ENVIRONMENTAL IMPACT ASSESSMENT
OF
INTEGRATED MUNICIPAL SOLID WASTE PROCESSING COMPLEX

GHAZIPUR, DELHI

Submitted to:
Delhi Pollution Control Committee

Submitted by:
East Delhi Waste Processing Company Pvt. Ltd.

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EXECUTIVE SUMMARY

1.0 INTRODUCTION

M/s Infrastructure Leasing & Financial Services (IL&FS) has initiated development of Municipal Solid Waste (MSW) processing complex in the country, with an objective of waste reduction and ultimately effective management.

East Delhi Waste Processing Company Private Limited (EDWPCL) has been set up as a special purpose company, for developing projects for processing and disposing off municipal wastes and also to produce by-products, inter-alia, fluff and Refuse Derived Fuel which results in power generation which is an incidental source of revenue.

The proposed facility is proposed at an abandoned site adjacent to Ghazipur Landfill site spread over 5.728 acres with an investment over of Rs.100 crores. The proposed plant at Ghazipur dumpsite will be designed to process 1300 TPD (Tons per Day) of MSW The proposed solid waste management facility shall involve conversion of waste to Refuse Derived Fuel (RDF) which will ultimately results in power generation. A RDF plant based on DST-TIFAC Technology will be designed to process 1300 TPD of MSW to generate around 433 TPD of RDF in the form of fluff and a power plant of 10 MW capacity based on RDF will be provided.. Non biodegradable products such as stones, sand ceramics and metal components will be separated from biodegradable and other organic matter waste.

The proposed project falls under Item 7 (i) (Common Municipal Solid Waste Management Facilities) as per Environmental Impact Assessment Notification dated September 14, 2006. The project will fall under Category A due to the application of general conditions i.e. interstate boundary, and will require environmental clearance from Ministry of Environment and Forests. M/s EDWPCL has retained the services of SENES Consultants India Private Limited (SENES) for carrying out a Rapid Environmental Impact Assessment (REIA) study and preparation of an EIA report, incorporating Environmental Management Plan (EMP) and Disaster Management Plan (DMP) for the proposed project. The EIA study has been done as per the approved Terms of Reference (TOR) provided by MoEF vide letter No.10-74/2007-IA.III dated 6th September 2007.

A REIA study report has been prepared for this project based on Post-Monsoon season (September-November, 2007) baseline environmental quality data in the study area. Identification & prediction of significant environmental impacts due to the proposed integrated waste processing facility with an Environmental Impact Statement followed by delineation of appropriate impact mitigation measures in an Environmental Management Plan are included in

the REIA Report. M/s EDWPCL has retained SENES Consultants India Pvt. Ltd. to conduct a Rapid Environmental Impact Assessment study for the proposed project.

The purpose of this Environmental Impact Assessment (EIA) study is to provide information on the nature and extent of environmental impacts arising from the construction and operation of the proposed project.

The solid waste at project site shall be provided by Municipal Corporation of Delhi. The proposed integrated waste processing facility will have a section for processing Municipal Solid Waste (MSW) which will involve manual segregation, shredding, screening to separate both fine inerts and some percentage of bio-degradable matter, fines screening, ballistic separation etc which will finally result in the production of RDF as byproduct. RDF, thus produced will be utilized for the generation of electricity.

2.0 SALIENT FEATURES OF PROJECT

The Salient features of the project are provided below:

- Total Project Cost: ~Rs.100 Crores
- Land area: 5.728 acres or 23180.22 sq.m
- MSW processing capacity 1300 TPD
- Power generation capacity 10 MW
- Water Requirement: 471 m^3/day
- Wastewater Generation ~ 172 m^3/day
- Source of water: Kondli sewage treatment plant augmented by Municipal supply

3.0 SITE LOCATION & DESCRIPTION

The proposed site is accessible from National Highway -24 via Kondli road running parallel to Ghazipur drain. The Kondli road is connected to 7.0 meter wide road facing the proposed site and Ghazipur Dairy farm. The coordinates of the proposed site are:

Latitude : 28^0 37' 22.4'' N
Longitude : 77^0 19' 25.7'' E
Site Elevation : 204 m above MSL

The site is bounded on the four sides in the near vicinity by the following:

East: On the eastern boundary of the proposed site is the Ghazipur landfill site. The Hindon cut canal flows at a distance of about 0.1 km and River Hindon flows at a distance of 6.9 km.

West: On the western side of site is the Ghazipur Dairy farm and DDA colony. River Yamuna flows at a distance of 5.5 km.

North: On northern boundary of the project site is a veterinary hospital. Further on the northern side of project site are settlements such as Hasanpur Bhuapur village within 1.8 km. Sahibabad Industrial area is at a distance of about 4.0 km.

South: Immediate southern boundary of project site is a Masjid. Few settlements such as Khichripur and Makanpur lie at a distance of 1.2 km and 3.4 km respectively.

4.0 PROJECT UTILITIES/AMENITIES

Fuel

The proposed integrated waste management facility will have a capacity to process 1300 TPD of MSW to generate about 433 MT of RDF. The mixed MSW shall be supplied to the facility by MCD. The boiler for the proposed power plant consume about 16.27 TPH of RDF Fluff for power generation

Water

The proposed power plant will be provided with air cooled condenser for condensing the exhaust steam from turbo generator. The usage of air cooled condenser reduces water requirement to a large extent. The water requirement for the proposed project would be around 471 m^3/day and would be met from Kondli Sewage Treatment Plant. It is proposed to have a water treatment plant of capacity 500m^3 /day for the tertiary treatment of the water received from Kondli Sewage Treatment Plant. The domestic water requirements will be met through municipal water supply.

Power

The total RDF used will be about 16.27 tonnes per hour in boiler for the generation of 10 MW of power. The boiler will generate about 50 TPH of steam. The total power generated after in house power use will be stepped up to 66 kV through 12.5 MVA generator transformer to 66 kV bus at Kondli substation of BSES located at a distance of about 1.5 km from project site.

Fire Fighting Facilities

Fire protection system will be provided as per LPA (Loss Prevention Association) norms. For every 100 m^2 area of plant, one DCP type and one CO_2 type fire extinguisher will be provided. "No Smoking" and hazard / danger warning stickers will be put up at appropriate places. All personnel deployed for the construction, erection and operation of the plant will be given

proper training for fire drill. Emergency numbers will also be put up at appropriate places. Empty fuel drums / tanks and other inflammable material will be stored in earmarked place and removed from the premises as soon as possible. Storage yard for chemicals and fuel lubricants will also be provided with fire extinguishers and sand bucket racks.

Road & site drainage

All roads in the plant area will be well-designed bitumen roads and will be of 4 m wide with 1m wide berm on each side. For effective storm water drainage, final finished road will have a camber of 1 in 60 and water bound macadam surface will have a camber of 1in 40.

Surface drainage will be designed based on the maximum rainfall intensity prevalent in the area. All the building would be provided with a plinth protection all round, sloped towards the side drain. The side drain will be connected to the main drain on either side of the road.

MSW storage area will be provided with a slope to drain the water collected to a sump from where it will be pumped to the Effluent Treatment Plant.

5.0 ENVIRONMENTAL SETTING OF THE STUDY AREA

The baseline environmental status was assessed based on primary and secondary data collected through on-site field observations and obtained from agencies such as IMD, Geological Survey of India, State Ground Water Department, Central Ground Water Board, State Pollution Control Board, Census of India and Local Forest Department. The following environmental components were focused at during this study:

- Air Environment (Meteorology, Ambient Air Quality, Noise Levels, Traffic Pattern, etc.)
- Water Environment (Quality and Quantity of Surface and Groundwater sources)
- Land Environment (Geology, Hydrogeology, Landuse, Solid Waste generation and characteristics)
- Ecological Environment (Terrestrial and Aquatic Flora & Fauna)
- Socio-Economic Environment (Demographic profile, Occupational structure, Educational status, Literacy status, etc.)

