Environmental Post Evaluation of the Projects under the Schemes in the Taj Trapezium Zone

Sponsor : MoEF, New Delhi

National Environmental Engineering Research Institute
Nehru Marg, Nagpur 440 020

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Final Report

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MoEF

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FOREWORD

Over last few decades, various industrial, commercial and residential activities surrounding the Taj Mahal have resulted in adverse impacts on the monument, prompting the Government of India, judiciary, activist groups and various donor agencies to raise awareness about the potential threat and also to develop programs to ensure the monument's survival and sustainability. Subsequently, a Mission Management Board under the Chairmanship of the Chief Secretary, UP was constituted for overseeing the implementation, monitoring and reviewing of the various programmes / schemes formulated for the protection of Taj Mahal. These schemes were related to uninterrupted power supply, construction & widening of roads, augmentation of water supply, improvement of drainage and sanitation, solid waste management, etc.

Ministry of Environment & Forests (MoEF) retained National Environmental Engineering Research Institute (NEERI) for conducting *Environmental Post Evaluation of the Projects under the Schemes in the Taj Trapezium Zone*. The objectives of the study was to see improvement in environmental quality on the environs of Taj Mahal and other historical monuments, to provide tangible/quantifiable benefits of the 8 completed projects and to provide clear cut directions on taking up new projects based on the evaluation report. The report based on the evaluation of various schemes has come out with clear cut recommendations which should facilitate the Ministry for taking necessary decisions.

The co-operation and assistance rendered by the concerned State Government Departments and Commissioner, Agra and the officials of MoEF in this study are gratefully acknowledged.

(Tapan Chakrabarti)
Director

Nagpur

Date:

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Contents

List of Figures

List of Tables

List of Exhibits

List of Annexure

Executive Summary

Consequent to the Hon'ble Supreme Court orders dated 4.9.96 in the Writ Petition No. 13381/84, the Planning Commission estimated (in consultation with the State Government) an amount of 600 crores on equal Centre-State partnership required to implement various schemes relating to protection of the Taj Mahal. A Mission Management Board under the Chairmanship of the Chief Secretary, UP was constituted for overseeing the implementation, monitoring and reviewing the various programmes/schemes formulated for the protection of the Taj Mahal. These schemes were related to uninterrupted power supply, augmentation of water supply, improvement of drainage and sanitation, efficient solid waste management and city tree plantation in the context of environmental protection of Taj Mahal. The EFC Memo, giving details of the scheme on Taj Protection Mission, was approved in the EFC meeting held on 26.10.98. On 23.2.99, the Cabinet Committee on Economic Affairs approved schemes of Rs. 222.21 crores for the envisaged projects, which were aimed at improving air, water and land environment of Agra (**Table 1**).

Table 1: List of Projects

Sr. No.	Name of the Project	Cost approved by EFC (Rs. in Crore)
1.	Improvement in Electric Supply at Agra	09.11
2.	Gokul Barrage	12.50
3.	Widening of Agra By-Pass	00.75
4.	Storm Water Drainage System (Agra)	06.60
5.	Solid Waste Management	07.49
6.	Construction of one part of Agra by-Pass	10.65
7.	Improvement in Electric Supply in and around the rural areas of Agra and Fatehpur Sikri	39.09
8.	Improvement of Master Plan of Roads of Agra City	21.22
9.	Water Supply (Agra)	72.80
10.	Water Supply (Mathura-Vrindavan)	42.00
	Total	**222.21**

- NEERI was to evaluate Project Nos. 1 to 8 only

- Project Nos 1,3,6,7 and 8, viz. “Improvement in Electric Supply at Agra”; “Widening of Agra By-Pass”; “Construction of one part of Agra By-Pass”; “Improvement in Electric Supply in and around Rural Areas of Agra and Fatehpur Sikri”; and “Improvement of Master Plan of Roads of Agra City” envisaged improving the overall air quality of the city.
- Project Nos. 2 and 4, viz. “Gokul Barrage” and “Storm Water Drainage System (Agra)” envisaged improvement of overall water-quality of the city
- Project no. 5, viz. “Solid Waste Management” envisaged improvement of overall aesthetics and environment of the city.

NEERI was retained by the Ministry of Environment and Forests (MoEF) for conducting post environmental evaluation of the eight schemes, which were either completed or neared completion. Accordingly, post environmental evaluation of project Nos 1 to 8 was taken up by NEERI.

The objectives of the post evaluation studies were:

- To see improvement in environmental quality on the environs of Taj Mahal and other historical monuments
- To provide tangible/ quantifiable benefits of the 8 completed projects
- To provide clear cut directions on taking up new projects since consideration of the new projects in the Taj Trapezium Zone (TTZ) was to be linked to the outcome of the post-evaluation report.

Methodologies followed for post environmental evaluation for electricity and road related projects

Improvement in environment due to implementation of electricity and road related projects was assessed in terms of reduction in emissions due to envisaged activities in the project. The reduction in emissions in an area distinctly improves air quality of the area. Reduction in emissions was calculated using published emission factors and annual mean concentrations of ambient air quality parameters as reported from the secondary data. While calculating emission reductions, certain assumptions were made where the required data were not available. Following assumptions were made:

In case of projects on electricity improvement - The electricity capacity expansion is equivalent to the DG sets use and AP-42 emission factors of DG sets were used to calculate reduction in emissions

In case of projects related to road – A mix of 100 vehicles per hour was considered for all the roads. Speed of the vehicle before the implementation of the project was considered to be 10-15 Km/h and that after implementation as 40-50 Km/h. Emission factors were picked up from the draft report on "Emission Factor Development for Indian Vehicles", as a part of Ambient Air Quality Monitoring and Emission Source Apportionment Studies by ARAI, Pune.

In case of calculating reduction in impact on Taj Mahal due to construction of bypass – Dispersion model CALINE4 was used for this purpose. This model is suitable for impact assessment due to roadways/highways

The post project environmental evaluation of Project 1: Improvement in electric supply at Agra-II (Rs. 9.11 Crore) has brought about reduction of 234.61, 218.736, 3316.320, 264.600 and 716.184 Kg/h for PM, SO_2, NOx, HC and CO emissions respectively in Agra.

The post project environmental evaluation of Project 7: Improvement in electric supply in and around the rural areas of Agra and Fatehpur Sikri (Rs. 39.09 Crore) has brought about reduction of 89, 83, 1263, 101 and 273 Kg/h for PM, SO_2, NOx, HC and CO emissions in the rural areas of Agra & Fatehpur Sikri. This project was also to provide rural electrification in 85 coded villages. The supply of domestic electricity to the villages will bring about social benefits to rural poor. Small-scale businesses and access to electric power for schools and public services was facilitated by this scheme. Potential beneficiary enterprises will be small industries like saw mills, grain mills and other agricultural processing and storage businesses. Improvement in public facilities (e.g. health & education) as a result of availability of electricity is also evident. The projects will cause increased economic activity in industrial, agricultural and commercial sectors as a result of availability of electric supply in the targeted rural areas. The facilities like communication, internet, computer literacy and charging of mobile phones will be generated. Electric lighting adds to security at night and enables extended opportunities for work and study. As a consequence, the quality of life and extent of economic opportunity of the targeted villagers will be transformed.

The post project environmental evaluation of Project No. 6: Construction of one part of Agra Bye-pass (Rs10.65 Crore later revised to 26.91 Crore) has resulted in the reduction of CO, HC, NOx, CO_2 and PM emissions by 14.4, 3.2, 3.8, 639 and 0.02 Kg/h and other pollutants, such as hydrocarbons, benzene, 1-3 butadiene, formaldehyde, total aldehydes and total PAH by 1007, 96, 146, 23, 235 and 4445 mg/h considering 100 vehicle mix per hour on the road.

The post project environmental evaluation of Project No. 3: Widening of Agra Bye-pass (Rs. 0.75 Crore) has resulted in the reduction of CO, HC, NOx, CO_2 and PM by 1.4, 2.5, 10, 726 and 1.6 Kg/h and hydrocarbons, benzene, 1-3 butadine, formaldehyde, total aldehydes and total PAH by 1002, 95, 145, 23, 234 and 4423 mg/h considering 100 vehicle mix per hour on the road.

The post project environmental evaluation of Project No. 8: Improvement of Master plan of Roads of Agra city (Rs. 21.22 Crore) has resulted in the reduction of CO, HC, NOx, CO_2 and PM by 20.8, 3.7, 9.3, 863 and 1 Kg/h and hydrocarbons, benzene, 1-3 butadine, formaldehyde, total aldehydes and total PAH by 1126, 127, 158, 28, 257 and 4505 mg/h considering 100 vehicle mix per hour in Agra.

Construction of 2 new Roads/bypass envisaged in this project – This will bring about 80% reductions in emission impact on Taj Mahal. The two bypasses would exchange the traffic at a distance of 2 and 4 Km away from Taj Mahal which was otherwise at 500 meters from Taj Mahal, when these roads/bypasses were not created.

Thus implementation of the electricity related projects has helped improving overall quality of life of the rural population around Agra and Fatehpur Sikri. This has also resulted in reduction in use of diesel generators in Agra city and in rural area for agriculture which were causing pollution in the TTZ, thereby bringing an improvement of air quality due to reduced emissions.

With the implementation of the road related projects, there had been vehicular decongestion on the TTZ roads thereby reducing air pollution emissions in the TTZ. The well-built and maintained roads in the Agra city would result in overall positive impact on the tourists visiting Agra.

The impact of the implementation of above projects in improving the ambient air quality is apparent from the tendency of the ambient air quality for 1996-2006 wherein it was observed that the ambient air concentration of acid forming gases, SO_2 and NO_2 substantially reduced in the years 2001-2002. A reduction of 27-41 % in SPM, 70-82% in SO_2 and 46-74% in NO_2 concentration has been observed. There is an increasing tendency beyond 2002 which may be attributed to rise in man and vehicular population. The rain water pH data for the year 2008 indicated that the pH is near neutral.

A comparison of ambient air quality of Taj Mahal with respect to SPM, RSPM, SO_2 and NO_2 with the nearby areas (Itmad ud Daulah, Nunhai and Rambagh) showed that the air quality at Taj Mahal is better with respect to all the 3 other areas. However, the SPM and RSPM concentrations at all the four sites are above the CPCB limit of 70 and 50 $\mu g/m^3$ respectively. The annual average concentration of SO_2 is within the CPCB limits of 15 $\mu g/m^3$ whereas the annual average NO_2 concentration has exceeded the CPCB limit of 15 $\mu g/m^3$.

A comparison of ambient air quality of Agra with neighboring cities (Mathura, Firozabad and Bharatpur), conducted by CPCB during winter months in 2006-07 followed by the analysis of organic fraction, showed that the anthropogenic sources were maximum at Nunhai Industrial area in Agra, followed by Industrial area in Firozabad. Mathura had the least organic fraction in SPM. PM2.5 concentration at Taj Mahal was reported to be 246 $\mu g/m^3$ in winter months and 25 $\mu g/m^3$ during monsoon. These concentrations are higher than the 24-h average concentration standard, 15 $\mu g/m^3$ of US EPA. India is yet to set standards for PM2.5.

Following suggestions have been made in the Environmental Management plan (EMP):

For Road related Projects:

- The roads shoulders should be paved to keep them free from vegetative growth
- Proper road drainage system should be in place and the drainage system should be periodically cleared so as to ensure water flow
- Restrain truckers from overloading
- Vehicles carrying loose materials should be covered to prevent spillage

- Trees should be replanted on roadsides wherever feasible to arrest traffic pollution and absorb noise
- Slopes along the road side should be stabilized to avoid road cutting/deterioration, for example, by planting grass on the slopes
- Emergency response system should be in place to offset accidents involving transportation of hazardous material
- Unqualified vehicles should not be permitted to run
- Road surface condition should be maintained to reduce noise pollution
- Any ditches/pot holes on the road surface should be immediately repaired/filled
- Traffic signs, regulating the speed of the vehicles, should be erected and maintained to enhance the efficiency of the vehicles
- Traffic rules should be strictly enforced

For Electricity related Projects:

- The threat of soil erosion around the electric towers can be alleviated by building a foundation embankment or contouring on sloping land
- Trees posing safety hazard, because they are too close to transmission lines, should be trimmed down periodically
- Efficiency measurement of the electricity distribution system (transmission and transformation) should be carried out
- Frequency of load shedding and cuts should be monitored and documented
- Extent of improvement in living conditions of the population and contribution to poverty alleviation and economic growth in the target rural area should be documented
- Steps should be taken to increase the efficiency, reliability, and quality of electricity supply
- Steps should be taken to reduce power cuts during peak time thereby limiting the use of private diesel powered generators

For Gokul Barrage:

- Resource operation plan and environment management system should be prepared and implemented
- Forcing factors or system states should be monitored
- Sufficient upstream measure should be taken to prevent breach
- Water level, flow rate, ground water level, water quality, biological indicators, bed level change, condition of structure, sluices, power supply, effluent loading (if any) etc should regularly be monitored
- Accidents/incident/near misses should be recorded
- Contingency plan should be prepared and implemented
- Silt/sediment/accretion should be periodically removed
- The EMP should be revised in the event of change in effluent loading (if any), change in upstream/downstream water quality, engineering works, abstraction

For Storm Water Drainage:

- A map illustrating areas to be protected/restored, together with proposed development patterns, should be developed and maintained
- Areas where special consideration is required at the subdivision plan stage should be identified
- Preliminary sediment control plan, operation and maintenance considerations should be in place
- Proper management of open areas and land use pattern
- Proper management/utilization of wetlands and wet ponds

For Solid Waste Management:

- House to house collection of MSW should be adopted in various areas of Agra. For this purpose containerized handcarts with bell ringing system, tricycles with container, small vehicles with separate compartments for dry and wet waste can be used
- Community bins used for storage of waste should be placed at appropriate locations. The rationality in allocation of bins should be maintained. Factors like magnitude of waste generation and resident's convenience should be taken into consideration.

- Old community bins should be removed after expiry of life period and new bins should be installed
- To avoid double handling of waste, closed metallic containers, which are lifted by dumper placers, can be used.
- Community bins should be emptied regularly. Care should be taken not to allow the bins to overflow and create unhygienic conditions
- Road sweeping should be done at least twice a day
- Long handled brooms or mechanical sweepers should be used in place of short-handled brooms
- All roadside dumps should be removed
- Proper work allotment to the sweeping staff should be done
- In the areas where road width is very small making it difficult for even tricycles, handcarts etc to enter, small collection bins should be provided
- Industrial and biomedical wastes should not be mixed with MSW as they are governed by separate Rules and Regulations
- Horticulture waste, debris, and slaughter house waste should be collected separately
- Routes for the vehicle transporting MSW should be properly planned
- Dumper placer vehicles can be attached with metallic container for carrying the containers to the disposal site and, after emptying, the containers can be brought back to the original place. This arrangement avoids double handling of waste
- All the vehicles should be parked in garages or covered parking places
- Old vehicles should be replaced by new ones for economy and better efficiency
- Transfer stations should be provided when the collection points are far away from the disposal site
- Preventive and routine maintenance of vehicles should be done in suitably equipped workshop
- Sanitary landfill should be developed and operated for MSW in accordance with Guidelines of Municipal Solid Wastes (Management and Handling) Rules, 2000.

- Selection of the landfill site should be based on environmental considerations and geological and hydro-geological factors
- The sanitary landfill should be developed which can be operated for 20-25 years
- Landfill site should be away from the habitation clusters, forest areas, water bodies, monuments, national parks, wet lands and places of cultural, historical or religious importance
- A buffer zone should be developed around the landfill site
- Proper approach road for the landfill should be developed
- Proper fencing should be provided around the landfill site to prevent unauthorized entry of persons or entry of animals
- Weighbridge facility should be provided for recording the quantity of waste reaching the landfill site
- Landfill site should be provided with office facility for record keeping, monitoring and other relevant activities
- Time to time health inspection of the solid waste management workers should be done
- Safety measures for the workers should be adopted
- Fire fighting equipment should be provided at the site
- First-aid facility should be made available
- Drinking water facility and electrical lighting arrangements should be made available
- A composite liner comprising of high density polyethylene (HDPE) of thickness of 1.5 mm and clay of thickness 90 cm should be provided at the bottom and sides of the landfill
- Permeability coefficient of the soil should be less than or equal to 1×10^{-7} cm per second
- Compaction of waste should be carried out by compactors
- Level of the ground water table should be at least 2 m below the base of the landfill

- Leachate collection, storage and treatment system should be provided
- Monitoring of ground water quality should be conducted at regular interval
- Gas collection facility with provision for flaring up or utilization should be installed
- During operation of the landfill, soil cover or debris of 10 cm thickness should be provided
- An intermediate cover of 65 cm thickness can be applied prior to rainy season
- While closing the landfill site, soil cover of thickness 60 cm and permeability coefficient less than or equal to 1×10^{-7} cm should be applied. A drainage layer of thickness of 15 cm should be provided on top of soil layer and a vegetative layer of thickness of 45 cm should be provided at the top
- Proper waste segregation should be practised followed by conversion of recyclable constituents, viz. plastics, metals, glass and paper to value added products
- Should composting be practiced, it should be done in an environment-friendly manner. Guidelines provided in the Rules should be followed
- Other processing options for the MSW are thermal processing with energy recovery, bio-processing, refuse derived fuel, etc. However, before adoption of any particular technology, there is a need to examine its sustainability, cost effectiveness and environment friendliness
- Protective materials, viz. gumboots, gloves, goggles and masks should be provided to the MSW workers
- Health check up programmes for MSW workers should be conducted biannually or annually
- Spot fining system can be introduced for controlling improper disposal of waste
- Incentive scheme can be introduced for increasing efficiency
- Supervision and monitoring system of the solid waste management activities should be strengthened
- Public awareness programme should be conducted from time to time
- A citizen forum can be constituted for interaction with public
- Training programme should be conducted from time to time for various levels of staff

Conclusions and recommendations

For Road and Electricity related Projects:

- The completed road and electricity related projects have brought improvement in TTZ with respect to immediate neighboring cities. There had been an improvement in the environs of Taj Mahal and other historical monuments.
- Construction of new roads, widening of existing roads and construction of missing links have helped ease out traffic movement, reduce frequency of engine idling and increase traffic speed thereby helped reducing vehicle exhaust emissions in the TTZ. This has, in turn, brought improvement in the ambient air quality and resulted in positive impact on the Taj Mahal marble and the environment
- Further improvement of road network in future should be funded to meet increased traffic volume over the years as evident from the rising tendency in concentration of NO_2.
- The benefits of the projects for domestic supply and use in small-scale businesses and in getting access to electric power for schools and public services are evident. Potential beneficiary enterprises will be small industries like saw mills, grain mills and other agricultural processing and storage businesses. Improvement in public facilities (e.g. health & education), as a result of availability of electricity, is also evident. The projects would cause increased economic activity in industrial, agricultural and commercial sectors as a result of availability of electric supply in project areas. The facilities like communication, internet, computer literacy and charging of mobile phones would be generated. Electric lighting adds to security at night and enables extended opportunities for work and study. As a consequence the quality of life and extent of economic opportunity would be improved
- Financial and technical support should be provided to achieve reductions in overall technical and commercial losses, increased availability of electricity, and improved voltage profile

- Financial support in the electricity supply infrastructure should be provided to enhance electricity access rate and to ensure improved efficiency, to reduce peaking shortages and therefore assist the country to alleviate poverty and achieve the set National goals
- Further enhancement in electric supply in future should be funded to meet increased domestic use of electricity to fulfill energy needs
- Feasibility of electrification of non-codified villages also may be looked into

For Storm Water Drainage Project:

The storm water drains of Agra city were half a century old. The storm water drainage systems constructed by the UP Jal Nigam (UPJN) are maintained by Agra Nagar Nigam (ANN). The ANN claims that the storm water drains are de-silted and cleaned annually. However, during our visit, we found that the existing structural conditions of the drains are not good. These drains are not functioning properly due to silting and accumulation of solid waste, which are not cleaned regularly by the authorities. There is no arrangement at outfall locations drains/nallas for arresting the solid waste, which is finding its way finally into the river Yamuna. Also, the outfalls of the drains are not provided with control structure to avoid back flow from the river.

Out of total area of 8360 hectares of agriculture land, only 1400 hectares has sewerage system. This is inadequate due to increase in population and extension of habited area. In the absence of comprehensive sewerage system, the storm water drains carry raw sewage and discharge directly into river Yamuna. As a result, most of the drains carry domestic sewage laden with solid wastes.

The data revealed that more than 92% of the work was completed in Mustfa Quarter area, Sikandra area, and Naval Ganj area. However, only 62% of the work was completed in Bhim Nagar area as the work has been stopped by the monitoring committee. An expenditure of 450.01 lacs has been incurred on the work executed as against the financial grant of Rs. 565.38 lacs.

The drain cleaning activities needs to be undertaken in all the major drains discharging into river Yamuna to improve the environmental status. The implementation of

the project did not give much advantage in term of development of the facility benefiting the environmental status of the area under study.

For Gokul Barrage Project:

Gokul barrage was constructed at Gokul in Mathura under the TTZ by Uttar Pradesh Irrigation Department, Mathura. The barrage has been constructed on the river Yamuna with view to augment the water availability for Agra, Mathura and Vrindavan and to improve the ground water table in the area and reducing the salinity level. The construction of the barrage at Gokul was initiated in the year 1990 and completed in 2001.

It maintained high flood levels within 162.9 - 164.05 meters. The downstream discharge was maintained between 421 and 3925 cumecs depending on the storage levels after monsoon. The quantity of water stored in the barrage was lowest during the year 2004. The major reasons attributed include low rainfall during the period and maintaining downstream minimum flow conditions. Presently, around 30 cusec (73.5 MLD) and 115 cusec (282 MLD) of water are supplied at Mathura and Agra. Based on the data provided by the UP Jal Nigam, the ground water levels have fallen over the years between 2003 and 2009.

Construction of the barrage on Yamuna River has bought mixed results to the public and environment at large. Some salient features of the project include.

- The flow in the river downstream has been impacted as a result of the impoundment, and the characteristics of the river Yamuna has changed due to reduced flow conditions downstream. The quality of impounded water of the barrage with respect to dissolved oxygen meets the CPCB classification D for propagation of wild life and fisheries in Inland surface water Standards, however, fail to meet the BOD parameter. Large-scale growth of water hyacinth was also found in the river at the Gokul barrage in Mathura.
- The TDS concentration in the ground water samples from the nearby areas indicated concentrations in the range of 777-1664 mg/l. However, the TDS concentration of the ground water collected from hand pumps was considerably higher in downstream vis-à-vis upstream quality. Some hand pumps water quality

does not meet the CPCB classification E (Irrigation, Industrial cooling and controlled disposal) of water quality for conductivity.

- The surrounding area near the barrage has increased vegetative cover due to availability of water.
- Construction of a four lane road on the barrage with foot path on both sides has resulted in partial reduction of traffic in Mathura due to diversion of vehicles through the barrage, reducing waiting times since the project was implemented

For Solid Waste Management:

- An amount of Rs. 749.00 lakhs were released by the MoEF for improvement of solid waste management system of Agra.
- The information collected by a team of scientists from Agra Municipal Corporation and from on-site inspection revealed that procurement and deployment of equipments, vehicles and community bins have improved the situation of MSW management in a few areas in the vicinity of Taj Mahal. Other areas also need such improvement. Sanitary landfill has not been developed for the city. As per ranking exercise carried by the Institute, Agra comes under 'fair' category with a score of 437 out of 1000.
- Various specific measures for improvement in solid waste management suggested in environmental management plan include collection and storage, transportation, treatment and disposal. Preparation of comprehensive DPR and action plan, introduction of MIS system for monitoring, release of funds in installment with time to time monitoring of the project activities and a third party evaluation of implemented project are also recommended and need to be considered during future funding of such types of project.

Chapter 1

Introduction

Agra (27°10′N, 78°05′E) is located in north central India 200 km southeast of Delhi. Two-thirds of its peripheral boundaries (SE, W and NW) are bounded by the Rajasthan desert. The soil type is a mixture of sand and loam, containing excess of salts. The city is about 169 m above the MSL and has semi-arid climate with atmospheric temperature ranging between 11 to 48°C (max.) and 0.7 to 30°C (min.), relative humidity between 25–95%, and average rainfall of about 650 mm per year. The climate of Agra has been broadly divided into three seasons: winter (November to February), summer (March to June) and monsoon (July to October). The prevailing directions follow two distinct patterns: during monsoon winds are from W, NW, SW and NE Sector, while during the rest of the seasons they are from W and NW sector.

The 10,400 sq km region covered under the TTZ has been categorized as a sensitive zone because of the existence of many world Heritage Sites. Some important urban centers, which come under the Taj Trapezium Zone, include Agra, Firozabad, Mathura, Bharatpur, Jalesar and Hathras. These are the primary growth centers of the region. They influence not only the regional economy but also the environment. The region is most fertile in the country. Besides the Taj Mahal, the TTZ includes two other world heritage monuments

- the “Agra Fort” and “Fatehpur Sikri”. About two million tourists visit Agra every year, making it a major source of revenue and foreign exchange for the region. However, continuously rising environmental pollution has been the cause of concern for the protection of Taj marble.

Over last few decades, the damage caused to the Taj Mahal by the pollution created by various industrial, commercial and residential activities surrounding it has been prompting the government of India, courts, activist groups and various donor agencies to raise awareness about the threat and to develop programs to protect the monument. In 1979, the Government of India (GOI) constituted a High Power Committee (HPC) to protect the Taj Mahal monument from chemical corrosion and degradation. Thereafter, no polluting industry was allowed to establish or expand in Agra. Subsequently, there had been many environmental interventions. They include installation of air pollution control units by 173 industries (out of 265) by 1994 and some others especially between 1996 and 2000 have resulted in overall improvement in environmental quality of Agra city during that period.

Consequent to the Hon’ble Supreme Court orders dated 4.9.96 in the Writ Petition No. 13381/84; the Planning Commission estimated (in consultation with the State Government) an amount of 600 crores on equal Centre-State partnership to implement various schemes relating to protection of the Taj Mahal. A Mission management Board under the Chairmanship of the Chief Secretary, UP was constituted for overseeing the implementation, monitoring and reviewing the various programmes/schemes formulated for the protection of the Taj Mahal. These schemes were related to uninterrupted power supply, augmentation of water supply, improvement of drainage and sanitation and city tree plantation in the context of environmental protection of Taj Mahal. The EFC Memo giving details of the scheme on Taj Protection Mission was approved in the EFC meeting held on 26.10.98. On 23.2.99, the Cabinet Committee on Economic Affairs approved schemes of Rs. 222.21 crores for the envisaged projects, which were aimed at improving air, water and land environment of Agra.

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Project No. 2, viz. “Gokul Barrage” envisaged improvement of overall water-quality of the city

Project Nos. 4 and 5, viz. “Storm Water Drainage System” and “Solid Waste Management” envisaged improvement of overall aesthetics and environment of the city.

