

**ACTION PLAN FOR CONTROL OF AIR POLLUTION WITH
RESPECT TO PM₁₀ IN NON-ATTAINMENT CITY / MILLION
PLUS CITY – MADURAI U. A. IN TAMIL NADU (REVISED)**



By

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1. Introduction

Ambient air pollution became one of the major health threats for the Indian population during recent decades. An effective clean air action plan is a powerful tool for achieving clean air for cities, comprising a list of mitigation measures for every air pollution source. Clean air plan is a collection of regulations, policies, and programs, which aims to improve air quality and public health by identifying cost-effective measures to reduce emissions from all the known sources. Government of India launched National Clean Air Programme (NCAP), in 2019, India's flagship program for better air quality in 124 cities to tackle air pollution problems of cities and states with a long-term, time-bound strategy to achieve a 20-30% reduction in the Particulate Matter (PM₁₀) ambient concentrations by 2024 considering the base year 2017.

Central Pollution Control Board (CPCB) has identified 122 non-attainment cities based on air pollution levels exceeding 60 µg/m³ limits for PM₁₀ as prescribed under National Ambient Air Quality Standards (NAAQS). In 2018, the National Green Tribunal (NGT) directed a state-level six-member committee called the Air Quality Monitoring Committee, comprising of Directors of Environment, Transport, Industries, Urban Development, Agriculture and the Member Secretary of Pollution Control Boards, for the purpose of preparing the city clean air action plans. The non-attainment cities were further advised to prepare action plans detailing how to build internal capacity and achieve clean air.

2. Profile of the City Madurai City

Madurai City, located in South Central Tamil Nadu, is the second largest corporation city after Chennai and third largest third largest city by population in Tamil Nadu. Madurai city is the headquarters of Madurai District and located at coordinates of 9° 56' 20.7348" N and 78° 7' 18.1884"E at an altitude of 101 meters (330 feet above mean sea –level(MSL)). The city of Madurai is situated on the banks of the river Vaigai. The Madurai Municipal Corporation (MCC) administers the city with the administrative jurisdiction extending over an area of 147.99 sq. km. (Source:<http://www.maduraicorporation.co.in/>). It is a pilgrimage centre and the gateway to South Tamil Nadu having the famous Meenakshi Temple at its core. It is also a trading centre famous for its handloom industry. Madurai is well connected with important cities of state and the country through National Highways NH-7, NH-45B and NH-49 and the Domestic Airport connects the city with other major cities of India and also Colombo, Sri Lanka. Besides, it is well connected with its hinterlands and surrounding towns by regional and local road and railway network. Madurai is a major junction on the Chennai-Kanyakumari railway line.5.

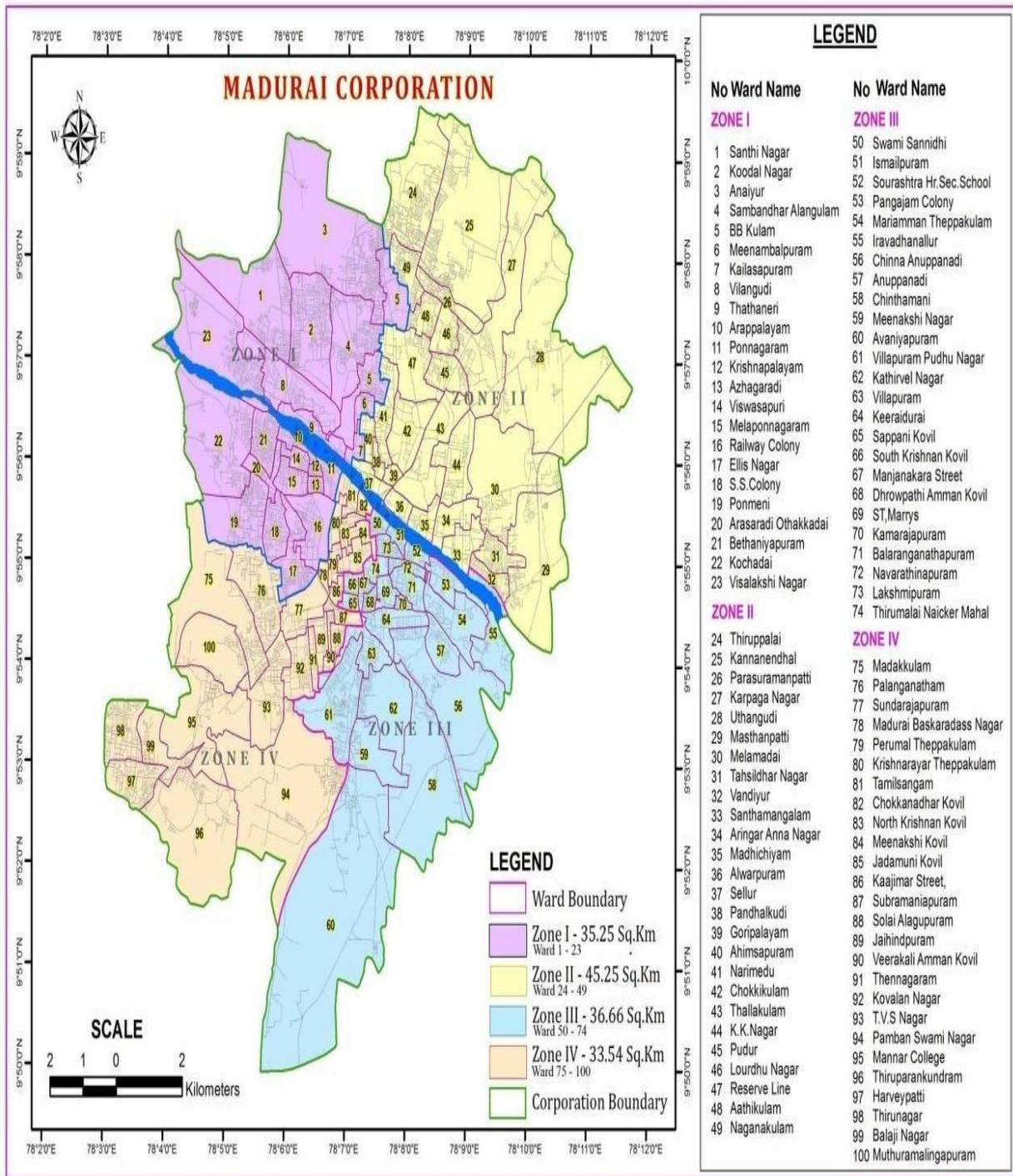


Figure 1: Madurai Urban Agglomeration- 2011

2.1 Demography

The Madurai Municipal Corporation has a population of 1,470,755 people, as per Census 2011. The average literacy of the city was 81.95%, compared to the national average of 72.99%. Tertiary Sector, mainly being Tourism Industry and related ancillary activities, provides major employment in the city. Approximately 92 percent of the workforce is employed in Tertiary Sector. A vast majority of the middle-class population in the city are government employees, teachers, professors or others working in educational institutions.

2.2 Climate

Madurai is hot and dry for eight months of the year. Cold winds are experienced during December to March as in the neighboring Dindigul. The hottest months are from March to July. The city experiences a moderate climate from August to October, tempered by heavy rain and thundershowers, and cool and climate from November to February. Fog and dew are rare and occur only during the winter season. Being equidistant from mountain and sea, it experiences similar monsoon pattern with Northeast monsoon and Southwest monsoon, with the former providing more rain during October to December. The average annual rainfall for the Madurai district at large is about 86cm. Temperatures during summer reach a maximum of 40 °C and a minimum of 26.3 °C, though temperature over 42 °C is not uncommon. Winter temperatures range between

29.6 °C and 18 °C. The relative humidity for Madurai District is on an average between 50 and 93%.

(Source: http://mohua.gov.in/upload/uploadfiles/files/42Mdr_TN_sfc-min.pdf).

2.3 Major Economic activities in the city

Madurai is an important industrial and educational hub in South Tamil Nadu. Major economic activities are trade & commerce, tourism related activities and to some extent industrial activities. The city houses various health care facilities, automobile, rubber, chemical, and textile manufacturing industries and has also developed as a second tier city for information technology as well. Small scale house hold Handloom industries also is contributing some extent of economy.

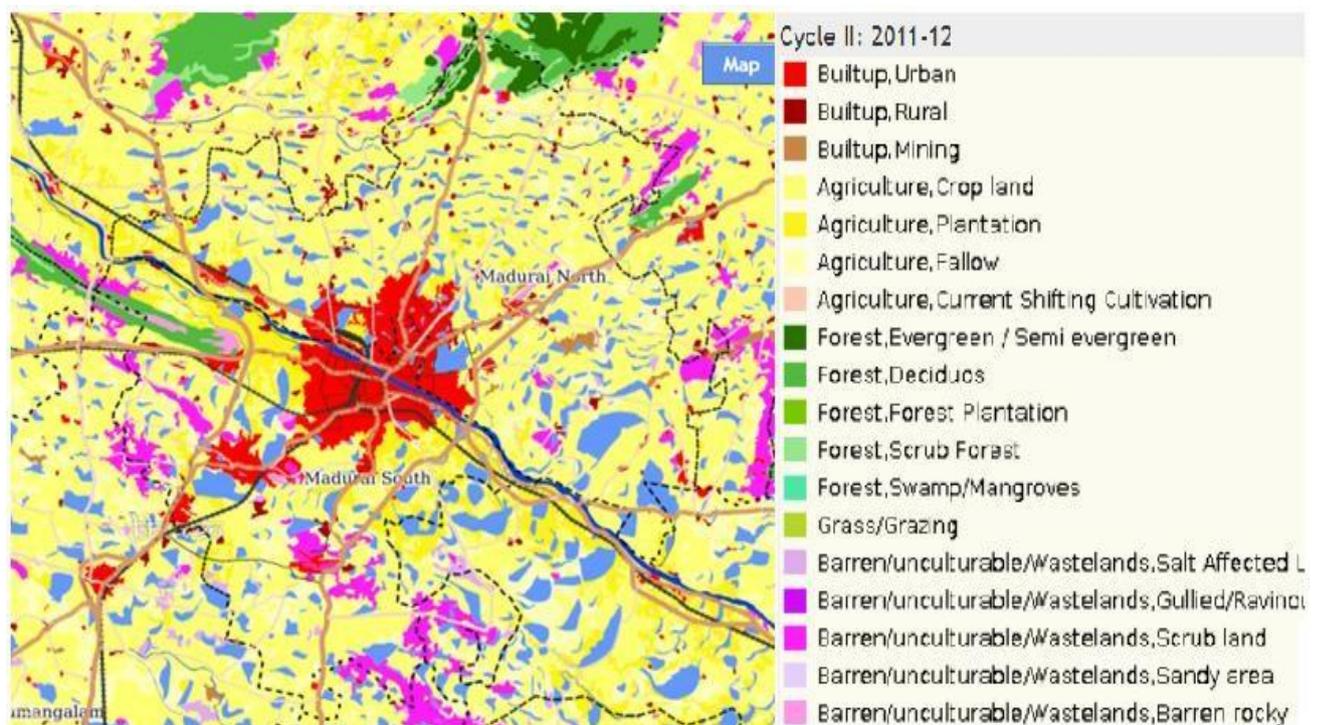


Figure 2: Land use and Land cover pattern of Madurai City

(Source: <https://bhuvan-app1.nrsc.gov.in/state/TN#>)

3. Back ground

3.1 Orders of the Hon'ble National Green Tribunal (PB) vide O.A. No 681 of 2018.

The Hon'ble National Green Tribunal (NGT), Principal Bench, New Delhi, in the matter of original application no.681/2018 (News Item Published in the "Times of India" authored by Shri Vishwamohan Titled August – 15" passed an order on 08.10.2018 that in paragraph 08 of the above order, it is mentioned that CPCB gave presentation before Hon'ble Green Tribunal on 08.10.2018 and the data of air quality from 2011-2015 were considered in the above presentation and thus on the basis of air quality data of CPCB.

In paragraph 15 (i, ii, iii, iv &v) Hon'ble National Green Tribunal has issued following directions: -

- i. All the States and Union Territories with non-attainment cities must prepare appropriate action plans within two months aimed at bringing the standards of air quality within the prescribed norms within six months from date of finalization of the action plans.*
- ii. The Action Plans may be prepared by six-member committee comprising of Directors of Environment, Transport, Industries, Urban Development, Agriculture and Member Secretary, State Pollution Control Board or Committee of the concerned State.*

The Committee may be called Air Quality Monitoring Committee (AQMC). The AQMC will function under the overall supervision and coordination of Principal Secretary, Environment of the concerned State/Union Territory. This may be further supervised by the Chief Secretaries concerned or their counterparts in Union Territories by ensuring intra-sectoral coordination.