The baseline status collated from analysis of secondary and primary data is summarized in the **Table E-1** below.

Table E-1: BASELINE ENVIRONMENTAL STATUS

Attribute	Baseline status
Meteorology	A meteorological station was set up on site. The minimum temperature recorded was 11 °C and maximum temperature was found to be 32 °C during the study period (i.e. September to November). The average wind speed was observed to be 1.5 m/s and the predominant wind direction was observed to be west.
Ambient Air Quality	Ambient air quality was monitored at 5 locations within a 5 km radius of the project site. The observed SPM levels were in range of 158 to 460 $\mu g/m^3$, while RSPM was in range of 56 to 134 $\mu g/m^3$. The range of SO_2 and NO_X was 5 to 21 $\mu g/m^3$ and 10 to 26 $\mu g/m^3$ respectively. Observed SPM levels at all locations and RSPM levels at 3 locations exceeded NAAQS whereas concentrations of SO_2, NOx were well within the prescribed limits. CO levels exceeded prescribed limits at project site.
Noise Levels	Noise monitoring was carried out at five locations. The results of the monitoring program indicated that both the daytime and night time levels of noise exceed NAAQSRN at all the five locations monitored .
Water Quality	10 Groundwater samples and 2 surface water samples were analyzed. Total Dissolved Solids (TDS) in groundwater samples exceeds the desired limit as per IS: 10500 at 6 locations (Project site, Arthala, Khora, Pasaunda, Raipurakhader and Kethwara) while Total Hardness exceeds the desired limit as per IS-10500 at 5 locations (Project site, Arthala, Makanpura, Parthala, Pasaunda and Raipurakhader). Chloride exceeds the desired limit at 4 locations (Project site, Pasaunda, Raipurakhader and Kethwara) while calcium exceeds the desired limit at 5 locations (Kinauni, Arthala, Khora, Raipurakhader and Kethwara) Surface water samples on analysis and comparison with CPCB class "C" water showed that DO of the samples is good and ranges form 3.8 to 4.1 whereas BOD is high in comparison to maximum 3 mg/l. Surface water samples also showed the presence of total Coliform and faecal Coliform indicating organic contamination.
Ground water Availability	The project site is characterized by 30-40 m thick unconfined to semi confined aquifers and has large groundwater yield prospects in the range of 50-100 m^3/hr.
Soil Quality	The proposed site is characterized by highly variable stratified soils. The result shows that the moisture retention capacity of the soil is 46 %, which is good. Soil of the area is slightly basic with a pH of 7.82. The CEC analysis of the soil sample is 12.14 meq /100 gm, which is low and it, can be concluded that the soil is sandy.
Biological Environment	Delhi falls under the biogeographic province 4A- Semi arid Punjab plains. No protected or reserve forest falls within 10 km radius of the proposed project site. Water bodies such as Yamuna and Hindon rivers and Hindon Cut are the three permanent water bodies flowing within 10 km from the proposed project site. The project site does not come within an existing or proposed ecological sensitive zone. No threatened or endangered plant or

Attribute	Baseline status
	animal species are known to exist in and around the site.
Socio-economy	The baseline study focuses on East zone {Ward 218-Mandawali [Gazipur Dairy] and Ward 227-IP Extension [Gazipur Village] of Delhi. The complete study area falls under Municipal Corporation of Delhi (MCD). Literacy rate for east zone is 84.9% as against the literacy rate of Delhi at 81.7% in census 2001. The sex ratio for east zone of Delhi is 843, as against the state average of 822. In the study area maximum number of people are found to be engaged as "other workers" in economic activity like Government/Private service, teachers, factory workers, commerce etc. negligible population is involved in agricultural activities.

6.0 ENVIRONMENTAL IMPACT ASSESSMENT & ENVIRONMENTAL MANAGEMENT PLAN

Environmental impact due to the construction and operation stages of the project were predicted quantitatively using models such as ISCST3 for air dispersion calculations, DHAWANI for noise impacts. Impacts were also evaluated qualitatively using engineering judgment and best management practices.

Adequate environmental management measures will be incorporated during the entire planning, construction and operation stages of the project to minimize the adverse environmental impacts and assure sustainable development of the area.

The impacts during the construction phase will be temporary in nature. This summary details the pollution sources and mitigation measures proposed for the project.

6.1 AIR ENVIRONMENT

During the construction phase, operation of construction equipments and vehicles will be the main sources of pollution. A dust control plan will be implemented and regular maintenance of vehicles and equipment will be carried out.

During the operation phase, the main sources of pollution shall be boiler stack emissions, emissions from RDF plant, fugitive dust and odor emissions from waste handling and processing and emissions due to vehicular movement. Adequate mitigation measures shall be implemented. Emissions from waste handling areas shall be controlled by provision of covered areas, proper ventilation and by maintaining negative pressure. Herbicides will be sprayed to discourage further decomposition of MSW. The RDF plant shall be provided with adequate dust control systems such as cyclones, bag filters to control the dust emissions. The boiler will be provided with adequate stack height of 65 m and an ESP shall be provided to reduce the PM emissions. NOx emissions shall be controlled by admission of secondary air and maintaining temperature balance. A gas recirculation system shall be provided to reduce CO formation.

Dioxins and Furans shall be controlled by extensive segregation to ensure complete removal of plastic and other chlorinated compounds, controlling PM emissions and appropriate furnace design. In addition to this, a High Performance dioxin removal device (Activated Carbon Packed Column) shall be provided.

6.2 NOISE ENVIRONMENT

During the construction phase, adequate mitigative measures such as controlled time of construction, job rotation etc. will be implemented.

During the operation phase, the sources of noise emissions shall be equipments such as shredders, boilers, generator etc and vehicular movement. Noise enclosures shall be provided wherever possible and workers shall be provided with ear plugs.

6.3 WATER ENVIRONMENT

During the construction phase, a septic tank shall be provided to treat the domestic wastewater generated due to labor settlements.

During the operation phase, approximately 471 m^3/day of treated wastewater from Kondli STP will be utilized for plant operation. The main source of process water available for the project will be treated sewage water. City water supply from Delhi Jal Board (DJB) would be used for drinking water and other service requirement. Effluent generated from the process will be recirculated back to the RDF plant. Spill over from the process would be collected and treated prior disposal.

The effluent generated from the RO rejects, MB unit regeneration waste and boiler blow down will be discharged into sewer after suitable treatment. Filter backwash water and cooling tower blow down will be discharged into public sewer after treatment. The small quantities of leachate generated will be collected in the sump and treated in Effluent Treatment Plant.

6.4 LAND ENVIRONMENT

During operation phase of the project, the rejects from waste segregation system/RDF plant. The organic waste shall be used as fuel for HAG and the other wastes shall be sold for recycling. The fly ash generated will be supplied to the brick manufacturing units. The bottom ash from the power plant shall be supplied to Zakhira to be used as soleing material in low cost housing units.

6.5 ECOLOGICAL ENVIRONMENT

There is no ecologically sensitive area within a 10 km radial distance of the project site. No wildlife sanctuary or national park is present within the study area. A peripheral greenbelt will be provided.

6.6 SOCIO ECONOMIC ENVIRONMENT

The proposed project will lead to employment generation and will have a positive impact on the socio economic environment. Preference to local population shall be given and adequate mitigation measures will be ensured to reduce odor emissions and disease vectors from proposed site.

8.0 ENVIRONMENTAL MANAGEMENT SYSTEM

For the effective implementation of the EMP, an Environmental Management System (EMS) will be established at the proposed project. The EMS will include the following:

1. An Environmental Management cell
2. Environmental Monitoring Program
3. Personnel Training
4. Regular Environmental Audits and Corrective Action
5. Documentation – Standard operating procedures Environmental Management Plans and other records.

