited, 25, MIDC Land, Thane Belapur Road, Navi Mumbai.	1. Ammonia leakage from process. 2. Traces of organic chemicals in effluent vaporises during aeration.	29.12.2023	**Short Term (Less than 1 year)** 1. Process vents to be connected through double condenser. 2. Process vents of condenser should be of adequate height. 3. Process vents of condenser should pass through absorption media like activated carbon. 4. Pumps shall be provided with mechanical seals to prevent leakages. 5. Implementation of LDAR to control NH3 emissions. 6. Removal of VOCs by air stripping before equalization tank. 7. Odours wastewater stream shall be handled in closed system from the source to primary treatment stages 8. Removal of VOCs by competing mechanisms of air stripping and adsorption on solids in aeration tank. 9. Aqueous activated sludge diffusion, by sparging the collected odor emissions into aeration tanks of CETP, a typical liquid-based odor control system. 10. Regular O&M of sludge thickeners i.e. treating the sludge with lime or iron salts to encourage thickening and reduce the degassing of sulfurous compounds (H_2S, organic sulphides, organosulphur based compounds etc.) and ammonia. **Long term (1 year and above)** Capping of various open-air treatment systems (collection tanks, equalization tanks) and venting with appropriate VOC traps/media based scrubbers.	1.Yes 2.Yes 3.Yes 4.Yes 5.NA 6.Yes 7.Yes 8.Yes 9.Yes 10. Yes In process

19	M/s. Shridi Chemicals Pvt Ltd, Plot No. C-118, MIDC Pawne, Navi Mumbai	1. Ammonia leakage from process. 2. Traces of organic chemicals in effluent vaporises during aeration.	01.02.2024	**Short Term (Less than 1 year)** 1. Process vents to be connected through double condenser. 2. Process vents of condenser should be of adequate height. 3. Process vents of condenser should pass through absorption media like activated carbon. 4. Pumps shall be provided with mechanical seals to prevent leakages. 5. Implementation of LDAR to control NH3 emissions. 6. Removal of VOCs by air stripping before equalization tank. 7. Odours wastewater stream shall be handled in closed system from the source to primary treatment stages 8. Removal of VOCs by competing mechanisms of air stripping and adsorption on solids in aeration tank. 9. Aqueous activated sludge diffusion, by sparging the collected odor emissions into aeration tanks of CETP, a typical liquid-based odor control system. 10. Regular O&M of sludge thickeners i.e. treating the sludge with lime or iron salts to encourage thickening and reduce the degassing of sulfurous compounds (H_2S, organic sulphides, organosulphur based compounds etc.) and ammonia. **Long term (1 year and above)** Capping of various open-air treatment systems (collection tanks, equalization tanks) and venting with appropriate VOC traps/media based scrubbers.	1.Yes 2.Yes 3.Yes 4.Yes 5.NA 6.Yes 7.Yes 8.Yes 9.Yes 10.NA In process
20	M/s. Zydus Takeda Healthcare Pvt Ltd, Plot No. C-4, MIDC Pawne, Navi Mumbai	1. Ammonia leakage from process. 2. Traces of organic chemicals in effluent vaporises during aeration.	29.12.2023	**Short Term (Less than 1 year)** 1. Process vents to be connected through double condenser. 2. Process vents of condenser should be of adequate height. 3. Process vents of condenser should pass through absorption media like activated carbon. 4. Pumps shall be provided with mechanical seals to prevent leakages. 5. Implementation of LDAR to control NH3 emissions. 6. Removal of VOCs by air stripping before equalization tank. 7. Odours wastewater stream shall be handled in closed system from the source to primary treatment stages 8. Removal of VOCs by competing mechanisms of air stripping and adsorption on solids in aeration tank. 9. Aqueous activated sludge diffusion, by sparging the collected odor emissions into aeration tanks of CETP, a typical liquid-based odor control system. 10. Regular O&M of sludge thickeners i.e. treating the sludge with lime or iron salts to encourage thickening and reduce the degassing of sulfurous compounds (H_2S, organic sulphides, organosulphur based compounds etc.) and ammonia. **Long term (1 year and above)** Capping of various open-air treatment systems (collection tanks, equalization tanks) and venting with appropriate VOC traps/media based scrubbers.	1.Yes 2.Yes 3.Yes 4.Yes 5.Yes 6.MEE and ATFD provided 7.Yes 8.MEE and ATFD provided 9.NA 10.Yes In process