- iii. The Action Plans may take into account the GRAP, the CAP and the action plan prepared by CPCB as well as all other relevant factors. The Action Plans may be forwarded to the CPCB by 31.12.2018. The same may be placed before the Committee as directed in direction no.vi. The Action Plan will include components like identification of source and its apportionment considering sectors like vehicular pollution, industrial pollution, dust pollution, construction activities, garbage burning, agricultural pollution including pollution caused by burning of crop residue, residential and indoor pollution etc. The action plan shall also consider measures for strengthening of Ambient Air Quality (AAQ) monitoring and steps for public awareness including issuing of advisory to public for prevention and control of air pollution and involvement of schools, colleges and other academic institutions and awareness programmes.*
- iv. The Action Plan will indicate steps to be taken to check different sources of pollution having speedy, definite and specific timelines for execution.*

- v. *The action Plan should be consistent with the carrying capacity assessment of the non-attainment cities in terms of vehicular pollution, industrial emissions and population density, extent of construction and construction activities etc. The carrying capacity assessment shall also lay emphasis on agricultural and indoor pollution in rural areas. Depending upon assessed carrying capacity and source apportionment, the authorities may consider the need for regulating number of vehicles and their parking and plying, population density, extent of construction and construction activities etc. Guidelines may accordingly be framed to regulate vehicles and industries in non-attainment cities in terms of carrying capacity assessment and source apportionment.*

Accordingly TNPCB has submitted the action plan of the Thoothukudi city for air quality improvement and the same was approved by CPCB during May 2019 and is under implementation.

The Hon'ble National Green Tribunal (NGT), Principal Bench, New Delhi, in the matter of original of application no.681/2018 (News Item Published in the "Times India" authored by Shri Vishwamohan Titled August – 15" passed an order on 06.08.2019 and in its directions for Additional NACs (Non-Attainment Cities) in the paragraph 14 that CPCB has identified Trichy city as non-attainment city for pollutant PM₁₀ parameter exceeding the prescribed

annual norms. Further in 2020, CPCB has identified Madurai as Non-Attainment City.

The Union government has disbursed Rs 4,400 crore as grant in aid for million-plus cities/agglomerations in its Union Budget for 2020-21 for formulating and implementing plans for ensuring cleaner air including capacity-building of the local bodies. The Union Ministry of Finance has released Rs 31 Cr to Madurai U A for clean air action in million-plus cities on the basis of recommendations of the 15th Finance Commission for the improvement of air quality for 2020-2025, based on the annual average concentration of PM₁₀ and PM_{2.5}.

4. Government past efforts to take control of air pollution in the city

Table 1: The actions taken by various department to tackle air pollution

S No	Departments/ Agencies	Actions	Status of action
1	Municipal corporation	Corporation has 5 Nos of Mechanical sweepers	Regular and continuous activity is done.
		Corporation has 13 Nos of water sprinklers	Regular and continuous activity is done
		Development of Miyawaki forest	Corporation has developed 25 Nos of Miyawaki forest at 23 locations of total 4 zones of the Madurai U A (Details are enclosed in the annexure 1
2	TNPCB	National Ambient Air quality Monitoring Stations – 3 Nos (functioning since 1996) Continuous Ambient Air quality	TNPCB is regularly monitoring ambient air quality and data are updating in the web portal of TNPCB and CPCB.

S No	Departments/ Agencies	Actions	Status of action
		Monitoring Station – 1	
3	Transport	Regular checking of vehicular emission and issue of Pollution Under Control (PUC)	<p>Directions issued by TNPCB is regular monitoring the Industrial emission and taking actions against the violators.</p> <p>51821 Nos of check report are issued for not carrying PUCC and 48514 Pollution Under Control Certificate (PUCC) are issued by Transport department upto October 2020. Out of 67 emission testing centers, 64 centers are linked with remote server and eliminate manual intervention in PUC (Vahan portal).</p>
		Battery operated vehicles	<p>53 Nos of E –vehicle are registered in Madurai.</p> <p>Madurai Corporation has also procured and operationalised 509 battery operated vehicles for door to door solid waste collection.</p> <p>Madurai Corporation has also procured 5 battery operated vehicles for ferrying tourists around Madurai Meenakshi Temple.</p>

S No	Departments/ Agencies	Actions	Status of action
		Intermediate public transport (IPT) and bus stem	Transport department has issued permit for 30 nos of mini buses and 1377 auto-rickshaws.

5. Air polluting Industries in Madurai

There are only 2 Red Large industries within the city limit and another 2 Red large in 17 category industries located in nearly 17 to 19 km of the city.

Table 2: Industries in Madurai

S No	Industries	Category
1	J K Fenner India Ltd	Red Large (Madurai City)
2	Sundaram Industries Ltd	Red Large (Madurai City)
3	Kothari Phyto Chemicals International,	17 Category-Red (19 Km from the City) Closed
4	M/s. The National Co-op. Sugar Mills Limited	17 Category Red Large 17 Km from the City)

6. Present Status of Ambient Environment

The major sources of air pollution at Madurai city is road dust, vehicular emission, construction activities etc., TNPCB is regularly monitoring the Ambient Air Quality at Madurai through three manual NAMP stations installed in and around the city as well as one Continuous Ambient Air Quality Monitoring Station (CAAQM).

TNPCB is regularly monitoring the air quality of the city through three manually operated Ambient air quality monitoring stations functioning under National Ambient Air Quality Monitoring (NAAQM) Project funded by CPCB under the Ministry of Environment, Forest and Climate Change (MoEF&CC), Govt. of India. The Ambient Air Quality of Madurai city is being monitored at the following 3 stations (Table 3).

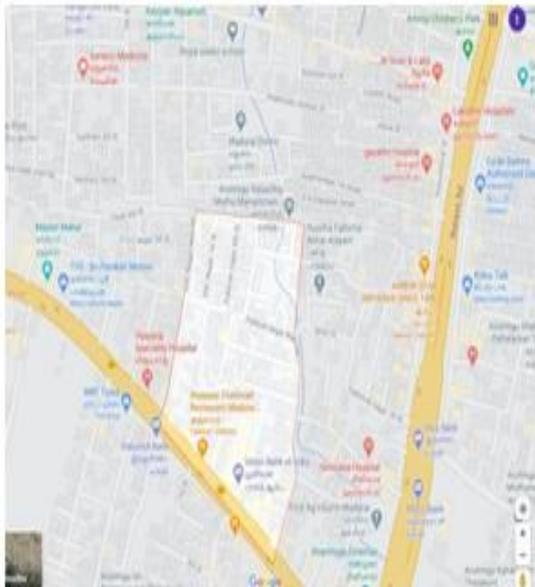
Monthly average of PM₁₀, PM_{2.5}, SO₂ and NO₂ levels are regularly analyzed under the National Ambient Air Quality Monitoring project funded by Central Pollution Control Board. The monitoring locations and its surrounding are shown in Fig.3.

Table 3: National Ambient Air Quality Monitoring Station in the City

S. No.	Station/ location	Land Use / Area
1	PP Chavadi/ Susi cars	Industrial area
2	Birla Vishram/ Madurai Corporation	Commercial
3	Hotel Tamil Nadu/ Highway Project building	Residential



HOTEL TAMILNADU, PUDHUR
LATITUDE: 9 56'27" N
LONGITUDE: 78 82' 2" E



P.P. CHAVADI LATITUDE: 9 55'58" N LONGITUDE: 78 5'33" E



BIRLA VISHRAM
LATITUDE: 9 91'89" N
LONGITUDE: 78 11' 79" E

Figure 3: NAMP Locations in the Madurai City

Categorization of PM₁₀ based on its value is furnished in Table 4.

Table 4: Categorization of air quality based on PM₁₀ Concentration

Category	PM ₁₀ $\mu\text{g}/\text{m}^3$
Severe + or Emergency	Ambient PM ₁₀ concentration values of 500 $\mu\text{g}/\text{m}^3$ persist for 48 hours or more
Severe	Ambient PM ₁₀ concentration value is between 430 $\mu\text{g}/\text{m}^3$
Very Poor	Ambient PM ₁₀ concentration value is between 351- 430 $\mu\text{g}/\text{m}^3$
Poor	Ambient PM ₁₀ concentration value is between 251- 350 $\mu\text{g}/\text{m}^3$
Moderate to Poor	Ambient PM ₁₀ concentration value is between 101- 250 $\mu\text{g}/\text{m}^3$
Satisfactory	Ambient PM ₁₀ concentration value is between 51- 100 $\mu\text{g}/\text{m}^3$
Good	Ambient PM ₁₀ concentration value is between 0- 50 $\mu\text{g}/\text{m}^3$

Based on the observed PM₁₀ concentration (Fig 4 & 5), the concentration of the PM₁₀ pertains to yearly and monthly average for the period April-15 to March21 at Pichai pillaichavadi, Birla Guest House, Hotel Tamil Nadu are varied from 63- 89, 70-92, 53- 74 $\mu\text{g}/\text{m}^3$ respectively. The Madurai city falls under Satisfactory (all three stations).

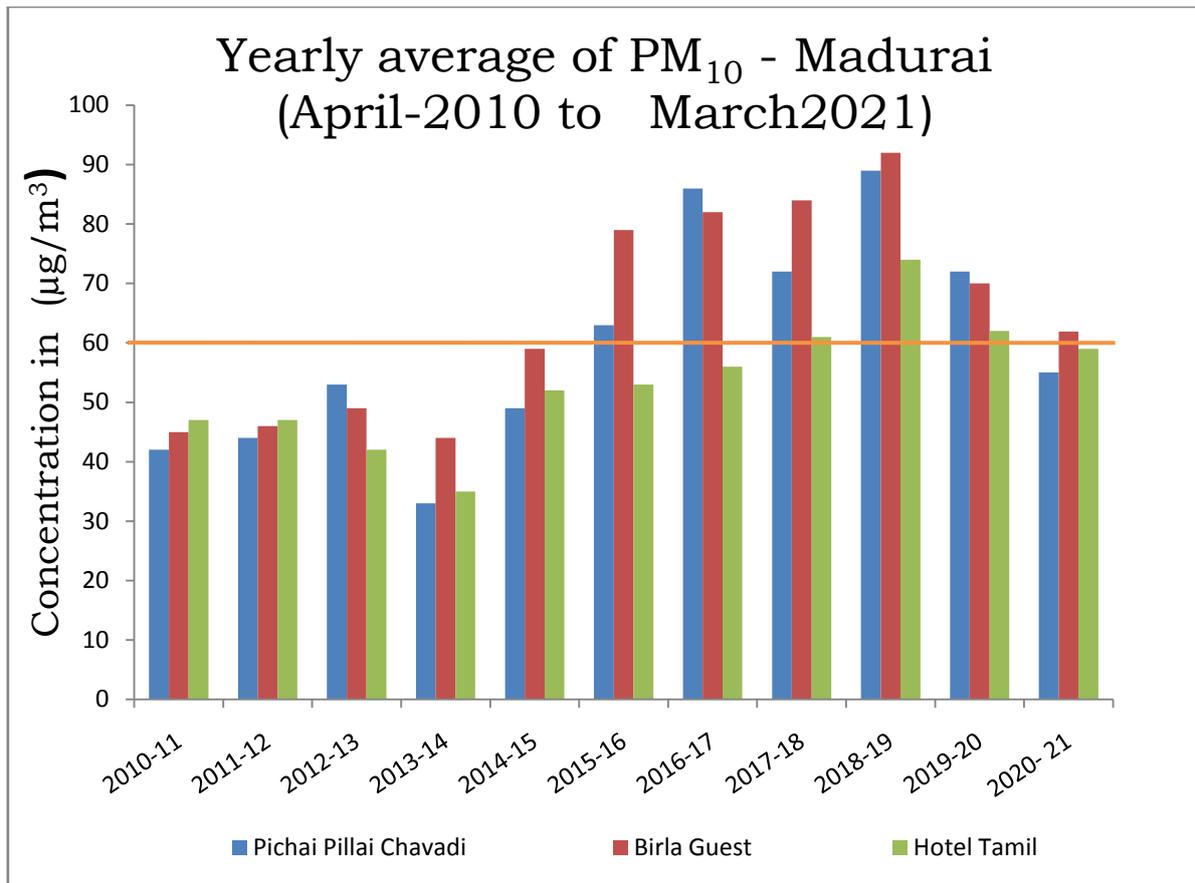


Figure 4: Yearly average of PM₁₀ at Madurai City

Table 5: Annual Average of PM₁₀ values (µg/m³) in Madurai city

Year	Pichai Pillai Chavadi/ Susi cars	Birla Guest House/ Madurai Corporation	Hotel Tamil Nadu/ Highway Project building
2010-11	42	45	47
2011-12	44	46	47
2012-13	53	49	42
2013-14	33	44	35
2014-15	49	59	52
2015-16	63	79	53
2016-17	86	82	56
2017-18	72	84	61
2018-19	89	92	74
2019-20	72	70	62
2020-21	61	58	54