9.0 CONCLUSION

All possible environment aspects have been adequately assessed and necessary control measures have been formulated to meet statutory requirements. Thus implementing this project will not have any appreciable negative impacts. Moreover, the landfill area requirement at Ghazipur and other landfill sites will progressively reduce significantly as the solid waste will be converted to stable form (inerts) before being sent for disposal at landfill site. This would save upon the future requirements of area for land filling. Power generation would be an added advantage.

1.0 INTRODUCTION

M/s Infrastructure Leasing & Financial Services (IL&FS) has initiated development of Integrated Municipal Solid Waste (MSW) Processing Complexes in the country, with an objective of

(a) Waste reduction and,
(b) Effective Management of Waste still, produced after waste reduction.

Initiatives of the past were, however based on a particular single technology and had no component of segregation before treatment or its disposal

The project approach is based on Integration of Technologies tried under Indian conditions justifying the confidence to take up such projects in the country. The State Government of Delhi is also supporting the development of integrated waste processing projects in NCR region.

The project Integrated Municipal Solid Waste Processing complex is proposed at an abandoned site adjacent to Ghazipur Landfill site spread over 5.728 acres with an investment of over Rs.100 crores. The proposed site had a Biogas plant which is now non functional. The location will have the facility of receiving, segregation and taking up waste for further processing. Project will be based on Public Private Partnership (PPP) basis and integrated facility will be made operational at proposed site. The handling and processing of Municipal Solid Waste will result in substantial reduction (60-80%) in the quantity of waste, reduction in green house gas emission and generation of value addition products viz. refuse derived fuel.

The proposed project falls under Item 7 (i) (Common Municipal Solid Waste Management Facilities) as per Environmental Impact Assessment Notification dated September 14, 2006. Due to the application of general conditions i.e. interstate boundary, the project will fall under Category A and will require environmental clearance from Ministry of Environment and Forests. M/s EDWPCL has retained the services of SENES Consultants India Private Limited (SENES) for carrying out a Rapid Environmental Impact Assessment (REIA) study and preparation of an EIA report, incorporating Environmental Management Plan (EMP) and Disaster Management Plan (DMP) for the proposed project. The EIA study has been done as per the approved TOR provided by MoEF vide letter No.10-74/2007-IA.III dated 6th September 2007.

1.1 PROJECT PROPONENT

Infrastructure Leasing & Financial Services (IL&FS) has incorporated Unique Waste Processing Company – a subsidiary set up for developing commercially viable municipal waste treatment projects through public/private framework in various parts of the country.

Unique Waste Processing Company joined hands with Delhi Power Company Ltd.-an undertaking of Govt. of NCT of Delhi for developing Renewable energy projects by way of Waste to Energy in the State of Delhi. Accordingly a master SPV has been formed in the name of New Delhi Waste Processing Company Private Limited (NDWPCL). Thereafter East Delhi Waste Processing Company Private Limited (EDWPCL) has been set up as a special purpose company for developing the project.

Infrastructure Leasing and Financial Services (IL&FS) and Andhra Pradesh Technology Development & Promotion Center (APTDC) promoted by Confederation of Indian Industry (CII), Technology Information Forecasting and Assessment Council (TIFAC) Govt. of Andhra Pradesh) have formed a consortium ("Consortium") with a common objective to assist municipalities/ local bodies in establishing Municipal Solid Waste (MSW) handling and Sewage Treatment Projects (STP) through Public-Private-Partnership (PPP) basis.

Consortium proposes to develop an integrated waste processing complex comprising of Refuse Derived Fuel (RDF) plant based on 1300 TPD of mixed waste at proposed site adjacent to Ghazipur landfill site .RDF will serve as fuel for boiler and for producing high pressure steam to run turbine for generation of 10.00 MW of Electric Power. Water requirements of RDF plant and Power Plant will be met through the treated sewage water drawn from Kondli Sewerage treatment plant. The proposed technology thus would be an integration of three unit processes:

(a) Refuse Derived Fuel (RDF) production from mixed Municipal Solid Waste based on DST-TIFAC Technology.
(b) Power Generation through thermal steam route using RDF as a potential fuel.
(c) Tertiary treated sewage water treatment plant for process water requirements.

1.2 PROJECT BACKGROUND

Municipal Solid Waste is described as a stream of solid waste which is generated in urban areas from household, commercial establishments, industries and institutes. It does not however include biomedical waste, hazardous or radioactive waste.

Municipal Solid Waste (MSW) is largely managed by disposal in landfill sites. Municipal Solid Waste contains organic and inorganic matter. Organic fraction can be recovered for gainful utilization through adoption of suitable waste processing technologies. When organic part of MSW is combusted, Waste -to - Energy technology is used in more or less the same way as fossil fuels are used in direct combustion process. Burning of MSW generates energy and the overall process results in reduction of 60% - 80% volume of waste.

Considering the present status of MSW generation and non availability of landfill sites in Delhi, Municipal solid waste management and its disposal has assumed a major environment challenge over the past few years. Municipal Corporation of Delhi (MCD) being one of the largest Urban Local Bodies (ULBs) in India is currently experiencing pressures on its already

overloaded/exhausted landfill sites to an extent of approximately 6000 Tons per day of Municipal solid waste (MSW).

Past trends show that waste generation rates are increasing by 3-4 % per annum and the waste is likely to increase to 18,000 tons per day by the year 2021. Hence an immediate requirement stems in the present situation, to take up suitable measures to develop waste processing and treatment facilities in Delhi so as to avoid unavailability of suitable sites for their disposal.

Ghazipur landfill site spread over an area of 72 acres is adjacent to proposed project site. The site receives MSW from North and South Sahadara. The landfill site on an average receives about 2000 TPD of MSW. The Ghazipur site is already matured and is still receiving MSW in its overloaded capacity.

Significant increase in urban waste, stringent Environmental Regulations and increasingly reduced availability of landfill disposal sites are generating world wide interest in recovering Energy from Municipal Solid Waste. Amongst the various options Refuse Derived Fuel (RDF) has been considered as one of combustible materials from Municipal solid waste for production of energy. RDF will be produced from municipal solid waste using mechanical means such as shredders and separators to remove recyclable products to produce a combustible product for boiler to generate Electric Power through the steam route.

The proposed project involves Integrated Solid Waste Management (ISWM) of Municipal waste. Integrated Solid Waste Management is the application of suitable techniques, technologies and management programs, covering all types of solid wastes from all sources to achieve the twin objective of:

(a) Waste reduction and,
(b) Effective Management of Waste produced after waste reduction.

Proposed Integrated municipal solid waste processing facility at Ghazipur will include the following components:

a) **Refuse Derived Fuel (RDF) Plant** -MSW processing plant, based on DST-TIFAC technology. The plant shall be capable of processing 1300 Tons per Day of Municipal Solid Waste and produce 433 Tons per Day of RDF.

b) **Power Plant**: the proposed project of Intergated Municipal Waste Management will also involve a Power Plant of 10 MW capacity based on RDF. A Water Treatment Plant will be provided to treat 500 m^3/day of sewage water drawn from Kondli Sewage Treatment Plant. Treated sewage water from Kondli Sewage Treatment Plant will be treated further up to tertiary level to make it fit for process use. After processing through conventional treatment methods and then further treating it up to tertiary level to make it fit for process use.

RDF would be used as a dedicated energy generation system fuel in the power plant. The advantage of RDF production on site will be in reduction of cost on transport of fuel, ready availability of RDF as fuel, and reduction in storage area and storage time for firing in boiler.

1.3 PROJECT NEED

The burgeoning amount of Municipal Solid Waste in Delhi and decreasing availability of dumping sites have increased focus and investment interests for adoption of integrated municipal solid waste facilities and drive demand for Environmental solutions by adopting suitable technologies.