Later, it was decided by the MoEF that new proposals would be considered for financial assistance under TTZ only after conducting the post evaluation of already funded projects primarily taken up for improvement of environmental quality around Taj Mahal and other important monuments. Subsequently, in the meeting held on 9th May 2006 at MoEF, it was decided that out of the above ten approved schemes, post evaluation of eight schemes, which were either completed or neared completion (S.No.1-8) be taken up based mainly on the existing guidelines and available information. Accordingly NEERI was retained for conducting the post environmental evaluation.

About Gokul barrage

A barrage was constructed at Gokul in Mathura under the TTZ by Uttar Pradesh Irrigation Department, Mathura (**Fig. 1.1**). The barrage (**Exhibit 1.1**) has been constructed on the river Yamuna with a view to augment the water availability in Agra, Mathura and Vrindhavan. The construction of the barrage was initiated in the year 1990. The catchment area covered by the barrage is about 25900 sq. km and is designed for a peak flood discharge at 9500 cumecs. Gokul Barrage project was intended to serve Mathura, Agra and Vrindhavan for an estimated population of 17.0 lakh [2001 census]. Major specification of the Gokul Barrage Project is presented in **Table 1.1**.

The initial cost approved for the Gokul Barrage project was Rs.12.5 crores. The cost of the project in 1988 was estimated at Rs. 29.75 crores based on 1988 price index (CWC lr.no.2/234/87/PAN/411 dated. 23/02/89). The project was revised again in 1995-96 with an estimated cost of Rs.74.38 crores based on 1995 price index (CWC letter No. 2/234/87 PAN/2044-47 dated 21/11/96) and revised again in 1998 to Rs. 93.64 crores (1998 price index). However, an amount of Rs. 92.20 crores was sanctioned and released.

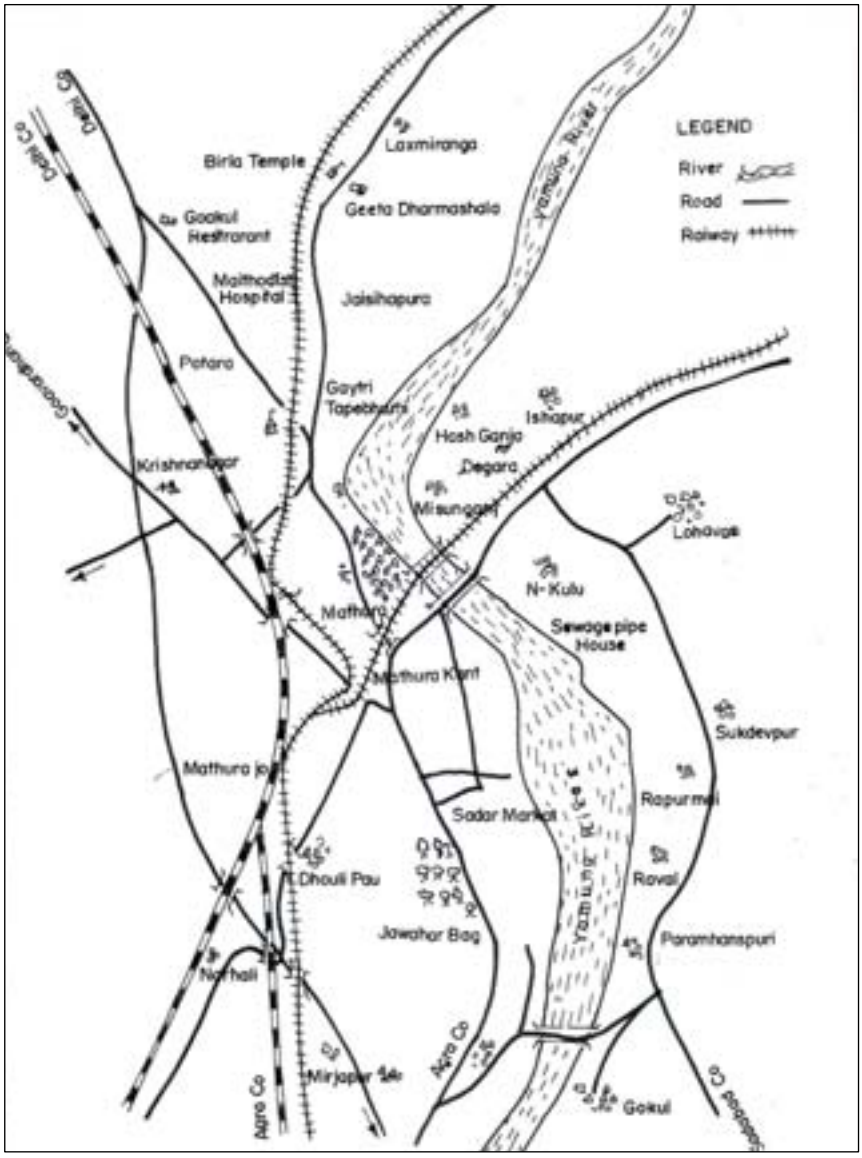


Fig. 1.1: Location of Gokul Barrage on River Yamuna in Mathura

Table 1.1

Major Specification of Gokul Barrage Project

Item	Specification
Design flood discharge, million cubic meters per day	820.8
Design high flood level, m	168.55
Storage gross , million cubic meters (MCM)	23 .94
Storage net, MCM	16.06
Water ways	
Lacey's water way, m	463.00
Total water way, m	435.5
Number of piers	21
Number of abutments	2
Average bed of river, m	160
Crest level of barrage m	160.90
Gates, Nos.	22
Free board, m	0.30
Top level of gate	165.30
Bridge	
Reduced level of top of road	172.00
Width of road, m	15.00

Exhibit 1.1: Gokul Barrage on Yamuna River

About storm water drainage system in Agra

Agra city is a class I city since 1901 and rapid growth of the city was experienced during the period 1991-2001. Agra is situated on the right bank of River Yamuna 200 km down stream of Delhi covering an area of around 148 km^2. The main part of the city is on the western side of Yamuna (Cis-Yamuna) and has also spread on the eastern side of the river (Trans-Yamuna area).

Geologically, the entire city area is underlain by alluvium deposits and it forms a part of the Indo-Gangetic alluvium, comprising of gravel, sand, silt and clay in various proportions and highly pervious to infiltration. The recent deposits are present all along the Yamuna river bank.

Prior to urbanization, the city catchment areas had more open space than the built up area with substantial absorption of water into soil during monsoon. Growth of the city in the last two decades resulted in an abnormal increase in built up area and imperviousness, increasing the inflow of rainwater into the storm water drains during rainy season. The average annual precipitation of the city is 686 mm (Drainage Master Plan for Agra city, UPJN). Maximum precipitation (90%) is during the monsoon season from July to September and the remaining ten percent during winter rains. The town does not have a proper storm water drainage network, some low-lying areas of the city including residential and commercial places flood during the monsoon remaining water logged for a long period. As

the city is situated on the bank of river Yamuna, the storm water of the town finally discharges into the river.

The existing storm water drains of Agra city are very old and were constructed half a century ago. Presently, the storm water drainage systems are constructed by the UP Jal Nigam (UPJN), while Agra Nagar Nigam (ANN) undertakes the task of maintaining the storm water drains in the city. Storm water drains in the city are annually desilted and cleaned as claimed by the ANN. An amount of Rs. 6.60 crore was approved towards construction and maintenance of the storm water drains in Agra.

About Solid waste management in Agra

As per 2001 census, total population of Agra was 12, 75,135. As per the data provided by Agra Municipal Corporation, the present population is about 15 lakh. Total area of Agra city is about 140 sq. km. For solid waste management, the whole Agra city has been divided into 19 zones. At present, Additional Health Officer is responsible for solid waste management activities. He is assisted by Chief Sanitary Inspectors, Sanitary Inspectors, Zonal Sanitary Officers and Supervisors. About 2750 staff is engaged for the collection municipal solid waste (MSW) including sweeping and other sanitation works. About 650-710 tonnes of MSW are generated per day in Agra. The MSW contains biodegradables like leaves, vegetable, fruits, kitchen waste etc. About 43-46% of biodegradables have been reported in the MSW of Agra. Besides, MSW also contains recyclables like glass, paper, metal and plastics.

At present, mainly community bin collection system is used for collection of MSW in Agra. The type of bins used in Agra is mainly RCC and dumper placer bins. Besides, there are a number of roadside dumps spread all over the city. For primary collection of wastes, handcarts, wheel barrows and tricycles are used. Vehicles used for transportation of waste from collection point to disposal site are mainly ordinary trucks, tipper trucks, tractor and trailer, dumper placer and autotype vehicles.

At present, sanitary landfill is not available at Agra. Only indiscriminate dumping of MSW is carried out at specific locations. Composting of MSW is done only at a small scale level.

Chapter 2

Objectives and Their Attainments

The overall objectives of the post evaluation studies were:

- To see improvement in environmental quality on the environs of Taj Mahal and other historical monuments
- To provide tangible/ quantifiable benefits of the 8 completed projects
- To provide clear cut directions on taking up new projects as consideration of the new projects in the TTZ was linked to the outcome of the post-evaluation report.

2.1 For Electricity related Projects

(Source: Respective Project Reports collected from respective State Government Departments)

Project No. 1: Improvement in Electric Supply at Agra: 9.11 Crore

Project No. 7: Improvement in Electric Supply in and around the rural areas of Agra and Fatehpur Sikri: 39.09 Crore

Objectives

The following were the objectives of the above two schemes related to electric supply as noted from the DPR (detailed project report) of "Taj Trapezium Yojna" of Rs 39.09 Crores and 9.11 Crores, U P Power Corporation Ltd. Agra Region, Agra:

"Experts are of the opinion that the smoke belching from the coal/diesel oil fired industries and diesel operated water pumping sets in the vicinity of Taj Mahal located in Taj Trapezium Zone is a potential threat to environment and elegance of Taj Mahal and other historic monuments in and around Agra for which our country is proud of. To prevent the elegance of these monuments and make smoke free atmosphere in TTZ area, this scheme was proposed and presented to State Govt. for funding of the creation of infrastructure and its maintenance afterwards. The above scheme was mainly the social welfare scheme; the society will be benefited from the implementation of the scheme".

The following were targeted to achieve the above objectives:

1 Electrification of 754 nos. of unelectrified, codified villages in the area and electrification of 95 numbers of slum colonies/villages in Agra Municipal area.

2 To reduce the voltage drop at the sub-station and feeders.

3 To supply electricity for at least 14 hrs. per day in the rural areas

4 To energize the private tube wells/state tube wells over agricultural development

5 To give electric connections to the rural people for lighting their houses and develop cottage industries

Attainment

Implementation of the above projects has helped improving overall quality of life of the rural population around Agra and Fatehpur Sikri. This has also resulted in reduction in use of diesel generators in Agra city and in rural area for agriculture which were causing pollution in the TTZ, thereby improvement of air quality due to reduced emissions.

The impact of the implementation of above projects in improving the ambient air quality is apparent from the **Figs. 1-3** (Chapter 4) wherein it can be seen that the ambient air concentration of acid forming gases, SO_2 and NO_2 was substantially reduced in the year 2000. A 27-41 % reduction in ambient SPM concentration, 70-82% reduction in concentration of ambient SO_2 and 46-74% reduction in concentration of ambient NO_2 was seen during 200-2-03 in comparison to 1996-98 levels. There is, however, an increasing tendency of these gases from 2001 onwards in ambient air. Also the rain water pH data for the year 2008 as in Table below suggests the pH is near neutral.

(**Source: CPCB, New Delhi**)

Table Showing Neutralization Ratio of Rain Water at Agra-2008

Months	pH	Conductivity (µmhos/cm)	Sum of Cations (Eq. wt)	Sum of Anions (Eq. wt)	NR=Neutralization Ratio of Cations & Anions
May	7.07	100.0	0.8954	0.5303	1.7
	6.78	40.6	0.3558	0.1629	2.2
June	7.29	68.2	0.9216	0.3586	2.6
	7.60	76.0	0.9844	0.2108	4.7
	7.32	133.1	1.4781	1.0957	1.3
July	7.31	46.7	0.6527	0.2898	2.3
	7.23	44.2	0.9216	0.2450	3.8
	7.34	47.5	0.4285	0.2530	1.7
	7.23	35.3	2.0773	0.1809	11.5
August	7.28	46.7	0.4962	0.1822	2.7

2.2 For Road related Projects

Project No. 3: Widening of Agra By-Pass: 00.75 Crore

Project No. 6: Construction of one part of Agra by-Pass: 10.65 Crore

Project No. 8: Improvement of Master Plan of Roads of Agra City: 21.22 Crore

Objectives

As noted from the U. P. P.W.D. (Lok Nirman Vibhag, Agra) project report, the objectives of the implementation of the above three projects were protecting the TTZ from environmental pollution and bringing out overall development from the angle of tourism.

Widening of canalpatri road and construction of road parallel to the existing canal Patri road, and construction of missing links in the master plan roads of Agra city were targeted.

Attainment

With the implementation of the above three projects, there will be vehicular decongestion on the TTZ roads thereby reducing air pollution emissions in the TTZ. The well-built and maintained rods in the Agra city will result in overall positive impact on the tourists visiting Agra.

2.3 For Gokul Barrage

Project No. 2: Gokul Barrage

Objectives

The major objectives of the project were to augment water supply in Agra Mathura and Vrindavan. Other objectives include increase ground water table in the area and reduce salinity levels.

Attainment

Construction of the barrage on Yamuna River has bought mixed results to the public and environment at large. Since the completion of the project on 2001, the downstream discharge was maintained between 421 and 3925 cumecs (**Table 2.1**) depending on the post monsoon storage levels. Presently around 30 cusec (73.5 MLD) and 115 cusec (282 MLD) is supplied at Mathura and Agra. Based on the data provided by the UP Jal Nigam, the ground water levels have fallen over the years between 2003 and 2009 (**Fig. 2.1**).

- The quality of impounded water of the barrage with respect to dissolved oxygen meets the CPCB classification D for propagation wild life and fisheries in inland surface water Standards, however failed to meet the BOD parameter. Large-scale growth of water hyacinth was also found in the river at the Gokul barrage in Mathura.
- The TDS concentration in the ground water samples from the near by areas indicated concentrations in the range 777-1664 mg/l. However, the TDS concentration of the ground water collected from hand pumps was considerably higher in downstream vis-à-vis upstream quality. Some hand pumps water quality does not meet the CPCB classification E (Irrigation, Industrial cooling and controlled disposal) of water quality for conductivity.
- The surrounding area near the barrage has increased vegetative cover due to availability of water.
- Construction of a four lane road on the barrage with foot path on both sides has resulted in partial reduction of traffic in Mathura due to diversion of vehicles through the barrage, reducing waiting times since project implementation

2.4 For Storm Water Drainage

Project No. 4: Storm Water Drainage System (Agra)

Objectives

The main objective of the project was improvement of overall aesthetics and environment of the city.

Attainment

These drains are not functioning properly due to silting and accumulation of solid waste, which are not cleaned regularly by the authorities. There is no arrangement at outfall locations of drains/nallas for arresting the solid waste, which is finding its way finally into the river Yamuna. Also, the outfalls of the drains are not provided with control structure to avoid back flow from the river. Out of total area of 8360 hectares of agriculture land, only 1400 hectares has sewerage system. This is inadequate due to increase in population and

extension of habited area. In the absence of comprehensive sewerage system, the storm water drains carry raw sewage and discharge directly into river Yamuna. As a result, most of the drains carry domestic sewage laden with solid wastes. The drain cleaning activities needs to be undertaken in all the major drains discharging into river Yamuna to improve the environmental status. The implementation of the project did not give much advantage in term of development of the facility benefiting the environmental status of the area under study.

2.5 For Solid Waste Management

Project No. 5: Solid Waste Management

Objectives

The main objective of the project was improvement of overall aesthetics and environment of the city.

Attainment

Procurement and deployment of equipments, vehicles and community bins have improved the situation of MSW management only in a few areas in the vicinity of Taj Mahal.

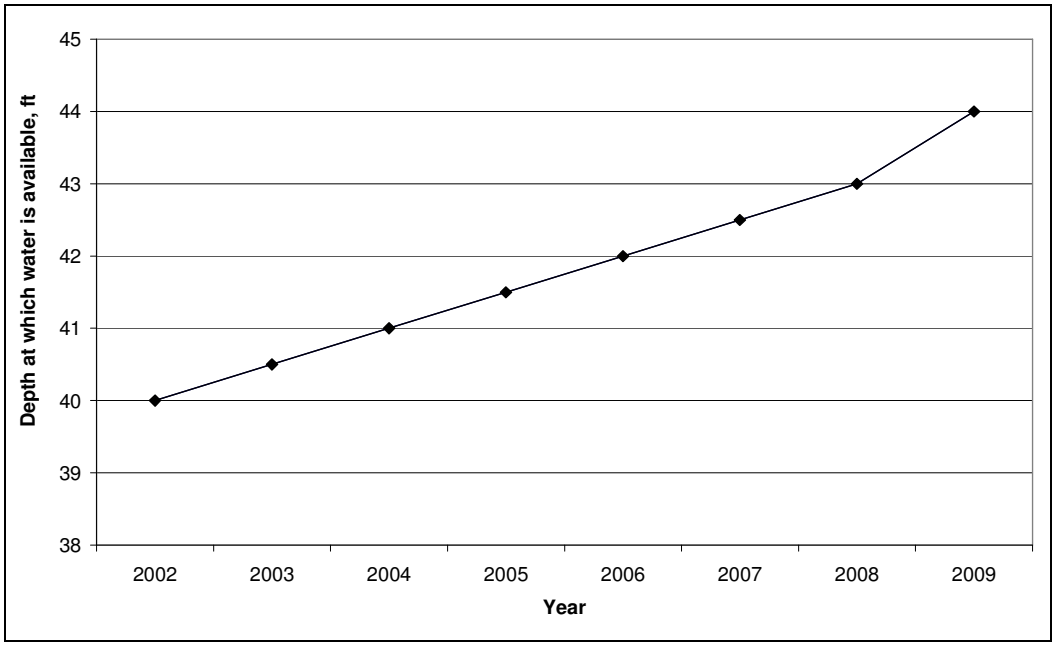


Fig. 2.1: Falling Ground Water Levels in the Vicinity of Gokul Barrage Project

Table 2.1

Storage and Discharge from the Barrage

Years	High Flood Level (m)	Storage Capacity (MCM)	Discharge from the Barrage (cumecs)
18-09-02	163.95	13. 22	3925.5
08-08-03	163.4	9. 57	3143.5
29-08-04	162.9	6.61	421.5
09-09-05	163.0	7.20	707.16
13-08-06	163.5	10 .16	486.46
18-08-07	163.4	9.57	576.42
23-08-08	164.5	13.72	2045.1
	Design HFL max.- 168.55	Gross storage - 23 .94	Design flood discharge - 9500

MCM - million cubic meters, cumecs - cubic meters per second, m – meter

2.6 Overall objectives and their attainment of the projects

Project wise overall objectives and their attainment are summarized in the following Table.

S No.	Project	Objectives	Attainment/Remarks
1.	Improvement in Electric Supply at Agra	Improvement in ambient air quality at Taj Mahal	Objectives attained.
2.	Gokul Barrage	Augmentation of water supply to Agra, Mathura and Vrindavan, improvement in ground water table, reduction in salinity	Partially attained. *Water supply increased, quality not good, ground water table went down, salinity not reduced*
3.	Widening of Agra By-Pass	Improvement in ambient air quality at Taj Mahal	Objectives attained.
4.	Storm Water Drainage System (Agra)	Improvement in Water availability and quality	Partially attained. *Drains constructed but poorly managed, sewage mix observed.*
5.	Solid Waste Management	Improvement in aesthetics & environment of Agra city and land/soil quality	Partially attained. *Open dumping still practiced, lacks proper SWM management, no sanitary landfill.*
6.	Construction of one part of Agra by-Pass	Improvement in ambient air quality at Taj Mahal	Objectives attained.
7.	Improvement in Electric Supply in and around the rural areas of Agra and Fatehpur Sikri	Improvement in overall ambient air quality	Objectives attained.
8.	Improvement of Master Plan of Roads of Agra City	Improvement in ambient air quality at Taj Mahal	Objectives attained.

Chapter 3

Methodology

For Projects related to Improvement in Air quality

Improvement in air environment due to implementation of a project can be assessed in terms of reduction in emissions due to envisaged activities in the project. The reduction in emissions in an area obviously improves air quality of the area. The impact of emission reduction on air quality can be assessed either through dispersion modeling or through actual ambient air quality monitoring. The air dispersion modelling requires extensive data on the sources and knowledge of micrometeorology of the area and therefore beyond the scope of this report. In this report the reduction in emissions have been calculated and annual mean concentrations of ambient air quality parameters have also been reported from the secondary data. While calculating emission reductions certain assumptions have been made where required data was not available. The assumptions made are listed below:

3.1 For Electricity related Projects

Since the detail information (numbers, capacity, operating hours, fuel consumption, location etc) on the diesel generator sets used in the different areas of the TTZ before and after the project is not available, it was assumed that the capacity expansion is equivalent to the DG

sets use. AP-42 emission factors for the DG sets (**Table 3.1**) were considered for the calculation of emissions.

3.2 For Road related Projects

i. Since the data on vehicle movements on the different roads in TTZ during the project period (1998-2002) is not available, all calculations regarding road projects have been made per 100 vehicles mix according to the **Table 3.2.**

ii. The speed of the vehicles before the implementation of the project is assumed to be 10-15 Km/h and, after the project implementation, the speed is assumed 40-50 Km/h. The emission factors have been adjusted accordingly for vehicle speed as given in **Table 3.3**.

iii. Emission factors considered as per the draft report on "Emission Factor development for Indian Vehicles", as a part of Ambient Air Quality Monitoring and Emission Source Apportionment Studies by ARAI, Pune (**Table 3.4**).

iv. For calculating reduction in impact on Taj Mahal due to construction of bypass at 2 and 4 Km away for allowing the vehicular traffic to change between Shamsabad and Fatehabad roads without going 500 m near the Taj for the change, we have taken the help of USEPA Line source model CALINE4. We have predicted the pollutant concentration at 500 m, 2 Km and 4 Km for the 100/125' wide road with the 100 vehicles per hour. A short write up on the model CALINE4 is appended as ***Annexure-I.***

3.3 For Gokul Barrage Project

Assessment was carried by obtaining details on the status of the project. The major objectives included improved water quantity and quality in the region to meet the potable water requirements of the region. Therefore water samples were collected from the barrage upstream and downstream and analyzed for assessing the quality of water from the barrage. Ground water samples were also collected and analyzed for assessing ground water quality near the barrage. Secondary data was collected

on the number of users of the road on the barrage for studying impact of the barrage on reducing traffic problems in the Mathura Agra highway.

3.4 For Storm Water Drainage Project

Following methodology was used for evaluating the storm water drainage project:

- Field studies were made to take overview of the project implementation and existing drainage basins and the areas covered by the drains. Outfalls of each major drain was also visited
- An assessment of condition of four major constructed drains identified for storm water management in the city was done
- Drain problems, Viz., flooding, silting, erosion, solid waste and sewage disposal, and cleaning and maintenance were identified and remedial measures suggested
- Guidelines for preparation of an environmental management plan has been included in the report for preparation to meet the exigencies arising out of natural disasters

3.5 For Solid Waste Management Project

A team of NEERI scientists visited Agra city in the month of March 2009 for data collection, inspection and assessment of solid waste management system. Interactions were made with various organizations directly or indirectly involved in the project. Data/information was provided by Agra Municipal Corporation (AMC) from various documents and also through questionnaire survey. Visits were undertaken to various areas of the city to assess the status of solid waste management. On the basis of field observations and data analysis, and ranking exercise, the status of solid waste management in Agra city was assessed. Areas where further improvements are needed were identified and various measures were suggested.

3.6 RTI Application

To obtain certain important information related to the project, an RTI application was filed with the Agra Municipal Commissioner on June 15, 2009. The copy of the covering letter and the questionnaire sent is attached as ***Annexure IX***. No reply to this questionnaire was received till the time of writing this report.

Table 3.1

Emission Factors for DG Set

(Source: AP 42, Fifth Edition, Volume I, Chapter 3.3: Gasoline and Diesel Industrial Engines, USEPA Document, Web Source Address http://www.epa.gov/ttnchie1/ap42/ch03/index.html)
(A print out is attached as ***Annexure II***)

Pollutant	Emission Factor (Kg/KW h)
Particulate matter (PM)	0.00133
Sulphurdioxide (SO_2)	0.00124
Nitrogen oxides (NOx)	0.0188
Hydrocarbons(HC)	0.0015
Carbon monoxide (CO)	0.00406

Table 3.2: Vehicle Mix

(Source: Tender Document, Development of Inner Ring Road at Agra, UP, Sept. 2008, Copy of relevant pages enclosed as ***Annexure –III***)

Vehicle Type and Percentage	No. of Vehicles as assumed
car/jeep/van/taxi 45%	45 (22 gasoline operated + 23 diesel operated assumed breakup)
LCVs, Mini Van & Mini truck 10%	10
Trucks & Buses- 2 axle 20%	20
Trucks & Buses- 3 axle 20%	20
Multi Axle (4Axle and more) 5%	5

Physical verification of the projects implementation and verification of funds, expenditure etc is beyond the scope of this report. The above assumptions were made as the details of vehicular movement on Agra city roads during 2001-2002 are not available.