Annexure-XI

List of Industres which are provided SCADA

Sr. No.	Name of Industry	Address	Scale
1	Lubrizol India Pvt. Ltd.	Plot No. 9/3	LSI
2	Mazda Colours Ltd.	D - 51	MSI
3	Sitec Labs Ltd.	G - 40	MSI
4	SI-Group India Ltd.	D-2/1	LSI
5	Arkema Chemicals India P. Ltd.	D-43/1	LSI
6	RPG Life Science Ltd.	P-25	MSI
7	MODICON Pvt. Ltd.	D-40/2	MSI
8	Allana Cold Storage P. Ltd.	D-38	MSI
9	Sky Industries Pvt. Ltd.	C-58	MSI
10	Croda India Company Pvt. Ltd.	Plot NO. 1/1	MSI
11	NOCIL LTD.	C-37	LSI
12	Henkel Adhesive Technologies India Pvt. Ltd.	P-1/1 Pt-II	MSI
13	Indoco Remedies Pvt. Ltd.	R-104	MSI
14	Hemmo pharmaceuticals Pvt. Ltd.	C-43	LSI
15	NGL Fine Chem Ltd.	W-142	SSI
16	Sujan Chemo Plast Pvt. Ltd.	A-697	SSI
17	Darshan Chemical	D-29/3	SSI
18	Darshan Chemical	A-38/39	SSI
19	L. N. Chemical Industries	D-14/9-10	SSI
20	Modhera Chemicals Pvt. Ltd.	D-8/2	SSI
21	Sonak Surface Technologies Pvt. Ltd.	C-450/2	SSI
22	Seasaga Enterprises Pvt. Ltd.	R-25&26	MSI
23	Priya Chemical	W-94	SSI
24	JHS Chemi Pharma Pvt. Ltd.	R-69	SSI
25	Anthea Aromatics Pvt. Ltd.	R-81/82	MSI
26	Godfrey Phillips India Ltd.	Plot nO.19	MSI
27	Beekalene Fabrics Pvt. Ltd.	C-1/1	MSI
28	Amines & Plasticizers Ltd.	D-21/21A	LSI
29	Hindustan Platinum Pvt. Ltd.	C-122	LSI
30	Hyva (India) Pvt. Ltd.	EL-215	MSI
31	Praktan Industries	W-298	SSI
32	Swastik Chemicals	W-155	SSI
33	Vaishnavi Esters Pvt. Ltd.	A-689	SSI
34	Mayur Chemicals	A-724	SSI
35	Expanded Polymer Systems Pvt. Ltd.	C-44/1&2	MSI
36	Akzonobel India Limited	P-1/1	MSI
37	Bennett & Coleman & Co. Ltd. (Times of India)	Plot-4	MSI
38	Fazlani Export Pvt. Ltd.	Gen. - 56	MSI
39	Kansai Nerolac Paints LTD.	W-188/189	LSI
40	Akash Fabrics Pvt. Ltd	P-63	MSI
41	BASF India Ltd.	D-12	LSI
42	Savita Oil Technologies Ltd.	Plot-17	LSI
43	Balmar Lawrie - Van Lee Ltd.	D - 195/2	LSI
44	USV Pvt. Ltd.	D - 115	LSI
45	AVM Appliances Pvt. Ltd.	w-328/329/330	SSI

46	Amruta Industries	A - 824/5	SSI
47	Beetachem Industries	W - 177	SSI
48	Raigad Chemicals Pvt. Ltd.	W - 181	SSI
49	Vintex Fire Protection Pvt. Ltd.	R - 363	SSI
50	Sunfresh Agro Inds. Pvt. Ltd.	D-37/4	MSI
51	Aarti Industries Limited	A-94/1	MSI
52	Zydus Takeda Healthcare Pvt. Ltd	C-4	LSI
53	Total Oil India Pvt. Ltd	P-26	MSI
54	Bhayani Auxi Chem Pvt. Ltd	A-703	SSI
55	Vijay Chemical Industries	R-422	SSI
56	Gargi Huttenes Albertus Pvt. Ltd	D-360	SSI
57	P P G Asian Paints	C-52	MSI
58	Padarsh Pharmaceuticals Pvt. Ltd.	C-45/1	SSI
59	Supra Chemicals	W-58	SSI
60	Soujanya Colour Pvt. Ltd	C-35/36	MSI
61	Malade Chemicals Pvt. Ltd	C-405	SSI
62	Zoetis Pharmaceutical Research Pvt. Ltd.	P-16	MSI
63	Yashraj Biotechnology Ltd	C-232/2	MSI
64	Vipul Chemicals India Pvt. Ltd.	C-53, C-53/1	SSI
65	Lapex	D-336	SSI
66	Master Builder Solutions	C-68	SSI
67	Aarav Fragrances & Flavours Pvt Ltd	C-61	MSI
68	Garden Flavours Co. Pvt. Ltd.	R-951	SSI
69	Saraf Organics Pvt Ltd	C-334	SSI
70	Suditi Industries	C-253	MSI
71	Sandoz Private Limited	D-31/32	MSI
72	Kamsons Chemicals Pvt Ltd	A-726	SSI
73	M. AMIN & Co	R-589	SSI
74	Shirdi Chemicals Pvt Ltd	C-118	SSI
75	V M Containers Pvt. Ltd.	A-418	SSI
76	Paras Organics	D-119	LSI
77	Lotus Enterprises	C-21/7	SSI
78	Asian Paints Ltd	C-3 B/1	LSI
79	Sandoz Private Limited	P-8A/2 & 8B	LSI
80	Fineotex Chemical Limited	A-699	SSI