Delhi has a number of waste processing and disposal facilities currently in operation, which include three compost plants, two at Okhla , one at Bhalswa and three landfill sites at Bhalswa, Okhla and Ghazipur. Almost all the existing treatment and disposal facilities either have exhausted their operational life or are on the verge of exhaustion, creating need for new treatment and disposal facilities. Although new landfill sites have been identified at Bhatti mines, Narela Bawana road and Jaitpur area, the regulatory clearances and approval of land for land filling is a complex and time consuming affair. In addition, with these new sites in operation, garbage may have to be transported nearly twice the current distance for land filling, escalating the cost of transportation.

According to recent estimates of Ministry of New and Renewable Energy, Govt. of India, potential of energy conversion from municipal solid waste is depicted as given below:

TABLE 1.1: PROJECTED SOLID WASTE GENERATION AND POWER GENERATION POTENTIAL

Period	Projected MSW Generation (TPD)	Potential for Power Generation MW
2007	148000	2550
2012	215000	3650
2017	304000	5200

In view of the above and realizing the potential of energy recovery from waste, technological options for waste disposal and treatment have been recommended for Delhi. While there is an obvious need to reduce the burden on the landfill sites by minimizing the generation of wastes, reusing and recycling, the technologies for recovery of energy from wastes can play a vital role in mitigating the problems of disposal of municipal solid waste. Besides recovery of substantial energy, these technologies will lead to a substantial reduction in the overall waste quantities requiring final disposal, which can be better managed for safe disposal in a controlled manner,

while meeting the pollution control standards and compliance to MSW Management and Handling Rules.

Proposed technology will reduce the quantum of waste, to be disposed at the landfill site by 60 % - 80 %, depending on the composition of the waste, increasing the life of the existing and proposed landfill sites for Delhi. Apart from generating power from waste, the proposed project will also reduce environmental impacts of municipal solid waste on land, air and ground water, including emissions of greenhouse gases.

The proposed approach ensures project development and benefits in the following ways:

1. The project development cost would be borne by EDWPCL and as such does not involve any funds from MCD. This also thus, ensures best possible project development activities.

2. EDWPCL is a subsidiary of IL&FS that has firmed up an understanding with TIFAC and its affiliate Andhra Pradesh Technology Development & Promotion Centre (APTDC) that has expertise in the area of treatment of municipal solid waste. Thus, project development activities shall be getting the best technical attention at the expense of EDWPCL which is otherwise not possible due to limited funds available with MCD.

3. EDWPCL would bring the latest technology to put up the most efficient plant.

4. The landfill area requirement at Ghazipur and other landfill sites will progressively reduce significantly as the solid waste shall be converted to stable form (inerts) before being sent for disposal at landfill site. This would save upon the future requirements of area for land filling.

1.4 SCOPE OF THE STUDY

The scope of study is to envisage the environmental changes anticipated due to the proposed project. To assess the environmental attributes of study area, core area of 10 km radius around the proposed project site is considered. The broad scope of the study includes:

i. Literature review to collect data relevant to the study area;
ii. Primary data collection coupled with secondary data collection so as to establish the baseline environmental status of the study area;
iii. Identify various existing pollution loads due to industrial and domestic activities in the study area;
iv. Predict incremental levels of pollutants in the study area due to the proposed power plant;
v. Evaluate the predicted impacts on the various environmental attributes in the study area by using scientifically developed and widely accepted environmental impact assessment methodologies/ models;

vi. Identification of mitigation measures and preparation of an Environmental Management Plan (EMP) outlining the measures for environment protection;
vii. Identify critical environmental attributes required to monitor regularly; and
viii. Identification and analysis of risk and prepare disaster management plan to deal with emergency situation.

The detailed EIA work has been carried out in accordance with the Terms of Reference (TOR) provided by MoEF vide letter no. No.10-74/2007-IA.III dated 6th September 2007 (**Refer Appendix I**).

1.5 STRUCTURE OF THE EIA REPORT

This EIA report presents the existing baseline scenario and the assessment and evaluation of the environmental impacts that may arise during the construction and operation of the proposed project. This report also highlights the Environmental Monitoring program during the construction and operation of the project and the post project-monitoring program. The content of the report is as follows:

Executive Summary: Contains summary of the EIA report
Chapter 1: Introduction and Objective of the study
Chapter 2: Project Description
Chapter 3: Legal and Administrative Framework
Chapter 4: Baseline Environmental Status
Chapter 5: Environmental Impacts and Mitigation Measures
Chapter 6: Environmental Management Plan
Chapter 7: Risk Assessment & Disaster Management Plan

1.6 TOR ISSUES

The salient points discussed during the Expert Appraisal Committee (EAC) meeting and provided in Terms of Reference (TOR) given by MoEF vide letter no. No.10-74/2007-IA.III dated 6th September, 2007 has been duly addressed. Summary is given below:

TABLE 1.2 : TOR ISSUES

S.No.	Points of TOR	Issues addressed in EIA
1	The details of measures taken to control the emissions of VOC and other toxic fumes to be provided.	The VOC emissions shall be controlled by ensuring extensive segregation to remove all plastic and other chlorinated compounds. SPM levels will be controlled and furnace shall be designed with 2 sec retention time and temperature of 850^{o} C to ensure further

		destruction of any dioxin formed, A high performance Dioxin Removal device (Activated Carbon packed Column) will also be provided. The details are presented in Section 6.1 (EMP for Air Environment)
2	Details of the pollution control measures taken to prevent spillage of municipal solid waste during the transportation, handling, processing, leaching into the sub soil and final disposal of ash from the thermal power station.	MCD will supply MSW in Tipper trucks will be unloaded in 9 m pits, sprayed with Herbal pesticide,Ch-2, and any leachate or washings generated will be treated in ETP to meet SPCB norms. The details are presented in Chapter 6.0 (Environment Management Plan)
3	Details with regard to the measures taken to minimize odour from waste treatment plant should be elaborated.	The waste handling and processing shall be carried out under covered areas and will be provided with adequate ventilation system. Municipal Waste shall be sprayed with herbal insecticides to discourage further decomposition of solid waste. The waste handling areas shall be kept under negative pressure and exhaust air shall be passed through Hot Air Generators to destroy volatile organic vapors causing odour.
4	The issue of capacity building in order to equip and train the rag pickers and lower level workers especially the householders and women who are associated with the plant should be addressed and the measures taken shall be incorporated in the EMP.	Environment Management Cell with help of parent company will train rag pickers and lower level workers associated with MSW handling segregation and its processing. Regular audits will be carried out and corrective action plan will be implemented.
5	While, preparing the EIA report the project proponent should carry out actual analysis of the solid waste with regard to the calorific value and incorporate the value in the EIA Report. The measures taken to increase the calorific value of the waste should be provided in detail. In	Analysis and characterization of MSW has been carried out and is presented in Table 2.1. Segregation shall be carried out through Fractional segregation, magnetic separation fines separation through Rotary Trommel and subjecting to Air classification in specially designed

	this context the project requires to take on board the measures for separation of the building materials and left overs from the wastes with some calorific value. Apart of from purely regulatory measures, what are the mechanisms that could be employed ensure segregation of wastes in general and the building and construction materials in particular. This aspect of waste classification and segregation should be built into the project as an important component and the report should bring out details with cost estimates.	Density separator. Methods of segregation of organic portion of MSW to convert into RDF fluff and into Pellets form have been elaborated in Chapter 2.0
6	The air pollution control equipments that are proposed to be set up should be examined thoroughly in terms of meeting the norms laid down by CPCB before installation.	Adequate air pollution control equipments shall be provided to meet the CPCB norms. The details of pollution control equipments are presented in Section 6.1 (EMP for Air Environment)

2.0 PROJECT DESCRIPTION

East Delhi Waste Processing Company Private Limited (EDWPCL) has been set up as Special Purpose Company, for developing Waste -to- Energy project at Ghazipur biogas plant site, thereby processing and disposing Municipal Waste and also to produce by-products, inter-alia, fluff and Refuse Derived Fuel for generating electricity. The proposed project shall comprise of a plant for conversion of MSW to RDF and a RDF based power plant of 10 MW capacity.