Table 3.3

Correction Factor for Vehicle Speed

(Source: Draft Report on "Emission Factor development for Indian Vehicles "by ARAI, Pune, copy of relevant pages enclosed as ***Annexure -IV***)

Pollutant	Speed	
	10-15 (Km/h)	**40-50 (Km/h)**
HC	1.8	0.8
CO	1.8	1
NOx	1.3	1
CO_2	1.5	0.8
PM/PM10	1.01	1

*** The above factors are ratios, therefore have no unit**

Table 3.4

Emission Factors

(Source: Draft Report on "Emission Factor Development for Indian Vehicles "as a part of Ambient Air Quality Monitoring and Emission Source Apportionment Studies by ARAI, Pune

Sr. No.	Vehicle type	Sub category	Vintage	Fuel	*Emissions (g/km)*					*(Emissions mg/Km)*					
					CO	HC	NOx	CO_2	PM	Benzene	1-3 butadine	Formal dehyde	Acetal dehyde	Total aldehydes	Total PAH
1	Car/ Petrol	<100 CC	1991-1996	BS-II	4.75	0.84	0.95	95.65	0.008	0.2126	0.1322	0.0181	0.0109	0.0453	0.1577
2	Car/ diesel	<160 CC	1996-2000	BS-II	0.87	0.22	0.45	129.09	0.145	1.5962	0.03132	0.0261	0.0003	0.0813	0.1013
3	LCV/ diesel	<3000 CC	1991-1996	BS-II	3.07	2.28	3.03	327.29	0.998	0.5427	0.0094	0.1975	0.0117	0.2957	8.1284
4	HCV Bus	>6000 CC	1991-1996	BS-II	13.06	2.4	11.24	817.52	2.013	0.1529	0.0313	0.1007	0.0148	0.1259	1.0123
5	HCV Truck	>6000 CC	1991-2000	BS-II	19.3	2.63	13.84	837.5	1.965	0.0199	0.0175	0.0925	0.0197	0.1374	4.5975

Chapter 4

Post Project Environmental Evaluation

4.1 Projects related to "Improvement in Electric Supply at Agra"

Project 1: Improvement in electric supply at Agra-II (Rs. 9.11 Crore)

Source: DPR of Rs. 9.11 Cr. Scheme of TTZ (Scheme for environment improvement in Taj-Trapezium Area), dated 3 April 2006 by Electricity transmission Circle, Power Corporation Ltd, 64 Khamba, Bypass Road, **Agra - 282007**

Electric supply capacity before the scheme (available power) = 615 MVA

Electric supply capacity after the scheme (available power) = 615+315 = 930 MVA

The scheme was completed in August 2001

It is stated that the demand load was more or less the same. Therefore, it was assumed that equivalent power was being generated by DG sets.

Assumption 1.	Assuming 30% transmission losses, available power at consumer end = 70% of 315 MVA= 220.5 MVA
	220.5 MVA= 220.5x0.8 MW=176.4 MW = 176400 KW
Assumption 2.	220.5 MVA worth of power was being generated by using DG sets
	Emission reduction for pollutant type i (Kg/h) = (emission factor for pollutant i (in Kg/KW h) x (Additional power available in KW)
Assumption 3.	AP-42 emission factors Kg per KW/h generation

Pollutant	**Emission factor (Kg/KW h)**	**Emission reduction (Kg/h)**
Particulate matter (PM)	0.00133	234.612
Sulphurdioxide (SO_2)	0.00124	218.736
Nitrogen oxides (NOx)	0.0188	3316.320
Hydrocarbons(HC)	0.0015	264.600
Carbon monoxide (CO)	0.00406	716.184

It is stated in the project report that the power was being rostered for 2 to 3 hours a day before implementation of the above project and that on completion of the project the demand load was more or less the same thereby fulfilling the requirement. It can, therefore, be stated that with the implementation of the above project, the PM, SO_2, NOx, HC and CO emissions in Agra had reduced by 234.61, 218.736, 3316.320, 264.600 and 716.184 Kg/h respectively.

Project 7: Improvement in Electric Supply in & around the Rural Areas of Agra & Fatehpur Sikri (Rs 39.09 Crore)

Source: **DPR of Rs. 9.11 Cr. Scheme of TTZ** (Scheme for environment improvement in Taj-Trapezium Area) dated 3 April 2006 by Electricity transmission Circle, Power Corporation Ltd, 64 Khamba, Bypass Road, Agra 282007

Following were envisaged under the scheme:

1. A New substation of 132/33 KV at Bodla (**40 MVA**)
2. Enhancement of transmission capacity of 132/33 KV substation at Bah (**20 MVA**)
3. Enhancement of transmission capacity of 132/33 KV substation at Gokul (**40 MVA**)
4. Enhancement of transmission capacity of 132/33 KV substation at Shamsabad Road (**20 MVA**)
5. Rural electrification in 85 villages

The scheme added 120 MVA power capacity

30% transmission losses, the incremental power available at the consumer end

Assumption 1. is 70% of 120 MVA = 84 MVA = 84x0.8 MW=67.2 MW=67200 KW

Assumption 2. 67200 KW power was being generated by using DG sets pre day

Assumption 3: AP-42 emission factors Kg/ KW h generation

Total Emission reduced by implementing the above 39.09 Crore Scheme

Pollutant	Emission Factor (Kg/KW h)	Emission Reduction (Kg/h)
Particulate matter (PM)	0.00133	89.376
Sulphurdioxide (SO_2)	0.00124	83.328
Nitrogen oxides (NOx)	0.0188	1263.36
Hydrocarbons (HC)	0.0015	100.8
Carbon monoxide (CO)	0.00406	272.832

With the implementation of the above project, the PM, SO_2, NOx, HC and CO emissions in rural areas of Agra and Fatehpur Sikri had reduced by 89, 83, 1263, 100.8 and 273 Kg/h respectively.

4.2 Projects related to Road Construction

Project No. 6: Construction of One Part of Agra Bye-pass (Rs.10.65 Crore later revised to 26.91 Crore)

Following were envisaged under the scheme:

1. Construction of 20 Km road parallel to existing 4.7 m wide canal road

Environmental and social Benefits:

This has helped easing vehicle jams on city roads and led to smooth flow of vehicles on 3 National Highways and reduced pollution

Reduction in emissions due to construction of parallel road (20 Km) for every 100 vehicles mix

Post project reduction in emission for i^{th} type of pollutant on a road length L (g or mg/h)
$RE_i = L \times \Delta CF_i \times (\sum EF_{ij} \times N_j)$ (j=1 to 5)

Where:

EF_{ij} = Emission factor for ith pollutant type and j^{th} vehicle type (g/Km)

ΔCF_i = difference in correction factor due to change in speed for i^{th} pollutant type

N_j = number of jth type of vehicle per hour

L= road length (Km)

Pollutant	Emission Reduction
	(g /h)
CO	14383
HC	3201.8
NOx	3794.1
CO_2	638878
PM	20.575
	(mg/h)
Benzene	1007.4

1-3 butadine	95.725
Formaldehyde	146
Acetaldehyde	23.044
Total aldehydes	235.53
Total PAH	4445.3

The above project has resulted in the reduction of pollutant emissions; CO, HC, NOx, CO_2 and PM by 14.4, 3.2, 3.8, 639 and 0.02 Kg/h respectively and other hydrocarbons, benzene, 1-3 butadine, formaldehyde, total aldehydes and total PAH by 1007, 96, 146, 23, 235 and 4445 mg/h respectively considering 100 vehicle mix per hour on the road.

Project No. 3: Widening of Agra Bye-pass (Rs. 0.75 Crore)

Canal patri road 19.9 Km long, to be widened from existing 3.72 m to 4.72m

Status: Completed (length=19.9 Km)

Post project reduction in emission for ith type of pollutant on a road length L (g or mg/h)

$RE_i = L \times \Delta CF_i \times (\sum EF_{ij} \times N_j)$ (j=1 to 5)

Where

EF_{ij} = Emission factor for ith pollutant type and j^{th} vehicle type (g/Km)

ΔCF_i = difference in correction factor due to change in speed for i^{th} pollutant type

N_j = number of jth type of vehicle per hour

L= road length (Km)

Pollutant	Emission reduction (g /h)
CO	14310.6
HC	2548.6
NOx	10067.0
CO_2	726495.9
PM	1637.8
	(mg/h)

Benzene	1002.4
1-3 butadine	95.2
Formaldehyde	145.3
Acetaldehyde	22.9
Total aldehydes	234.3
Total PAH	4423.1

The above project has resulted in the reduction of pollutant emissions; CO, HC, NOx, CO_2 and PM by 1.431, 2.548, 10.067, 726.495 and 1.637 Kg/h and hydrocarbons, benzene, 1-3 butadine, formaldehyde, total aldehydes and total PAH by 1002, 95, 145, 23, 234 and 4423 mg/h considering 100 vehicle mix per hour on the road.

Project No. 8: Improvement of Master Plan of Roads of Agra City (Rs. 21.22 Crore)

Source: Letter Memo/D/EEII/09 dated 18 March 2009

Following were envisaged under the scheme:

1. Construction of 10 Missing Links (Roads Sections) as listed below:

Road No.	Link Location	Length (Km)	Status
1	Mau-Ram Mohan Vihar	0.53	Completed
7	Rishi marg- Maruti Estate	0.448	Completed
8	Maruti Estate-Avadhpuri	0.45	Completed
9	Avadhpuri-Bichpuri road	0.29	Completed
16	Kabir nagar-mphan vihar	0.28	Completed
10	Shastripuram-UPSIDC road	0.55	Completed
15	Shastripuram-NH2	1.5	Completed
13	Shastripuram - Fatehpur sikri road	3.435	Completed
5	Transport nagar-NH2	0.07	Completed
6	Kothi meena bazar	0.3	Completed
2	Rammohan vihar-Kabir nagar-poiya Ghat	0.51	
	Total length (Km)	**8.363**	(7.943 Km has been completed)

2. Construction of 2 New Roads as listed below :

1. Shamsabad-Fatehabad 100' wide road via Nehru enclave (2 Km away from Taj)	1.88	
2. Shamsabad-Fatehabad 125' wide road (4 Km away from Taj)	2.75	
Total length (Km)	**4.63**	(4 Km has been constructed, then stay order)
3. Electrification of master plan roads	Completed	
4. Electrification of above missing links	Completed except for new roads and links No. 2 and 13	
5. Electrification of above new roads	Completed	
6. Strengthening of some(C, E, F, G, H, I, J) master plan roads (map enclosed as **Fig. 4.1**)	Completed 9.25 km against projected 9.75 km	

Calculation of emission reduction due to construction of missing links

Emission for i^{th} type of pollutant (g or mg/h) $E_i = L \times CF_i \times (\sum EF_{ij} \times N_j)$ (j=1 to 5)

Where:

EF_{ij} = Emission factor for ith pollutant type and jth vehicle type (g/Km)

CF_i = speed correction factor for ith pollutant type

N_j = number of jth type of vehicle per hour

L= total road length (Km)

Pollutant	Emissions before the project (g /h)	Emissions after the project (g/h)	Emission Reduction (g/h)
CO	25704.1	4816.2	20887.9
HC	4577.7	850.7	3727.0
NOx	13059.1	3723.5	9335.5
CO2	1087416.6	224264.8	863151.7
PM	1650.6	654.0	996.6
	(mg/h)	**(mg/h)**	**(mg/h)**
Benzene	1440.4	314.7	1125.7
1-3 butadine	136.8	9.9	126.9
Formaldehyde	208.7	50.6	158.1
Acetaldehyde	32.9	5.2	27.7
Total aldehydes	336.7	80.0	256.7
Total PAH	6355.6	1850.7	4504.9

The above project has resulted in the reduction of pollutant emissions; CO, HC, NOx, CO_2 and PM by 20.888, 3.727, 9.335, 863.152 and 0.997 kg/h and hydrocarbons, benzene, 1-3 butadine, formaldehyde, total aldehydes and total PAH by 1126, 127, 158, 28, 257 and 4505 mg/h in Agra considering 100 vehicle mix per hour.

Calculation of Impact on Taj Mahal by Construction of 2 New Roads

1. Shamsabad-Fatehabad 100' wide road via Nehru Enclave (1.88 Km), 2 Km away from the Taj
2. Shamsabad-Fatehabad 125' wide road (2.75 Km), 4 Km away from the Taj

Impact of shifting of diversion of vehicles, for changeover between Shamsabad and Fatehabad roads, from 500 m to 2-4 Km away from Taj by implementation of the project was predicted by approximate simulation of roads and running CALINE 4 model of USEPA for worst case meteorology conditions (SE winds,

low mixing height, low ambient temperature etc). The impact (units) and percent reduction are tabulated below:

	Impact at 500 m	Impact at 2 Km	Impact at 4 km
Before the project	104	--	--
After the project	--	22	21

Change in impact of vehicular traffic on the Taj due to construction of new roads 2-4 Km away from Taj

Worst Case Scenario	Unit
Impact before the project (at 500 m)	104
Impact at 2000 and 4000 m	22
Impact reduction (%)	80

Thus the impact reduction of 80 percent is expected by the implementation of this part of the project.

The annual average concentration of air quality parameters as reported in the literature (Source: Draft report "Environmental Post Evaluation of the Projects Under the Schemes in the Taj Trapezium Zone", NEERI, Nagpur, August 2008) is depicted in the **Figs. 4.2-4.4** for SPM, SO_2 and NO_2 during 1996 –2006. The pollutant concentration during 2001-2002, when most of the above projects were completed, was the least. Various other interventions, viz. reduction in sulphur concentration in fuel, use of CNG, replacing diesel/petrol operated vehicles with battery operated vehicles etc within 500 m of the Taj have also contributed to change in ambient air quality in the Taj Mahal area. Further change in ambient air pollution concentration over the years after 2002 may be attributed to rise in human and vehicular population.

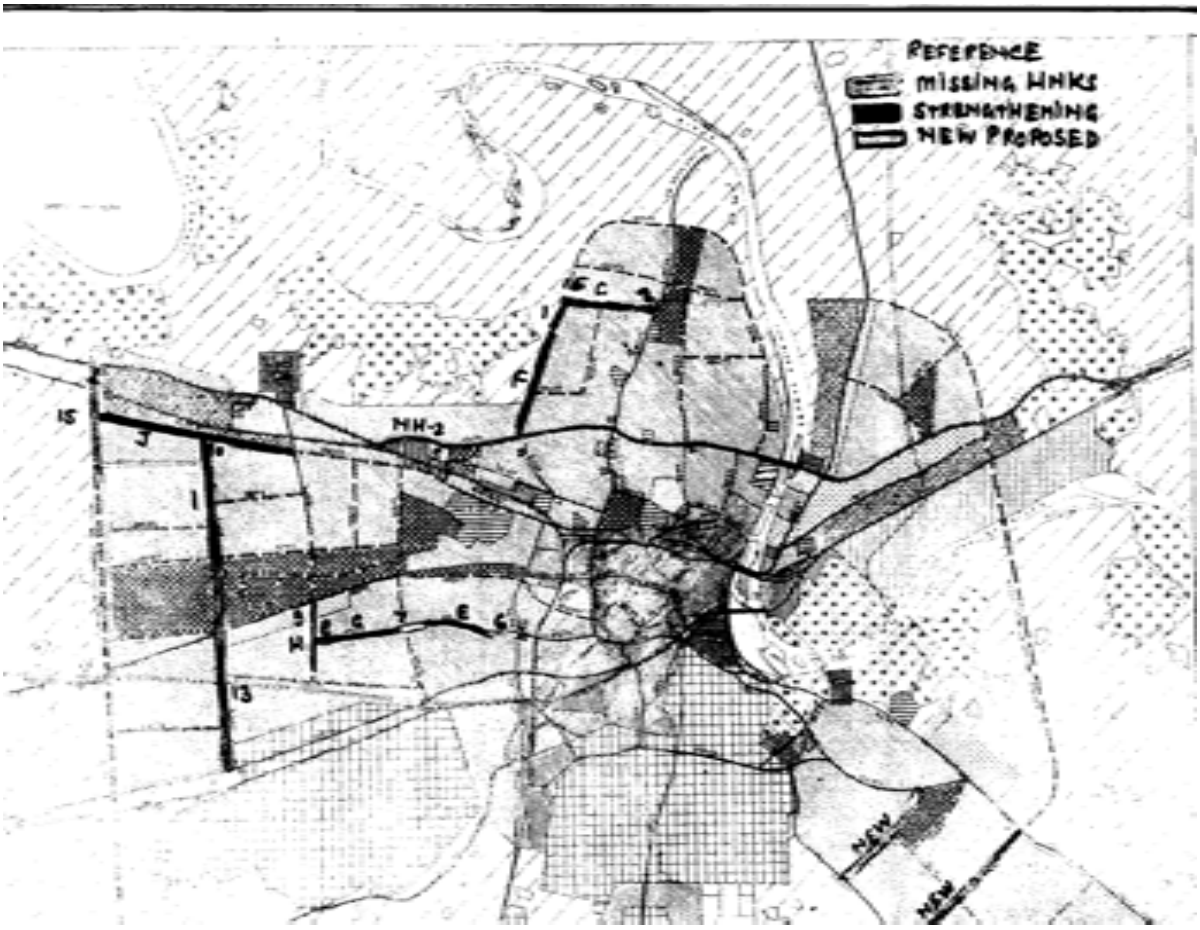


Fig. 4.1: Agra city map showing Missing Link and New Roads

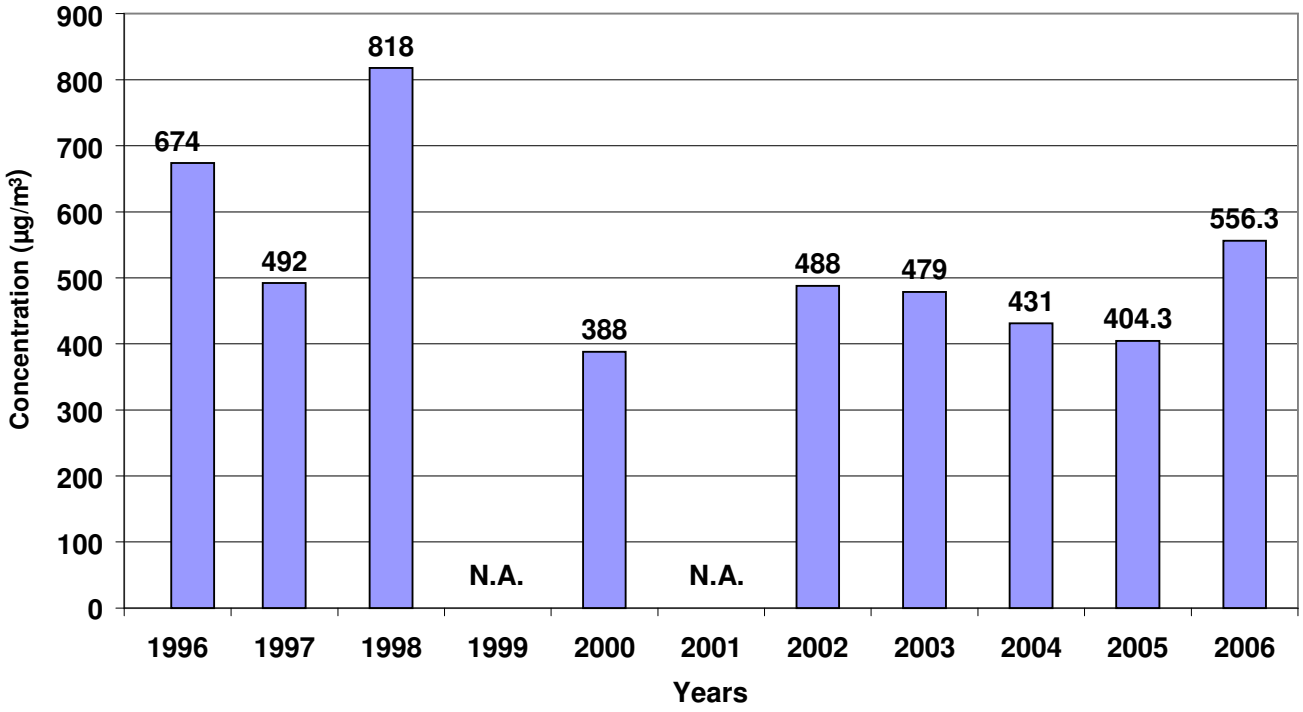


Fig. 4.2: SPM Concentration in Agra: Temporal Variation

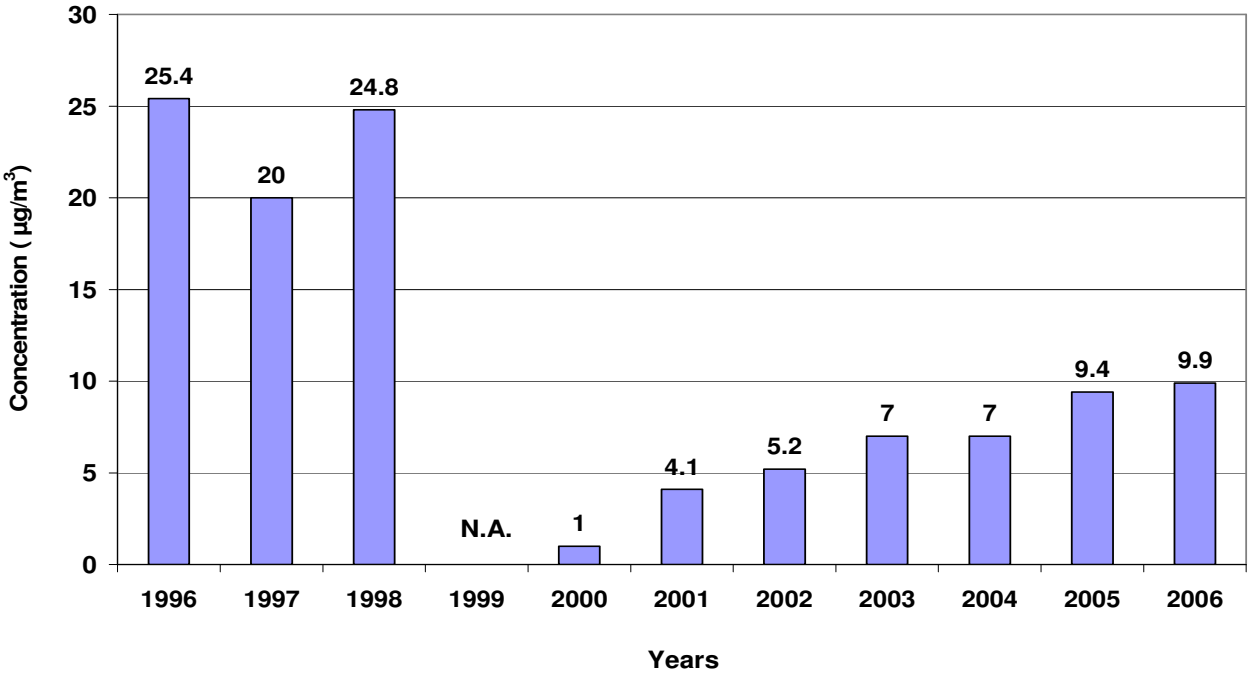


Fig. 4.3: SO_2 Concentrations in Agra: Temporal Variation

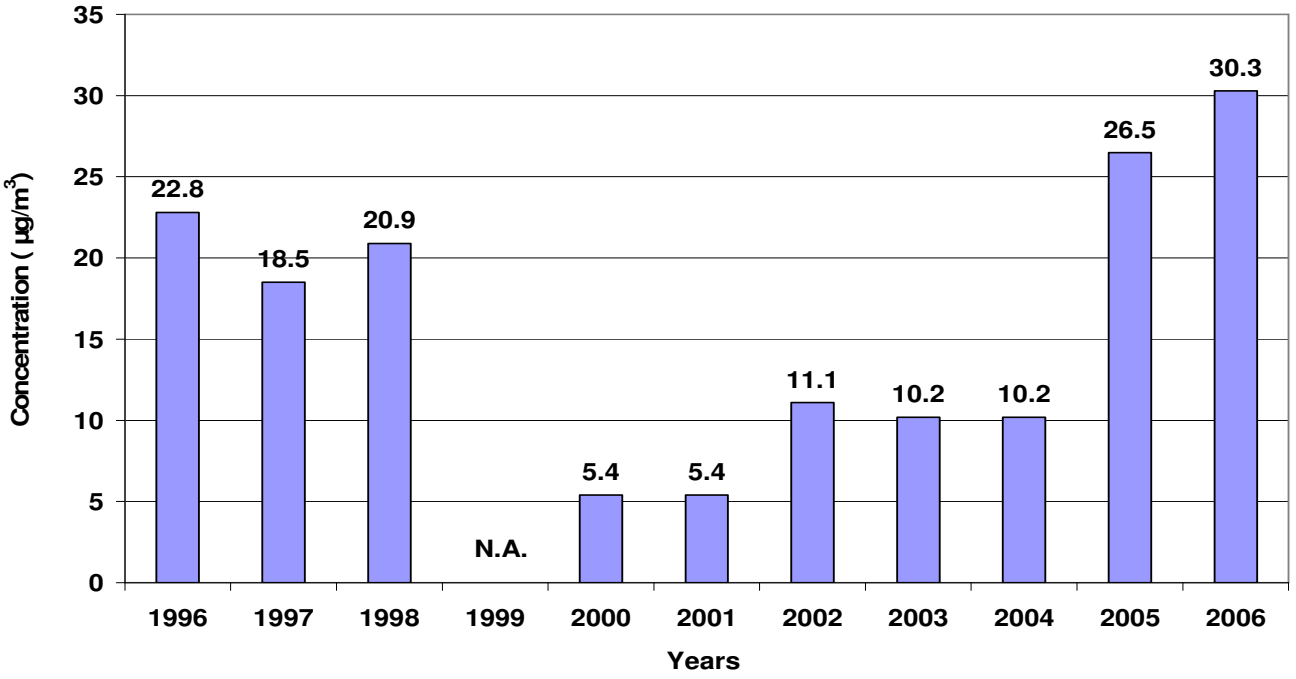


Fig. 4.4: NO_2 Concentrations in Agra: Temporal Variation

Comparison of Air Quality at Taj Mahal with Nearby Areas

Air quality of Taj Mahal with respect to SPM, RSPM, SO_2 and NO_2 has been compared in the **Figs. 4.5-4.8** with the nearby areas. The annual average concentration of each pollutant at the four sites, viz. Taj Mahal, Itmad ud Daulah, Rambagh and Nunhai have been plotted for the years 2004 to 2006. The figures clearly show that the air quality at Taj Mahal is better with respect to all the 3 other stations. However, the SPM and RSPM concentrations at all the four sites are above the CPCB limit of 70 and 50 µg/m^3 respectively. The annual average concentration of SO_2 is within the CPCB limits of 15 µg/m^3 whereas the annual average NO_2 concentration has exceeded the CPCB limit of 15 µg/m^3.