Annexure-XII

Navi Mumbai Municipal Corporation MSW Dumping Ground, Turbhe Navi Mumbai

			Borewell	Borewell	Borewell	Borewell	Borewell	Borewell	Borewell	Borewell	Borewell	Borewell	Borewell	Borewell	Borewell
SR. NO.	**PARAMETERS**	**UNIT**	**10.10.2022**	**20.04.2023**	**22.09.2023**	**06.10.2023**	**28.12.2023**	**09.01.2024**	**15.02.2024**	**26.03.2024**	**10.04.2024**	**25.06.2024**	**10.07.2024**	**29.08.2024**	**13.09.2024**
1	pH		7.3	7.1	6.8	7.9	6.9	7	6.9	7.2	7	6.9	7.6	7.7	8
2	Total Dissolved Solids(TDS)	mg/l	984	1516	988	1164	867	1181	921	900	1251	1250	1040	990	1046
3	Suspended Solids (SS)	mg/l	32	16	3	8	11	9	8	10	8	10	14	14	6
4	Biochemical Oxygen Demand (BOD)	mg/l	20	6	4	4	8	7	6	5	4	7	8	17	12
5	chloride	mg/l	-	-	223.93	180.94	271.92	349.89	223.33	279.91	289.91	312.4	279.91	315.9	303.91
6	Chlorine Residual	mg/l	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
7	Chemical Oxygen Demand (COD)	mg/l	48	36	12	16	56	40	25.9	31.2	43.1	40.8	72	64	44
8	cynide	mg/l	BDL	BDL	BDL	BDL	BDL	0.02	BDL	BDL	BDL	BDL	BDL	BDL	BDL
9	Hardness (total)	mg/l	488	326	166	354	362	408	484	596	495	766	525	475	572
10	Nitrate nitrogen	mg/l	2.27	2	0.98	0.88	0.78	1.5	2.25	0.38	0.62	13.22	0.48	0.8	0.21
11	Sulphate	mg/l	-	-	68.12	37.49	22.97	34.04	48.54	59.9	40.84	85.24	51.94	57.62	75.82
12	Chromium total	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
13	Copper	mg/l	BDL	0.53	BDL	BDL	BDL	0.03	0.02	BDL	BDL	0.01	BDL	BDL	0.01
14	Iorn	mg/l	0.62	0.29	0.35	BDL	0.18	0.25	0.2	0.39	0.3	0.05	0.41	0.01	0.2
15	Lead	mg/l	0.35	0.3	0.03	0.4	0.38	BDL	BDL	0.5	BDL	BDL	BDL	BDL	BDL
16	Mercury (Processing & analysis)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
17	Nickel	mg/l	BDL	0.04	BDL	0.05	BDL	0.1	0.5	BDL	0.28	BDL	BDL	BDL	0.01
18	zinc	mg/l	BDL	0.11	0.02	0.04	0.08	0.06	0.02	0.08	0.14	0.04	BDL	0.01	0.02
19	Phenol	mg/l	BDL	0.29	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.03	BDL	

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Navi Mumbai Municipal Corporation MSW Dumping Ground, Turbhe Navi Mumbai