The RDF plant will be based on DST-TIFAC Technology and will be designed to process 1300 TPD of MSW to generate around 433 TPD of RDF in the form of fluff. The fluff is expected to have a Gross Calorific Value of 2600 Kcal/kg to 3000Kcal./kg. MSW for production of RDF fluff will be supplied by Municipal Corporation of Delhi being collected from East Delhi areas. Non biodegradable products such as stones, sand ceramics and metal components will be separated from biodegradable and other organic matter waste. It is estimated that 34% will be the solid rejects.

EDWPCL Ghazipur power plant will be designed to produce 10 MW power (gross) at generators terminals. Power plant will use RDF as the only fuel and will have single boiler / single turbine configuration.

RDF Fluff will have the following properties:

a) Particle size: (-)100 mm
b) Calorific Value 2600 ±100 kcal/kg
c) Bulk Density 80 – 100 kg/cum
d) Ash 20% ± 5%
e) Moisture 20% ± 5%

RDF fluff requirement to produce 10 MW power with air cooled condenser would be about 16.27 TPH (16.27 x 24 = 390.5 TPD). RDF Fluff production at Ghazipur plant is estimated to be around 433 TPD which has 11% excess capacity than requirement. RDF plant sizing will be based on 18 hr. a day operation to process 1300 TPD of MSW to produce 43 TPD RDF.

Power plant will be using air cooled condenser for condensing the exhaust steam from turbo generator. The usage of air cooled condenser reduces water requirement to a large extent. The water requirement for the proposed project would be met from Kondli Sewage Treatment Plant. It is proposed to have a water treatment plant of capacity 500m^3 /day for treating water from Kondli sewage treatment plant. Sewage water after secondary treatment will be taken from Kondli Common sewage treatment plant which will be given tertiary treatment to make it fit for further uses. The domestic water requirements will be met through municipal water supply. The schematic diagram depicting process chart for the proposed project is shown as **Figure 2.1.**

2.1 SITE LOCATION & DESCRIPTION

The proposed site is accessible from National Highway -24 via Ghazipur Road running parallel to Ghazipur drain. The Kondli road is connected to 7.0 meter wide road facing the proposed site and Ghazipur Dairy farm. The coordinates of proposed site is:

Latitude : 28^0 37' 22.4'' N
Longitude : 77^0 19' 25.7'' E
Site Elevation : 204 m above MSL

The site location is shown as **Figure 2.2**

FIGURE 2.1: PROCESS CHART FOR THE PROPOSED PROJECT

TECHNICAL DETAILS:

RDF PLANT ATGHAZIPUR = 1300 TPD MIXED WASTE (MSW)

POWER PLANT = 10 MW

SEWERAGE TREATMENT PLANT = 500 cu.mt.per day

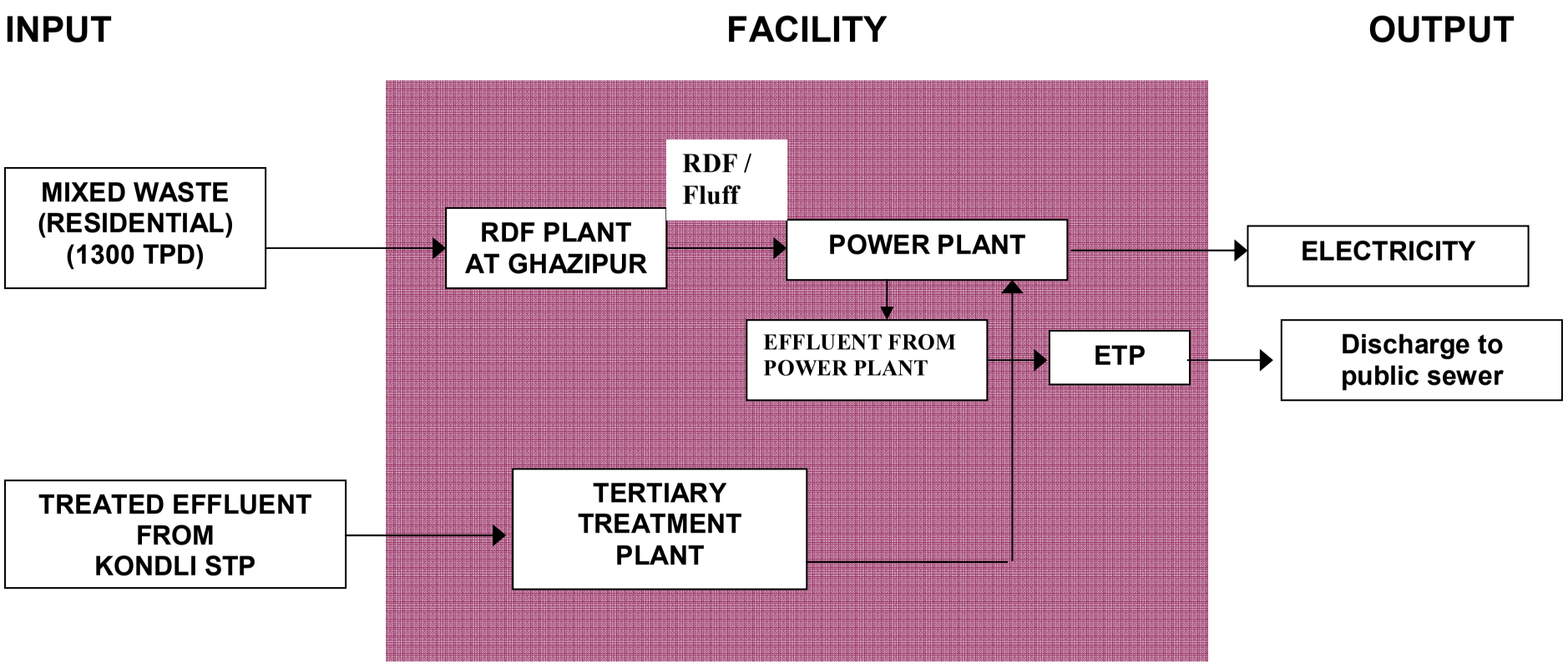
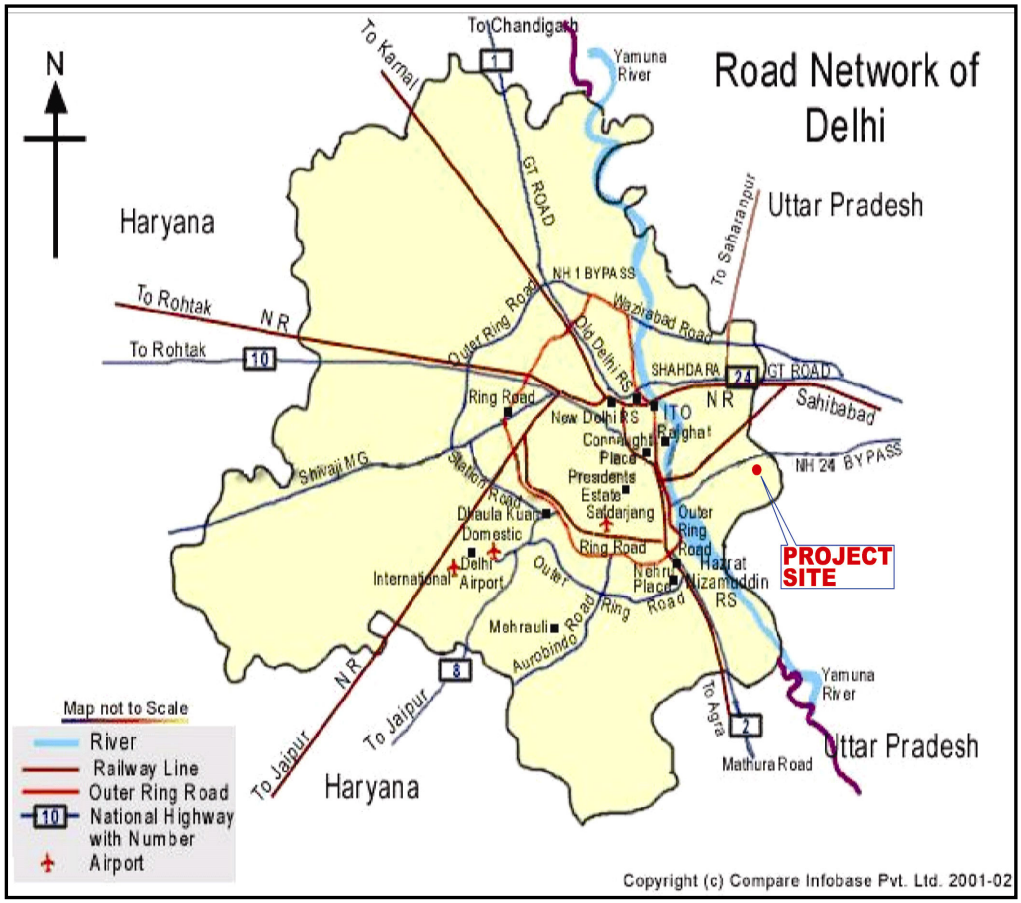