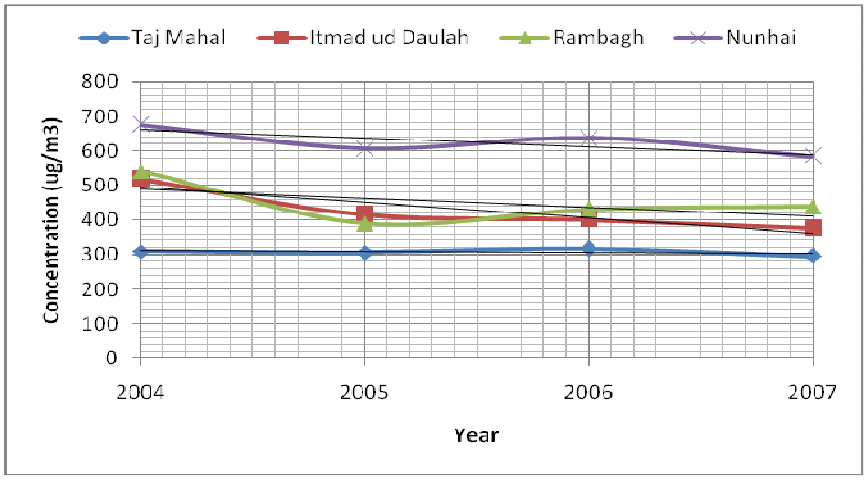


Fig. 5: Comparison of Taj Mahal Air Quality with that of Nearby Area: SPM

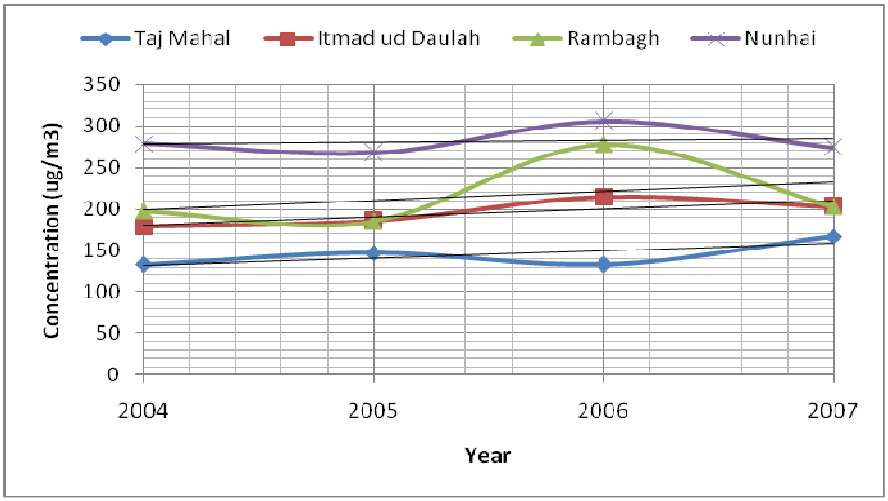


Fig. 6: Comparison of Taj Mahal Air Quality with that of Nearby Area: RSPM

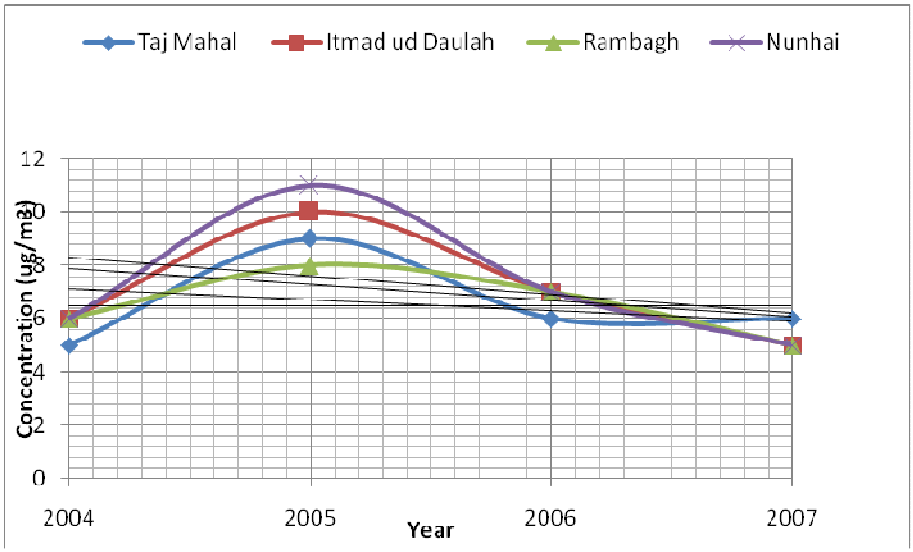


Fig. 7: Comparison of Taj Mahal Air Quality with that of Nearby Area: SO_2

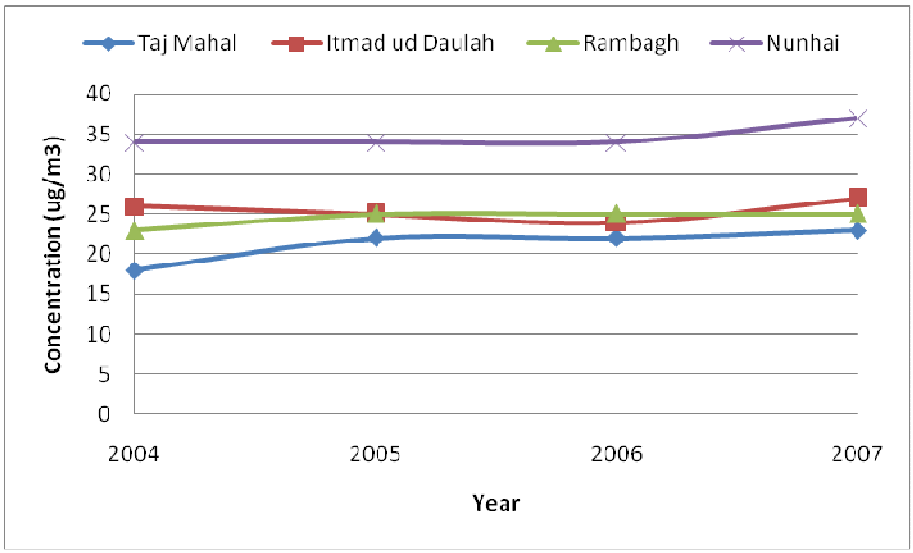


Fig. 8: Comparison of Taj Mahal Air Quality with that of Nearby Area: NO_2

Comparison of Agra air quality with nearby cities:

(Source: CPCB Annual Report 2006-07)

TTZ is one of the air pollution sensitive zones in the country. The CPCB compared the ambient air quality of Agra with the nearby cities, viz. Mathura, Firozabad and Bharatpur during winter months in 2006-07. The three most critical parameters, viz. SPM, SO_2 and NO_2 were measured. In addition, total soluble organic fraction (TOSF) in SPM was also measured in order to assess the anthropogenic origin of the organic fraction in SPM. The data (**Table 4.1**) of the organic fraction in SPM revealed that the anthropogenic sources are the maximum at Nunhai Industrial area in Agra, followed by Industrial area in Firozabad (maximum industries using coal). Mathura had the least organic fraction in SPM. PM2.5 concentration at Taj Mahal has been reported to be 246 µg/m^3 in winter months and 25 µg/m^3 during monsoon. These levels are higher than the 24-h average US EPA standard of 15 µg/m^3 (***Annexure-V*).** India has not yet set standards for PM2.5.

Table 4.1

Comparison of Ambient Air Quality of Agra with Neighboring Cities (source: CPCB Annual Report 2006-07, a print out of the relevant pages of the Report is appended as *Annexure VI*)

City		Mathura			Agra			Firozabad	
Parameter	**Krishna Nagar**	**Industrial Area**	**Janam Sthan**	**Itmad ud Daulah**	**Nunahi**	**Taj Mahal**	**Rambagh**	**Mahavir Nagar**	**Industrial Area**
SPM	720	862	510	514	814	463	597	971	936
SO_2	26	51	13	17	BDL	34	8	10	29
NO_2	44	35	34	46	51	51	25	47	81
TSOF in SPM	18	9	27	31	70	24	27	23	36

BDL: below detection limit

4.3 Post-Project Environmental Evaluation of Gokul Barrage

Construction of the barrage on Yamuna River has bought mixed results to the public and environment at large. Some salient features of the project include :

- The barrage is designed to store about 13,017 acre-foot (23.94 million cubic meters) of water.
- The total catchment area of the barrage is about 25900 square kilometer and discharges about 3.35 lakh cusecs.
- The project initiated for augmentation of surface water supply for drinking purpose to Mathura and Agra has resulted in supply of 282 MLD to Agra and 73.5 MLD to Mathura. The quantum of water supply released to Vrindavan was not available/ provided.
- The project implementation also aimed at increasing the ground water table. However, based on the UPJN report on ground water availability at site, the data indicated that the depth of groundwater availability is increasing since the project completion. This may be due to increased abstraction of ground water in the area.
- The flow in the river downstream has been impacted as a result of the impoundment, and the characteristics of the river Yamuna has changed due to reduced flow conditions downstream. The quality of impounded water of the barrage with respect to dissolved oxygen meets the CPCB classification D for propagation of wild life and fisheries in inland surface water Standards, however, fail to meet the BOD parameter (**Table 4.2**). However, some reports have even suggested worsening of the pollution on Yamuna since inception of the barrage (Devendra Bhargava, 2006, Revival of Mathura's ailing Yamuna River, Environmentalist, 26: 111–122). Large-scale growth of water hyacinth was also found in the river at the Gokul barrage in Mathura.
- The TDS concentration in the ground water samples from the nearby areas indicated concentrations in the range 777-1664 mg/l (**Table 4.3**). However, the TDS concentration of the ground water collected from hand pumps was considerably higher in downstream vis-à-vis upstream quality. Some hand pumps water quality does not meet the CPCB classification E (Irrigation, Industrial cooling and controlled disposal) of water quality for conductivity.

- The surrounding area near the barrage has increased vegetative cover due to availability of water.
- Construction of a four lane road on the barrage with foot path on both sides has resulted in partial traffic reduction in Mathura due to diversion of vehicles through the barrage, reducing waiting times. **Fig. 4.9** presents the increase in number of vehicles over the bridge since project implementation.

Table 4.2

Surface Water Concentration of Dissolved Oxygen and BOD in Gokul Barrage Project

Year	Dissolved Oxygen mg/l	BOD mg/l	Designated Best Use Classification of Surface water- Central Pollution Control Board
2002	6.8	14.6	Class D- Propagation of Wild life and Fisheries – Dissolved Oxygen : ≥4mg/l – BOD : < 6 mg/l
2003	5.4	16.8	
2004	6.1	15.4	
2005	5.9	14.9	
2006	5.6	13.5	
2007	5.5	14.7	
2008	5.8	15.6	
2009	5.3	16.1	
Source: UP Irrigation Department, Mathura			

Table 4.3

Storage and Discharge from the Barrage

S. No.	Sampling Location*	Conductivity (µS/cm)	TDS (mg/L)
At Stream Point			
1	Up Stream-I (~20 m from barrage)	1760	904
2	Up Stream-II (~30 m from barrage)	1744	867
3	Mid Stream (at barrage)	1767	892
4	Down Stream (~50 m from barrage)	1745	900
Up Stream Ground Water Sample			
5	Hand Pump No.-I (~10 m from Gokul Water Treatment Plant)	1746	883
6	Hand Pump No.-II (~20 m from Gokul Water Treatment Plant)	1400	777
7	Hand Pump No.-III (~100 m from Gokul WTP, in nearby adjacent residential colony)	3345	1664
Down Stream Ground Water Sample			
8	Hand Pump No.-I (~150 m from barrage, adjacent to small Shiv temple, Gokul)	1827	1051
9	Hand Pump No.-II (140 m approximately from barrage, behind the small Shiv temple)	2810	1284
10	Hand Pump No.-III (~350 m from barrage, in residential colony upwards of Shiv temple)	1746	1002
***Sampled on 29/04/09**			

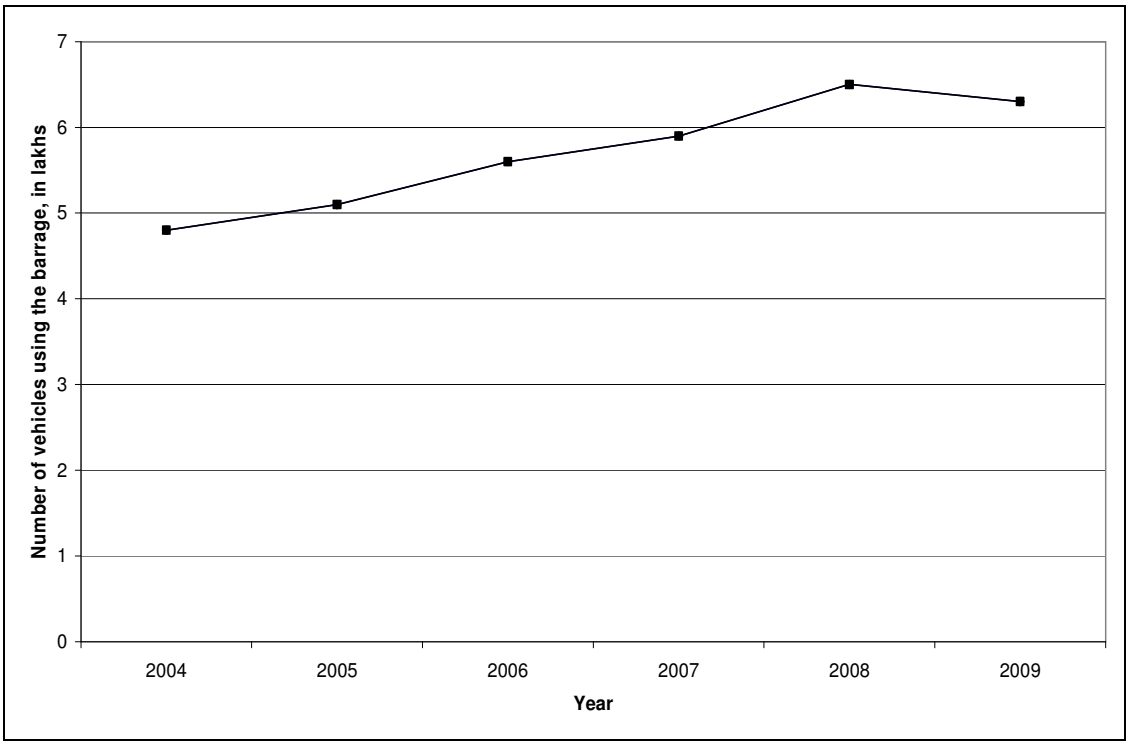


Fig. 4.9: Passage of Vehicles through the Bridge

4.4 Post-Project Environmental Evaluation of Storm Water Drainage

Storm Water Drainage Network in the City

The existing drainage system, as per the data available with UPJN, indicated that the drainage system in the city has been classified into 11 major catchments/zones and a number of kacha open drains. Around 21 major open drains spread across the entire Agra city, collect and convey the storm water finally into river Yamuna (**Fig. 4.10**). However, no data is available on the details of the catchment area served by the drains. Table 4 presents the 21 major drains in the city and the coverage areas (names) of the respective drains with discharge points. Mantola and Bhairon drains are the largest drains. In addition, there are several medium and small drains which discharge into the major drains.

Challenges in the Maintenance of Existing Storm Water Drains

Agra city is densely built up with a network of manmade and kacha drains for collection and conveyance of storm water. The drains are of composite nature with lined and unlined sections, trapezoidal and rectangular sections, regular and irregular sections. However, the existing conditions of the drains are not good, as far as structures are concerned. These drains are not functioning properly due to silting and accumulation of solid waste, which are not cleaned regularly by the authorities. There is no arrangement at outfall locations drains/nallas for arresting the solid waste, which is finding its way finally into the river (Exhibits 4.1 to 4.8). Also, the outfalls of the drains are not provided with control structure to avoid back flow from the river.

The city lacks a sewerage system for collection and conveyance of the domestic and industrial effluents. A small area of the city (1400 ha.) has been covered by an aging sewerage system out of total area of 8360 ha of the city. The old system that exists in 1400 ha area is inadequate due to increase in population and extension of habited area. In the absence of comprehensive sewerage system, the storm water drains carry raw sewage and discharge directly into river Yamuna. As a result, most of the drains presented in the **Table 4.4** carry domestic sewage laden with solid wastes.

Status of Storm Water Drain constructed under the Project

UPJN has constructed four drains in Agra city in coordination with the ANN and Agra Development Authority (ADA). **Table 4.5** presents the current status of the project implementation as provided by the UPJN. The data revealed that more than 92% of the work

was completed in Mustfa Quarter area, Sikandra area, and Naval Ganj area. However, only 62% of the work was completed in Bhim Nagar area as the work has been stopped by the monitoring committee. An expenditure of 450.01 lakh has been incurred on the work executed as against the financial grant of Rs. 565.38 lakh.

The ANN undertakes annual maintenance of the storm water drains constructed in Agra city before monsoon. Based on the information available with the ANN, Table 4.6 provides the desilting and repairing activity undertaken during the year 2007 for maintenance work including the cost incurred. Maintenance work comprising desilting was carried out in Paliwal Park, Mantola, Bhairon and Taj East Gate drains covering around 4.49 km stretch. The expenditure incurred towards the maintenance work was Rs. 94.48 lacs as against the grant of Rs.94.62 lacs.

Cleaning of storm water drains as indicated in the Table 4.6 has resulted in partial reduction of clogging of the drains mentioned and reduced waterloging in the respective catchment areas as claimed by the concerned authority. However, the activities needed to be undertaken in all the major drains discharging into river Yamuna wore to improve upon the environmental status.

The implementation of the project has literally not gained much advantage in terms of development of the facility benefiting the environmental status of the area under study.

Issues of Concern in Storm Water Drainage System

The problems of existing storm water drainage system in Agra city are as follows:

- Open drains: The storm water drainage provided are open, allowing disposal of garbage, polythene bags, waste material and construction debris thereby reducing the drain capacity and choking leading to flooding during monsoon.
- Siltation: Since most of the drains are open, lot of silt deposits in the drains reducing the carrying capacity. Choking of the drains at culverts is a common feature.
- Domestic sewage/wastewaters: Majority of the storm water drains were observed to carry domestic sewage from the residential and commercial areas in absence of sewerage system.

- Encroachment: Most of the drains in the commercial areas of the city were encroached by the shopkeepers (extending their shops or constructing steps towards their shops). Construction of temporary toilet shades over drain was also observed. In some areas, there was no service road/lane to access the drain for cleaning or repair.
- Water logging: The vacant land and low lying areas have been progressively developed with building construction. The old ponds, which used to hold excess storm run-off, have now been habited. This aggravated the problem of water logging.
- Vegetation near drains: Penetration of roots from nearby trees through the cracks in the drains and growth of plants inside the drain eventually leads to choking of the drains.
- Lack of storm water drains: There is inadequate provision of storm water drainage in the newly developed areas of the city.
- Inefficient cleaning: The city has poor facility for cleaning and maintenance of the drainage system due to limited resources.

Table 4.4

Storm Water Drains in Agra City and the Coverage Areas

Sr. No.	Drain name	Coverage areas	Discharge points
Kachha Drains - Cis-Yamuna			
1.	Rajwaha	Rajwada, Sita Ram Colony, New Adarsh Nagar, Ganga Gauri colony, Balkeshwar Road	Routed to STP of capacity 78MLD (Dhandpura STP) and finally discharged into Yamuna river
2.	Balkeshwar	Nagala Thipri, Lohiya Nagar, New Saraswathi Nagar, Balkeshwar Road	
3.	Water Works	Kaushal Pur, Bhagwan Crossing, Indra Puri, Suresh Nagar, Nehru Nagar, Mughal Road, Karbala, Nagla Bihari, parts of Kamla Nagar, Sultan Ganj, Langre Ki Chauk, Jeoni Ma, Water works Chauraha crossing	
4.	Krishna Colony	Patel Nagar Road, Laxmi Mill Crossing, Krishna colony and Jeoni Mandi	Directly into river
5.	Paliwal	Jewamo Mandi, Bhairon Bazaar, Yamuna Kinara Road	Directly into river
6.	Bhairon	Nagla Beni Prasad, Gandhi Nagar, Valmiki Basti, Paliwal park Road, Moti LL Nehru Road, Old Vijay Nagar, Ambedkar Nagar, Peer Kalyani, Railway Maal Godam, Wazeerpura Road, Sanjay Place Road, Chimman Lal road, Free Ganj, Ghas Ki Mandi Road, Madar Gate, Belan Ganj, Bhairon Bazaar	Pumped from Bhairon Sewage pumping station into Yamuna river
7.	Belanganj	Joins Bhairon Ganj	
8.	Khoja	Jeen Khana, Kala Mahal, Gulab Khana, Kotwali, Gali, Kacheri Ghat, Drum Mandi, Baans Darwaza, Belan Ganj, Chatta Bazaar	Directly into river
9.	Papal Mandi	Maal Ka Bazaar, Peepal Mandi, Ram Chand Gupta Road, Namak Ki Mandi, Daresi, Fountain Chauraha, Chatta Road	Directly into river
11.	Taj West Gate	Taj Tourist Shopping Complex, Taj Mahal Parking, Sham Shan Ghat, Udhyan nursery	Directly into river
12.	Taj East Gate	Rajpur, Shamshabad Road, Vashistpuram, Kalindi Vihar Road, Bank Colony, Bagh Rajpur, Pakki Sarai, Lacchipura, Shaheed nagar, Kareem Nagar, Gobar Chauki, Harjupura, Gummat, Purani Mandi, Taj Ganj, Navada, Impeypura, Bagichi Patira, Park Tola, Basai Kalan, Marutam Nagar, Billochpura Tajganj, Telipara, Kohai, Taj East Gate Road	Directly into river

Sr. No.	Drain name	Coverage areas	Discharge points
Constructed drains			
13.	Mantola	Bichpuri Road, Maghatai Village, Pakka Bagh, Amarapura, Bharatpur road, Manish Nagar colony, Bodla Sarai, Bodla Chauraha, Awas Vikas colony, Kishorpura, Hanuman Nagr, **Bhim Nagar**, Gadhi Bhadoria, Gopal Pura, Khatena, Alam Ganj, Nauvasta, Sirki Mandi, Gokul Pura, Shankar Garh, Ram nagar ki puliya, Kothi Meena Bazaar, Saket colony, Nai Ki Mandi, Chungi quarters, Mantola area, Hing Ki Mandi, Teela Gaj singh, Mahavir Cinema, Jama Mazjid, Dholi Khar etc.	Directly into river.
14.	Sikkandara	**Sikkandara area,** Bain Ka bazaar, Gurudwara.	Into river through Kakraita forest
15.	Arjun Nagar	Azampada, Nagla Prithvi, Kedar Nagar puliya, Fatehpur sikhri, Gyaspura, Arjun nagar, Bara Khamba, Sona Nagar, Ajit Nagar, VIP Road, Shyam Nagar, Kheria Road, Kishan Garh, Nagla Chaua, FCI, Sarai Khwaza, Idgah railway station, Idgah colony, Namner Road, **Mustafa Quarters area**, Prithvi Raj Road, Sultanpura, Cantt. Station Road, Chippitola, Dholikhar**.**	Disposal into Mantola drain.
Kachha drains-Trans-Yamuna			
16.	Pilakhar	Balaji Nagar, Mahavir Nagar, Mandi Samiti, Peela Khar, Nagla Bihari, Shadara Road, Nunhai link Road.	Routed into STP of capacity 10MLD (Pilakhar STP) and finally and discharged into river
17.	Industrial Estate	Nunhai Road, Industrial Estate	
18.	Motimahal	Motimahal and immediate surrounding areas	Directly into the river.
19.	Ram Bagh	Foundary nagar, Naraich, Agra Hathras Road and Trans-Yamuna colony.	Into STP of capacity 10MLD (Pilakhar STP) and discharged into Yamuna river
20.	Naunihai	Nunhai Industrial estate and surrounding areas	
21.	**Constructed drains**		
	Etamad-ud-daula	Nagla Balchand, **Naval Ganj**, Etmad-ud-daula road, Katra Wazir Khan, Ram Bagh Chauraha Road, Moti Bagh, Seeta Pur.	

Source: Uttar Pradesh Jal Nigam

Table 4.5
Status of Storm Water Drainage Scheme
(Status February 2009)

Sr. No.	Work	Provision	Work level
A.	DRAIN		
1.	Bhim Nagar Area	6.25 km	62% complete. Work stopped as per direction of monitoring committee
2.	Naval Ganj Area	4.73 km	100% completed
3.	Sikandra Area	2.30 km	95% completed
4.	Mustfa Quarter Area	5.35 km	92% completed
B.	FINANCIAL (in lakh Rupees)	565.38 (Granted)	Rs.450.01 (Incurred)

Source: Uttar Pradesh Jal Nigam

Table 4.6

Maintenance of Storm Water Drainage System and Expenditure Incurred (Status in December, 2007)

Sr. No.	Project Requirement	Physical Target	Financial Allocation Rs. in Lacs		Remarks
			Granted	Expenditure	
1.	Desilting of Paliwal Park drain	0.980 km	5.92	5.83	Completed
2.	Desilting and repair of Mantola drain	1.770 km	31.27	31.30	
3.	Desilting of Bhairon drain	0.483 km	1.33	1.25	
4.	Desilting of Taj East Gate drain	1.260 km	56.10	56.10	
	SUB TOTAL	4.493 km	94.62	94.48	

Source: Agra Nagar Nigam

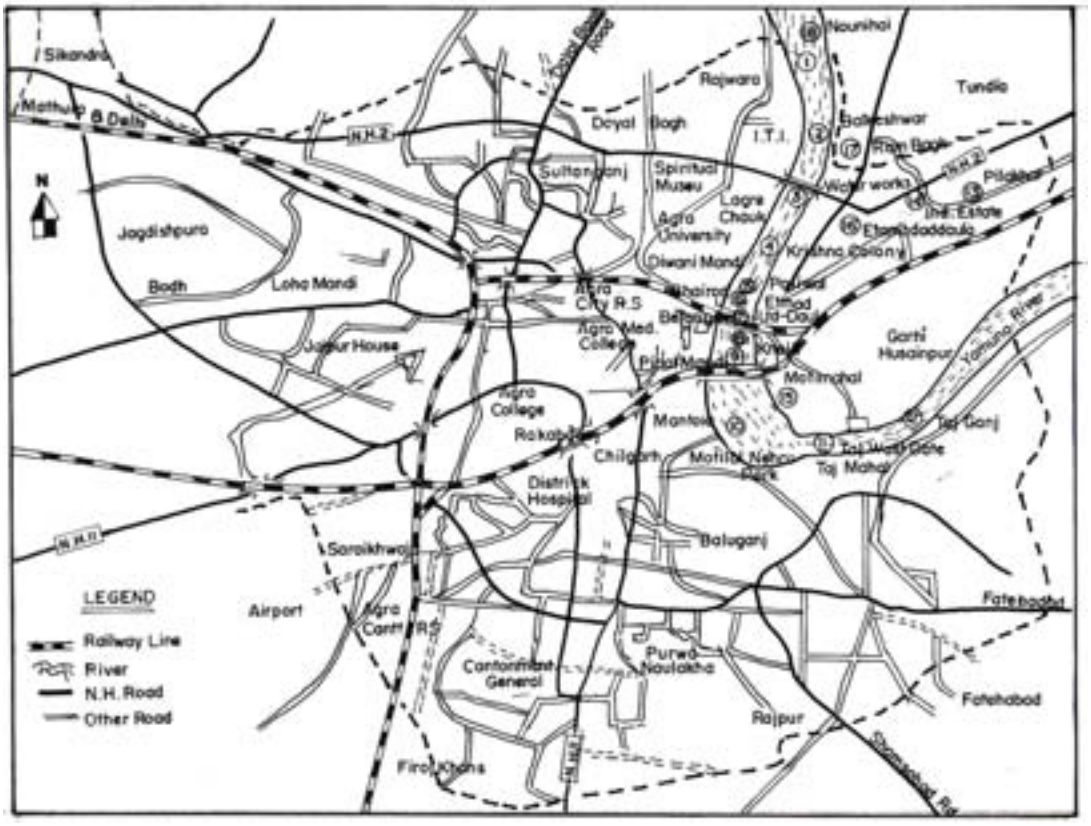


Fig. 4.10: Location of Major Storm Water Drains Discharge into River Yamuna

Exhibit 4.1: Broken Storm Water Drains which helps in increasing Silting and Seepage from the Surrounding Environment

Exhibit 4.2 : Indiscriminate Disposal of Solid Wastes in Open Storm Water Drains in Azampara drain

Exhibit 4.3 : Storm Dater Drain near Agra Fort discharging into Yamuna River

Exhibit 4.4: Sludge and Silt Removal from Storm Water Drains by Workers. Workers not protected while undertaking the task

Exhibit 4.5: Storm Water Drain in the Yamuna Kinara Road near Jahangir Palace Taj Mahal seen in the background about 2.0 km from the Site

Exhibit 4.6: Bhairon Drain Outfall in Yamuna River

Exhibit 4.7: Excavated Silt Material in front of a House blocking entry to the House and reducing the Width of Road

Exhibit 4.8: Excavated Silt and Sludge is dried on the Roads before removed through Excavator for Disposal into Low-Lying Area

4.5 Post Environmental Evaluation of Solid Waste Management Project

For proper management of MSW generated at the rate of about 650-710 tonnes per day, funds of Rs. 749.00 lakh were received in different installments by AMC, which also included the budgets for construction of latrines and mud pumps in different areas. The amount was approved in 1998-99 against the proposal submitted by AMC to the government. **Table4.7** indicates the amounts released in different installment and their utilization as per the information provided by Agra Municipal Corporation. As reported by Agra Municipal Corporation, various infrastructure facilities were established and equipments were procured during project period (1999-2003). It has also been reported by AMC that, in majority cases, target has been achieved. **Table 4.8** indicates the status of procurement of infrastructure facilities, as reported by AMC.