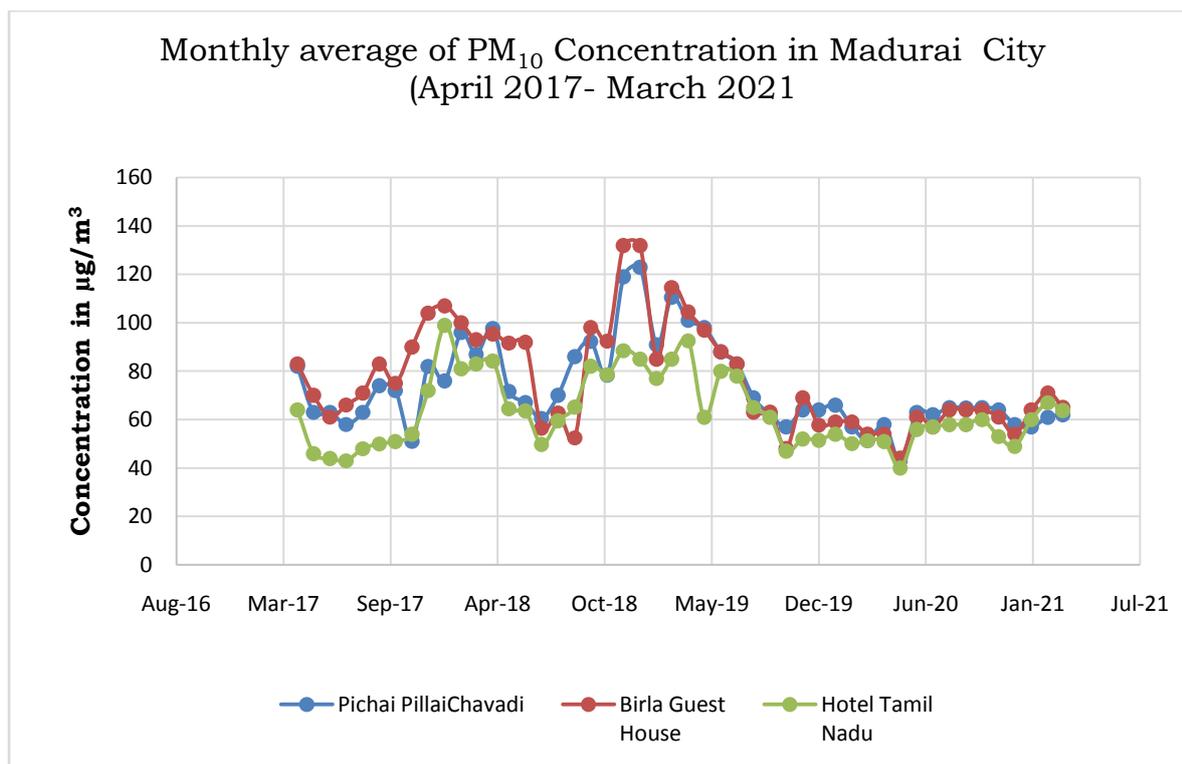


Figure 5: Monthly Average (April 2017 - March 2021) of PM₁₀ values in Madurai city

Table 6: Monthly Average (April 2017 - March 2021) of PM₁₀ values (µg/m³) in Madurai city

Year	Pichai PillaiChavadi/ Susi cars			Birla Guest House/ Madurai Corporation			Hotel Tamil Nadu/ Highway Project building		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
Apr-17	115	64	82	98	64	83	78	65	64
May-17	81	52	63	92	53	70	54	37	46
Jun-17	74	54	63	71	52	61	52	32	44
Jul-17	65	55	58	81	58	66	47	37	43
Aug-17	75	48	63	82	65	71	56	42	48
Sep-17	93	58	74	102	46	83	71	36	50
Oct-17	101	57	72	86	61	75	72	43	51
Nov-17	69	35	51	117	50	90	82	34	54
Dec-17	98	59	82	132	56	104	94	51	72
Jan-18	104	51	76	123	78	107	141	72	99

Year	Pichai PillaiChavadi/ Susi cars			Birla Guest House/ Madurai Corporation			Hotel Tamil Nadu/ Highway Project building		
	Max	Min	Avg	Max	Min	Avg	Ma x	Mi n	Avg
Feb-18	130	71	96	134	56	100	108	67	81
Mar-18	119	44	87	109	67	93	106	57	83
Apr-18	129	62	97.7	146	66	95.4	113	61	84.25
May-18	103	48	71.66	135	58	91.62	116	48	64.5
Jun-18	102	36	67.1	190	63	92	99	37	63.6
Jul-18	69	48	60.5	74	43	56.4	92	30	49.8
Aug-18	73	60	70.1	76	49	62.7	78	41	59.5
Sep-18	125	66	86	107	23	52.4	86	42	65.2
Oct-18	126	60	92.3	108	79	98	98	52	82.1
Nov-18	91	60	78.4	149	53	92.4	98	59	78.6
Dec-18	139	101	119	144	113	132	115	60	88.5
Jan-19	139	105	123	144	113	132	99	60	85
Feb-19	98	82	91	89	83	85	93	65	77
Mar-19	118	95	110.5	120	109	114.6	91	76	85
Apr-19	105	98	101	111	100	104.5	95	89	92.6
May-19	101	92	98	100	89	97	72	51	61
Jun-19	91	85	88	98	81	88	87	70	80
Jul-19	90	81	83	91	77	83	83	78	78
Aug-19	74	67	69	87	57	63	94	60	65
Sep-19	69	56	62	68	57	63	67	54	61
Oct-19	72	32	57	59	37	48	67	61	47
Nov-19	69	58	64	65	59	69	59	46	52
Dec-19	72	55	64	65	50	57.7	55	49	51.5
Jan-20	71	59	66	66	51	59	58	48	54
Feb-20	71	62	57	68	57	59	60	54	50.1
Mar-20	57	37	51.3	64	51	54	57	37	51.3
Apr-20	41	36	58	36	29	54	34	29	51

Year	Pichai PillaiChavadi/ Susi cars			Birla Guest House/ Madurai Corporation			Hotel Tamil Nadu/ Highway Project building		
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
May-20	60	29	43	56	31	44	53	29	40
Jun-20	66	59	63	68	57	61	60	52	56
Jul-20	65	57	62	59	57	57	60	54	57
Aug-20	68	57	65	65	63	64	61	57	58
Sep-20	68	62	65	65	61	64	61	55	58
Oct-20	67	64	65	68	62	64	62	54	60
Nov-20	68	61	64	76	50	61	61	47	53
Dec-20	64	52	58	58	50	54	56	43	49
Jan-21	64	49	57	70	56	64	66	56	60
Feb-21	66	57	61	78	69	71	70	64	67
Mar-21	67	58	62	73	59	65	69	59	64

7. Proposed detailed Source Apportionment Study and Emission Inventory and Carrying Capacity

7.1 Approaches to the Source Apportionment Study

A Common methodology for the study has been designed by the CPCB. Accordingly, the study has to focus on air quality monitoring, development of emission inventory, dispersion and receptor modeling, collection of primary data and Secondary data and finally the development of an air quality management plan. A schematic for the overall approach for the source apportionment study is show in the figure.6.

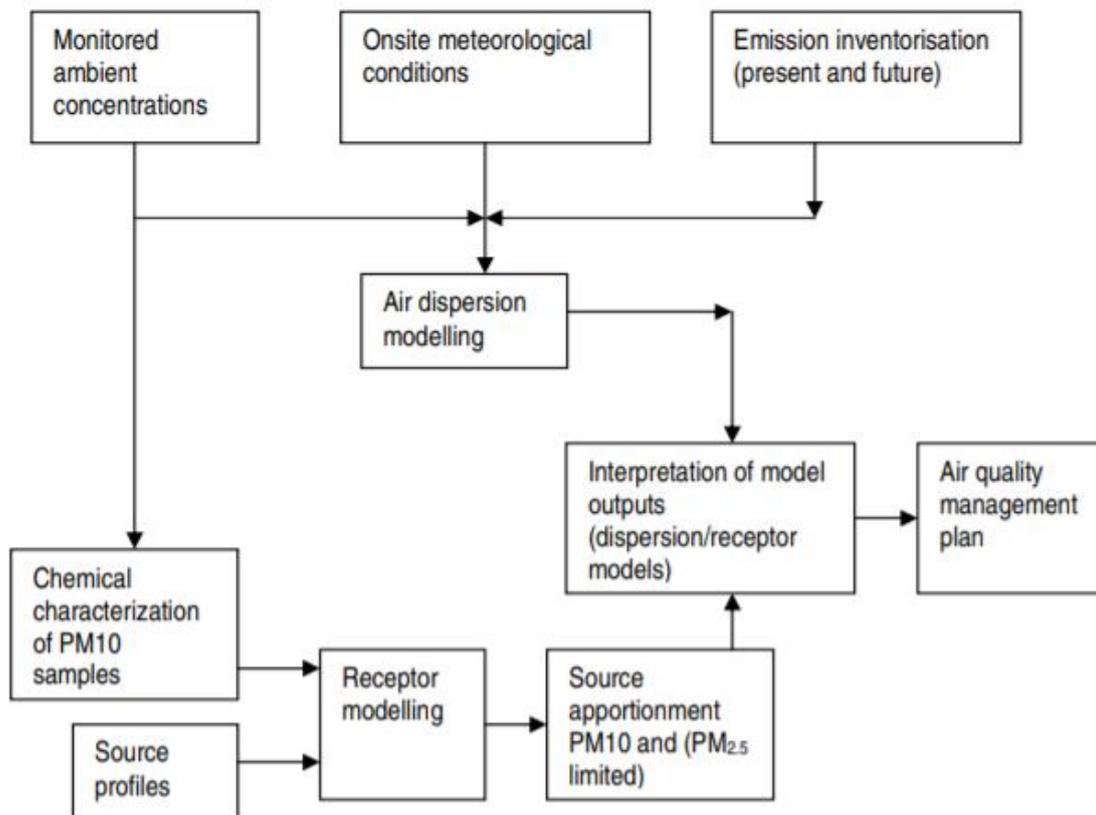


Figure 6: Overall approach for the Source Apportionment

The samples of PM₁₀ will be collected from existing and any new locations. The PM₁₀ and PM_{2.5} sampling will be collected using respirable dust sampler through glass fiber filter and Teflon filter paper, respectively. The 24h sampling of PM₁₀ and PM_{2.5} will be carried out. The concentration of the PM₁₀ and PM_{2.5} will be calculated based on the gravimetric analysis. The chemical analysis will be carried out in the collected samples for Elements through XRF (X-Ray fluorescence), Scanning Electron Microscopy-Energy-Dispersive X-Ray (SEM/EDX), Total Organic Carbon analyzer, Thermal Optical Transmittance, and Ion Chromatography.

The receptor modeling based on the chemical speciation results and major sources of PM₁₀ will be identified by Chemical Mass Balance and

Factor analysis (R Programming) for quality and quantification of major sources respectively. Factor Analysis is a statistical approach, which allows determining the important factors which can explain the variations in the experimental data set. Thus, the variations in a large set of data are explained using a small set of factors. The factors are allowed to qualitatively determine the sources contributing to a particular site. Based on the analysis, a detailed Control Strategy for the reduction of PM₁₀ will be recommended in the Madurai city.

7.2 Emission Inventory

Emission inventory is an important tool for identifying the source of pollutants and quantitative expression of pollution load in a defined area at a particular time. Emissions inventories are an essential input to mathematical models that estimate air quality. The effect on air quality of potential regulatory actions can be predicted by applying estimated emissions reductions to emissions inventory data in air quality models.

Emission trends over time can be established with periodic updates of the emissions inventory. Inventories also can be used to raise public awareness regarding sources of pollution. An emissions inventory includes estimates of the emissions from various pollution sources in a geographical area. It should include all pollutants associated with the air quality problems in the area.

An emissions factor is a representative value that attempts to relate the quantity of a pollutant emitted with an activity level associated with the emission of that pollutant.

These factors are usually expressed as the weight of pollutant divided by a unit weight, volume, distance, or duration of the activity emitting the pollutant (e.g., kilograms of particulate emitted per mega gram of coal burned). Such factors facilitate estimation of emissions from various sources of air pollution. In most cases, these factors are simply averages of all available data of acceptable quality and are generally assumed to be representative of long-term averages for all facilities in the source category (i.e., a population average). Emission factors have long been the fundamental key to developing emissions inventories for air quality NAAQS implementation.

The general equation for emissions estimation is:

$$E = A \times EF \times (1 - ER / 100)$$

where: E = emissions, A = activity total

EF = Emission factor

ER = Overall reduction efficiency

EF = emission factor, and ER = overall emission reduction efficiency percent. The ER term is the combination of the relevant percentages related to emissions controls and rules that reduce emissions, as listed in Section 2.5.18. Emission factors are not limited to factors that are only representing broad national industry averages published by the EPA. Emission factors can also be stack-, process-, unit-, or facility specific, depending on the basis of the source test information. Whether for a single facility or a group

of facilities of the same type, it is still considered an emission factor for the purposes of this guidance.