FIGURE 2.2: SITE LOCATION OF PROPOSED FACILITY



2.2 SITE SETTINGS

The proposed project site is at a distance of 0.7 km from Hapur bypass on National Highway-24. The proposed site is a flat land with gentle slope towards south and southeast direction.

The site is bounded on the four sides in the near vicinity by the following:

East: On the eastern boundary of the site is Ghazipur landfill site. The Hindon cut canal and River Hindon are at a distance of 0.1 km and 6.9 km from the site respectively. Few settlements and colonies such as Khora and Makanpur lie across the Hindon cut.

West: On the western side of site lies the Ghazipur Dairy farm and DDA colony. River Yamuna flows at a distance of 5.5 km.

North: On the northern boundary of project site lies a veterinary hospital. Few settlements such as Hasanpur Bhuapur village are at a distance of 1.8 km. Sahibabad Industrial area is at a distance of about 4.0 km.

South: On the southern side of the project site lies a mosque. Settlements such as Khichripur and Makanpur lie at a distance of 1.2 km, and 3.4 km respectively from the proposed project site.

The site surrounding feature features are shown in **Figure 2.3**

2.3 SITE ACCESSIBILITY

The proposed project site is at a distance of 0.7 km from Hapur bypass on National Highway-24. Shahdara and Nizamuddin Railway station lie at a distance of 6.9 and 7.6 km respectively. The nearest airport is the Indira Gandhi International airport at a distance of about 23 km from the site.

The site layout plan is shown as **Figure 2.4**

FIGURE 2.3: SURROUNDING FEATURES OF THE PROPOSED PROJECT SITE

FIGURE 2.4: SITE LAYOUT PLAN

2.4 BRIEF PROCESS DESCRIPTION

The proposed integrated waste processing facility will have a section for processing Municipal Solid Waste (MSW) which will involve manual segregation, shredding, screening to separate both fine inerts and some percentage of bio-degradable matter, fines screening, ballistic separation etc which will finally result in the production of RDF as byproduct. RDF, thus produced will be utilized for the generation of electricity.

The Ghazipur landfill site on an average receives about 1300 TPD of MSW. **Table 2.1** depicts the characteristics of Municipal Solid waste samples taken from Ghazipur Landfill site.

TABLE 2.1: CHARACTERISTICS OF MSW SAMPLES - GHAZIPUR LANDFILL SITE

S. No	Parameter (%)	Average Value
1	Density of total waste (kg/m^3)	531.91
2	Density of kitchen waste (kg/m^3)	568.38
3	Fuel	22.81
4	Organics	45.42
5	Inert	30.22
6	Recyclable	1.32
7	Other	0.19
8	Moisture content	25.39
9	Total Volatile Substance	17.48
10	Ash Content	31.48
11	Fixed Carbon	26.65
12	Calorific Value	**1308.67**

The proposed project would designed to process 1300 MT of MSW and is expected to generate approximate 433 MT of RDF per day in the form of fluff. RDF Fluff requirement to produce 10 MW of power would be 390 TPD .RDF production is thus estimated to be about 11% in excess of its requirement on per day basis. The fluff is expected to have a gross calorific value (GCV) of 2600 kcal/kg to 3,000 Kcal/kg. The quantity of RDF produced from MSW is indicated in **Table 2.2**

TABLE 2.2: RDF QUANTITY PRODUCED FROM MSW AT GHAZIPUR FACILITY

RDF Production	Tons Per Day	Tons Per Annum
Total RDF generated	433	1,42,890
RDF Fluff (for on-line combustion in power plant)	390	1,28,700

In order to meet the regular requirement of fuel for the boiler, it is envisaged to have storage pits for RDF.

RDF Plant will have a provision of separate receiving and processing line for biomass/horticultural waste whenever available during season. This will be mixed with RDF in storage pits. Power plant will have storage of two days RDF Fluff requirement for about 750 MT.

2.4.1 THE CONVERSION OF MSW INTO RDF

The conversion of MSW into RDF involves the following operations

- Manual Segregation.
- Shredding.
- Screening to separate both, fine inerts and some percentage of bio-degradable matter.
- Rotary conveying and as per requirements of drying system.
- Fines Screening.
- Density Separator (Ballistic separation)

MCD will supply MSW as per agreement to EDWPCL at Ghazipur biogas plant site in two or three shifts as per regulation. After weighment and inspection, trucks will be brought to MSW storage area and the material shall be unloaded into the pits. After unloading in the pits immediately, MSW shall be sprayed with herbal pesticide to retard its decomposition.

As the raw MSW received at site is stored into the storage pits, no yard segregation is envisaged. The overhead cranes (EOT) with their respective grab buckets pickup MSW and put it onto the "Vibrating Feeders", installed at the top floor (second) of the processing building. The main conveyor shall discharge the MSW to a manual inspection conveyor at elevated level of about 7.0 m elevation. From the slow moving inspection conveyor, all the odd sized and unwanted objects shall be hand picked at the manual separation station. The constituents segregated at this stage are mostly large textile pieces, large twigs and woody pieces, any stray dead animal and consumer durables. The dead animal and consumer durables (hardly noticed in MSW) are put into trolleys and periodically taken out from the processing system and suitably disposed off. The material after manual inspection is subjected through magnetic separator to remove ferrous objects.

The MSW, after inspection and magnetic separation is fed into a primary shredder. Matrix of moving blades and fixed blades decide the size of end product. During this operation, all the materials will get homogenized and its size will be reduced to minus 100 mm. These shredders are very sensitive to hard materials. Therefore, separation by manual operation previously deployed are to be very effective.

The MSW after inspection is fed into a de-dusting cum pre-drying system to remove dust/sand/earth (10 mm particle size) in a *Fines Separation Rotary Screen* in which hot air is

injected. After the fines separation, MSW is fed into another *Rotary Screen* to classify the material into two fractions: Over size + 150 mm and undersize –150 mm.

Undersize fraction (- 150 mm) will primarily contain organic matter and is directly fed through a belt conveyor in to the *Rotary Dryer*. The oversize fraction (+ 150 mm) is fed into a *Primary Shredder through a Magnetic Separator* (to separate ferrous material) to reduce its size to -150 mm. The output from the *Primary Shredder* is then fed into Rotary Dryer.