The following observations on solid waste management have been made during the visit of the NEERI scientists:

Observations on Collection and Storage System for MSW

- House to house collection is not carried out rigorously
- Segregation of dry waste and wet waste is not carried out in an organized manner and on a large scale. Even in some community bins, biomedical waste was found along with municipal solid waste

Table 4.7

Fund Released against the Project Budget and its Utilization by AMC

Sr. No.	Go No. and Date	Amount Released (Rs. in lakh)	Amount Utilized (Rs. in lakh)	Amount Returned (Rs. in lakh)
1.	1094/9-5-98-99 ct V 97 date 30.03.1998	342	714.36	34.64
2.	1394/9-5-98 date 09.05.1998	100		
3.	2971/9-5-98-13 ct V /98 date 26.08.1998	200		
4.	3675/55-I; kZ-2000 date 26.08.2000	107		

Source: Agra Municipal Corporation

Table 4.8

Infrastructure Proposed and Procured by AMC (Period 1999-2003) in the Project

Sr. No.	Item	Number Proposed/ Targeted	Number Achieved
1.	Dumper Placer Vehicles (for container capacity 8 cum)	16	16
2.	Dumper Placer Vehicles (for container capacity 4.5 cum)	14	14
3.	Dumper Placer Bins (8.0 cum capacity)	200	200
4.	Dumper Placer Bins (4.5 cum)	160	160
5.	Wheel Dozer (10 tonne)	1	1
6.	Excavator/Loader	2	2
7.	Tipper trucks (10 cum capacity)	10	10

8.	Jeeps	2	2
9.	Handcarts	750	750
10.	Tipping handcarts	500	500
11.	New workshop with equipments	1	1
12.	Dumping grounds	3	• At present no sanitary landfill is available and scientific landfilling is not practiced. Only indiscriminate dumping of waste is carried out • One site was in use for uncontrolled disposal of waste and recently operation has been stopped • One site is in temporary use • One site has been identified by AMC for future use
13.	Community toilet	8	8
14.	RCC Platforms for DP bins	40	133
15.	Mud/sullage pumps	8	8

Source: Agra Municipal Corporation

- It was observed that roadside dumps have been created at some locations. Some of the roadside dumps were observed at Karbala, near Lalmasjid, Saint Merry Church etc. It has been reported that there are 200 roadside dumps spread over Agra city. This is due to inadequate and inappropriate allocation of bins, improper assessment of location-wise waste generation and lack of public awareness. There are places where roadside drains are filled with MSW. At some places, though there are bins, waste is lying outside. Many bins are very old and need replacement. Some of them were observed at near Etmad Thana, Etmad Dargah, etc. Exhibits **4.9, 4.10 and 4.11** show roadside dumps and bins in poor condition.

Observations on Transportation System

- Many open body trucks/tipper trucks are used instead of closed body vehicles for transportation of waste. This practice is not eco-friendly.
- Some of the vehicles are old. It is necessary to replace these vehicles

- At present no MSW transfer station is available at Agra. This creates problems specially when the collection spots are located far away from the disposal site
- Some vehicles are parked in open place. This deteriorates the condition of vehicles and causes reduction of active life of the vehicle

Observations on Disposal System

- There is no sanitary landfill site for MSW disposal assigned for Agra city. Therefore, MSW is dumped openly in specific locations. At these sites there are no liners and leachate collection facility. Compaction of waste is not carried out. Soil cover is not applied over the waste. The previous dumping ground was located at Shahdra near Nangla-Rambal area. Recently, dumping of MSW in this area has been discontinued. At present, MSW is dumped near Chhalesar (West) railway station. Uncontrolled disposal is being practiced in this area also. A site at Kuberpur (near modern slaughter house) has been proposed for developing sanitary landfill. Exhibits **4.12 to 4.17** show the old, present and proposed disposal sites of Agra.

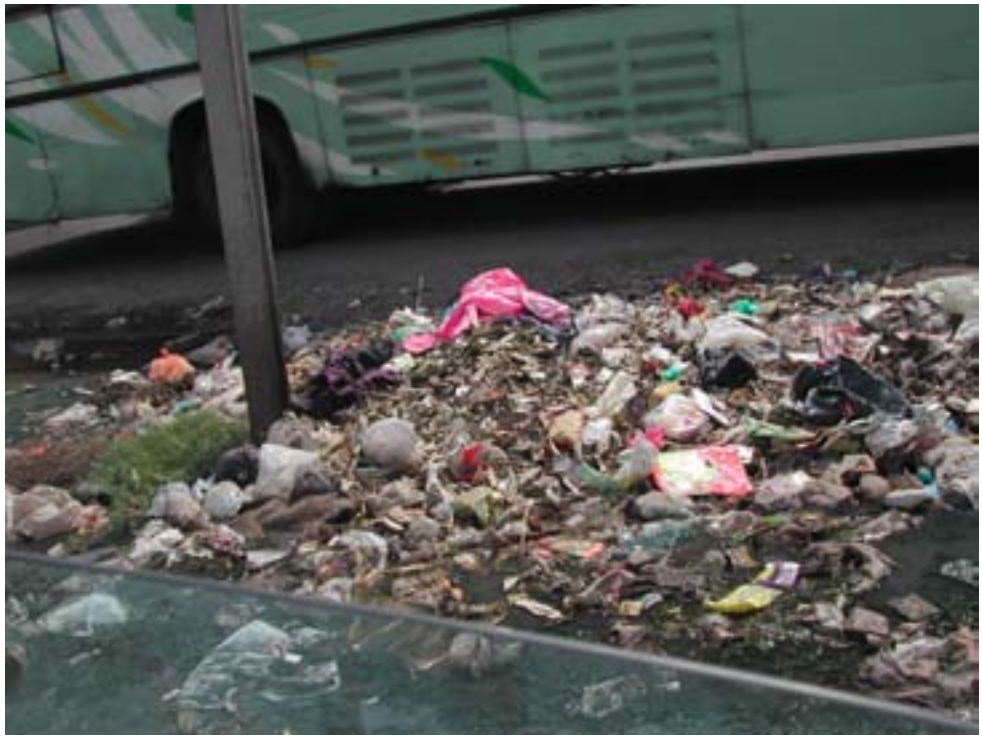


Exhibit 4.9: Open Roadside Dumps

Exhibit 4.10: Dumper Placer Bin in Improper Condition

Exhibit 4.11: Lifting of Waste from Roadside Dump

Exhibit 4.12: Old Disposal Site near Nangla-Rambal

Exhibit 4.13: Old Disposal Site near Nangla-Rambal

Exhibit 4.14: Active Landfill Site near Chhaleswar (West) Railway Station

Exhibit 4.15: Active Landfill Site, near Chhaleswar (West) Railway Station

Exhibit 4.16: Proposed Sanitary Landfill Site at Kuberpur

Exhibit 4.17: Proposed Sanitary Landfill Site at Kuberpur

Observations on Processing System

- No proper waste processing facility for treating a large amount of biodegradables is available in Agra.

Observations on Occupational Heath Aspects

- At present only dresses/uniforms are provided to the workers. No protective materials are provided to the workers for protection of health.
- Heath check up programme for workers is not conducted

Ranking of Existing Solid Waste Management System

Ranking exercise has been carried out to evaluate the existing solid waste management system. A maximum mark of 1000 was distributed to the following activities/factors influencing the management activities on the basis of importance.

- Waste characteristics
- Climatic condition
- Collection of waste
- Storage of waste
- Transportation of waste
- Treatment of waste
- Disposal of waste

Various criteria were identified for each activity and accordingly the marks were allotted. Four gradations viz., very good, good, fair, and not satisfactory were assigned against different ranges of score. Criteria and results of ranking are presented in **Table 4.9 and 4.10**. As per ranking, solid waste management of Agra can be placed in 'fair' category.

Table 4.9

Ranking Criteria for Solid Waste Management System

Sr. No.	Criteria	Marks Allotment	Marks of Agra
1.	**Waste Characteristics**	**100**	10
i	Plastic content	60	
	Plastic content is less than 3%	60	
	Plastic content is between 3-8%	40	
	Plastic content is more than 8%	10	
ii	Biodegradables	40	20
	Biodegradables content is less than 30%	40	
	Biodegradable content is between 30-50%	20	
	Biodegradable content is more than 50%	10	
2.	**Climatic condition**	**80**	**40**
	Cold climate	80	
	Hot and dry	40	
	Humid and wet	20	
3.	**Collection of waste**	**150**	
i	Mode of collection	30	10
	House to house collection is adopted in most of the areas	30	
	House to house collection is adopted in some areas	20	
	House to house collection is adopted in a few areas/not adopted	10	
ii	Source segregation	30	10
	Source segregation is adopted in most of the areas	30	
	Source segregation is adopted in some areas	20	
	Source segregation is adopted in a few areas/not adopted	10	

Sr. No.	Criteria	Marks Allotment	Marks of Agra
iii	Sweeping implements	20	20
	Mostly mechanical sweepers/long handled brooms are used	20	
	Mostly short handled brooms are used	5	
iv	Frequency of sweeping	20	6
	Mostly frequency is 2 to 3 in a day	10	
	Mostly frequency is once in a day	6	
	Mostly frequency is one in two days	2	
v	Collection efficiency	25	10
	More than 90%	25	
	Between 70-90%	15	
	Less than 70%	10	
vi	Protective garments for collection staff	25	15
	Protective garments are provided to collection staff	25	
	Protective garments are not provided to collection staff	15	
vii	Collection implements	20	20
	Mostly handcarts are used	20	
	Mostly wheelbarrows are used	12	
	Mostly baskets are used	5	
4.	**Storage of waste**	**100**	
i	Allocation of bins	40	10
	Highly satisfactory	40	
	Moderately satisfactory	20	
	Not satisfactory	10	
ii	Type of bins used	30	20
	Mostly dumper placer bins and a few RCC/masonry bins are used	30	

Sr. No.	Criteria	Marks Allotment	Marks of Agra
	Mostly RCC/Masonry bins and a few dumper placer bins are used	20	
	Mostly open collection spots are available	5	
iii.	Condition of bins	10	2
	Mostly intact and painted	10	
	Mostly intact but not painted	5	
	Mostly broken/not maintained	2	
5.	**Treatment of MSW**	**250**	
I	Processing of waste	130	70
	Most of the biodegradables are processed	130	
	Some of the biodegradables are processed	70	
	No processing	20	
Ii	Reuse of recyclables	120	80
	Most of the recyclables are processed	120	
	Some of the recyclables are processed	80	
	Most of the recyclables reach the landfill site/are uncollected	20	
6.	**Transportation of waste**	**120**	
i.	Condition of the vehicles	40	10
	Majority of the vehicles are in good condition	40	
	Majority of the vehicles are in poor condition	10	
ii.	Type of vehicle	30	10
	Majority of the vehicles is closed body	30	
	Mostly open body vehicles are used	10	
iii.	Maintenance	25	8
	Preventive and routine maintenance are done	15	
	Only routine maintenance is done	8	
iv.	Vehicles are parked in garages	25	8
	Vehicles are parked in sheds	18	

Sr. No.	Criteria	Marks Allotment	Marks of Agra
	No garages/sheds are available	8	
7.	**Disposal of waste**	**200**	
i.	Protection of ground water	50	10
	Liners of specific thickness are available	50	
	No liners provided	10	
ii.	Application of soil cover	50	10
	Soil cover of specified thickness is applied	50	
	Soil cover is not applied	10	
iii.	Compaction of waste	30	20
	Compaction of waste is carried out	30	
	Compaction of waste is not carried out	20	
iv.	Leachate collection and treatment	30	8
	Leachate is collected and treated	30	
	No leachate collection system is available	8	
v.	Drainage system	20	5
	Drainage system is available	20	
	No drainage system is available	5	
vi.	Landfill gas recovery	20	5
	Landfill gas is recovered and utilized	20	
	Landfill gas is collected and flared up	15	
	No landfill gas recovery system is available	5	

Table 4.10

Ranking of Municipal Solid Waste Management System of Agra

Scope	Grade	Score of Agra	Category
800-1000	Very good	437	Fair
600-799	Good		
400-599	Fair		
Below 400	Not satisfactory		

Overall Assessment of the Status of MSW Management

- It was observed that at Taj Mahal locality, initiatives have been taken for rapid collection and removal of waste. However, there is no uniformity in MSW management within the city and thus many areas are neglected.
- Review of the relevant documents provided by AMC, analysis of the available information and inspection of MSW management at Agra city during the visit indicate that there is limited improvement in MSW management in Agra city. Procurement and employment of more equipment, vehicles and community bins as reported by AMC have improved the situation only in some areas. However, there is substantial scope for improvement with respect to all the components of solid waste management viz., collection and storage, transportation, treatment and disposal.
- Like Taj Mahal, Fatehpur Sikri and Agra Fort are also famous for historical monuments. Tourist activities are prominent in these areas. These areas should also be given attention for rapid collection and removal of MSW
- Prior to 1998-1999, solid waste management services were very poor and a very few facilities were available. With procuring the infrastructure facilities in the present project, slight improvement could be achieved. As a whole, a lot of measures need to be adopted to achieve a quality solid waste management system.

- As per ranking exercise, score for Agra is 437 out of 1000 which comes under fair category. To upgrade the solid waste management system, there is necessity to adopt further improvement measures
- Comprehensive DPR was not available. This is needed for comprehensive studies on solid waste management.

Chapter 5

Environmental Management Plan

5.1 For Electricity Related Projects

- The threat of soil erosion around the towers can be alleviated by building a foundation embankment or contouring on sloping land
- Trees posing safety hazard because they are too close to transmission lines should be trimmed down periodically
- Efficiency measurement of the electricity distribution system (transmission and transformation) should be carried out
- Frequency of load shedding and cuts should be monitored and documented
- Extent of improvement in living conditions of the population and contribution to poverty alleviation and economic growth in the target area should be documented
- Steps should be taken to increase the efficiency, reliability, and quality of electricity supply

- Steps should be taken to reduce power cuts during peak time thereby limiting the use of private diesel powered generators

5.2 For Road Related Projects

- The roads shoulders should be paved to keep them free from vegetative growth
- Proper road drainage system should be in place and the drainage system should be periodically cleared so as to ensure water flow
- Truckers should be restrained from overloading
- Vehicles carrying loose materials should be covered to prevent spillage
- Trees should be replanted on roadsides wherever feasible to arrest traffic pollution, absorb noise and provide alternative fuel source
- Slopes along the roadsides should be stabilized to avoid road cutting/deterioration by e.g. planting grass on slopes
- Emergency response system should be in place to offset accidents involving transportation of hazardous material
- There should be a proper coordination between transportation and RTO to prevent traffic jams
- Vehicle exhaust inspection system should be enhanced
- Unqualified vehicles should not be permitted to operate
- Road surface condition should be maintained to reduce noise pollution
- Any ditches/pot holes on the road surface should be immediately repaired/filled
- Traffic signs, regulating the speed of the vehicles should be erected and maintained to enhance the efficiency of the vehicles
- Traffic rules should be strictly enforced

5.3 For Gokul Barrage

- Resource operation plan and environment management system should be prepared and implemented
- Downstream minimum flow should be maintained

- Forcing factors or system states should be monitored

  - Algae

  The environmental conditions within the rivers impounded behind the barrage favours formation of large blooms of planktonic algae. Blooms can die forming scums on the surface of the water and is unsightly and giving rise to malodours as they decompose. Blue-green algal scums are reported to contain toxins that could pose a risk to public health. Decaying blooms also cause a dip in the oxygen concentration. This is of particular concern that toxic algae can poison fish and other wildlife within the lake and also pose a threat to public health. Periodical monitoring and clearing mechanisms should to be devised.

  - Dissolved oxygen

  Warm weather and little wind reduces the dissolved oxygen concentration in the deeper waters. Low dissolved oxygen levels could significantly impact upon the fish, invertebrate and birds living in the barrage. The dissolved oxygen concentration levels should be a minimum of 5mg/l in all places and all times. Continuous real-time water quality monitoring and routine water quality sampling analysis facilitate the measurement of dissolved oxygen levels.

  - Groundwater

  Groundwater should be analysed on a regular basis to check for deterioration in quality. Ground and river water quality should be monitored regularly.

  - Water related health problems.

  Increased incidences of malaria, hepatitis and stomach related ailments are largely associated with water contamination. The severity of health related problems indicate that problem is largely related to water and its management.

- Sufficient upstream measure should be taken to prevent breach
- Water level, flow rate, ground water level, water quality, biological indicators, bed level change, condition of structure, sluices, power supply, effluent loading (if any) etc should regularly be monitored

- Accidents/incident/near misses should be recorded
- Contingency plan should be prepared and implemented
- Silt/sediment/accretion should be periodically removed
- The EMP should be revised in the event of change in effluent loading (if any), change in upstream/downstream water quality, engineering works, abstraction

5.4 For Storm Water Drainage

A write up on guidelines for preparation of EMP for storm water management system is appended as ***Annexure-VII***.

- A map illustrating areas to be protected/restored together with proposed development patterns
- Preliminary design of restoration/enhancement measures, e.g., proposed cross-section of terrestrial/aquatic/recreation corridor
- Summary of findings from the eenvironmental impact statement
- Location sizing and preliminary design of all SWMPs, together with drainage areas
- Identification of areas where special consideration is required at the subdivision plan stage, e.g., areas requiring grading limits and tree preservation planning
- Detailed description of steps to be undertaken at the subdivision plan phase
- Preliminary sediment control plan
- Operation and maintenance considerations
- Other deliverables that may be presented, depending upon the level of details and preference/requirements of the agencies include: land use patterns
- Open areas

The integration of storm water management initiatives as components of the open areas system contributes to the realization of these goals by increasing the physical area of available open space, enhancing terrestrial and aquatic habitat diversity and enhancing recreational and educational opportunities. The following are examples of

techniques which have been applied to integrate storm water management initiatives and enhance the open space network:

- Incorporation of wet ponds and wetlands within active or passive parks as ecological or recreational features
- Integration of ponds and wetlands with school blocks to provide outdoor environmental education opportunities
- Design of pond systems to replicate a new valley corridor and extension of a tributary of an existing river system
- Design of a series of wet ponds as an aesthetic feature or entrance feature within a community
- Creation of a wetland as an extension of an existing forest community
- Integration of playfields within the basin of a dry detention pond
- Design of subsurface storage and/or infiltration systems beneath playfields within parks or school yards
- Installation of infiltration galleries beneath walkways as part of a recreational trail system
- Incorporation of a constructed biofilters as an educational amenity within a park

5.5 EMP for Solid Waste Management

Environmental management plan for solid waste is delineated in keeping with the guidelines of Municipal Solid Waste (Management & Handling) Rules, 2000. The various improvement measures needed to be adopted are as follows:

Improvement Measures for Collection and Storage of Waste

- House to house collection involves door to door collection. The system should be adopted in various areas of Agra. Waste may be collected at specific time by municipal corporation staff from houses. Containerized handcarts with bell ringing system, tricycles with container, and small vehicles with separate compartments for dry and wet waste can be provided for this purpose.
- Source segregation of dry and wet waste should be carried out. Dry waste includes paper, plastic, metals, glass etc. Wet waste includes leaf, vegetables, fruits, food waste etc. Dry and wet waste should be collected separately.

- Community bins used for storage of waste should be placed at appropriate locations. The rationality in allocation of bins should be maintained. Factors like magnitude of waste generation and resident's convenience should be taken into consideration.
- Old community bins should be removed after expiry of life period and new bins should be installed
- To avoid double handling of waste, closed metallic containers, which are lifted by dumper placers, can be used.
- Community bins should be emptied regularly. The bins should not be in overflowing condition creating unhygienic condition
- Community bins should be closed type
- Road sweeping should be done at least twice a day
- Long handled brooms or mechanical sweepers should be used in place of short-handled brooms
- All roadside dumps should be removed
- Proper work allotment to the sweeping staff should be facilitated
- In the slum areas, sometimes road width is very small. So entry of even tricycles, handcarts are also difficult. For collection of waste, small bins should be provided in those areas
- Industrial and biomedical wastes should not be mixed with MSW as they are governed by separate Rules and Regulations
- Horticulture waste, debris, and slaughter house waste should be collected separately

Improvement Measures for Transportation System

- Vehicle routes should be properly planned
- Dumper placer vehicles can be attached with metallic container for carrying the containers to the disposal site and after emptying, the containers to be brought back to the original position along the roadsides. This system avoids double handling of waste
- The vehicles should be closed
- All the vehicles should be kept at covered space of garages or covered parking place

- Old vehicles should be replaced by new ones for economy and better efficiency
- Transfer stations can be provided when the collection points are far away from the disposal site
- Preventive and routine maintenance should be facilitated at the workshop
- The workshop should be provided with the necessary equipments

Improvement in Disposal System of MSW

At present uncontrolled land filling is practiced at Agra. It is necessary to develop and operate sanitary landfill for municipal solid waste following guidelines of Municipal Solid Wastes (Management and Handling) Rules, 2000. Selection of the landfill site should be based on environmental considerations, geological and hydrogeological factors. It is also desirable to follow the following factors:

- Developing a sanitary landfill which can be operated for 20-25 years
- Landfill site shall be away from the habitation clusters, forest areas, water bodies, monuments, national parks, wet lands and places of cultural, historical or religious importance
- A buffer zone should be developed around the landfill site
- Landfill site should be located minimum 20 km away from the airport
- Proper approach road for the landfill should be developed
- Proper fencing should be provided around the landfill site to prevent unauthorized entry of persons or entry of animals
- Weighbridge facility should be provided for regular entry of quantity of waste reaching the landfill site
- Landfill site should be provided with office facility for record keeping, monitoring and other relevant activities
- Time to time health inspection of the solid waste management workers should be facilitated
- Safety measures for the workers should be adopted. Fire fighting equipment should be provided at the site

- First-aid facility should be made available
- Drinking water facility and electrical lighting arrangements should be made available

Salient Features of Sanitary Landfill

Salient features of sanitary landfill are as follows:

- A composite liner comprising of high density polyethylene (HDPE) of thickness 1.5 mm and clay of thickness 90 cm should be provided at the bottom and sites of the landfill
- Permeability coefficient of the soil should be less than or equal to 1×10^{-7} cm per second
- Compaction of waste should be carried out by compactors
- Level of the ground water table should be at least 2 m below the base of the landfill
- Leachate collection, storage and treatment system should be provided
- Monitoring of ground water quality should be conducted at regular interval
- Gas collection facility with provision for flaring up or utilization should be installed
- During operation of the landfill, soil cover or debris of 10 cm thickness should be provided
- An intermediate cover of 65 cm thickness can be applied prior to rainy season

Closure of the Landfill Site

The following measures need to be adopted during closure of the landfill site:

- Soil cover of thickness 60 cm and permeability coefficient less than or equal to 1×10^{-7} cm should be applied
- A drainage layer of thickness 15 cm should be provided on top of soil layer
- A vegetable layer of thickness 45 cm should be provided at the top

Improvement Measures for Processing Facility

Proper utilization of the recyclables like plastics, metals, glass and paper is a pathway of waste minimization. Proper waste segregation should be practised followed by conversion of recyclable constituents to value added products.

Compost is a good soil conditioner and can be used in agriculture and gardening. However, composting should be done in an environment-friendly manner. Guidelines provided in the rules should also be followed.

There are many processing options available like thermal processing with energy recovery, bio-processing, refuse derived fuel, etc. However, before adoption of any particular technology, there is a need to examine the following factors:

- Whether the technologies are sustainable to meet the future need
- Whether the technologies are environment-friendly and cost-effective
- Whether the technologies adopted in developed countries are suitable in Indian condition

Occupational Health Aspects

- Protective gears like gumboots, gloves, goggles and masks should be provided to the workers
- Health check up programme should be conducted biannually or annually

Institutional Aspects

- Spot fining system can be introduced for controlling improper disposal of waste
- Incentive scheme can be introduced for increasing efficiency
- Supervision and monitoring system of the solid waste management activities should be strengthened
- Public awareness programme should be conducted from time to time
- A citizen forum can be constituted for interaction with public
- Training programme should be conducted from time to time for various levels of staff

Chapter 6

Conclusions and Recommendations

6.1 For Road Related Projects

- The completed road and electricity related projects have brought improvement in TTZ with respect to immediate neighboring cities. There had been be an improvement in the environs of Taj Mahal and other historical monuments.
- Construction of new roads, widening of existing roads and construction of missing links helped ease out traffic movement, reduced frequency of engine idling, increased traffic speed thereby helped reducing vehicle exhaust emissions in the TTZ. This has, in turn, improved the ambient air quality and resulted in positive impact on the Taj Mahal marble and the environment
- Further improvement of road network in future should be funded to meet increased traffic volume over the years as evident from the rising tendency in concentration of NO_2.