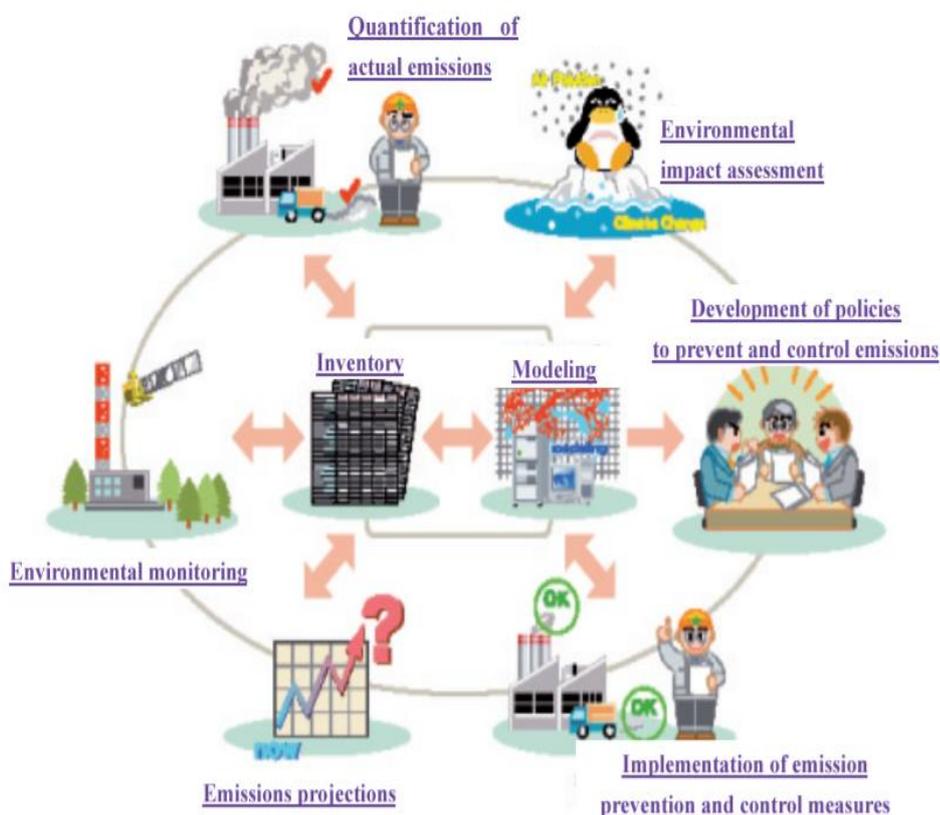


Figure 7: Role of the emission inventory for air quality management

(Source <https://www.acap.asia/wp-content/uploads/emissioneng.pdf>)

The quantitative emissions estimates provided by an inventory promote a better understanding of the actual emissions and help to raise the awareness of both policy makers and the general public. Through this process, the major emission sources can be identified, priorities for emission reduction defined and any data gaps requiring further work are revealed.

Emission inventory will be carried out based on the secondary data collection with the PM₁₀. An emissions inventory is a database that lists, by

source, the amount of air pollutants discharged into the atmosphere from the community for a given time period. For listing the sources of air pollution, sources classified as

- Area Sources: Domestic cooking, Bakeries, Crematoria, Hotels and Restaurants, open eat pouts, Open burning (refuse/biomass/tyre etc. burning, paved and unpaved roads, construction/Demolition/ Alteration activities for building, roads, flyovers, Waste incineration and DG sets.
- Point Source: Large scale Industries and power plants, Medium scale industries and small scale industries.
- Line Sources: 2Wheelers (Scooters, Motor Cycles, Mopeds), 3 wheeler (CNG), 4 wheelers, (Gasoline, Diesel, CNG), LCVs (Light Commercial Vehicle), Trucks (Trucks, mini-trucks, multi-axle trucks) and buses (Diesel, CNG).

The major air pollutant sources identified in the city are road dust, vehicular emission, construction activities and Industrial emission.

The major air pollutant sources identified in the city are road dust, vehicular emission, construction activities and small scale rubber retreading and rubber belt industries.

7.3 Atmospheric Assimilative Capacity of pollutant

Assimilative capacity or carrying capacity is the maximum amount of pollutant load an area can take without exceeding the specified standards

(Goyal et. al.,2003)¹. Assimilative capacity of the atmosphere can be determined using two different approaches (Goyal 2006)².

First approach is based on ventilation coefficient, which is directly proportional to the assimilative capacity of the atmosphere and computed through micro-meteorological parameters Second approach is based on pollution potential, which is inversely proportional to the assimilative capacity of the atmosphere and estimated through dispersion models in terms of concentration of pollutants.

The proposed study on carrying capacity will be using Box model approach concept that assumes air pollutants are uniformly dispersed in the atmosphere by active advection.

Estimation of Annual inflow and out flow of PM₁₀ including the dry deposition and chemical conversion

$$V \frac{dc}{dt} = qC_{in} - qC_{out} + S - K_{dd} \cdot CLW - K_{cr} CV$$

where, q = volumetric flow rate (m³/sec)

C_{in} = influent air concentration of a pollutant (m³/sec)

C_{out} = effluent air concentration of a pollutant (m³/sec)

K_{dd} = dry deposition velocity (g/sec)

K_{cr} = First order chemical reaction constant (1/sec)

qC_{in} = influent mass flow rate of pollutants (g/sec)

qC_{out} = effluent mass flow rate of pollutants (g/sec)

S = source emission rate (g/sec)

$K_{dd}CLW$ = the amount of pollutants removed by dry deposition (g/sec)

$K_{cr}CV$ = the amount of pollutants converted by chemical reaction (g/sec)

W_i = wind speed (m/sec)

In equation, V - equal to volume of city ($L \times W \times H$)

H (m) – mixing height

¹ Goyal, P., T.V.B.P.S.R. Krishna, and S. Anand. 2003. Assimilative capacity and dispersion of pollutants in Delhi. Proc. Indian Natl. Sci. Acad. Part A 69:775–84

² Goyal, P., S. Anand, and B.S. Gera. 2006. Assimilative capacity and pollutant dispersion studies for Gangtok city. Atmos. Environ. 40:1671–82. doi: 10.1016/j.atmosenv.2005.10.057.

The model is further simplified with following assumptions

Assuming steady state ($V \frac{dc}{dt} = 0$),

Pollutant does not undergo any chemical transformation $K_{cr}=0$

Pollutant does not give any deposition in the box $K_{dd}=0$

Carrying capacity can be estimated as follows

$$Q_{cc} = (C - C_0) \times u \times W \times H$$

In this calculation, Area (A) of the system boundary, Width (W) of the system boundary, mixing height (H) (average for winter and summer) within the system boundary, Wind Speed (s) within the system boundary is required. Background concentration C_B into the system boundary is also required.

8. The locations of proposed water fountain at major intersection/circle

The Madurai City Corporation has proposed to construct water fountain areas in the following major junctions in the city.

1. Anaiyur Road junction near BSNL Office
2. Sellur Roundabout
3. East Veli Street – South Marat Street Junction
4. Avaniapuram Bye pass – Airport Road Junction
5. Theppakulam junction
6. Sivagangai Road Junction
7. Lake View Road – Melur Road Junction
8. Kalavasal – Theni Road Junction
9. Arapalayam Bus stand junction
10. Thiruparankundram temple kirivala paathai – Avaniapuram Road Junction

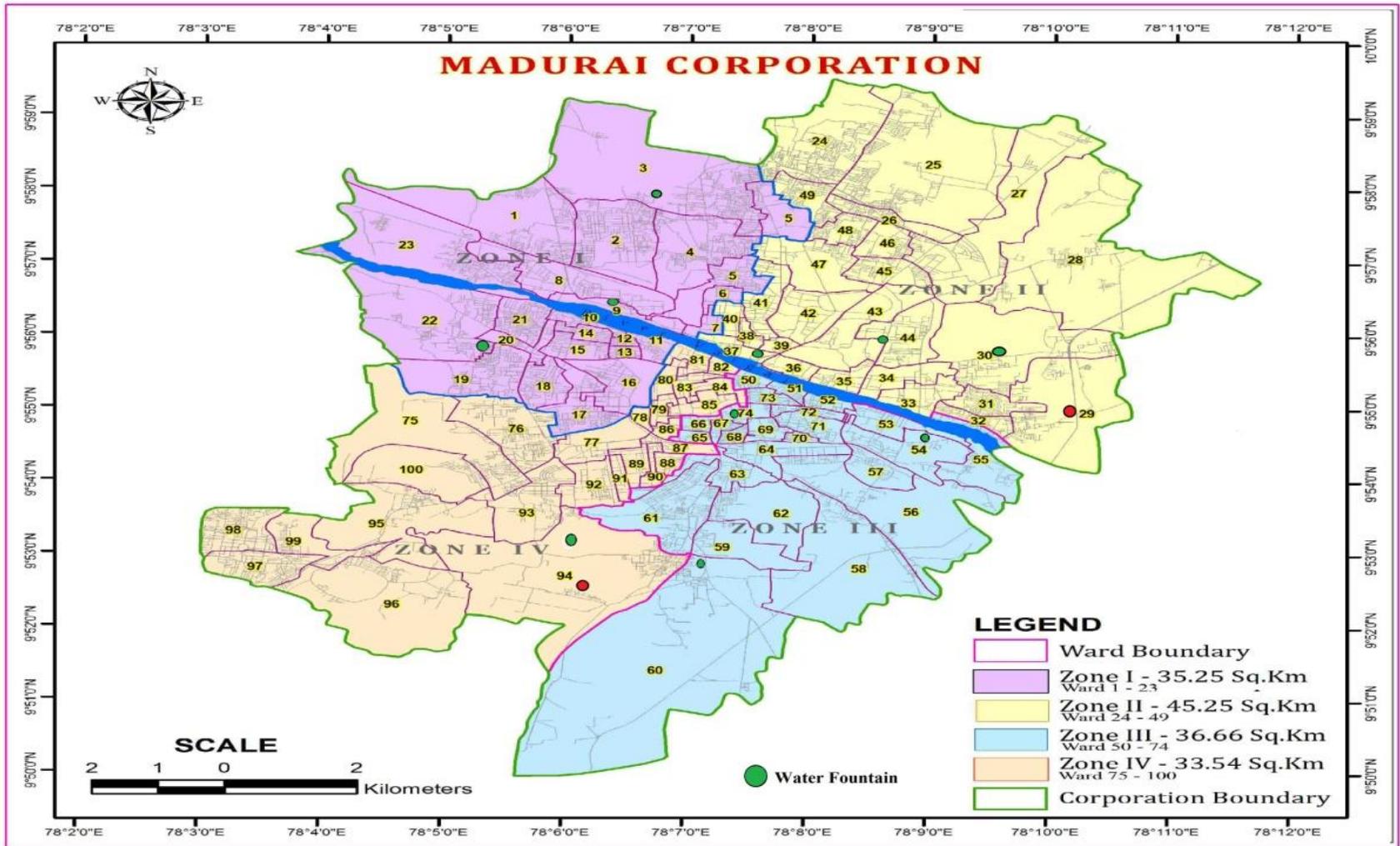


Figure 8: Locations of Water fountains proposed in Madurai U A

9. Planning for express way/ by pass/ under pass and Flyovers

The following bye pass roads / flyovers are under construction.

1. Madurai North bye pass road connecting Melur of Madurai-Chennai Highway and Vadipatti of Madurai – Bangalore Highway – Land acquisition nearing completion.
2. Thallakulam (Core city area) – Oomachhikulam flyover for 11 km – nearing completion.
3. Pandikovil junction flyover, Madurai Ring Road – under construction.

The following flyovers, expressways, underpasses are in planning stage.

1. Apollo Hospital junction to Rajaji Govt Hospital flyover
2. Airport Road flyover at Therkuvasal area
3. Pazhanganatham – Thirunagar flyover
4. Maattuthavani Moffusil and omni bus stations – flyover
5. Madurai outer ring road from Melur to Rajapalayam Road
6. Railway junction to Periyar Bus stand pedestrian underpass by Indian Rail Land Authority

The status of the following flyovers, expressways, underpasses by highway Department

1. Fly over at Kalavasal Junction and Goripalyam Junction- Kalavasal work completed and Goripalauyam work is under progress
2. Elevated corridor from Periyar bus stand to Yanaikal Junction – Survey work and Traffic study completed the report has been submitted to Technical audit committee for approval.
3. Improvement of 5 roads leading to A IMS in Madurai District- LPS has been submitted to District Collector, Madurai
4. Four lane elevated corridor Km 0/0-1/8 of Madurai- Natham Road is under progress
5. Three lane Elevated corridor Km 0/0-1/8 of Madurai- Thondi road
6. Up gradation of highways road within Corporation limit in Madurai District
7. Construction of elevated corridor in km 0/4-2/6 of Madurai- Tuticorin is proposed

10. Identified locations to handle C&D waste

The following locations have been identified for handling C&D wastes in the city.