			Leachate ETP Outlet	Leachate others	Leachate ETP Outlet	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate
SR. NO.	**PARAMETERS**	**UNIT**	**22.03.2022**	**12.07.2022**	**10.10.2022**	**20.04.2023**	**24.08.2023**	**22.09.2023**	**06.10.2023**	**28.12.2023**	**09.01.2024**	**15.02.2024**	**26.03.2024**	**10.04.2024**	**25.06.2024**	**10.07.2024**	**29.08.2024**	**13.09.2024**
1	pH		7.7	7.3	8	8.5	8.4	8.7	7.5	8.1	8	8.3	8.3	8.2	8.1	7.8	7.8	8.3
2	Total Dissolved Solids(TDS)	mg/l	-	1548	467	13454	789	249	573	3414	691	2450	5460	3858	5880	4220	1967	1480
3	Suspended Solids (SS)	mg/l	-	80	28	320	39	22	154	138	32	24	78	106	60	48	14	20
4	Amonical Notrogen	mg/l	-	-	6.83	655	0.07	0.02	0.47	198	0.68	81.8	120.5	116	74	10.46	0.89	0.05
5	Biochemical Oxygen Demand (BOD)	mg/l	-	420	16	725	18	26	24	55	32	44	90	54	160	180	30	30
6	Chlorine Residual	mg/l	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
7	Chemical Oxygen Demand (COD)	mg/l	-	920	44	2096	68	84	108	344	120	199.6	432.7	286.7	509.6	604	124	116
8	cynide	mg/l	BDL	-	BDL	0.03	BDL	BDL	BDL	BDL	0.02	BDL	0.07	BDL	BDL	BDL	BDL	BDL
9	Fluoride	mg/l	-	-	-	-	2.06	BDL	0.54	5.8	1.18	0.2	0.11	0.11	0.59	0.08	0.11	0.04
10	Sulphide	mg/l	NA	NA	NA	NA	NA	NA	NA	NA	NA	BDL	BDL	BDL	NA	NA	NA	NA
11	Total Kjeldahl Nitrogen (TKN)	mg/l	-	-	-	-	0.56	0.56	1.12	386.4	2.24	232.4	313.6	302.4	196	25.2	1.62	0.11
12	Arsenic	mg/l	BDL	-	BDL	BDL	BDL	BDL	BDL	0.01	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
13	Cadmium	mg/l	BDL	-	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
14	Chromium total	mg/l	0.06	-	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.1	BDL	BDL	BDL	BDL	BDL
15	Copper	mg/l	0.01	-	-	3.23	BDL	BDL	BDL	BDL	0.03	0.02	BDL	0.07	BDL	BDL	0.05	0.01
16	Lead	mg/l	BDL	-	0.31	0.59	BDL	BDL	0.31	0.52	BDL	BDL	0.78	BDL	BDL	BDL	BDL	BDL
17	Mercury (Processing & analysis)	mg/l	BDL	-	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
18	Nickel	mg/l	0.07	-	BDL	1.06	-	BDL	BDL	0.22	BDL	0.57	0.14	0.13	0.17	0.05	BDL	0.02
19	zinc	mg/l	0.04	-	BDL	0.82	0.04	0..10	0.06	0.28	0.12	0.07	0.26	0.24	0.06	0.05	BDL	0.01
20	Oil & Grease	mg/l						BDL	BDL	BDL	BDL	BDL	1.2	BDL	BDL	BDL	BDL	BDL
21	Phenol	mg/l	2.96	-	0.01	0.29	BDL	0.05	0.02	BDL	BDL	0.02	0.04	BDL	BDL	0.03	BDL	BDL

Annexure-XIII

List of Spent Solvent Distilation Industries	
Sr. No.	**Name of the industries**
1	M/s. Darshan Chemicals Plot No. A-38/39, MIDC Pawane, Thane Belapur Road, Navi Mumbai 400705
2	M/s. Beetachem Industries, W-177, TTC MIDC, Pawane, Thane Belapur Road, Navi Mumbai 400710
3	M/s. Darshan Chemicals Plot No. D-29/3, MIDC Turbhe, Navi Mumbai 400705
4	M/s. Jyoti Dye Chem Pvt. Ltd. Plot No. D-76/1, TTC MIDC, Turbhe, Navi Mumbai
5	Rajput Organics Pvt. Ltd.,D-206, TTC, MIDC Turbhe, Navi Mumbai
6	M/s. Shri Gajanan Industries, Plot No. W-299, TTC Industrial Area, MIDC, Rabale, Navi Mumbai.
7	M/s. Praktan Industries Plot No. W 298 T T C Industrial Area Rabale MIDC Navi Mumbai
8	M/s. ROMEL HOLDINGS PVT. LTD., Plot No. W-292, TTC Indl. Area, M.I.D.C., Rabale, Navi Mumbai
9	M/s.Sujan Chemoplast Pvt Ltd, Plot No.A -697,TTC Industrial Area,MIDC Mahape,Navi Mumbai
10	M/s. Mayur Chemicals, Plot No. A-724, TTC MIDC Area, MIDC Mahape, Navi Mumbai
11	M/s. JHS chemipharma Pvt. Ltd. Plot No. R-69, MIDC Rabale, TTC Industrial area, Navi Mumbai.