6.2 For Electricity Related Projects

- The benefits of the projects for domestic supply and use in small-scale businesses and in access to electric power for schools and public services are evident. Potential beneficiary enterprises will be small industries like saw mills, grain mills and other agricultural processing and storage businesses. Improvement in public facilities (e.g. health & education) as a result of availability of electricity is also evident. The projects will cause increased economic activity in industrial, agricultural and commercial sectors as a result of availability of electric supply in project areas. The facilities like communication, internet, computer literacy and charging of mobile phones shall be generated. Electric lighting adds to security at night and enables extended opportunities for work and study. As a consequence the quality of life and extent of economic opportunity will be transformed.
- Financial and technical support should be provided to achieve reductions in overall technical and commercial losses, increased availability of electricity, and improved voltage profile
- Financial support in the electricity supply infrastructure should be provided to enhance electricity access rate and to ensure improved efficiency, to reduce peaking shortages and therefore assist the country to alleviate poverty and achieve the set National goals
- Further enhancement in electric supply in future should be funded to meet increased domestic use of electricity to fulfill energy needs
- Feasibility of electrification of non-codified villages also may be looked into

6.3 For Gokul Barrage

The implementation of the Gokul Barrage project has definitely augmented potable water supply to Agra and Mathura. However, the water quality in the river doesn't meet drinking water requirement as the CPCB classification for inland surface water (***Annexure-X***). The water needs to be treated for use as potable water. In addition, the ground water table of the area as well as salinity of ground

water had not improved which was one of the objectives of the project, and this may be due to increased abstraction of ground water from the area.

6.4 For Storm Water Drainage System

Agra is a world-class architectural heritage site and hence requires extensive storm water drainage and sewerage system to reduce damage to the roads and streets and to provide and maintain sanitary conditions to the people of Agra city meeting JNNURM objectives. An amount of Rs.6.60 crores was sanctioned towards storm water management in Agra. Around, Rs.4.50 crores have been utilized by the UPJN towards construction of the four storm water drains covering a stretch of around 18.63 km. Further, Rs. 0.95 crores was spent towards maintenance for de-silting and cleaning of four drains by ANN. A total amount of Rs. 5.45 crores have been spent against Rs.6.60 crore sanctioned.

The construction of the engineered storm water drains have been carried out only in some areas which is minuscule when compared to the area of the city (presently 148 sq. km). Sewerage systems do not exist in major part of the city which leads to discharge of sewage and domestic effluents into the storm water drains which finally drains into the Yamuna. Thus, the storm water drains basically carry sanitary sewage.

Water logging in the low-lying areas can be prevented through regular maintenance comprising removal of solid waste, silt, plants and roots from the drains accompanied by a public awareness campaign by the relevant authorities. Guidelines for staffing and equipment necessary for drainage maintenance works must be followed which include drain cleaning frequency, manpower required to maintain the system, fixing of management structure, training and skill development.

The recommendations to improve the storm water systems should include:

- Development of a proper sewerage system for the city to restrict domestic sewage entering the storm water systems
- Proper maintenance of the existing drain structures
- Prevention of solid waste dumping into storm water drains by providing drain covers, and adopting proper solid waste management practices

- Allow the existing and new drains to function at their design capacities, through regular maintenance comprising of cleaning, desilting, repairing and remodeling of the existing drains
- Construction of cross drainage works
- Drainage outfall structure and construction of rainwater harvesting structures and recharging ponds

6.5 For Solid Waste Management

- Environmental management plan as discussed in the earlier chapter can be taken into consideration during implementation of solid waste management project
- A comprehensive Detailed Project Report (DPR) should be prepared for solid waste management project through competent agency
- DPR can be prepared in keeping with the guidelines of CPCB
- Action plan can be prepared with the time period for various activities
- Quantification and characterization of waste should be carried out. Quantity and characteristics are the two basic parameters for estimation of infrastructure requirement
- Funds can be released in installments for implementation of solid waste management project with time to time monitoring of the progress of the work
- A Management Information System (MIS) must exist
- For implementation, the possibility of Public-private-participation (PPP) may be explored.
- The outcome of PPP may be evaluated by third party where requirement of compliance and status of compliance management need to exist. A write up on MIS is enclosed as ***Annexure –VIII***

Other Developmental Project on Solid Waste Management

Though, it is out of context of the present study, it is felt necessary to mention that one project proposal on solid waste management under Jawaharlal Nehru National Urban Renewal Mission (JNNURM) is in process as reported by Agra Municipal Corporation. The proposed activities include development of sanitary landfill, development of processing facilities, improvement of collection, storage and transportation system etc.

Annexure I

About CALINE4 Model

CALINE4 is dispersion model for predicting air pollutant concentration near roadways. It is a simple line source Gaussian plume dispersion model developed by California Department of transportation (CALTRAN). The user defines the proposed roadway geometry, worst-case meteorological parameters, anticipated traffic volumes, and receptor positions. The user also defines air pollutant emission factors for each roadway link. CALIN4's accuracy is well balanced with the accuracy of state of the art predictive models for emissions and traffic.

The CALINE4 divides individual highway links into a series of elements from which incremental concentrations are computed and then summed to form a total concentration estimate for a particular receptor location. The receptor distance is measures along a perpendicular from the receptor to the link central line.

CALINE4 treats the region directly over the highway as a zone of uniform emission and turbulence. This is designated as mixing zone and is defined as the region over the traveled way plus 3 meters on either side. The additional width accounts for the initial horizontal dispersion imparted to pollutants by the vehicle wake. Within the mixing zone, the mechanical turbulence created by moving vehicle and the thermal turbulence created by hot vehicle exhaust are assumed to be the dominant dispersive mechanism. Vehicle emissions are released and rapidly dispersed within the trailing wake of each vehicle. Further initial dispersion occurs through the action of turbulence generated by the other passing vehicle. In CALINE4 it is assumed that the longer a parcel of air resides I the turbulence mixing zone, the greater the amount of initial vertical dispersion the parcel will undergo.

For vertical dispersion parameter the CALINE4 uses modified version of Pasquill-Smith vertical dispersion curves that includes thermal effects of vehicle exhaust emissions. For horizontal dispersion parameter the model uses a method developed by Draxler to compute values for the Gaussian horizontal dispersion parameter.

CALINE4 permits specifications up to 20 links and 20 receptors within an x-y plane. A link is a straight line segment of roadway having a constant width, height, traffic volume, and emission factor. The location of link is specified by end point coordinates of its central line. The location of receptor is specified in terms of x,y,z coordinates. Thus CALIN4 can be used to model multiple sources and receptors, curved alignments, or roadway segments with varying emission factors. The model program automatically sums the contributions from each link to each receptor. Surface roughness is assumed to be uniform throughout the area. The meteorological variables of atmospheric stability, wind speed, and wind direction are also taken as constant over the study area.

In CALNE4 the concentration is not one-to-one related with traffic volume because of the vehicle induced heat flux component. It shows lower concentrations for higher traffic volumes at the constant overall source strength maintained in the analysis.

Table 3.3-2. SPECIATED ORGANIC COMPOUND EMISSION FACTORS FOR UNCONTROLLED DIESEL ENGINES[a]

EMISSION FACTOR RATING: E

Pollutant	Emission Factor (Fuel Input) (lb/MMBtu)
Benzene[b]	9.33 E-04
Toluene[b]	4.09 E-04
Xylenes[b]	2.85 E-04
Propylene	2.58 E-03
1,3-Butadiene[b,c]	<3.91 E-05
Formaldehyde[b]	1.18 E-03
Acetaldehyde[b]	7.67 E-04
Acrolein[b]	<9.25 E-05
Polycyclic aromatic hydrocarbons (PAH)	
Naphthalene[b]	8.48 E-05
Acenaphthylene	<5.06 E-06
Acenaphthene	<1.42 E-06
Fluorene	2.92 E-05
Phenanthrene	2.94 E-05
Anthracene	1.87 E-06
Fluoranthene	7.61 E-06
Pyrene	4.78 E-06
Benzo(a)anthracene	1.68 E-06
Chrysene	3.53 E-07
Benzo(b)fluoranthene	<9.91 E-08
Benzo(k)fluoranthene	<1.55 E-07
Benzo(a)pyrene	<1.88 E-07
Indeno(1,2,3-cd)pyrene	<3.75 E-07
Dibenz(a,h)anthracene	<5.83 E-07
Benzo(g,h,l)perylene	<4.89 E-07
TOTAL PAH	1.68 E-04

[a] Based on the uncontrolled levels of 2 diesel engines from References 6-7. Source Classification Codes 2-02-001-02, 2-03-001-01. To convert from lb/MMBtu to ng/J, multiply by 430.
[b] Hazardous air pollutant listed in the *Clean Air Act*.
[c] Based on data from 1 engine.

Table 3.3-1. EMISSION FACTORS FOR UNCONTROLLED GASOLINE AND DIESEL INDUSTRIAL ENGINES[a]

Pollutant	Gasoline Fuel (SCC 2-02-003-01, 2-03-003-01)		Diesel Fuel (SCC 2-02-001-02, 2-03-001-01)		EMISSION FACTOR RATING
	Emission Factor (lb/hp-hr) (power output)	Emission Factor (lb/MMBtu) (fuel input)	Emission Factor (lb/hp-hr) (power output)	Emission Factor (lb/MMBtu) (fuel input)	
NO_x	0.011	1.63	0.031	4.41	D
CO	6.96 E-03[d]	0.99[d]	6.68 E-03	0.95	D
SO_x	5.91 E-04	0.084	2.05 E-03	0.29	D
PM-10[b]	7.21 E-04	0.10	2.20 E-03	0.31	D
CO_2[c]	1.08	154	1.15	164	B
Aldehydes	4.85 E-04	0.07	4.63 E-04	0.07	D
TOC					
Exhaust	0.015	2.10	2.47 E-03	0.35	D
Evaporative	6.61 E-04	0.09	0.00	0.00	E
Crankcase	4.85 E-03	0.69	4.41 E-05	0.01	E
Refueling	1.08 E-03	0.15	0.00	0.00	E

[a] References 2,5-6,9-14. When necessary, an average brake-specific fuel consumption (BSFC) of 7,000 Btu/hp-hr was used to convert from lb/MMBtu to lb/hp-hr. To convert from lb/hp-hr to kg/kw-hr, multiply by 0.608. To convert from lb/MMBtu to ng/J, multiply by 430. SCC = Source Classification Code. TOC = total organic compounds.

[b] PM-10 = particulate matter less than or equal to 10 μm aerodynamic diameter. All particulate is assumed to be ≤ 1 μm in size.

[c] Assumes 99% conversion of carbon in fuel to CO_2 with 87 weight % carbon in diesel, 86 weight % carbon in gasoline, average BSFC of 7,000 Btu/hp-hr, diesel heating value of 19,300 Btu/lb, and gasoline heating value of 20,300 Btu/lb.

[d] Instead of 0.439 lb/hp-hr (power output) and 62.7 lb/mmBtu (fuel input), the correct emissions factors values are 6.96 E-03 lb/hp-hr (power output) and 0.99 lb/mmBtu (fuel input), respectively. This is an editorial correction. March 24, 2009

DEVELOPMENT OF INNER RING ROAD AT AGRA, UTTAR PRADESH

Under Integrated Urban Rejuvenation Plan

ON DESIGN, BUILD, FINANCE, OPERATE AND TRANSFER (DBFOT) BASIS UNDER PUBLIC PRIVATE PARTNERSHIP (PPP)

REQUEST FOR QUALIFICATION DOCUMENT

SEPTEMBER 2008

Nodal Agency

AWAS BANDHU, UTTAR PRADESH,
HOUSING & URBAN PLANNING DEPARTMENT,
GOVERNMENT OF UTTAR PRADESH

IST FLOOR, JANPATH MARKET,
LUCKNOW-226001

TEL: 0522-2237161 FAX:0522-2612098,
E-MAIL: awasbandhu@gmail.com
WEB: awas.up.nic.in

Project Consultants

SREI Infrastructure Finance Limited
In Association with
DHV India Private Limited

Minimum Vehicular growth required

15000 PCUS in the year 1
Traffic growth rate assumed at 3.5 %

Assumed Modal Mix

Car / Jeep /Van / Taxi	45%
LCVs, Mini Van & Mini Truck	10%
Trucks & Buses – 2 axle	20%
Trucks and Buses – 3 axle	20%
Multi Axle (4axle and more)	5%

- It is planned to club the flyovers and ROB/underpasses with the ring road the details of which are :
  - Location - **Ring Road from Gwalior road to NH-2 on Kanpur Road** (according to Master Plan Map -2021)
  - Length – **20.5 kms**
  - start and end point - **Ring Road from Itora Village at Gwalior road to NH-2 on Kuberpur village at Kanpur Road (**according to Master Plan Map -2021)
  - Benefits – D**econgest the city from unwanted heavy vehicular traffic into the Agra city.**

1.2 BRIEF DESCRIPTION OF BIDDING PROCESS

a) ABUP intends to follow a two stage bidding process for selection of the Preferred Bidder for the Project comprising a Pre-Qualification Stage followed by a Proposal Stage. The first stage involves pre-qualification of interested bidders (Bidders).

b) A pre application meet will be held before RFQ application submissions. Queries with respect to the project may be sent through email at the address provided in this RFQ document latest by 9th Sept 2008 by 1900hrs.

c) During the Qualification stage Bidders would be required to furnish the information specified in this RFQ Document.

d) This RFQ deals with the first stage (Qualification Stage) and at the end of this stage ABUP will announce shortlisted Bidders for the next stage (Proposal Stage) who would then be invited to submit detailed proposals (Proposal) in respect of the Project in accordance with a Request for Proposal (RFP) Document.

e) A pre bid meet will be held before RFP submissions. Queries with respect to the project may be sent thru email at the address provided in the RFP document .

f) During the Proposal Stage, short-listed Bidders (Bidders) would be expected to examine the Project in further detail, and to carry out such Studies as they deem fit to submit Proposals for the implementation of the Project.

DRAFT

THE AUTOMOTIVE RESEARCH ASSOCIATION OF INDIA

Air Quality Monitoring Project-Indian Clean Air Programme (ICAP)

Draft report on

"Emission Factor development for Indian Vehicles"

as a part of Ambient Air Quality Monitoring and Emission Source Apportionment Studies

Project Sponsored by

CPCB / MOEF
Indian Oil Corporation Ltd. Faridabad
Hindustan Petroleum Corporation Ltd.
Bharat Petroleum Corporation Ltd.
Reliance Industries Ltd.

Project Executed by

ARAI, Pune

P.O. Box. 832, Pune-4

Revision Status:
Revision-4 Dt. August 8, 2007

Sr. No. (With ref. to report)	Type of veh.	Sub-Category	Vintage	Fuel	Emission Factors											Applicable Vehicle Models
					g/km					mg/km						
					CO	HC	Nox	Co2	PM	Benzene	1-3 Butadiene	Formaldehyde	Acetaldehyde	Total Aldehyde	Total PAH	
34	Passenger Cars (Petrol)	<1000cc	1991-96	BS-II	4.75	0.84	0.95	95.65	0.008	0.2126	0.1322	0.0181	0.0109	0.0453	0.1577	Maruti Omni, Maruti Gypsy, Premier Padmini, Premier 118NE, Ambassador, etc
35	Passenger Cars (Petrol)	<1000cc	1996-2000	BS-II	4.825 (8.09)	0.58 (1.31)	0.645 (1.13)	98.615 (108.22)	0.0195 (0.002)	0.00095 (0.0168)	0.0067 (0.0048)	0.0013 (0.0023)	0.00005 (0.0008)	0.00835 (0.0069)	0.1862 (0.1212)	Maruti Omni, Fiat Uno, Maruti Gypsy Premier Padmini, Premier 118NE Daewoo Matiz, Maruti 1000, Ambassador, etc
36	Passenger Cars (Petrol) BS-II	<1000cc	Post 2000 (MIDC)	BS-II	1.30	0.24	0.20	126.37	0.004	0.0002	0.0031	0.0034	0.0012	0.0088	0.0955	Zen, Alto, Santro, Matiz, etc
37	Passenger Cars (Petrol) BS-I	1000 - 1400 cc	Post 2000 (MIDC)	BS-II	3.01	0.19	0.12	126.50	0.006	0.0007	0.0034	0.0034	0.0012	0.0079	0.1324	Fiat Palio, Wagon R, Getz, Tata Indica Esteem, etc
38	Passenger Cars (Petrol) BS-I	>1400cc	Post 00 MIDC	BS-II	2.74	0.19	0.21	142.86	0.006	0.0009	0.0001	0.0086	0.0012	0.0101	0.4636	Skoda Octavia, sonata, accent, beleno Corolla, Camry, etc
39	Passenger Cars (Petrol)	>1400cc	Post 05 MIDC	BS-II	0.84	0.12	0.09	172.95	0.002	0.0003	0.0003	0.0003	0.0000	0.0096	0.0500	Indica, Ford Ikon, Maruti Swift, Hyundai Getz, Fiat Palio, Esteem, Hyundai Ascent honda city, , etc
40	Passenger Cars (Diesel)	<1600cc	1996-2000	BS-II	0.87	0.22	0.45	129.09	0.145	1.5962	0.3132	0.0261	0.0003	0.0813	0.1013	Fiat 137D(1366cc), Ambassador (1500cc) Maruti Zen (1527cc) , etc
41	Passenger Cars (Diesel)	<1600cc	Post 2000(MIDC)	BS-II	0.72	0.14	0.84	156.76	0.19	0.0386	0.0528	0.0206	0.0021	0.0422	0.1490	Zen Diesel(1527cc), Esteem Diesel(1527cc), Indigo (1405cc), Accent(1493cc), Ambassador(1489cc) Zen Diesel(1527cc), Esteem

Sr. No. (With ref. to report)	Type of veh.	Sub-Category	Vintage	Fuel	Emission Factors											Applicable Vehicle Models
					g/km					mg/km						
					CO	HC	Nox	Co2	PM	Benzene	1-3 Butadiene	Formaldehyde	Acetaldehyde	Total Aldehyde	Total PAH	
	BS-I															Diesel(1527cc), Indigo (1405cc) Accent(1493cc), Ambassador(1489cc) , etc
41	Passenger Cars (Diesel) **BS-II**	<1600cc	Post 2000(MIDC)	BS-II	0.30	0.26	0.49	154.56	0.06	0.0010	0.0025	0.0108	0.0015	0.0131	0.1112	Zen Diesel(1527cc), Esteem Diesel(1527cc), Indigo (1405cc), Accent(1493cc), Ambassador(1489cc) Zen Diesel(1527cc), Esteem Diesel(1527cc), Indigo (1405cc) Accent(1493cc), Ambassador(1489cc) , etc
42	Passenger Cars (Diesel)	<1600cc	Post 2005 (MIDC)	BS-II	0.06	0.08	0.28	148.76	0.015	0.0018	0.0007	0.0889	0.0033	0.0922	0.2109	Indica, Palio, Skoda Superb, Hyundai Ascent, Ambassador, Mercedes C Class Hyundai Elantra, Ford Ikon, etc
43	Passenger Cars (Diesel)	1600 - 2400 cc	1996-2000	BS-II	0.66	0.25	0.61	166.14	0.180	0.0032	0.0118	0.0400	0.0005	0.1244	0.1301	Ford Escort Diesel (1800cc), Fiat Uno (1700cc) , etc
44	Passenger Cars (CNG) BS-I	1000 - 1400 cc	Post 2000 (MIDC)	BS-II	0.60	0.36	0.01	131.19	0.002	0.0009	0.0002	0.0007	0.0011	0.0018	0.0154	Maruti Esteem retrofit CNG, Lancer Retrofit CNG, Maruti 800 CNG, Maruti OMNI CNG, etc
45	Passenger Cars (CNG)	<1000cc	1996-2000	BS-II	0.85	0.79	0.53	149.36	0.001	NA	NA	NA	NA	NA	NA	Ambassador retrofit CNG Ford Escort Retrofit CNG, etc
46	Passenger Cars (CNG) BS-I	<1000cc	Post 2000 (MIDC)	BS-II	0.06	0.46	0.74	143.54	0.006	0.0001	0.0003	0.0108	0.0022	0.0130	0.0164	Maruti baleno retrofit CNG , etc

Sr. No. (With ref. to report)	Type of veh.	Sub-Category	Vintage	Fuel	Emission Factors											Applicable Vehicle Models
					g/km					mg/km						
					CO	HC	Nox	Co2	PM	Benzene	1-3 Butadiene	Formaldehyde	Acetaldehyde	Total Aldehyde	Total PAH	
47	Passenger Cars (LPG)	1000 - 1400 cc	1996-2000	BS-II	6.78	0.85	0.50	130.85	0.001	0.004	0.0062	0.0145	0.0101	0.0245	0.06	Maruti Esteem retrofit LPG, Maruti 800 LPG, Maruti OMNI LPG, etc
48	Passenger Cars (LPG) BS-I	>1400cc	Post 2000 (MIDC)	BS-II	2.72	0.23	0.20	140.05	0.002	0.0006	0.0016	0.0005	0.0011	0.0021	0.0247	Maruti Esteem retrofit LPG , Lancer Retrofit LPG, Indigo LPG Retrofit, Ambassador Retrofit LPG, etc
49	MUV Diesel	<3000cc	1991-96	BS-II	2.49	1.39	1.70	163.56	0.570	0.0131	0.0057	0.0135	0.0003	0.0153	1.7892	Trax (2399cc), Sumo(1948cc), Matador, etc
50	MUV Diesel	<3000cc	1996-2000	BS-II	1.38	1.39	0.65	189.48	0.560	0.0059	0.0593	0.0003	0.0028	0.0300	5.0397	Sumo(1948cc), Tata Sierra(1948cc), M&M Commander(2523cc), Marshal(2523cc), Qualis(2446) , etc
51	MUV Diesel **BS-I**	<3000cc	Post 2000 (MIDC)	BS-II	1.94	0.89	2.46	242.01	0.48	0.008	0.006	0.000	0.003	0.006	2.604	M&M CL 550 MDI(2523cc) ,Scorpio(1998cc), Ford Endeavour(2500cc), Sumo(1948cc) Safari(1948cc), Trax(2399cc), Pajero(3200cc), Terra can (2902cc) Innova(2494cc) , etc
51	MUV Diesel **BS-II**	<3000cc	Post 2000 (MIDC)	BS-II	0.39	0.10	0.62	216.75	0.10	0.0104	0.0010	0.0039	0.0015	0.0109	0.3153	M&M CL 550 MDI(2523cc) ,Scorpio(1998cc), Ford Endeavour(2500cc), Sumo(1948cc) Safari(1948cc), Trax(2399cc), Pajero(3200cc), Terra can (2902cc) Innova(2494cc) , etc
52	MUV Diesel	<3000cc	Post 2005 (MIDC)	BS-II	0.25	0.19	0.67	255.98	0.096	0.2675	0.0403	0.0142	0.0083	0.0370	0.1252	Scorpio CRDI (2.6 ltr), Safari (2.95ltr) Innova (2.5 ltr), Tata 207 (2.95ltr), Spacio (2.95ltr) Endeavor (2.5) Tavera (2.5 ltr) Tourister (2.6 ltr) , etc

Sr. No. (With ref. to report)	Type of veh.	Sub-Category	Vintage	Fuel	Emission Factors											Applicable Vehicle Models
					g/km					mg/km						
					CO	HC	Nox	Co2	PM	Benzene	1-3 Butadiene	Formaldehyde	Acetaldehyde	Total Aldehyde	Total PAH	
53	LCV Diesel	<3000cc	1991-96	BS-II	3.07	2.28	3.03	327.29	0.998	0.5427	0.0094	0.1975	0.0117	0.2957	8.1284	Eicher 10.70 (3298cc), BTL Excel (2650cc), M&M DI Load Carrier(2523cc) M&M Loadking(2609cc), Telco SFC410 (2956cc), Telco LPT712(3783cc), Eicher Skyline(3298cc), M&M DI Express(2523cc), M&M Tourister(2609cc) AL PSV3 LYNX(3839cc), Tata SFC 407 minibus(2956cc), Telco LP709minibus(3783cc), HM RTV(3.3 and 2ltr) , etc
54	LCV Diesel	<3000cc	1996-2000	BS-II	3.00	1.28	2.48	333.31	0.655	0.2015	0.2147	0.1176	0.0059	0.2169	3.7742	Eicher 10.70 (3298cc), BTL Excel (2650cc), M&M DI Load Carrier(2523cc) M&M Loadking(2609cc), Telco SFC410 (2956cc), Telco LPT712(3783cc) Eicher Skyline(3298cc), M&M DI Express(2523cc), M&M Tourister(2609cc) AL PSV3 LYNX(3839cc), Tata SFC 407 minibus(2956cc), Telco LP709minibus(3783cc), HM RTV(3.3 and 2ltr) , etc
55	LCV Diesel	>3000cc	Post 2000	BS-II	3.66	1.35	2.12	401.25	0.475	0.1959	0.4154	0.0028	0.0083	0.0222	8.2679	BTL Traveller (2650cc), M&M DI Express(2523cc), M&M Tourister(2609cc) AL PSV3 LYNX(3839cc), Tata SFC 407 minibus(2956cc), Telco LP709minibus(3783cc), HM RTV(3.3 and 2ltr) , etc
56	HCV Diesel Bus	>6000cc	1991-96	BS-II	13.06	2.40	11.24	817.52	2.013	0.1529	0.0313	0.1007	0.0148	0.1259	1.0123	Eicher 20/16RHD(4.9lt), TELCO LF936CE(5.9ltr), TELCO LP1510(5.9lt) Eicher 20/16RHD(4.9lt), TELCO LF936CE(5.9ltr), TELCO LP1510(5.9lt), AL 3/1 COMET (6.54Lit) , etc

Sr. No. (With ref. to report)	Type of veh.	Sub-Category	Vintage	Fuel	Emission Factors											Applicable Vehicle Models
					g/km					mg/km						
					CO	HC	Nox	Co2	PM	Benzene	1-3 Butadiene	Formaldehyde	Acetaldehyde	Total Aldehyde	Total PAH	
57	HCV Diesel Bus	>6000cc	1996-2000	BS-II	4.48	1.46	15.25	920.77	1.213	0.1008	0.0093	0.1015	0.0029	0.1191	3.6515	Eicher 30.25RHD(4.9lt), TELCO LPT2515(5.9lt), TELCO LP/LPO /LPS/SE/SK(5.9lt), Eicher 30.25RHD(4.9lt) TELCO LPT2515(5.9lt), TECO LPT 2518(5.9lt) , etc
58	HCV Diesel Bus	>6000cc	Post 2000	BS-II	12.14	0.39	11.50	668.00	0.795	0.0126	0.0017	0.0104	0.0136	0.0458	0.2833	Volvo FM9, B7R (9.4lt) , Volvo FM12 (12.3lt), TECO LPT 2518(5.9lt), TELCO LPT2515(5.9lt), Volvo FM9, B7R (9.4lt) Volvo FM12 (12.3lt), TECO LPT 2518(5.9lt) TELCO LPT2515(5.9lt) , etc
59	HCV Diesel Bus	>6000cc	Post 2005	BS-II	3.92	0.16	6.53	602.01	0.300	0.0101	0.0096	0.0523	0.0082	0.1458	1.3715	Volvo FM9, B7R (9.4lt), Volvo FM12 (12.3lt), TATA NOVUS, TATA LPT2515, etc
60	HCV CNG Bus	>6000cc	Post 2000	BS-II	3.72	3.75	6.21	806.50	N A	N A	N A	N A	N A	N A	N A	All TATA and AL CNG Buses , etc
61	HCV Diesel Truck	>6000cc	1991-2000	BS-II	19.30	2.63	13.84	837.50	1.965	0.0199	0.0175	0.0925	0.0197	0.1374	4.5975	Eicher 20/16RHD(4.9lt) TELCO LF936CE(5.9ltr) TELCO LP1510(5.9lt) ALCO 3/1 COMET (6.54Lit) Eicher 20/16RHD(4.9lt) TELCO LF936CE(5.9ltr) TELCO LP1510(5.9lt) ALCO 3/1 COMET (6.54Lit), etc
62	HCV Diesel Truck	>6000cc	Post 2000	BS-II	6.00	0.37	9.30	762.39	1.240	0.0049	0.0074	0.0610	0.0000	0.0837	3.9707	TECO LPT 2518(5.9lt) , TELCO LPT2515(5.9lt) , Volvo FM9, B7R (9.4lt) , Volvo FM12 (12.3lt) , TECO LPT 2518(5.9lt) , TELCO LPT2515(5.9lt) , etc

**ID's in red color are the vehicles whose data is not to be considered for EF. These vehicles would be repeated under Source Profiling of Vehicular Emissions project.*

@ Since 2W 2s Motorcycle>80cc are very few in no. actually plying on road, the expert group has decided to neglect this category

43	2,5,8,11	Mex	LDV TWC MPFI 0.7 NOx

FIGURE (A) HYDROCARBON CYCLE CORRECTION FACTOR CURVES.