1. Vellakal area for South of Vaigai River
2. Masthanpatti – for north of Vaigai River

EoI has been floated to identify suitable player to process C&D

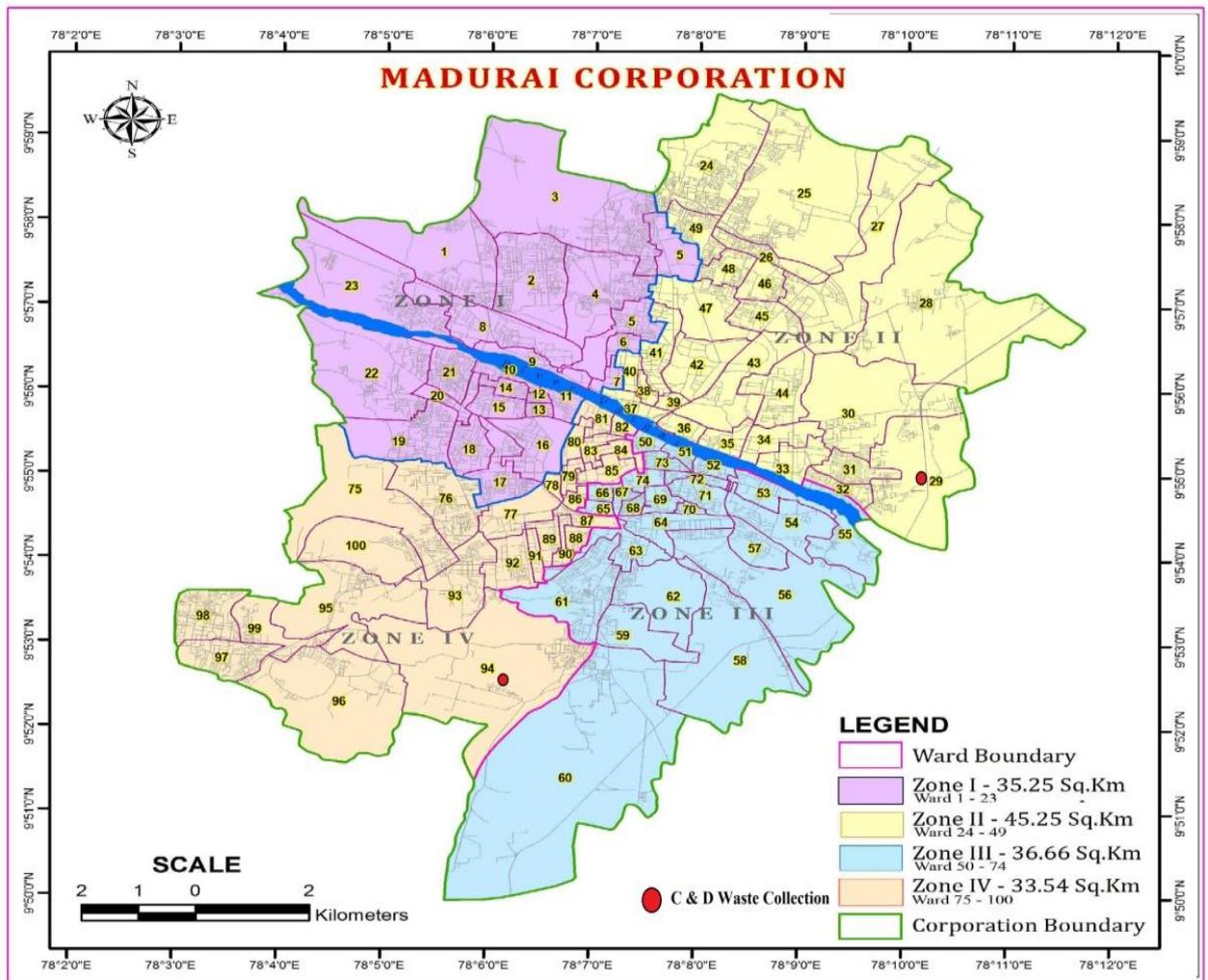


Figure 9: Location of C&D waste in Madurai U A

11. Establishment of CNG and Expansion plan

Indian Oil and Oil Marketing Companies are moving forward with several efforts for availability of CNG and CBG and other green energy fuels for domestic, automotive and industrial uses. Government of Tamil Nadu has commissioned 25 CNG (compressed natural gas) stations in Chennai and Tiruvallur in collaboration with Torrent gas for setting up the gas distribution infrastructure and other items. Torrent gas company also aim to commission 50 CNG station by this September 2021 and 100 by June

2022. Torrent gas proposed to provide 70,000-80,000 domestic CNG connection across the state. (Source: *Times of India*, 20.07.2021).

12. Expansion plan for E-Vehicles

Clean transport system has become necessary due to the rapid depletion of fossil fuel, increase in fuel cost, vehicle population and environmental pollution. Adoption of electric vehicle (EVs) for transport promises a potential air pollutant and greenhouse gas emission reduction co benefits, reduced noise pollution and enhanced energy security. Considering the current chaotic scenario in India, Government of Tamil Nadu has initiated a Rs 50,000 Crore of investment in EV manufacturing and creates a comprehensive EV transport system in the state. Incentives and Concessions are proposed by Government of Tamil Nadu.

- E-vehicle Manufacturing
- E Battery Manufacturing or Assembly
- EV charging infrastructure manufacturing
- Equipment Manufacturing Enterprise

State has proposed each class of vehicle as follows

a. Electric Cars and Two wheelers

Nearly 25 lakh personal cars have been registered in the state so far and 85% of the vehicle population is two-wheeler.

- By providing fast charging solutions through standard charging infrastructure
- Encouragement of conversion of current vehicle to EV through fiscal concessions and development of charging network.

b. Electric vehicle in shared mobility

- By promoting conversion of all auto rickshaws in the major cities- Chennai, Coimbatore, Trichy, Madurai, Salem and Tirunelveli.
- State also proposed to support conversation of all taxis and app-based transport operators and aggregators in the above major cities to EVs within a span of ten years.

c. Electric Vehicle in Public Transport

State Transport Corporation operate around 21,000 public transport buses

- State Transport Undertakings in the state proposed to replace around 5% of the buses as EV every year and around 1000 EV buses may be introduced every year
- Private operators of the buses will be encouraged to transition to EV buses at their choices
- Promoting the conversion of the buses operated to pilgrimage centers, tourist places, national parks, etc into EVs

d. Electric Vehicle in Educational Institution

- There are 32,000 buses; mini buses and vans runs by Educational institutions such as schools and colleges in the state Transition of such vehicle to EVs will be encouraged.

Electric Vehicle in Educational Institution

e. Electric Vehicle in Goods Carrier

- Small Commercial vehicles used for delivering light loads such as mini goods vehicle and E-commerce and delivery

companies in Tamil Nadu will be encouraged to transition of their vehicle to mini goods EVs.

Government has proposed demand side Incentives as follows

- A. Incentives on purchase of Electric Two wheelers
- B. Incentives for Three –Seater Auto Rickshaws
- C. Incentives for transport Vehicles such as Taxi, Tourist Cars, etc
- D. Incentives for light goods Carriers (including the Three Wheelers)
- E. Incentives for private cars
- F. Incentives and Support for Charging Stations

Government of Tamil Nadu has initiated supply side incentive to promote the EV manufacturing within Tamil Nadu. Govt of Tamil Nadu has proposed special package of incentives to the manufacturer of electric vehicle, their auto components, particularly EV batteries and manufacture of charging infrastructure.

13. Traffic congestion points and decongestion plan in the Madurai U A

Table 7 Traffic congestion points and decongestion plan in the Madurai U A

S No	Traffic Police Station	Traffic Congestion points	Road belongs to	Plan for Decongestion
1	Teppakulam Traffic Police Station	St Mary's Church Junction in East Veli Street	Corporation	To provide fly over from East Marret junction upto south Marret junction in East and South veli streets for outgoing vehicle from town to Thirunagar and
2	South Gate Traffic Police Station	South Gate junction in South veli street		

3	South Traffic Police Station	South Marret Junction		other districts These three points are in one stretch
		Katta bomman Statue Junction		To modify the present Fly over design
4	Theppakulum Traffic Police Station.	Muni salai Junction	NH-49	To provide fly over from East marret junction up to Iravathanallur Police check post for outgoing vehicle from town to four lane towards Trichy, Ramanad and other districts, (these four points are in one stretch)
		Kuruvikaran Salai Junction		
		PTR Bridge Junction		
		Teppakkulam Arch Junction		
5	Avaniyapuram Traffic Police Station	Chinthamani Road Junction in four lane	State Highway	To provide fly over
		Mandela Nagar Junction		
6	Central traffic Police Station	Anna Statue to Crime branch	Corporation	To provide fly over from East Veli Street & South Veli Street
		Yanai kal to Periyar bus stand.		
7	Thilagar Thidal Traffic Police Station	South veli Street – West Veli Street North Veli Street – East Veli Street	Corporation	Circular bridge
		Branches from Meenakshi Bazar to LIC bridge		

		through Raja Mil road		
		Branches from Simmakkal to Amma bridge through Thaikal Street		
		Workshops road to Puttuthoppu		To provide fly over Girder bridge Railway track.
8	Karimedu Traffic Police Station	Arasaradi Junction to Muduku Salai Junction	Corporation & National Highway	To provide fly over
		Kenet road Junction to four way Track		
9	Thallakulam Traffic Police Station	Goripalayam New bridge to GRH Junction	Corporation	To modify the present fly over design
		B B Kulam		To provide fly over from Narimedu to Income tax office
		Konnavayan Salai to Thathaneri		To provide fly over
10	Mathichiyam Traffic Police Station	Panagal Road	Corporation	Goripalayam New bridge to GRH Junction.
		Pudur bus Stand		To provide fly over from Pudur ITI bus stop to Sury Nagar Junction.

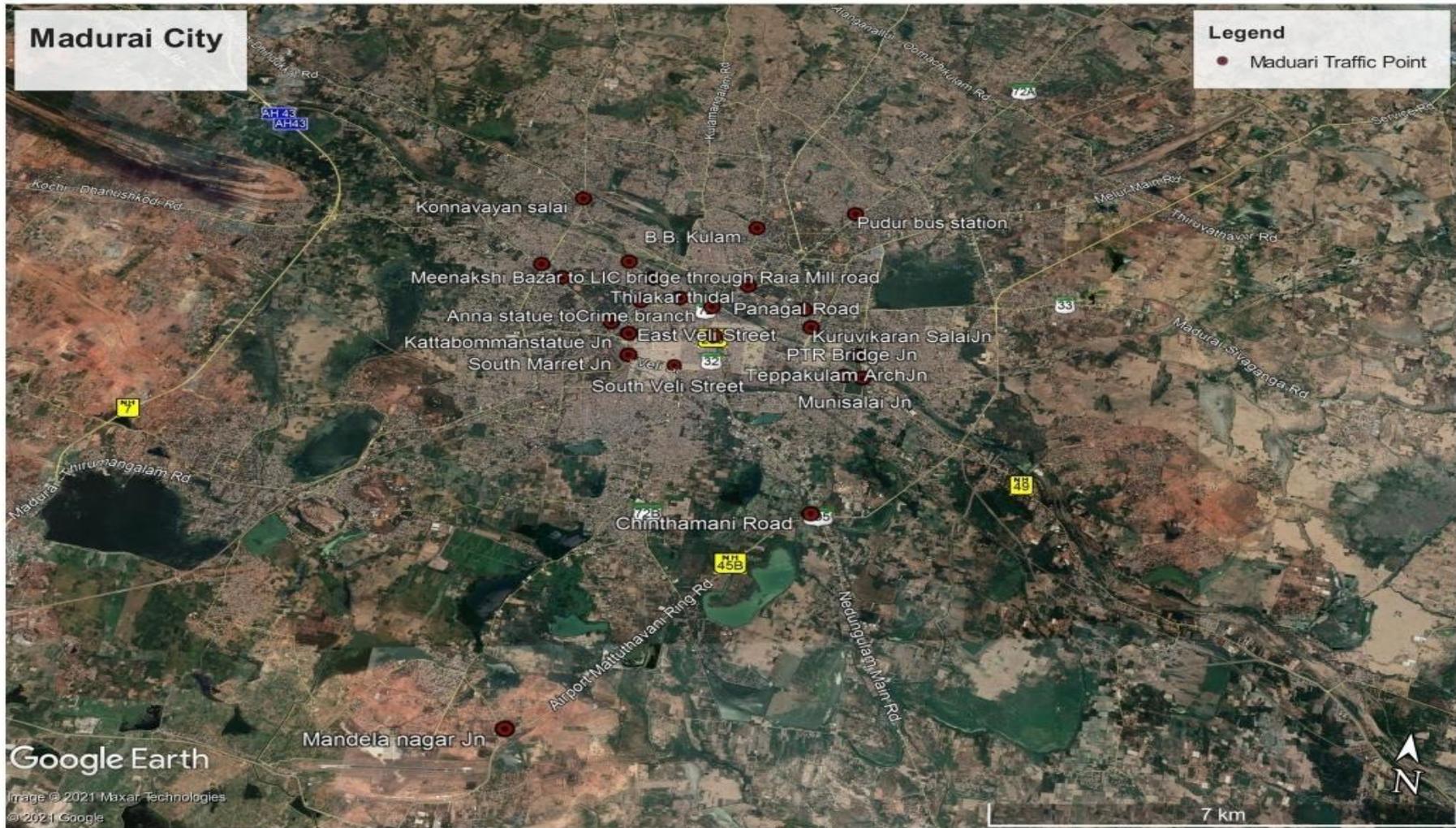


Figure 10: Congestion points at Madurai City

The Ministry of Road Transport and Highways (MoRTH), which is formulating the scrapping policy, will issue the criteria for vehicle scrapping centres, revised vehicle re-registration and fitness test charges and fitness rules, which will form the eligibility criteria for a vehicle to be scrapped. Though Transport department, Tamil Nadu has taken action on banning of new Petrol and diesel autorickshwas in Chennai (Source: <https://tnsta.gov.in/pollution.jsp>), the measures are to be still implemented in Madurai. The Oil companies of Tamil Nadu supplies BS-VI grade fuel. Linking of PUC to vahan portal is already done and the vehicle which does not possess valid PUC are levied a fine of Rs1000/. A draft notification on scrapping of 15 years vehicle has to be issued in Tamil Nadu) TNPCB be issued by Govt of Tamil Nadu after the notification issued by Government of India.

14. Timeframe

Considering 2020-21 as base year, the action plan of Madurai is prepared for next 3 years to begin and which is further extendable up to the 2025 after mid-term review of the outcomes.