In the *Rotary Dryer,* the material is dried by using Hot Air in a co-current manner. The hot air is generated in a fixed grate in a specially designed Hot Air Generator (HAG), in which woody biomass segregated from MSW is combusted. Suitable pollution control equipment will be incorporated in the HAG. The output from the Rotary Dryer is then fed into the *Rotary Trommel* to separate the fines through 8 mm screen. The fine fraction so separated has significant quantum of organic matter that is useful as a soil enricher.

After screening, the material is subjected to Air Classification in a specially designed *ballasitic Separator*, wherein lighter components are entrained in the air and collected separately. The heavy material such as stones, glass falls through the classifier and is separated as *Inert*.

The light fraction thus separated comprises of biomass, paper, textiles and other combustible material and is termed as *Refuse Derived Fuel (RDF) Fluff*, having an average GCV of 2,600 to 3000 kcal/kg.

A description of the fluff and pellets produced from MSW combustibles, its proximate and ultimate analysis, and ash analysis is indicated in the **Table 2.3**. The materials flow & mass balance for MSW to RDF process is provided in **Figure 2.5**. The schematic process flow diagram for conversion of MSW to RDF is given in **Figure 2.6**

TABLE 2.3 DESCRIPTIONS OF RDF PELLETS

Description	Details
RDF type	**Fluff**   **Pellets**
Shape	Irregular
Size	100^{mm} X 100^{mm}
Bulk Density	80-100 kg/m^3
Proximate analysis	
Moisture	15 % - 25 %
Ash content	15 % - 25 %
Volatile matter	40 % - 60 %
Fixed carbon	10 % - 20 %
Ultimate analysis	
Moisture	15 % - 25 %
Mineral matter	15 % - 25 %
Carbon	35 % - 40 %
Hydrogen	5 % - 8 %
Nitrogen	1 % - 1.5 %
Sulphur	0.2 % - 0.5 %
Oxygen	25 % - 30 %
Gross Calorific Value of RDF (Avg)	2,600 kcal / kg
Ash Fusion Temperature	
Initial Deformation temperature	860 ^oC
Softening temperature	950 ^oC
Hemispherical temperature	1040 ^oC
Fluid temperature	1100 ^oC
Chloride Content	*0.04%*

Description	Details
Elemental Ash Analysis (% of Oxides)	
Silica	53.10%
Alumina	11.18%
Iron Oxide	4.87%
Titanium dioxide	0.89%
Calcium Oxide	13.15%
Magnesium oxide	2.90%
Sodium oxide	5.79%
Potassium oxide	1.56%
Sulphur trioxide	2.55%
Phosphorous pentoxide	1.43%

FIGURE 2.5: SCHEMATIC FLOW DIAGRAM OF MATERIALS FLOW & MASS BALANCE FOR MSW TO RDF PROCESS

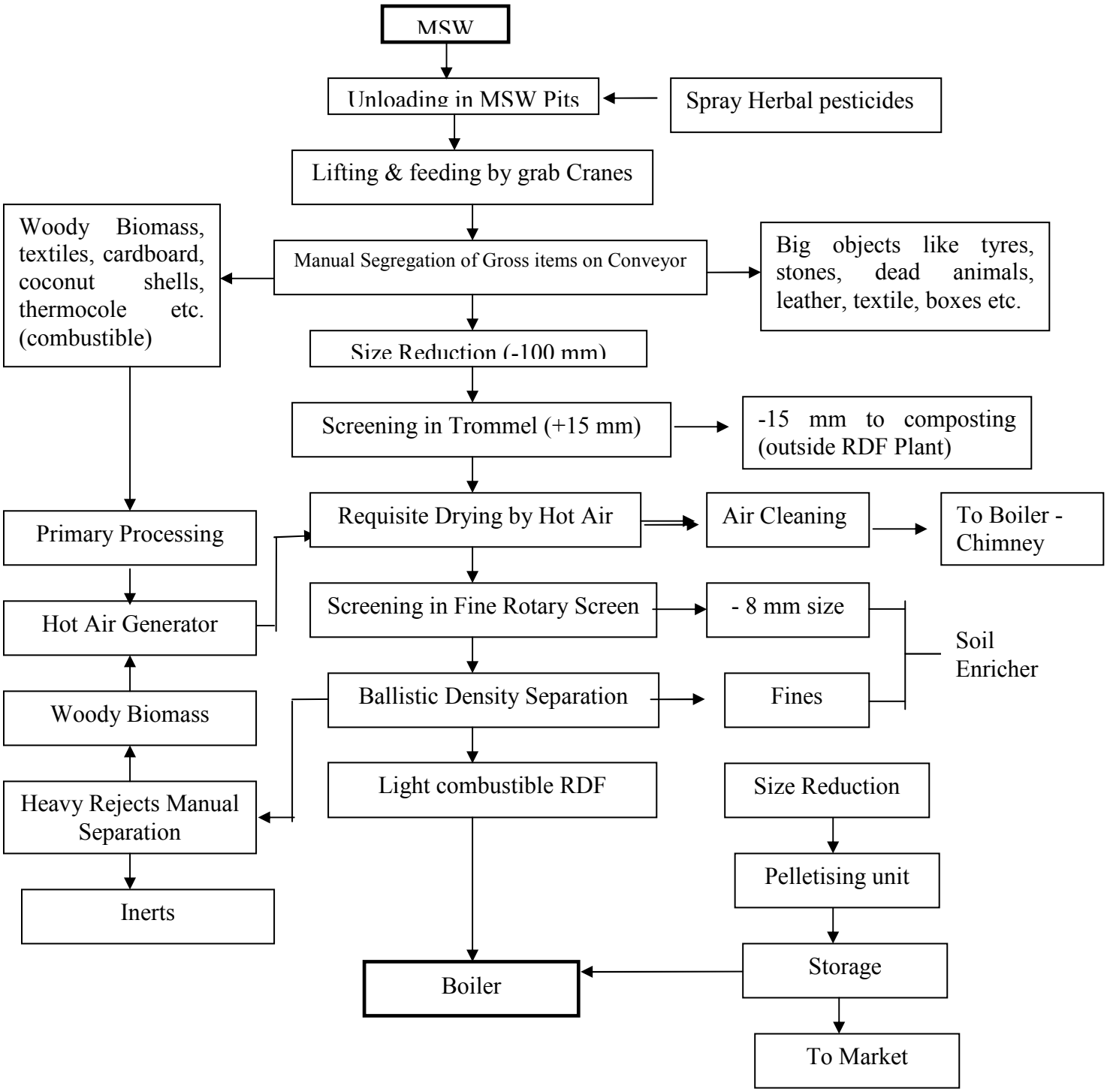
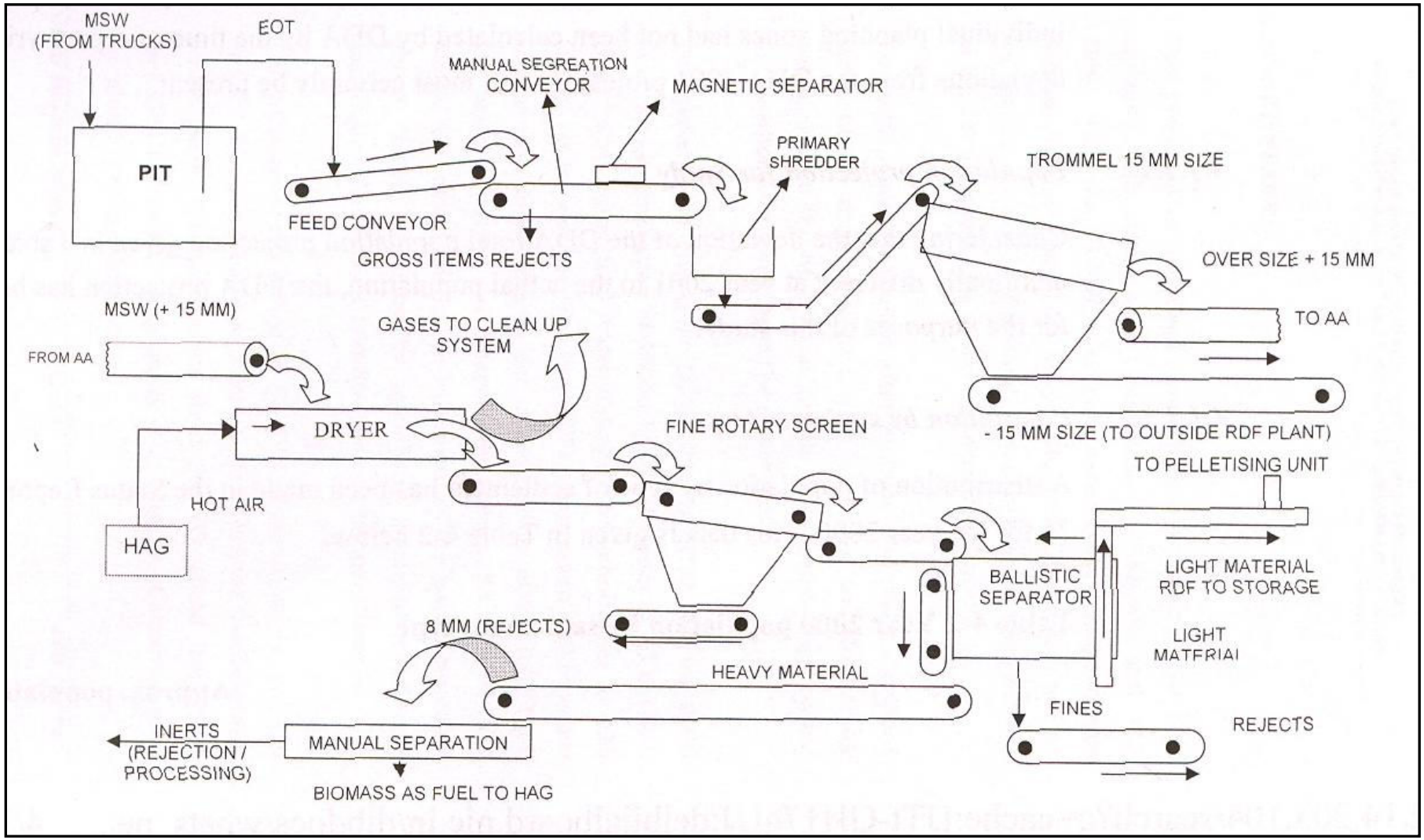