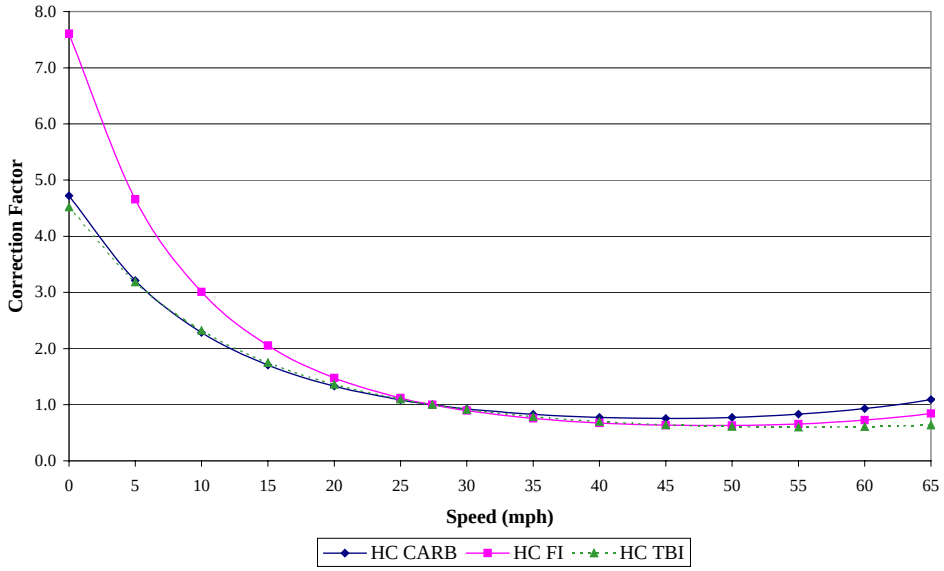


FIGURE (B) CARBON MONOXIDE CYCLE CORRECTION FACTOR CURVES.

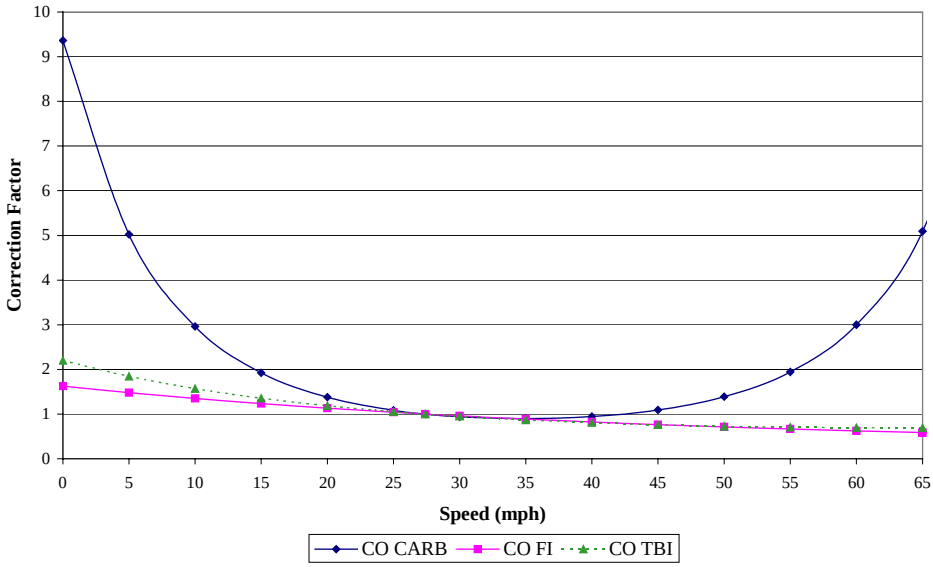


FIGURE (C). OXIDES OF NITROGEN CYCLE CORRECTION FACTOR CURVES.

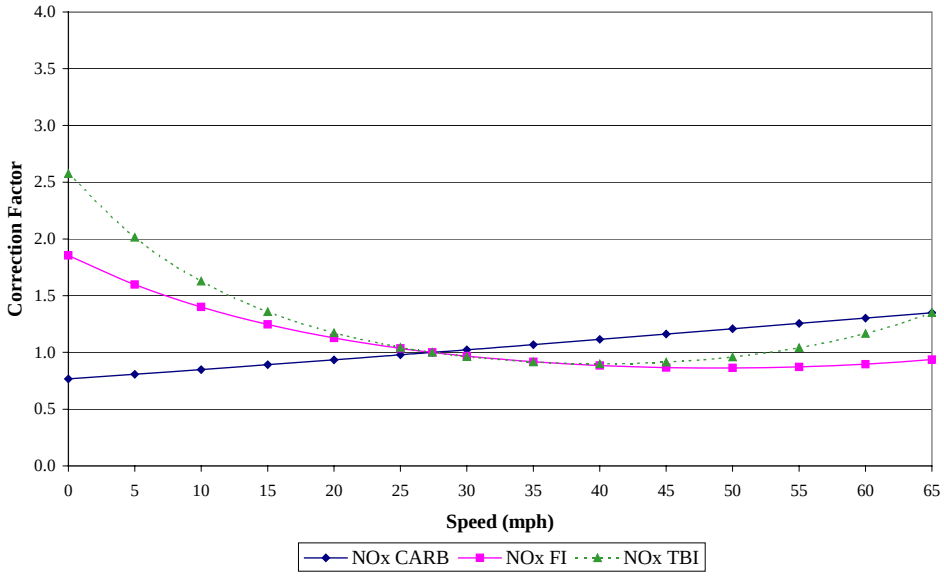
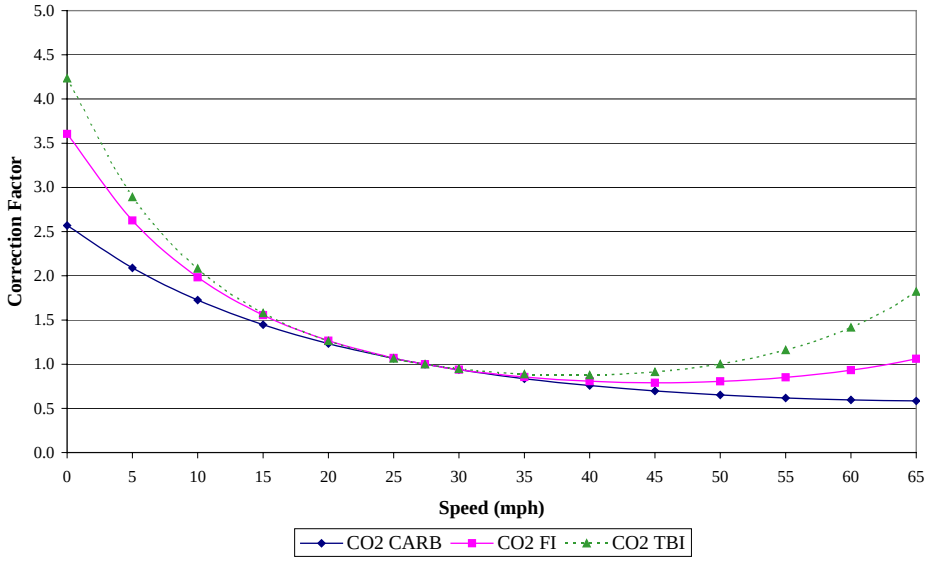


FIGURE (D). CARBON DIOXIDE CYCLE CORRECTION FACTOR CURVES.



Federal Register

Wednesday,
April 25, 2007

Part II

Environmental Protection Agency

40 CFR Part 51

Clean Air Fine Particle Implementation Rule; Final Rule

Agency Information Collection Activities: Proposed Collection; Comment Request; $PM_{2.5}$ Ozone National Ambient Air Quality Standard Implementation Rule; EPA ICR No. 2258.01; Notice

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 51

[EPA–HQ–OAR–2003–0062; FRL–8295–2]

RIN 2060–AK74

Clean Air Fine Particle Implementation Rule

AGENCY: Environmental Protection Agency (EPA).

ACTION: Final rule.

SUMMARY: This final action provides rules and guidance on the Clean Air Act (CAA) requirements for State and Tribal plans to implement the 1997 fine particle ($PM_{2.5}$) national ambient air quality standards (NAAQS). Fine particles and precursor pollutants are emitted by a wide range of sources, including power plants, cars, trucks, industrial sources, and other burning or combustion-related activities. Health effects that have been associated with exposure to $PM_{2.5}$ include premature death, aggravation of heart and lung disease, and asthma attacks. Those particularly sensitive to $PM_{2.5}$ exposure include older adults, people with heart and lung disease, and children.

Air quality designations became effective on April 5, 2005 for 39 areas (with a total population of 90 million) that were not attaining the 1997 $PM_{2.5}$ standards. By April 5, 2008, each State having a nonattainment area must submit to EPA an attainment demonstration and adopted regulations ensuring that the area will attain the standards as expeditiously as practicable, but no later than 2015. This rule and preamble describe the requirements that States and Tribes must meet in their implementation plans for attainment of the 1997 fine particle NAAQS. (Note that this rule does not include final $PM_{2.5}$ requirements for the new source review (NSR) program; the final NSR rule will be issued at a later date.)

DATES: This rule is effective on May 29, 2007.

ADDRESSES: The EPA has established a docket for this action under Docket ID EPA–HQ–OAR–2003–0062. All documents relevant to this action are listed in the Federal docket management system at *www.regulations.gov*. Although listed in the index, some information is not publicly available (e.g. Confidential Business Information or other information whose disclosure is restricted by statute). Certain other material, such as copyrighted material, is not placed on the Internet and will be publicly available only in hard copy form. Publicly available docket materials are available either electronically through www.regulations.gov or in hard copy format at the EPA Docket Center, EPA/DC, EPA West, Room 3334, 1301 Constitution Avenue, NW., Washington, DC. The Public Reading Room is open from 8:30 a.m. to 4:30 p.m., Monday through Friday, excluding legal holidays. The telephone number for the Public Reading Room is (202) 566–1744, and the telephone number for the Office of Air and Radiation Docket and Information Center is (202) 566–1742. A variety of information and materials related to the fine particle NAAQS and implementation program are also available on EPA's Web site: *http://www.epa.gov/air/particles*.

FOR FURTHER INFORMATION CONTACT: For general information, contact Mr. Richard Damberg, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Mail Code C539–01, Research Triangle Park, NC 27711, phone number (919) 54l–5592 or by e-mail at: *damberg.rich@epa.gov*.

SUPPLEMENTARY INFORMATION:

General Information

A. Does this action apply to me?

Entities potentially regulated by this action are State and local air quality agencies.

B. Where can I get a copy of this document and other related information?

In addition to being available in the docket, an electronic copy of this final rule will also be available on the World Wide Web. Following signature by the EPA Administrator, a copy of this final rule will be posted at *http://www.epa.gov/particles/actions.html*.

C. How is the preamble organized?

I. Background

Fine particles in the atmosphere are comprised of a complex mixture of components. Common constituents include: sulfate (SO_4); nitrate (NO_3); ammonium; elemental carbon; a great variety of organic compounds; and inorganic material (including metals, dust, sea salt, and other trace elements) generally referred to as ''crustal'' material, although it may contain material from other sources. Airborne particles generally less than or equal to 2.5 micrometers in diameter are considered to be ''fine particles'' (also referred to as $PM_{2.5}$). (A micrometer is one-millionth of a meter, and 2.5 micrometers is less than one-seventh the average width of a human hair.) ''Primary'' particles are emitted directly into the air as a solid or liquid particle (e.g., elemental carbon from diesel engines or fire activities, or condensable organic particles from gasoline engines). ''Secondary'' particles (e.g., sulfate and nitrate) form in the atmosphere as a result of various chemical reactions. (Section II of the proposed rule included detailed technical discussion on $PM_{2.5}$, its precursors, formation processes, and emissions sources.)

The EPA established air quality standards for $PM_{2.5}$ based on evidence from numerous health studies demonstrating that serious health effects are associated with exposures to elevated levels of $PM_{2.5}$. Epidemiological studies have shown statistically significant correlations between elevated $PM_{2.5}$ levels and premature mortality. Other important

effects associated with $PM_{2.5}$ exposure include aggravation of respiratory and cardiovascular disease (as indicated by increased hospital admissions, emergency room visits, absences from school or work, and restricted activity days), changes in lung function and increased respiratory symptoms, as well as new evidence for more subtle indicators of cardiovascular health. Individuals particularly sensitive to $PM_{2.5}$ exposure include older adults, people with heart and lung disease, and children.

On July 18, 1997, we revised the NAAQS for particulate matter (PM) to add new standards for fine particles, using $PM_{2.5}$ as the indicator. We established health-based (primary) annual and 24-hour standards for $PM_{2.5}$ (62 FR 38652).[1] The annual standard was set at a level of 15 micrograms per cubic meter, as determined by the 3-year average of annual mean $PM_{2.5}$ concentrations. The 24-hour standard was set at a level of 65 micrograms per cubic meter, as determined by the 3-year average of the 98th percentile of 24-hour concentrations.

Attainment of the 1997 $PM_{2.5}$ standards is estimated to lead to reductions in health impacts, including tens of thousands fewer premature deaths each year, thousands fewer hospital admissions and emergency room visits each year, hundreds of thousands fewer absences from work and school, and hundreds of thousands fewer respiratory illnesses in children annually. The EPA's evaluation of the science concluded that there was not sufficient information to either support or refute the existence of a threshold for health effects from PM exposure.[2]

We subsequently completed in October 2006 another review of the NAAQS for PM. With regard to the primary standards, the 24-hour $PM_{2.5}$ standard was strengthened to a level of 35 micrograms per cubic meter, based on the 3-year average of the 98th percentile of 24-hour concentrations, and the level of the annual standard remained unchanged.[3] Attainment of the 2006 $PM_{2.5}$ standards is estimated to lead to additional reductions in health impacts, including approximately 1,200 to 13,000 fewer premature deaths each year, 1,630 fewer hospital admissions and 1,200 fewer emergency room visits for asthma each year, 350,000 fewer absences from work and school, and 155,300 fewer respiratory illnesses in children annually.[4]

In both 1997 and 2006 EPA established welfare-based (secondary) standards identical to the levels of the primary standards. The secondary standards are designed to protect against major environmental effects of $PM_{2.5}$ such as visibility impairment, soiling, and materials damage. The EPA also established the regional haze regulations in 1999 for the improvement of visual air quality in national parks and wilderness areas across the country. Because regional haze is caused primarily by light scattering and light absorption by fine particles in the atmosphere, EPA is encouraging the States to integrate their efforts to attain the $PM_{2.5}$ standards with those efforts to establish reasonable progress goals and associated emission reduction strategies for the purposes of improving air quality in our treasured natural areas under the regional haze program.

The scientific assessments used in the development of the $PM_{2.5}$ standards included a scientific peer review and public comment process. We developed scientific background documents based on the review of hundreds of peer-reviewed scientific studies. The Clean Air Scientific Advisory Committee, a congressionally mandated group of independent scientific and technical experts, provided extensive review of these assessments, and found that EPA's review of the science provided an adequate basis for the EPA Administrator to make a decision. More detailed information on health effects of $PM_{2.5}$ can be found on EPA's Web site at: *http://www.epa.gov/air/urbanair/pm/index.html*. Additional information on EPA's scientific assessment documents supporting the 1997 standards are available at *http://www.epa.gov/ttn/oarpg/t1cd.html*; additional scientific assessment information on the 2006 standards is available at: *http://www.epa.gov/ttn/naaqs/standards/pm/s_pm_cr_cd.html.*

The EPA issued final $PM_{2.5}$ designations for areas violating the 1997 standards on December 17, 2004. They were published in the **Federal Register** on January 5, 2005 (70 FR 944). On April 5, 2005, EPA issued a supplemental notice which changed the designation status of eight areas from nonattainment to attainment based on newly updated 2002–2004 air quality data (70 FR 19844; published in the **Federal Register** on April 14, 2005). A total of 39 areas were designated as nonattainment for the 1997 $PM_{2.5}$ standards. The population of these areas is estimated at about 90 million (or more than 30% of the U.S. population). Most of these areas only violate the annual standard, but a few violate both the annual and 24-hour standards.

The nonattainment designation for an area starts the process whereby a State or Tribe must develop an implementation plan that includes, among other things, a demonstration showing how it will attain the ambient standards by the attainment dates required in the CAA. Under section 172(b), States have up to 3 years after EPA's final designations to submit their SIPs to EPA. These SIPs will be due on April 5, 2008, 3 years from the effective date of the designations.

Section 172(a)(2) of the Act requires States to attain the standards as expeditiously as practicable but within 5 years of designation (i.e. attainment date of April 2010 based on air quality data for 2007–2009), or within up to 10 years of designation (i.e. to April 2015) if the EPA Administrator extends an area's attainment date by 1–5 years based upon the severity of the nonattainment problem or the feasibility of implementing control measures.

Virtually all nonattainment problems appear to result from a combination of local emissions and transported emissions from upwind areas. The structure of the CAA requires EPA to develop national rules for certain types of sources which are also significant contributors to local air quality problems, including motor vehicles and fuels. It also provides for States to address emissions sources on an area-specific basis through such requirements as RACT, RACM, and RFP.

We believe that to attain the $PM_{2.5}$ standards, it is important to pursue emissions reductions simultaneously on the local, regional, and national levels. The EPA issued the Clean Air Interstate

[1] The original annual and daily standards for particles generally less than or equal to 10 micrometers in diameter (also referred to as PM_{10}) were established in 1987. In the 1997 PM NAAQS revision, EPA also revised the standards for PM_{10}, but these revised PM_{10} standards were later vacated by the court, and the 1987 PM_{10} standards remained in effect. In the 2006 NAAQS revision, the 24-hour PM_{10} standard was retained but the annual standard was revoked. Today's implementation rule and guidance does not address PM_{10}.

[2] Environmental Protection Agency. (2004a). Air Quality Criteria for Particulate Matter. Research Triangle Park, NC: National Center for Environmental Assessment—RTP, Office of Research and Development, U.S. Environmental Protection Agency, Research Triangle Park, NC 27711; report no. EPA/600/P–99/002aF and EPA/600/P–99/002bF. October 2004.

[3] The revised fine particle NAAQS were published on October 17, 2006 (71 FR 61144). See EPA's Web site for additional information: *http://www.epa.gov/pm/index.html.*

[4] Regulatory Impact Analysis for Particulate Matter National Ambient Air Quality Standards (September 2006), page ES–8. The mortality range includes estimates based on the results of an expert elicitation study, along with published epidemiological studies.

Rule (CAIR)[5] on March 10, 2005 to address the interstate transport of sulfur dioxide and nitrogen oxide emissions primarily from power plants. Section 110 gives EPA the authority to require SIPs to ''prohibit * * * any source or other type of emission activity within the State from emitting any air pollutant in amounts which will contribute significantly to nonattainment in, or interfere with maintenance by, any other State with respect to'' any NAAQS, and to prohibit sources or emission activities from emitting pollutants in amounts which will interfere with measures required to be included in State plans to prevent significant deterioration of air quality or to protect visibility (such as the protection of 156 mandatory Federal class I areas under the regional haze rule[6]). CAIR employs the same emissions trading approach used to achieve cost-effective emission reductions under the acid rain program. It outlines a two-phase program with increasingly tighter power plant emissions caps for 28 eastern states and the District of Columbia: SO_2 caps of 3.6 million tons in 2010, and 2.5 million in 2015; NO_X caps of 1.5 in 2009 and 1.3 in 2015; and NO_X ozone season caps of 580,000 tons in 2009 and 480,000 tons in 2015. Emission caps are divided into State SO_2 and NO_X budgets. By the year 2015, the Clean Air Interstate Rule is estimated to result in:

—$85 to $100 billion in annual health benefits, including preventing 17,000 premature deaths, millions of lost work and school days, and tens of thousands of non-fatal heart attacks and hospital admissions annually.
—Nearly $2 billion in annual visibility benefits in southeastern national parks, such as Great Smoky and Shenandoah.
—Significant regional reductions in sulfur and nitrogen deposition, reducing the number of acidic lakes and streams in the eastern U.S.

Over the past several years, EPA has also issued a number of regulations addressing emissions standards for new cars, trucks and buses. These standards are providing reductions in motor vehicle emissions of volatile organic compounds (VOCs, also referred to as hydrocarbons), NO_X, and direct PM emissions (such as elemental carbon) as older vehicles are retired and replaced. Other existing rules are designed to reduce emissions from several categories of nonroad engines. The Tier 2 motor vehicle emission standards, together with the associated requirements to reduce sulfur in gasoline, are estimated to provide additional benefits nationally beginning in 2004.[7] When the new tailpipe and sulfur standards are fully implemented, Americans are estimated to benefit from the clean-air equivalent of removing 164 million cars from the road. These new standards require passenger vehicles to have emissions 77 to 95 percent cleaner than those on the road today and require fuel manufacturers to reduce the sulfur content of gasoline by up to 90 percent. In addition, the 2001 heavy-duty diesel engine regulations[8] will lead to continued emissions reductions as older vehicles in that engine class are retired and fleets turn over. New emission standards began to take effect for model year 2007 and apply to heavy-duty highway engines and vehicles. These standards are based on the use of high-efficiency catalytic exhaust emission control devices or comparably effective advanced technologies. Because these devices are damaged by sulfur, the level of sulfur in highway diesel fuel was to be reduced by 97 percent by mid-2006. We project a 2.6 million ton reduction of NO_X emissions in 2030 when the current heavy-duty vehicle fleet is completely replaced with newer heavy-duty vehicles that comply with these emission standards. By 2030, we estimate that this program will reduce annual emissions of hydrocarbons by 115,000 tons and PM by 109,000 tons. These emissions reductions are on par with those that we anticipate from new passenger vehicles and low sulfur gasoline under the Tier 2 program.

The EPA also finalized national rules in May 2004 to reduce significantly $PM_{2.5}$ and NO_X emissions from nonroad diesel-powered equipment.[9] These nonroad sources include construction, agricultural, and industrial equipment, and their emissions constitute an important fraction of the inventory for direct $PM_{2.5}$ emissions (such as elemental carbon and organic carbon), and NO_X. The EPA estimates that affected nonroad diesel engines currently account for about 44 percent of total diesel PM emissions and about 12 percent of total NO_X emissions from mobile sources nationwide. These proportions are even higher in some urban areas. The diesel emission standards will reduce emissions from this category by more than 90 percent, and are similar to the onroad engine requirements implemented for highway trucks and buses. Because the emission control devices can be damaged by sulfur, EPA also established requirements to reduce the allowable level of sulfur in nonroad diesel fuel by more than 99 percent by 2010. In 2030, when the full inventory of older nonroad engines has been replaced, the nonroad diesel program will annually prevent up to 12,000 premature deaths, one million lost work days, 15,000 heart attacks and 6,000 children's asthma-related emergency room visits.

The EPA expects the implementation of regional and national emission reduction programs such as CAIR and the suite of mobile source rules described above to provide significant air quality improvements for $PM_{2.5}$ nonattainment areas. At the same time, analyses for the final CAIR rule indicate that without implementation of local measures, a number of $PM_{2.5}$ areas are projected to remain in nonattainment status in the 2010–2015 timeframe. Thus, EPA believes that local and State emission reduction efforts will need to play an important role in addressing the $PM_{2.5}$ problem as well. The EPA will work closely with States, Tribes, and local governments to develop appropriate in-state pollution reduction measures to complement regional and national strategies to meet the standards expeditiously and in a cost-effective manner. States will need to evaluate technically and economically feasible emission reduction opportunities and determine which measures can be reasonably implemented in the near term. Local and regional emission reduction efforts should proceed concurrently and expeditiously.

The promulgation of a revised 24-hour $PM_{2.5}$ standard effective on December 18, 2006 has initiated another process of State recommendations, and the eventual designation by EPA of areas not attaining the revised standard. The additional designations are to be completed within two years from the effective date, although EPA may take an additional year to complete the designations if it determines it does not have sufficient information. State plans to attain the 24-hour standard would then be due within three years of the final designations. A number of areas, including some that are already designated as not attaining the 1997 standards, may be exceeding the revised 24-hour standard. The EPA encourages State and local governments to be mindful of the strengthened 24-hour standard as they adopt emission reduction strategies to attain the 1997 standards. Such steps may help with

[5] See *http://www.epa.gov/cair.*

[6] See 64 FR 35714, July 1, 1999.

[7] See Tier II emission standards at 65 FR 6698, February 10, 2000.

[8] See heavy-duty diesel engine regulations at 66 FR 5002, January 18, 2001.