15. Action Plan Category

Action Plan for Madurai city has prepared based on different source contribution as below with the time scale for implementing/initiation.

- Short- term (within 6 months)
- Mid-term (6 – 12months)
- Long-term (12 months and 36 months)

Table 8: Action plan for control of air pollution in non- attainment city of Tamil Nadu (Madurai)

1	Name of the city	:	Madurai
2	Air Pollution issue	:	PM ₁₀
3	Air pollution levels (provide range of 24-hourly average concentration values; annual average for past five years)	:	Figure-5
4	Months with higher air pollution levels	:	March, April, May June, and July, August

Source group	Actions	Implementation period (Short /Mid/ Long term)	Time limit for implementation	Budget (lakhs)	Responsible Agency(ies)	Remarks
Road Dust	Maintain potholes free roads	Short- term	January 22	60.22	Highways & State Highways	Immediate action will be taken to ensure the Pothole free roads as and when required as it may vary according to the monsoon condition. Fund utilised for 10 no of works were completed at a cost of Rs.5455306 in the 15 th CFC fund.

Source group	Actions	Implementation period (Short /Mid/ Long term)	Time limit for implementation	Budget (lakhs)	Responsible Agency(ies)	Remarks
	Immediate lifting of solid waste generated from de-silting and cleaning of municipal drains for its disposal	Mid terms	August 2022	63.45	Municipal Corporation	<p>Continuous and regular activity. Silt is dried and disposed to Vellakkal (Municipal Solid Waste and Disposal Processing unit)</p> <p>Immediate action will be taken to ensure the Pothole free roads as and when required as it may vary according to the monsoon condition. Fund utilised for 10 no of works were completed at a cost of Rs.5455306 in the 15th CFC fund</p>
	Regular cleaning of street surfaces and spraying of water to suppress dust	Short-tem	January 22	18.00	Municipal Corporation	<p>Continuous and regular activity Fund utilised for 12no of works were completed at a cost of Rs. 21301000 in the 15th CFC fund</p>

Source group	Actions	Implementation period (Short /Mid/ Long term)	Time limit for implementation	Budget (lakhs)	Responsible Agency(ies)	Remarks
Road Dust	Black-topping of unpaved road.	Mid Term	August 22	3526.00	Municipal Corporation /PWD/ State Highway/ National highway	Continuous and regular activity
	Identify road stretches with high dust generation and Increase frequency of mechanized clearing of road and sprinkling of water on paved and unpaved roads	Mid -Term	August 22	NA	Municipal Corporation	Continuous and regular activity. Municipal Corporation is following sprinkling of water before sweeping of roads by treated water from sewage treatment plant using the jetting lorry (4 nos) of capacity -3000 Liters.
	To take appropriate action to remove road dust/silt regularly by using mechanical sweepers.	Short term	March 20 22	25.04	Municipal Corporation	Continuous and regular activity after short term implementation
Road Dust	End-to-end paving of the road	Long-Term	August 2023	270.00	Municipal Corporation /State Highway and National Highway	The Space between kerb and shoulders edge of the road are to be covered by paving. End to end Paving has been done for 3.2 km.

Source group	Actions	Implementation period (Short /Mid/ Long term)	Time limit for implementation	Budget (lakhs)	Responsible Agency(ies)	Remarks
	Introduce water fountain major traffic intersection.	Midterm	August 2022	480.00	Municipal Corporation	In 12 locations water fountain are to be installed.
	Improvement of Infrastructure for decongestion of road.	Long-Term	August 2023	4617.00	Municipal Corporation /State Highway / National Highways	Municipal Corporation : Construction of High Level Bridge – 2Nos Kuruvikaran Salai Opulapadithurai After implementation, maintenance activity will be done. Fund utilized for 3 no of works Expenditure Rs.892323
	Designing and Construction of environmental friendly roads.	Long-Term	Completed	1994.00	Municipal Corporation /State Highway / National Highways	Maintenance activity will be done as and when required. 56 nos of works completed under general fund at a cost of Rs.103042452

Source group	Actions	Implementation period (Short /Mid/ Long term)	Time limit for implementation	Budget (lakhs)	Responsible Agency(ies)	Remarks
	Implement truck loading guidelines; use of appropriate enclosures for haul tracks; gravel paving for all haul routes.	Mid-Term	Completed	NA	Municipal Corporation / Transport/ Traffic	Notification issued After gravelling, the haul routes maintenance activity will be done.
Road Dust	All the canals/ nullah's side roads should be brick lined. Proper Plantation also carried out.	Long-Term	August 2022	380	Municipal Corporation	3.2 km canals are brick lined at four Masi street. Under smart city mission.
	Creation of green buffers along the traffic corridors and their maintenance.	Long-term	Completed	NA	Municipal Corporation/State Highway/ NHAI	Green buffers are developed at 1. Fatima College 2. Palanganathan 3. Rajamuthiaya mantram 4. Sellur Palam Station 5. Thirupparankundram 6. Thavittu Santhai
	Necessary changes in byelaws - Greening of open areas, gardens, community places, schools and housing societies	Long-term	August 2023	NA	Municipal Corporation	By-law to be framed and published

Source group	Actions	Implementation period (Short /Mid/ Long term)	Time limit for implementation	Budget (lakhs)	Responsible Agency(ies)	Remarks
	Urban greening with vertical garden	Long term	August 2023	NA	Municipal Corporation	Vertical gardens proposed in 3 flyovers. <ol style="list-style-type: none"> 1. Kalavasal Fly over 2. Yannakkal Fly over 3. Thathaneri flyover
	Create Proper Pedestrian infrastructure	Long-term	Completed	400	Municipal corporation/ PWD/ State Highway/ NHAI	Proper pedestrian infrastructure of 12 km work has completed at Heritage route and Four Masi street under smart city mission fund.
Road Dust	Ensure transport of construction material in covered vehicle	Short Term	January 2022	NA	Transport/ Traffic Police	Notification is issued and Periodical checking is done.

Source group	Actions	Implementation period (Short /Mid/ Long term)	Time limit for implementation	Budget (lakhs)	Responsible Agency(ies)	Remarks
	Builders should leave 25%/33% area of green belt in residential colonies to be made mandatory.	Mid Term	August 2022	NA	Municipal Corporation	Guidelines to be issued. Combined building rule dated 04.02.2019 has been issued by Govt of Tamil Nadu has been notified. Policy implementation and regular activity afterwards.
	Adopt street design guidelines for paving of roads and foot paths (hard and soft paving) and vegetative barriers.	Mid Term	August 2022	NA	Municipal Corporation / Highway/ State highway	Guidelines to be issued. Implementation of guidelines and regular activity afterwards
	Implementation of maintaining at least 33% forest covers area in the city in master plan.	Long-Term	August 2023	NA	Municipal Corporation /Forest Department	Master plan is under preparation Regular and continuous activity after implementation.
Road Dust	Installation of WAYU (wind Augmentation and Purifying Units) at Urban traffic intersection	Midterm	August 2022	190.00	Municipal Corporation	WAYU are proposed to be installed at 20 Intersections.

Source group	Actions	Implementation period (Short /Mid/ Long term)	Time limit for implementation	Budget (lakhs)	Responsible Agency(ies)	Remarks
Construction Activities	Strict enforcement of CPCB guidelines for construction (use of green screens, side covering of digging sites, etc.)	Short- Term	January 2022	NA	Municipal Corporation/ District Administration	Direction to the construction agencies will be issued by concerned authorities.
	Restriction of storage of construction materials along the road.	Short- Term	January 2022	NA	Municipal Corporation / Police Department	Corporation is regularly monitoring and taking action against violation
	Covering of construction site	Short- Term	January 2022	NA	Municipal Corporation	Corporation has issued notification and strictly monitoring
	To create separate space/zone to handle solid waste, C&D waste and other waste in the city	Long-Term	August 20223	NA	Municipal Corporation	4 locations are identified to handle C&D waste.
Construction Activities	To mandate facility of tar road inside the construction site for movement of vehicles carrying construction material	Mid-Term	August 2022	250.00	Municipal Corporation	Directions to the builders inside the construction site for the movement of vehicles carrying construction material are being issued.

Source group	Actions	Implementation period (Short /Mid/ Long term)	Time limit for implementation	Budget (lakhs)	Responsible Agency(ies)	Remarks
	Promotion of the use of prefabricated blocks for building construction	Short-Term	January 2022	NA	Municipal Corporation	Corporation has given direction for the use of prefabricated blocks for the building construction.
	Enforcement of Construction and Demolition Waste Rules	Short-term	January 2022	NA	Municipal Corporation	Continuous and regular activity. The corporation is following the C&D rules and taking actions against violators.
	Develop and implement dust control measures for all types of construction activities buildings and infrastructure	Short-Term	January 2022	NA	Municipal Corporation	Notification has issued to control dust at construction sites, the site are being covered with green screen.
	Frame and Implement policy for segregation of construction and demolition waste and provide a network decentralized C&D was segregation and collection site across the city.	Short-Term	January 2022	NA	Municipal Corporation	Policy Implementation. A network of decentralized C&D waste segregation and collection sites across the city has to be established. EoI Called for.

Source group	Actions	Implementation period (Short /Mid/ Long term)	Time limit for implementation	Budget (lakhs)	Responsible Agency(ies)	Remarks
Construction Activities	Promote recycling construction and demolition waste.	Short Term	January 2022	NA	Municipal Corporation	Expression of Interest called for the 4 locations identified for the processing of C&D waste. The use of recycled C&D waste as components of composite material will be promoted.
	Adopting Better construction practices with PM reduction of 50%	Mid-Term	August 2022	NA	Municipal Corporation	Clean construction practices guidelines by Government will be followed.
	Regular check and control of burning of municipal solid wastes	Short-Term	January 2022	NA	Municipal Corporation	All Sanitary workers were educated, not to burn biomass/ waste through information, Education and Communication (IEC)
	Defaulters for open burning to be imposed fines	Short-Term	January 2022	NA	Municipal Corporation	Corporation is regularly monitoring and taking action against violators.
Waste Dumping and Burning	Prohibition /complete ban on garbage burning	Short-term	January 2022	NA	Municipal Corporation	Notification issued.

Source group	Actions	Implementation period (Short /Mid/ Long term)	Time limit for implementation	Budget (lakhs)	Responsible Agency(ies)	Remarks
Waste Dumping and Burning	Construction of advanced waste management site.	Midterm	August 22	2522.00	Municipal Corporation	The vacant site onward Micro Composting Centre is to be utilized for advanced SWM implementation.
	Regular collection and control of municipal solid waste	Short Term	January 2022	NA	Municipal Corporation	Regular and continuous activity. For O&M of Municipal Solid Waste Processing and Disposal Rs. 9392818 was spent during the 15th CFC fund.
	Providing Organic Waste Compost machines, decentralization of processing of Waste, dry waste collection centers.	Short Term	January 2022	2522.00	Municipal Corporation	Onsite Composite Center (OCC) and Micro Composting Centers (MCC) are constructed. under Swachh Bharat Mission, Smart City and General Fund
	No plots should be left open more than 02 year and planting of trees must be mandatory on vacant plots belong to govt.	Long-Term	August 2023	NA	Municipal Corporation	Planting of trees will be done in the 4 Hectares of vacant plot belong to Welfare association of Madurai corporation

Source group	Actions	Implementation period (Short /Mid/ Long term)	Time limit for implementation	Budget (lakhs)	Responsible Agency(ies)	Remarks
	Dead bodies of Animal should be disposed through proper treatment facility lime teneing plant etc.	Mid-Term	August 2022	10.00	Municipal Corporation	This facility is to be added in the prescribed Municipal waste processing and disposal at Vellakkal.
Waste Dumping and Burning	Ensure segregation of waste source	Mid Term	August 2022	50.00	Municipal Corporation	Regular activity and continuous. Waste segregation at source is practiced in 25 Nos of ward out of 100 wards. Remaining 75wards source segregation will be implemented.
Biomass burning	Launch extensive against open burning of biomass, crop residue, garbage, leaves etc.,	Short term	January 2022	NA	Municipal Corporation/ Agriculture department	In Schools, Colleges and Public places the extensive drive in to be followed, for agriculture bends in the city limit awareness is to be created. 600 farmers will be benefitted. In Tamil Nadu open burning of biomass, Paddy crop residue, garbage, leaves were not done and they are in-situ ploughed to enrich the soil fertility.

Source group	Actions	Implementation period (Short /Mid/ Long term)	Time limit for implementation	Budget (lakhs)	Responsible Agency(ies)	Remarks
	Awareness for controlling of burning of agricultural waste and crop residues	Short term	January 2022	NA	Municipal Corporation/ Agriculture department	The farmers were advised by the department to go for in-situ ploughing of agriculture waste and crop residues.
Vehicle	Provide truck rest areas/parks along national and state highways to prevent entry of trucks into cities during peak hours.	Long Term	August 2023	NA	Municipal Corporation/State Highways/ NHAI	The NHAI/ SH has provide the truck rest areas are provided.
Vehicle	Restriction on plying and phasing out of 15 years old commercial diesel drive vehicles	Long-term	Policy decision	NA	Transport Department	Central Government launched scrapping policy. State may also follow up.
	Development of multilayer parking	Long Term	August -2023	16396	Municipal Corporation	1 No of Multi Level Car Parking at Tamukkum Periyar Construction is in progress by Corporation and 98% of the works have completed and remaining works under progress. Multilayer parking facilities are to be proposed in MGR bus stand, and Arappalayam Bus stand.

Source group	Actions	Implementation period (Short /Mid/ Long term)	Time limit for implementation	Budget (lakhs)	Responsible Agency(ies)	Remarks
	Prepare plan for construction of diversion ways/bypasses to avoid congestion due to non-destined vehicles. And Improvement of infrastructure for decongestion of road.	Long-Term	August 2023	2800.00	Municipal Corporation/ State Highways/ NHAI	In Bus route road, its planned to wide the roads 1.South Veli Street 2.South Marret Street
	Strengthen and Encourage public transport services to reduce the vehicular congestion	Long-Term	August 2023	NA	Transport Corporation	To reduce the number of Private cars/two wheelers on road, the government/private buses may be increased by about 5% every year. Also women are allowed to travel free of cost in TNSTC Buses
Vehicle	Introducing cycle tracks along with roads.	Long Term	August 2023	950.00	Municipal Corporation	For the exclusive cycle tracks in consultations with traffic police action will be taken in city roads.
	Prepare and implement zonal plans to develop an NMT network	Long Term	August 2023	950.00	Municipal Corporation	In consultation with traffic police and stakeholders will be implemented.

Source group	Actions	Implementation period (Short /Mid/ Long term)	Time limit for implementation	Budget (lakhs)	Responsible Agency(ies)	Remarks
	Compact city development to reduce distances and improve access	Long Term	August 2023	2200.00	Municipal Corporation	Scheme roads are to be formed to reduce distance and improve access. DPR is under preparation for Intelligent Traffic Management System through Tamil Nadu Urban Infrastructure Financial Services Limited
	Improve and Strengthen PUC Programme	Long Term	August 2023	112	Transport corporation	One PUC center established by Tamil Nadu State Road TNSTC Madurai Pvt. Ltd in the city. 16 Pollution centers may be installed in other TNSTC depots and RC unit
	Number of PUC centers in the city	Mid- term	August 22	NA	Transport Department	19 no of PUC private centers are in operation and the numbers may .be increased.

Source group	Actions	Implementation period (Short /Mid/ Long term)	Time limit for implementation	Budget (lakhs)	Responsible Agency(ies)	Remarks
Vehicle	Regular Checking of vehicular emission and issue of Pollution under Control Certificate	Short-term and (Periodical checking are being carried out to	(Periodical checking are being carried out to check the vehicular emission)	NA	Transport Department/ Traffic Police.	318542 Nos of check report issued for not carrying PUC and 3,11,803 PUC has been issued.
	Periodic calibration test of vehicular emission	Short-term (Periodic activity)	March 2022	NA	Transport department and TNPCB.	Periodic calibration of emission equipments are done by Emission Testing Centers and monitored by Transport Department and TNPCB.
	Linking of PUC centers with remote server and eliminate manual intervention in PUC testing	Midterm	Implemented	NA	Transport Department	All PUC centers in Tamil Nadu are linked with vahan portal 19 no of Emission testing center are there in Madurai city
	Check over loading Use weigh-in motion bridges /Machines (WIM) and weigh bridges at entry points to the city to check the pay load of commercial vehicles.	Short term	On-going process	NA	Transport Department and Traffic Police	Regular activity and Continuous action are taken.

Source group	Actions	Implementation period (Short /Mid/ Long term)	Time limit for implementation	Budget (lakhs)	Responsible Agency(ies)	Remarks
Vehicle	Deploy traffic police for smooth traffic flow at identified vulnerable areas	Short-term	On-going process	NA	Traffic Police	Regular activity and Continuous action are taken
	Steps promoting battery operated vehicle like E rickshaws/E cart	Long term	In progress	NA	Transport Department	563 Nos of E-Vehicle/ Battery operated vehicles are registered upto August 2021. Three wheeler goods-2 Nos Motor cycle and others-561
	Introduction of new electric buses (with proper infrastructure facilities such as charging stations) and CNG buses for public transport	Long Term	In Progress		Transport Corporation	Government of Tamil Nadu has issued order on E-vehicle policy in 2019 G.O. (MS) No. 176, dated 9.10.2019 https://cms.tn.gov.in/sites/default/files/g_o/ind_e_176_2019.pdf No of LPG vehicle registered till august 2021-9856 No of CNG vehicle registered till august 2021-11
	Retrofitting of Particulate filter in diesel driven vehicle and ban on registration of Diesel driven auto rickshaws	Long term	August 2023		NA	Transport/ District Collector

Source group	Actions	Implementation period (Short /Mid/ Long term)	Time limit for implementation	Budget (lakhs)	Responsible Agency(ies)	Remarks
	Introduction of cleaner fuels (CNG/LPG) for vehicles	Long Term	August 2023	NA	Oil companies	Indian Oil Corporation has Commissioned 2 CNG Stations in Chennai and in Tiruvallur. The Torrent gas Pvt Ltd has proposed for installing 100 CNG station in Tamil Nadu by July 2022.
	Installation of CNG Stations within city	Long Term	August 2023	NA	Petroleum Companies	Installation of CNG stations are proposed by Oil companies and Torrent Gas Pvt Ltd.
	Checking of fuel adulteration	Short-term	January 2022 Regular and continuous activity afterwards	Not Applicable	District Administration Oil Companies, Food and Civil Supplies department	Regularly monitored by Oil companies, food and civil suppliers and taking actions against those who violates.
Vehicle	Monitoring of Vehicle fitness	Short Term Regular and continuous activity	January 2022	NA	Transport Department	Continuous and regular activity

Source group	Actions	Implementation period (Short /Mid/ Long term)	Time limit for implementation	Budget (lakhs)	Responsible Agency(ies)	Remarks
	Enforcement of law against visibly polluting vehicles: remove them from road, impose penalty, and launch extensive awareness drive against polluting vehicles.	Regular and continuous activity	On-going process	NA	Transport Department and Traffic police	Regular activity and Continuous action are taken.
	Strict vigilance and no tolerance for visible emissions-stop plying of visibly polluting vehicles by impounding of fine.	Regular and continuous activity	Ongoing process	NA	Transport Department and Traffic police	Regular activity and Continuous action are taken
	Good traffic management restriction/ redirection of heavy vehicles entering inside the city.	Short Term	Implemented	Not Applicable	Transport Department and Traffic police	Regular activity and Continuous action are taken.
	Define routes, permits, fares, vehicle design and safety standards and vehicle technology standards for para-transit vehicles.	Mid term	Implemented	NA	Transport corporation	Madurai transport corporation is operating 4 mini bus around the city.
Industries	Strict action against industries having non-compliance to the norms.	Short- term	January '2022	NA	TNPCB	TNPCB is regularly Monitoring the industries and taking action against the Industries violating the norms.

Source group	Actions	Implementation period (Short /Mid/ Long term)	Time limit for implementation	Budget (lakhs)	Responsible Agency(ies)	Remarks
	Ensure access to quality electricity supply	Short term	January 2022	N A	TNEB	Power supply is being maintained through the state.
	Identify and target commercial and industrial establishments for installation of roof top solar system	Midterm	August 2022	NA	TNEB/ TEDA	As per the Tamil Nadu Solar energy policy 2019, 3600 MW earmarked for category. Solar rooftop plants are being installed in commercial and industrial establishments. The solar rooftop plants installed throughout Tamil Nadu in all LT categories except Hut and Agriculture as on 30.09.2020 is 90.45MW.
	Identify canals and open spaces for installation of solar systems	Midterm	August 2022	NA	TNEB/ TEDA/ Municipal Corporation	To install solar power plants near canals, clearance has to be obtained from public works department. The definition of open spaces is not clear and as far as solar power plants are concerned, only dry and uncultivable lands are utilized in TANGEDCO.

Source group	Actions	Implementation period (Short /Mid/ Long term)	Time limit for implementation	Budget (lakhs)	Responsible Agency(ies)	Remarks
Industries	Ensuring emission standards in industries	Short term	January 2022	NA	TNPCB	TNPCB is regularly monitoring the emission standards in industries.
	Adoption of cleaner technology in brick kilns.	Mid- Term	August 2022	NA	TNPCB	There is no active brick kilns within 50 Km boundary of city
	Shifting of polluting industries	Long- term	August 2023	. NA	TNPCB and Industrial Department	After the source apportionment, EI and Carrying Capacity decision on shifting on Industries may be considered.
			August 33	4060	Industries Departments	Shifting of 5 numbers of Rice mills located at Madurai city Installing of refiring Chamber for 5 rice mills units as improved combustion Technology
			August 28	1 4200		Shifting of 36 Textile unit outside the city limits

Source group	Actions	Implementation period (Short /Mid/ Long term)	Time limit for implementation	Budget (lakhs)	Responsible Agency(ies)	Remarks
	Ban on polluting industries	Long- term	August2023	.	TNPCB and Government of Tamil Nadu	After the source apportionment, EI and Carrying Capacity decision on shifting on Industries may be considered.
Strengthening of Air monitoring network	Air Quality Monitoring may be strengthened by increasing the no of monitoring site location covering all regions especially industries, and road transportation areas/ educational institution areas by the Installation of Additional CAAQMS at Madurai city. (Commercial/ Residential)	Long- Term	March	500 lakhs	Municipal Corporation/ TNPCB/ CPCB	In Madurai 3NAAMP stations are under operation and 1 CAAQMS is commissioned outside the city limit 2 CAAQMS are proposed under XV-FC by ULBs 3 more CAAQMS may be established in temple town with the funding from NCAP
	Source Apportionment (SA), Emission inventory (EI) Carrying Capacity (CC) Study,	Long- Term	March 23	90 Lakhs	ULB Municipal Corporation / TNPCB	The study will be carried out for 2 critical seasons as per the Conceptual guidelines on methodology of SA, CC framed by CPCB. The fund for the study has been proposed under XV-FC fund received by ULB.

Source group	Actions	Implementation period (Short /Mid/ Long term)	Time limit for implementation	Budget (lakhs)	Responsible Agency(ies)	Remarks
Public Awareness	Create awareness about polluting vehicles, open burning and its health impacts	Mid Term	March 22	30 Lakhs	Corporation/D epartment of Education. Department of Health, District administration	Display boards at traffic junction to display real time noise level carbon monoxide level at that point with audio messages to switch of the vehicles when the signal is red and commuters can see the increase and decrease in noise level and Carbon monoxide levels due to their actions. Similar type of display with awareness message on health issues due to burning of waste.

16. Graded/ Emergency Response Action Plan for Madurai

In pursuant to the direction of the Central Pollution Control Board, Delhi a Graded Response Action plan has been prepared for implementation in Madurai town under different Air Quality Index (AQI) categories namely, Moderate & Poor, Very Poor as per National Air Quality Index.

Severe (Ambient PM_{2.5} or PM₁₀ concentration value is more than 250 µg/m³ or 430 µg/m³ respectively)	Agency responsible/ Implementing Agency
Increase power generation from existing wind and solar plants (renewable source) to reduce operation of coal-based power plants	TANGEDGO
Strengthen and encourage public transport services to reduce the vehicular congestion.	State Transport Corporations and District Administration
Identify road stretches with high dust generation and Increase frequency of mechanized clearing of road and sprinkling of water on paved and unpaved roads	Municipal Corporations, State Highway and National Highway Authority of India.
Very Poor (ambient PM_{2.5} or PM₁₀ concentration value is between 121-250 µg/m³ or 351- 430 µg/m³ respectively)	Agency responsible/ Implementing Agency
Stop use of diesel generator sets	TNPCB, District administration.
Compliance to norms by the industries	TNPCB
Cleaner technology in coal based power plants	Industries.
Reduction of non-point pollution emission sources such as handling of coal, transport of coal.	Industries
Stop use of coal/firewood in hotels and open eateries	Municipal Corporation
Alert in newspapers / TV / Radio to advise people .to avoid polluted areas and restrict outdoor movement.	District Administration and Police.
Moderate to poor (ambient PM_{2.5} or PM₁₀ concentration value is between 61-120 µg/m³ or 101- 350 µg/m³ respectively)	Agency responsible/Implementing Agency

Stringently enforce/stop garbage burning in landfills and other places and impose heavy fines on person responsible	Municipal Corporation
Close / stringently enforce all pollution control regulations in industries	TNPCB ,District Administration
Stringently enforce pollution control in thermal power plants through PCB monitoring	Industries ,TNPCB
Do periodic mechanized sweeping on roads with heavy traffic and water sprinkling also on unpaved roads	Municipal Corporation
	Municipal Corporation ,Traffic Police
	Highways and NHAI
Strict vigilance and no tolerance for visible emissions – stop plying of visibly polluting vehicles by impounding or fine	Regional Transport Officer, Traffic police
Strict vigilance and enforcement of PUC norms	
Stringently enforce rules for dust control in construction activities and close non – compliant sites	Municipal Corporation, Town planning authorities.
Deploy traffic police for smooth traffic flow at identified vulnerable areas	Traffic Police
Ensure fly ash ponds* are watered every alternate day during summer months (March – May)	Industries
Moderate to poor (ambient PM_{2.5} or PM₁₀ concentration value is between 61-120 µg/m³ or 101- 350 µg/m³ respectively)	Agency responsible / Implementing Agency
Information dissemination Social media, mobile Apps should be used to inform people about the pollution levels, contract details of control room, enable them to report polluting activities / sources to the concerned authorities, and that will be taken by government based on the level of pollution.	TNPCB, District Administration.