[9] For more information on the proposed nonroad diesel engine standards, see EPA's Web site: *http://www.epa.gov/nonroad/.*

Ambient Air Quality Monitoring (AAQM) at Agra

CPCB is monitoring Ambient Air Quality at Agra as a floow up of direction of Hon'ble Supreme Court of India in the year 2000. The annual average values, standard deviations and percentage violation of primary pollutants viz. SPM, RSPM, SO_2 and NO_2 for the year 2006-07 at all four monitoring locations, viz. Tajmahal, It-mad-ud-daulah, Rambagh and Nunhai. with reference to sensitive area ambient air quality goal are presented Table 5.26.

Table 5.26 : Ambient Air Quality Status at Agra (Year 2006-07)

Locations	Parameters	Annual Average	Standard Deviations	No of Valid monitoring days	% Violations
Tajmahal	SO_2 (Day Average = 30 $\mu g/m^3$ & Annual Standard =15$\mu g/m^3$)	5	2	267	00
Itmad ud daulah		6	2	103	00
Rambagh		6	2	116	00
Nunhai		6	2	115	00
Tajmahal	NO_2 (Day Average = 30 $\mu g/m^3$ & Annual Standard =15$\mu g/m^3$)	21	8	266	21
Itmad ud daulah		24	8	103	29
Rambagh		23	6	116	28
Nunhai		35	11	115	67
TajMahal	RSPM (Day Average = 75 $\mu g/m^3$ & Annual Standard =50$\mu g/m^3$)	129	73	269	66
Itmad ud daulah		221	88	101	91
Rambagh		235	90	114	91
Nunhai		280	124	107	93
TajMahal	SPM (Day Average = 100 $\mu g/m^3$ & Annual Standard =70$\mu g/m^3$)	295	127	264	83
Itmad ud daulah		375	148	95	98
Rambagh		414	116	108	99
Nunhai		563	221	113	99

Remarks:

- All the values are in $\mu g/m^3$ of Air
- % Violation: Percentage violation with respect to National Ambient Air Quality Standards (24 Hourly Average)
- Valid monitoring day: Sampling time 16 hours or more in a day
- Sensitive Area Ambient Air Quality Goal are referred for calculations

Considering 2% violation in a year as mentioned in the ambient air quality goal, no violation for parameter SO_2 was observed at any locations. The situation with respect to violation of norms for Nitrogen Dioxide was 21%, 29%, 27% and 66% at Tajmahal, Itmad-ud-daulah, Rambagh and Nunhai respectively. The other parameters viz. RSPM and SPM remained critical. Ambient air quality at Tajmahal remained least polluted among four stations, while Nunhai has maximum air pollutant concentration. Both SPM and RSPM were critical as were observed in last four years.

Measurement of Benzene Soluble Organic Fraction in FPM ($PM_{2.5}$) at Agra

Within the purview of Fine Particulate Matter (FPM or $PM_{2.5}$) characterizations program, the study is in progress since January 2006, wherein 4-6 selected representative samples for measurement of Benzene Soluble Organic Fraction (BSOF) in $PM_{2.5}$ at Agra of $PM_{2.5}$ monitored at Tajmahal by an indigenous manual sampler manual monitoring are subjected for analysis of Benzene Soluble Organic Fraches (BSUR) in $PM_{2.5}$. The data as obtained during the period Jan-Oct, 2006 is presented at Table 7.5.

Table 7.5 : Benzene Soluble Organic Fraction in $PM_{2.5}$ at Agra

Month	Fine Particulate Matter ($PM_{2.5}$) µg/m^3	Organic fraction µg/m^3	% Fraction
January 2006	232	208	90
February 2006	109	96	88
May 2006	28	21	74
June 2006	19	8	41
July 2006	25	14	56
August 2006	13	5	36
September 2006	25	7	27
October 2006	65	47	72

Bi-lateral R & D Activities undertaken at Agra

a) Monitoring of Fine Particulate Matter (India-Canada Program)

Under Canada-India Institutional Strengthening Program, the Beta Attenuation Particulate Sampler (US-EPA approved, Met-One USA make) has been received for real time (clock hourly data) monitoring of $PM_{2.5}$ at Tajmahal, Agra during January 2005 which is maintained and operated by Central Pollution Control Board, Project Office at Agra. The monthly average data for the year 2006-07 is presented in Fig 7.1. The highest concentration of $PM_{2.5}$ was recorded in January Avg. 193 µg/m^3), followed by February (Avg. 140 µg/m^3) (winter months), while least concentration has been recorded during August (Avg. 24 µg/m^3) (monsoon month). The day peak was recorded between 0800 to 1100 hrs, while evening peak inititated at 1900 hrs and continues till 0600 hrs (Fig. 7.1)

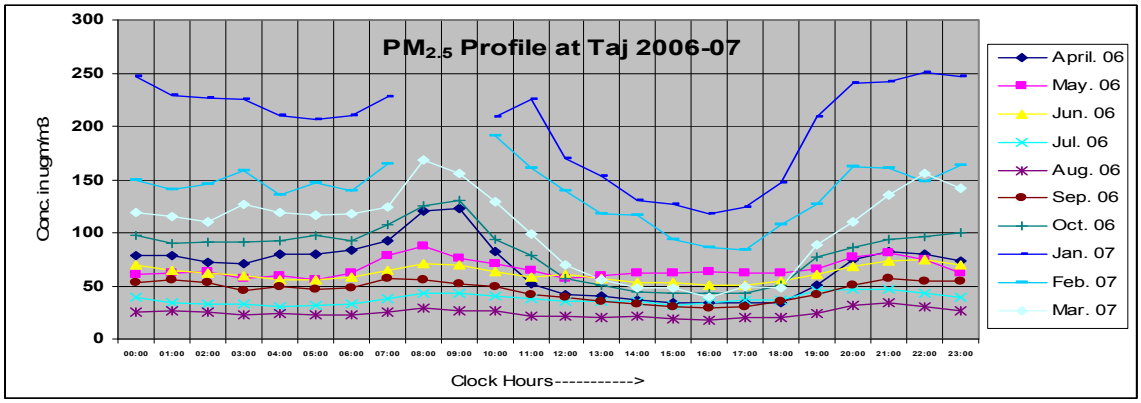


Fig 7.1 : $PM_{2.5}$ profle at Tajmahal Agra during year 2006-2007.

Trend in annual average concentration of NO_2 in residential areas of various cities are depicted in Fig 5.39. Levels were within the prescribed NAAQS in the cities except Agra (Sensitive Area) during most of the years. A decreasing trend has been observed in residential areas of Faridabad, Kolkata, Solapur and Pune. Fluctuating trends in NO_2 were observed in Bangalore, Hyderabad etc. Vehicles are one of the major sources of NO_2 and their number is increasing day by day. The factors responsible for decreasing levels of NO_2 are measures such as banning of old vehicles, better traffic management, introduction of improved vehicular technology in the form of Bharat Stage –III vehicles, banning of old vehicles in some cities, improved traffic management etc.

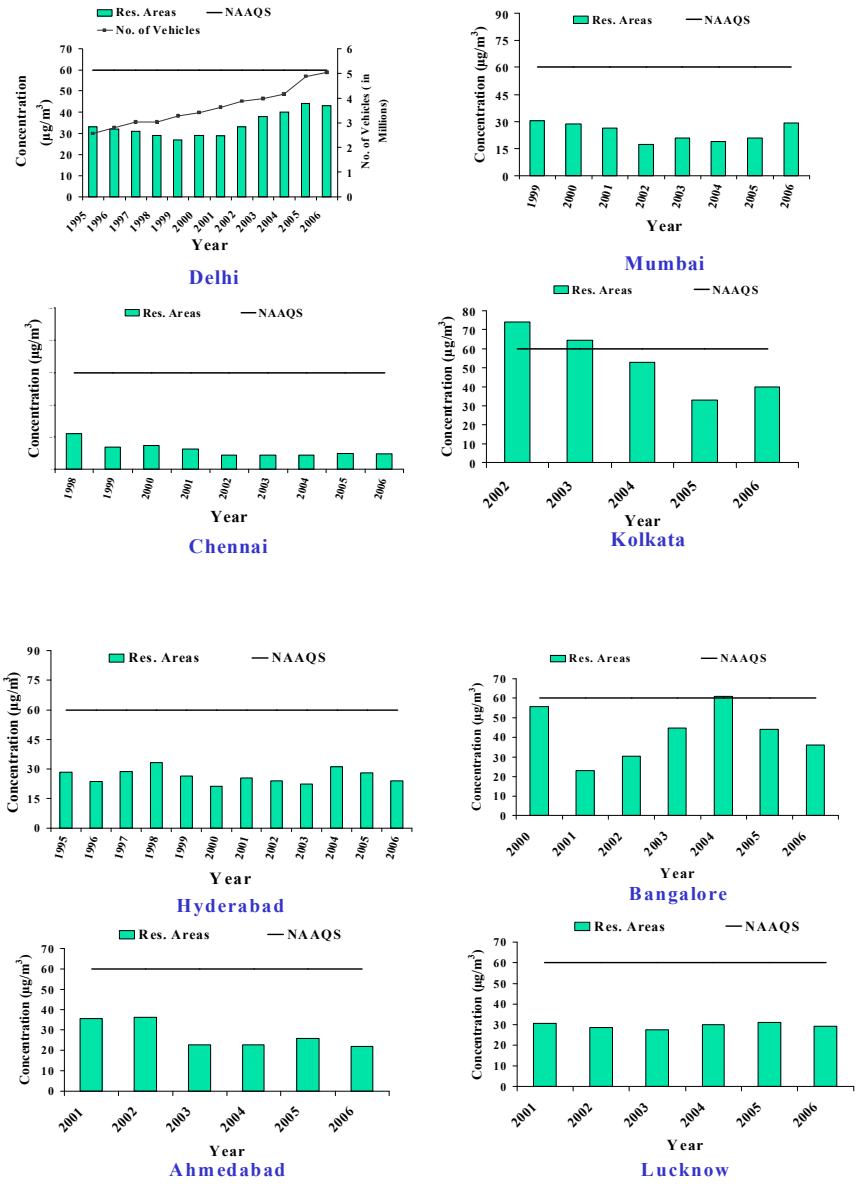


Figure 5.39 : Trends in Ambient NO_2 Levels (Annual average concentrations) in various cities.

National Ambient Air Quality Standards

Pollutants	Time-weighted average	Concentration in ambient air Industrial Areas	Residential, Rural & other Areas	Sensitive Areas	Method of measurement
SulphurDioxide (SO_2)	Annual Average*	80 µg/m3	60 µg/m3	15 µg/m3	- Improved West and Geake Method - Ultraviolet Fluorescence
	24 hours**	120 µg/m3	80 µg/m3	30 µg/m3	
Oxides of Nitrogen as (NO_2)	Annual Average*	80 µg/m3	60 µg/m3	15 µg/m3	- Jacob & Hochheiser Modified (Na-Arsenite) Method
	24 hours**	120 µg/m3	80 µg/m3	30 µg/m3	- Gas Phase Chemiluminescence
Suspended Particulate Matter (SPM)	Annual Average*	360 µg/m3	140 µg/m3	70 µg/m3	- High Volume Sampling, (Average flow rate not less than 1.1 m3/minute).
	24 hours**	500 µg/m3	200 µg/m3	100 µg/m3	
RespirableParticulate Matter (RPM) (size less than 10 microns)	Annual Average*	120 µg/m3	60 µg/m3	50 µg/m3	- Respirable particulate matter sampler
	24 hours**	150 µg/m3	100 µg/m3	75 µg/m3	
Lead (Pb)	Annual Average*	1.0 µg/m3	0.75 µg/m3	0.50 µg/m3	- ASS Method after sampling using EPM 2000 or equivalent Filter paper
	24 hours**	1.5 µg/m3	1.00 µg/m3	0.75 µg/m3	.
Ammonia1	Annual Average*	0.1 mg/ m3	0.1 mg/ m3	0.1 mg/m3	.
	24 hours**	0.4 mg/ m3	0.4 mg/m3	0.4 mg/m3	.
CarbonMonoxide (CO)	8 hours**	5.0 mg/m3	2.0 mg/m3	1.0 mg/ m3	- Non Dispersive Infra Red (NDIR)
	1 hour	10.0 mg/m3	4.0 mg/m3	2.0 mg/m3	Spectroscopy
*	Annual Arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval.				
**	24 hourly/8 hourly values should be met 98% of the time in a year. However, 2% of the time, it may exceed but not on two consecutive days.				

NOTE:

1. National Ambient Air Quality Standard: The levels of air quality with an adequate

margin of safety, to protect the public health,, vegetation and property.

2. Whenever and wherever two consecutive values exceeds the limit specified above for the respective category, it would be considered adequate reason to institute regular/continuous monitoring and further investigations.
3. The standards for H2S and CS2 have been notified seperately vide GSR No. 7, dated December 22, 1998 under Rayon Industry - for details please see Sl. No. 65 of this document.

[S.O. 384(E), Air (Prevention & Control of Pollution) Act, 1981, dated April 11, 1994]
[EPA Notification: GSR 176 (E), April 02, 1996]

1. Included vide Notification SO. 955 (E), Air (Prevention & Control of Pollution) Act, 1981 dated October 14, 1998)

Annexure VII

Guidelines for Preparation of Environmental Management Plan for Storm Water Management Systems

The Environmental Management Plan (also referred to as an Environmental Impact Report) is typically carried out prior to consideration of Draft Plan Approval. Typically, impact assessments are carried out for the proposed land use. Alternative management strategies are developed on storm water management practices. Collectively, the management practices will ensure that the environmental resources are protected, restored or enhanced in accordance with defined goals and objectives. Comparative evaluation of the strategies will lead to the selection of the preferred alternative.

Good planning for the storm water management has a strong ecological attribute. It also provides a fundamental basis for achieving storm water quality and improvement efficiently and cost effectively. Soils which are permeable and existing vegetation communities are suited to infiltration and can function as biofilters and landscape that are naturally conducive to the implementation of detention initiatives should be identified along with other characteristics to achieve storm water management objectives. The watershed planning approach, which is now ingrained within the municipal planning process, ensures that the important features and other interrelated factors are identified and understood at a regional scale. As a result, storm water management opportunities afforded by the existing natural heritage features and functional systems are identified early in the process. This helps ensure that these opportunities will not be overlooked or lost when storm water management initiatives are implemented at a site-specific scale.

Annexure VIII

Environmental Management Information Systems for Urban Environment

Environmental Management Information Systems (EMIS) concentrates on the spatial aspect of urban planning and management. Information is crucial to various planning and managemental activities. The challenges experienced by cities usually are :

- to determine what data and information is needed for the purpose at hand;
- to find out if it exists and where;
- how to get hold of it if it exists and how to collect it if it does not;
- how to store this information in easily accessible and referenced form;
- how to interpret the data, resolve questions of quality, inconsistencies;
- to determine who needs the information, when and in what form(s); and
- to disseminate it as required.

These challenges can be overcome by formalising, institutionalising and sustaining an information system in inspite of data gathering exercise. Management information systems has standardised and clear procedures and formats, which are flexible in application; is integrated into a permanent organisational structure, is independent of any critical individual input; and is sustained with the necessary resources (funding, staffing, etc.) and political backing. It is an attractive system whose services are actively sought, and is capable of fulfilling this demand. An EMIS concentrates on the spatial aspect of urban planning and management and provides the basis for an open planning framework which complements or even supercedes traditional master planning concepts and, therefore, is applicable not only to environmental planning but to a broad range of urban planning approaches.

Purpose

“EMIS Provides concise timely and relevant information for the decision-making process on urban issues"

1. To provide Concise, Timely, and Usable Information on Urban Issues

One purpose of an EMIS is to show the relationships between environment and developmental issues. Such a system consists of formalised steps to capture information, as

well as fixed procedures to retrieve this information. Generally speaking, the EMIS covers the gathering of relevant information for a participatory urban environmental planning and management process. However, it can also include the collection of information about the various urban issues (such as poverty, environment, security) facing a particular city. This information is stored in archives, databases and in maps. Information maintained and generated through such a system is usually up-to-date as it allows for continuous input of data generated through an agreed standard, involving public and popular participation. The information is presented in an easily understandable form using attractive maps, graphics and photos. The information is widely accessible, for example through information kiosks, newspaper features, local neighbourhood exhibitions, general distribution publications, etc.

2. To support Participatory Decision-making Process in an Urban Management Framework

The EMIS is designed to provide information which is directly usable by the participants involved in an urban management process. The information is therefore not comprehensive or overly technical, but highly focused, concentrating on what is relevant for the decision-making process. Because it is up-to-date, issue-oriented, and well-presented, the EMIS information directly supports a consultative and participatory working group process. Because it relies on stakeholder participation for finding and inputting data, the EMIS is not an exclusive technical exercise but a broader-based participatory one.

Principles :

Dynamic learning system: An EMIS is a dynamic information system, so new data has to be fed into it continuously. An information system does not have to be comprehensive to be useful, and in any case it takes considerable time to assemble and process the necessary data. In the meantime, decisions on environmental issues have to be taken - they cannot wait for ever more information. Provided that attention focuses on the priorities of the users, even modest, incremental improvements in information and knowledge about an issue can be very useful. This tends to be especially valid in the environmental area, where the major problem is not necessarily a complete lack of information, but its fragmentation, perhaps a reflection of the fact that environment is not generally recognised as a technical sector in its own right. Over time, as new issues crop up, the information system will increase its coverage and scope, through both passive and active collection modes of system, provided that an appropriate framework is in place. At an advanced stage, the framework can be a

sophisticated computerised GIS. The important point is that the system receives regular maintenance and updating.

Uses best available information: An EMIS accepts and uses the best information which is available. It is tempting when defining information systems to be too ambitious and technical professionals often insist on being complete and all-encompassing. This of course can never be achieved, and seeking perfection in this way is invariably counter-productive. A law of diminishing returns applies here, the time and resource costs of getting "better" data will quickly exceed the benefits gained from that extra data. Frequently projects can be delayed because essential information is missing, but available time and resources do not allow in-depth research. In such cases it is necessary to rely on estimated figures, common sense or community knowledge. The more the data is partial, missing, inconsistent etc; the more judgmental expertise is required to convert it into meaningful and reliable information. Non-scientific information may quite properly and effectively be used as long as the source and its limitations are understood. The challenge is to find the right balance. Of course the objective would be to replace this kind of information at a later stage of the EMIS with more accurate data. But for the moment, what counts is that some information is better than none.

Avoid the data trap: Specific attention should be given to avoid falling into the "data trap", i.e. getting bogged down in a large, general purpose, open-ended and unfocused data collection exercise, almost invariably unsuccessful and therefore largely irrelevant. The purpose of EMIS is not to substitute for general purpose or even sectoral statistical services or research institutions. Nor is information synonymous with data, only with analysis, interpretation and synthesis does data turn into information.

Distinguishes between facts and policies : An EMIS makes a clear distinction between factual information and policy information. Factual thematic maps show quantifiable or "countable" data, for example geology maps, soil maps, population density maps, etc. Policy maps show information about certain policy decisions such as national acts, laws and by-laws, global environmental standards or rules and conditions developed by stakeholders during the working group process. Policy maps are based on an intensive participatory process. They are subjective as they show policy aims and represent different opinions which have been negotiated during the working group process. These maps will be always disputed and discussed - but they provide an extremely valuable support for those discussions.

Generally Accessible: Information in the EMIS has to be easily accessible for all stakeholders and for civil society as a whole. The EMIS helps therefore to avoid the all too common "data bank syndrome". The information system should not be viewed as static hoard of valuable information, deposited by its owners to be carefully guarded from unauthorised access, as in the vaults of a bank. Rather it should be seen as a continual flow, like a newspaper, where information is incessantly and actively sought out, quickly analysed and summarised, and rapidly distributed widely and without restriction. Information is like news, a perishable product that loses value over time. The usefulness and influence of a newspaper comes from immediately disseminating new information, not retaining it. An effective information outreach strategy is absolutely necessary for the success of the EMIS.

Appropriate technology: An EMIS does not depend on highly sophisticated technology. The system can be implemented at various levels of sophistication, manual or computerized, and it will make best use of tools available. Not the best technology but the compatibility to existing systems and capacities is the key to a successful EMIS. The main outputs of an EMIS are attractive and colourful maps and therefore a geographical information system (GIS) is a suitable tool for the EMIS.

Working Methodology:

The following experiences on key elements of the EMIS are based on practical experience from its application in many cities around the world. It has used environment as a particular entry point, but experience has shown that, with suitable but simple modifications, the EMIS can easily be adapted to other thematic areas and sectors, such as security and disaster management. The following steps focus on the spatial analysis part of the EMIS by using maps and geographical information systems.

Step 1: Setting-Up the System

Setting up an EMIS unit takes quite some resources, and must be supported by an adequate number of personnel, at least one dedicated professional officer and one assistant. An EMIS system can be built without computer equipment, but it is much easier to use a computer-based Geographic Information System (GIS) to handle the amount of data the system will contain. Fortunately, good "off the shelf" GIS software is readily available and will run on a standard high-performance desk-top computer; an A0 inkjet printer and input devices such as a digitising board and a scanner are also key equipment. For fieldwork, a Global Positioning System (GPS) receiver will be essential, but these are now widely available at

reasonable prices. A light table is vital for group discussions around particular maps printed on transparent material.

Step 2: Forming the Mapping Group

To link the EMIS with the stakeholders and users of the system, it is very useful to establish a Mapping Group. The major task of such a group is to support and work with the EMIS technical unit and to provide a continuous link between users and providers. This group can be useful by providing inputs and asking questions during the EMIS-building exercise. In Step 1 they advise on purchasing equipment. For Step 3 they can provide information about existing maps and for Step 4 they can decide on the content and lay-out of the Basic Map. The Mapping Group facilitates the link between the Working Groups and the EMIS unit, and it is this group which discusses the needs of Thematic Maps, the mapping rationale for Suitability and Sensitivity Map, and the overlay procedures. Finally, the Mapping Group can play a role in capacity-building and training.

Step 3: Taking Inventory

The EMIS inventory stage covers the search for existing data and maps (a difficult task which involves searching over a wide range of organisations and potential sources), setting up a filing system for hardcopies, developing a filing system for the digital data, and establishing a reference database of all relevant maps and data.

Step 4: Preparing the Base Map

A Base Map includes the main features of the city such as major rivers, main roads, historical monuments and basic landforms. These basic features should be used in each map created later on to give some guidance and orientation on the location. The layers of the Base Map function as master layers, so rivers, roads or boundaries will never ever be digitised again unless they undergo physical change (i.e. a river may change course). When printing the first Base Maps, it is essential to decide on a standard layout which can be used for all the EMIS maps. It is important to design the Base Map, in terms of the inclusion of information and the graphics chosen.

Step 5: Preparing Thematic Maps

In the EMIS, Thematic Maps show strictly factual information, for example, height of water table level in metres underneath the ground, soil eroded each year in centimetres, persons

per hectare for each administrative sub-unit, and so on. The input for these Thematic Maps will come from existing maps, scientific reports or existing data, which can be found in different city departments or academic and research institutions, or which can be generated by the Issue-Specific Working Groups.

Step 6: Preparing Suitability and Sensitivity Maps

The creation of a Suitability and Sensitivity Map involves the interpretation of factual data as found in Thematic Maps and the evaluation of these findings. This focuses on drawing conclusions about conditions in specific areas and defining and applying "rules and regulations" according to these conditions. For instance, the Working Groups may assign ranks to these "rules and conditions" according to the impact of urban issues on development or the impact of development on the various environmental issues. A Suitability Map could show, for example, areas marked or graded by their suitability for housing development, say on environmental criteria such as slope of land, soil stability, ground water table, flooding exposure, etc.

Step 7: Overlaying of Fact and Policy Maps

For some outputs of the EMIS it is necessary to combine information from several maps or data sets. The interaction between environment and developmental issues, i.e. the identification of crucial, hotspots can be simulated by overlaying a variety of maps. (Overlaying can be done manually, using transparent maps in combination, or on the computer through the GIS system.) Different combinations of overlays will generate the necessary outputs which are significant for urban planning and management.

Step 8: Information Outreaching

The EMIS uses a participatory approach and therefore public information activities are an important part of the system. Continuous and active "outreach" to the public at large can stimulate the identification or provision of new information into the system, and equally it can be used to field-text and refine the outputs to ensure they are understandable and useable. Methods to promote the system include city-wide and local exhibitions, the world-wide-web, printed publications, use of print and television/radio media, interactive map publication on CD-ROM, etc.

Step 9: Maintaining the System

An EMIS is a continuously evolving system. Thus, even though the design of the system is completed, the data content grows and changes continuously over time. In order to maintain the system it is vital to anchor the system in the most appropriate department or institution, to ensure public involvement, and to acquire a regular budget on a long-term basis. The anchoring department has to commit itself to continuously up-date the system (undertaking the costs involved) and must provide a continuous training programme for the EMIS users and operators.

Sample Areas of Application:

Though presented as Environmental MIS, this approach is capable with limited modification, of responding to diverse needs and uses in urban planning and management. Thus, a generic EMIS (which could also be called an Urban Management Information System - UMIS) has the capability to serve a number of urban management functions. The planning department is concerned about the physical development of the city, while the environment department needs to better manage environmental resources and hazards. The EMIS has been used to attract investors by providing maps which show the best locations for investment in the city.

Linkage with UG Norms:

The key elements of EMIS established within a participatory decision making framework are its interactive nature and its accessibility to all users and stakeholders including community groups, organized informal sector operators, developers, researchers and public activists. This greatly enhances transparency and makes information a shared resource, so the EMIS also becomes an effective tool to empower the different stakeholder groups.

Reference: http://www.serd.ait.ac.th/ump/html/emistk.htm

Annexure – X

Water quality criteria (CPCB):

Designated-Best-Use	**Class of water Criteria**
Drinking Water Source without conventional treatment but after disinfection: • Total Coliforms Organism MPN/100ml shall be 50 or less • pH between 6.5 and 8.5 • Dissolved Oxygen 6mg/l or more • Biochemical Oxygen Demand 5 days 20°C 2mg/l or less	A
Outdoor bathing (Organized): • Total Coliforms Organism MPN/100ml shall be 500 or less • pH between 6.5 and 8.5 Dissolved Oxygen 5mg/l or more • Biochemical Oxygen Demand 5 days 20°C 3mg/l or less	B
Drinking water source after conventional treatment and disinfection: • Total Coliforms Organism MPN/100ml shall be 5000 or less • pH between 6 to 9 Dissolved Oxygen 4mg/l or more • Biochemical Oxygen Demand 5 days 20°C 3mg/l or less	C
Propagation of Wild life and Fisheries: • pH between 6.5 to 8.5 Dissolved Oxygen 4mg/l or more • Free Ammonia (as N) 1.2 mg/l or less	D
Irrigation, Industrial Cooling, Controlled Waste disposal • pH between 6.0 to 8.5 • Electrical Conductivity at 25°C micro mhos/cm Max.2250 • Sodium absorption Ratio Max. 26 • Boron Max. 2mg/l	E
Not Meeting A, B, C, D & E Criteria	Below-E