17. Status of Public Grievance Response and Emergency Response System including details of app/portal/ plan of Non-attainment City/Million Plus city- Madurai.

S No	Directions of Non attainment city as per NGT order 681/2018	Details of status of PGRP/ERS
1	<p><u>Direction -V</u> <u>Development of Public Grievance Redressal Portal (PGRP)</u></p> <p>PGRPs may be developed for the remaining NACs and report furnished by the SPCBs/PCCs to CPCB within two months. In default, SPCBs/PCCs concerned will be liable to pay compensation @ Rs. 2 lakhs per month from 01.02.2020. CPCB may file a compliance report. Failure may also be reflected in the ACRs of the Member Secretaries of SPCBs/PCCs.</p>	<p>1. <u>Chief Minister Cell- Tamil Nadu</u> App -Nil Portal -http://cmcell.tn.gov.in/ Phone Number : 044 - 2567 1764 E-Mail : cmcell@tn.gov.in</p> <p>2. <u>Amma Cell</u> App-<u>Amma Call Centre</u> mobile app Portal- http://www.ammacallcentre.tn.gov.in/ Toll free number -1100. The complaints received through the above media are immediately attended and replies were furnished to the complainant.</p> <p>3. <u>TNPCB</u> – Online Grievance Petition Redressal System Portal http://pcbolgprs.in/</p> <p>Email: tnpcbgrivance@gmail.com Ph.No 044 - 2235 3134</p> <p>TNPCB has Toll-free number for lodging public grievances on issues related to pollution.</p> <p>Toll free No: 1800 - 425-6750</p>
2	<p><u>Direction -XV</u> <u>Finalization of Emergency Response System</u></p> <p>With regard to finalization of Emergency Response System (ERS), we are of view that the State Disaster Management Authorities in coordination with the SPCBs/PCCs and State</p>	<p>State Disaster Management authority of Tamil Nadu has policy and plan for the Emergency Response system for the natural disasters such as cyclones, floods, drought, landslides, earth quake, tsunami, heatwave and for manmade disasters such as chemical, biological and nuclear.</p> <p>App-TN SMART mobile app</p> <p><u>Disaster management section –</u></p>

	<p>Units of Meteorological Departments may include emergency as a part of disaster management and develop ERS accordingly which may be placed in public domain.</p>	<p>Collectorate – Madurai</p> <p>Tahasildar (Disaster management)- Phone No:04522546160</p> <p>What’s App- 8428425000/9597176061</p> <p>Toll free No -1077</p>
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18. Potential Source of PM₁₀ at Madurai UA



19. Monitoring mechanism for implementation.

District level Committee constituted under the chairmanship of District collector and monthly meeting of the District level Committee will be conducted to discuss/ monitor the progress of the activities to be performed under the Action Plan. The committee shall involve various stakeholders and their participation will be ensured for achieving various targets mentioned in the Action plan. Tamil Nadu Pollution Control Board shall regularly review the implementation of aforesaid action plan. The status reports on action taken are to be submitted to Central Pollution Control Board on regular basis to furnish the same to Hon'ble National Green Tribunal (NGT).

The details of the various committee members involved in the over all guidance, monitoring and implementation of the city action plan are given below

a) The District Level Committee shall be constituted as follows

1	District Collector Madurai	Chairman
2	Superintendent of Police Madurai	Member
3	Joint chief Environmental Engineer (Monitoring) Tamil Nadu Pollution Control Board	Member &Convener
4	District Environmental Engineer, Madurai	Member
5	Regional Transport Officer Madurai	Member
6	Superintendent Engineer State highways Department Madurai	Member
7	Municipal Corporation Commissioner Madurai	Member
8	Oil Companies representative from HPCL, BPCL and IOC	Member
9	National Highway Authority of India	Member
10	Executive Engineer, Agriculture Department, Madurai	Member
11	Hotel Owners Association	Member
12	Local Planning Authority	Member
13	Nodal officer - NCAP	Member
14	Deputy Director (Labs)/ Chief Scientific Officer,	Member

b) Steering Committee members

The Steering committee members to provide overall guidance for the National Clean Air Programme in respect of Madurai U A will be constituted as follows

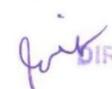
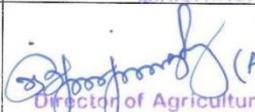
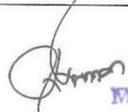
1	Chief Secretary to Government of Tamil Nadu	Chairman
2	Additional Chief Secretary Government, Finance Department	Member
3	The Principal Secretary to Government, Environment and Forest Department	Member
4	The Principal Secretary to Government, Municipal Administration and Water Supply Department	Member
5	The Principal Secretary to Government, Industries Department	Member
6	The Principal Secretary to Government, Home(Transport) Department	Member
7	The Principal Secretary to Government, Agriculture Department	Member
8	The Principal Secretary to Government Highways & Minor Ports Department	Member
9	The Member Secretary, Tamil Nadu Pollution Control Board	Member Convener &

c) Air Quality Monitoring Committee (AQMC) at State Level

The Government of Tamil Nadu has constituted the Air Quality Monitoring Committee (AQMC) at state level with following members for the non attainment cities/ million plus cities Chennai, Madurai and Trichy Vide GO (D) no.96 dated 14.06.2021

1	The Principal Secretary to Government, Environment Climate Change and Forest Department.	Chairman
2	Commissioner/ Director Industries and Commerce	Member
3	Commissioner, Municipal Administration Department	Member
4	Commissioner, Transport Department	Member
5	Director, Agriculture Department	Member
6	The Director of Environment	Member
7	The Member Secretary, Tamil Nadu Pollution Control Board	Member & Convener

The above action plan is placed before the Air Pollution Monitoring Committee on 2.12. 2021 and approved for forwarding the same to Central Pollution Control Board, Delhi.

S.No	Department		Signature
1	The Director of Environment, Panagal Building, Saidapet, Chennai-15.	Member	 DIRECTOR, ENVIRONMENT DEPARTMENT OF ENVIRONMENT CHENNAI-15 CHENNAI-600 015.
2	The Transport Commissioner Transport department, Chepauk, Chennai-5	Member	 Transport Commissioner, Chepauk, Chennai - 5.
3	The Commissioner/Director of Industries and Commerce, Guindy, Chennai-32	Member	 Commissioner and Director of Industries and Commerce Guindy, Chennai - 600 032
4	The Commissioner, Municipal Administration and Water Supplies department, MRC Nagar, Chennai-28.	Member	 DIRECTOR OF MUNICIPAL ADMINISTRATION M.R.C. NAGAR, CHENNAI - 28
5	The Director, Agricultural department, Chepauk, Chennai-5	Member	 (A. ANNADURAI) Director of Agriculture Chepauk, Chennai-600 005.
6	Member Secretary, Tamil Nadu Pollution Control Board, Chennai-32	Member and Convener	 Member Secretary, Tamil Nadu Pollution Control Board, CHENNAI-600 032.
7	The Principal Secretary to the Government Environment and Forests Department, Government of Tamil Nadu, Chennai-9	Chairman	 Principal Secretary to Government Environment, Climate Change and Forest Department Secretariat, Chennai-9.

Annexure-1

Madurai Corporation
Miawaki Details

SI.No	Ward No.	Name of the Place	Nos
1	1	Vilangudi Indira Nagar	1
2	9	Thathaneri Burial Ground	2
3	17	Ellish Nagar Pumping Station	1
4	22	Kochadai	2
5	23	Vilangudi Burial Ground	1
6	27	Karpaga Nagar Pumping Station	1
7	29	Palathottam, Masthanpatti	1
8	34	Anna Nagar, OHT	1
9	34	Sathamangalam, Ward Office	1
10	35	Mathichiyam ward Office	1
11	37	Sellur OHT	1
12	43	Thamukkam, Rajaji Park	1
13	44	Dr.Thangaraj Salai Ward Office	1
14	47	Reserve Line OHT	1
15	55	Kallambal MCC	1
16	57	Slaughter House	1
17	64	Avaniyapuram Bye pass Road	1
18	60	Moolakarai Burial Ground	1
19	71	I.I.Roadf	1
20	94	MMC Colony MCC Site	1
21	94	Vellaikkal MCC Site	1
22	96	Thirupurankundram MCC Site	1
23	97	Harveypatti MCC Site	1



ABSTRACT

Environment - Air Quality Monitoring Committee (AQMC) constituted for preparation and implementation of action plan for improving the ambient air quality in non-attained city (Thoothukudi) as per the orders of Hon'ble National Green Tribunal in O.A.No.681/2018, dated 08.10.2018 - Extending the scope of the Air Quality Monitoring Committee to the newly included non-attainment cities and Million Plus Cities - Orders - Issued.

Environment, Climate Change and Forest (EC.2) Department

G.O.(D)No.96

Dated: 14.06.2021

பிலவ, வைகாசி-31,

திருவள்ளூர் ஆண்டு-2052

Read :

1. G.O.(D).No.20, Environment and Forests (EC.2) Department, Dated:10.01.2019.
2. From the Member Secretary, Tamil Nadu Pollution Control Board, Guindy, Chennai-32. Letter No.TNPCB/DD(L)/3064/2013, Dated:30.03.2021.

ORDER

In the Government order first read above, an Air Quality Monitoring Committee has been constituted based on the directions of the Hon'ble National Green Tribunal, Principal Bench in O.A.No.681 of 2018, dated 08.10.2018 for preparation and implementation of action plan for improving the air quality in non-attainment city Thoothukudi with the following members :-

1.	Principal Secretary to Government, Environment and Forests Department	Chairman
2.	The Director of Environment, Department of Environment	Member
3.	Commissioner, Transport Department	Member
4.	Commissioner / Director Industries and Commerce	Member
5.	Commissioner Municipal Administration Department	Member
6.	Director, Agriculture Department	Member
7.	The Member Secretary Tamil Nadu Pollution Control Board	Member/Convener

-2-

2. The Member Secretary, Tamil Nadu Pollution Control Board in his letter second read above has stated that the Hon'ble National Green Tribunal, New Delhi in its further order in O.A.No.681 of 2018, dated 06.08.2019 has identified the Trichy in Tamil Nadu also as non-attainment city based on the air quality data for the period from 2014-2018 and further in the month of November 2020, Central Pollution Control Board has included Madurai as non-attainment city based on the data for the period from 2015-2019.

3. The Member Secretary, Tamil Nadu Pollution Control Board has also stated that Chennai city have been included as Million Plus Cities for control of abatement of air pollution and the Central Pollution Control Board has requested the Tamil Nadu Pollution Control Board to prepare action plan for the Non-attainment Cities and Million plus cities (i.e., Trichy, Madurai and Chennai). The said Action plan for the non-attainment cities and the Million Plus Cities have to be approved by the Air Quality Monitoring Committee.

4. The Member Secretary, Tamil Nadu Pollution Control Board has therefore requested to extend the scope of Air Quality Monitoring Committee constituted vide G.O.Ms.No.20, Environment and Forests(EC.2) Department, dated 10.01.2019 to the other non attainment cities and Million Plus cities (i.e.,Trichy, Madurai and Chennai) for approval of the action plans.

5. The Government after careful examination have decided to accept the proposal of the Member Secretary, Tamil Nadu Pollution Control Board and to extend the scope of Air Quality Monitoring Committee constituted in G.O.Ms.No.20, Environment and Forests(EC.2) Department, dated 10.01.2019, to the other newly included non attainment cities and Million Plus cities of Trichy, Madurai and Chennai for approval of the action plans.

(BY ORDER OF THE GOVERNOR)

SUPRIYA SAHU
PRINCIPAL SECRETARY TO GOVERNMENT

To
The Chairman,
Tamil Nadu Pollution Control Board,
Guindy, Chennai-32.
The Commissioner, Transport Department,
Chepauk, Chennai-5.
The Commissioner of Municipal Administration,
Raja Annamalaipuram, Chennai-28.
The Commissioner / Director,
Department of Industries and Commerce,
Guindy, Chennai - 32.

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-3-

The Director, Agriculture Department,
Chepauk, Chennai -5.
The Director of Environment,
Department of Environment, Saidapet, Chennai -15.
The Member Secretary,
Tamil Nadu Pollution Control Board,
Guindy, Chennai 32.

Copy to:

The Additional Chief Secretary to Government,
Municipal Administration and Water Supply Department,
Secretariat, Chennai-9.
The Additional Chief Secretary to Government,
Transport Department, Secretariat, Chennai-9
The Principal Secretary to Government,
Industries Department, Secretariat, Chennai-9.
The Principal Secretary to Government,
Agriculture Department, Secretariat, Chennai - 9.
The District Collectors concerned.
The Special Personal Assistant to Hon'ble Minister
(Environment-Climate Change and Youth Welfare and Sports Development),
Secretariat, Chennai-9.
The Private Secretary to Principal Secretary to Government,
Environment and Forests Department, Secretariat, Chennai-9.
Stock File/Spare Copy.

// FORWARDED : BY ORDER //

n-B
18-6-2024
Section Officer
15/6/2024