FIGURE 2.6 : SCHEMATIC FLOW DIAGRAM MSW CONVERSION TO RDF



2.4.2 POWER PLANT

The proposed power plant will consist of one boiler of 50 TPH capacity with steam outlet parameters of 43 ata & 415 ^{o}C steam outlet temperature with one 10 MW bleed cum condensing turbogenerator generating power at 11 kV level. The generated power will be stepped down to 433 V through two distribution transformers of 2.5 MVA capacity for in-house power distribution. The total power generated after inhouse use will be stepped up to 66 kv through a 12.5 MVA generator transformer for connection to the 66 kv bus at Kondli substation located 1.5 kilometer away from the power plant.

The boilers will consume 16.27 TPH of RDF fluff of 2600 Kcal/kg for generation of 48000 kg/hr of steam at 43 ata 415 ^{o}C with boiler feed water entering the economizer at 125 ^{o}C It is possible that the fluff consumption will increase or decrease depending upon calorific value of the RDF fluff. The boiler efficiency is conservatively fixed at 73.25% on GCV basis.

The turbogenerator takes in 48 TPH of steam at 41 ata 410 ^{o}C. There is bleed at 2.50 ata (5.1 TPH) for the deareator which heats the condensate from the TG island from 60.4^{o}C to 125 ^{o}C. A quantity of 350 kg/hr of steam is used for gland sealing and ejector.

The RDF will be fed into the furnace by air-swept fuel spouts and thus up to 50% of the fuel will burn in suspension above the grate. This will significantly reduce the heat release rate on the traveling grate and thus permits it to be smaller in size. The recommended ash bed thickness, is such that the grate temperatures are lowered, wear is reduced, and grate life is increased. To achieve this optimum ash bed thickness requires controlled metering of the RDF and proper distribution of the fuel to the grates.

Accumulation of melted aluminum on the grate will be avoided by completely removal of aluminum from the fuel stream. Apart from this, proper ash bed thickness will be maintained so that the aluminum can solidify in the ash bed rather than on the grate.

Combustion products from municipal refuse are very corrosive. Corrosion in refuse-fired boilers is usually caused by chloride compounds which deposit on the furnace, superheater and boiler tubes. Several modes of chloride corrosion, which may occur include the following.

- Corrosion by hydrochlorides (HCI) in the combustion gas,
- Corrosion by NaCl and KCI deposits on tube surfaces,
- Corrosion by low melting point metal chlorides (mainly $ZnCI_2$, and $PbCl_2$), and
- Out-of-service corrosion by wet salts on the tube surface.

The rate of tube metal loss due to corrosion is related to the tube metal temperature – high metal temperatures correlate with high rates of metal loss. Refuse boilers operating at higher steam pressures have higher temperature saturated water in the furnace tubes resulting in higher tube metal temperature. These higher tube metal temperatures will increases the corrosion rate. Superheater tube metal temperatures are directly related to the steam temperature inside the tubes. In both cases it is the temperature of the water or steam inside the tube that largely

controls the tube metal temperature, rather than the temperature of the flue gas outside of the tube. Furnace-side corrosion can also be aggravated by poor water chemistry control. If waterside deposits are permitted to form, tube wall metal temperature will rise and furnace corrosion will be accelerated. To avoid corrosion, special materials are proposed in the boiler circuit.

2.5 STEAM TURBINES AND AUXILIARY SYSTEM

The turbine will be designed for the operation with the inlet steam parameters at 43 ata and 415 °C. The turbine will be designed to provide the uncontrolled extraction steam at 6.5 ata. The balance of the steam supplied to the turbine flows through the LP section of the turbine into the surface condenser at a pressure of 0.1 ata. The turbogenerator shall be designed to the technical requirements given in the section on the Design Criteria.

The turbine shall be a horizontal, single cylinder, Single extraction cum Condensing type. All casings and stator blade carriers shall be horizontally split and the design shall be such as to permit examination of the blading without disturbing shaft alignment or causing damage to the blades. The design of the casing and the supports shall be such as to permit free thermal expansion in all directions.

The oil coolers shall be water cooled with a duplex arrangement and changeover valves. The coolers shall be of shell and tube type with removable tube bundle. The coolers shall be constructed in accordance with TEMA class C. The provided surface area shall be adequate to cool the oil with 32 °C inlet cooling water temperature even with 20% of the tubes plugged.

The turbine governing system shall be electro-hydraulic designed for high accuracy, speed and sensitivity of response. The electrical/electronic and hydraulic components of the control system shall be selected on the basis of reliability over a wide range of operating conditions. All components used shall be well proven to assure overall system reliability and shall be designed for easy and quick replacement when necessary. The governor shall be configurable in the field.

The governor shall ensure controlled acceleration of the turbo generator and shall prevent overspeed without tripping the unit under any operating condition or in the event of maximum load rejection. The governor shall have linear droop characteristics with a suitable range for stable operation and shall have provision for adjusting the droop in fine steps.

The governing system shall have the following important functions:

- Speed control
- Overspeed control
- Load control

- Steam pressure control

Vibration measuring and monitoring systems of reputed make shall be provided at each bearings and the shaft. This system shall also include the generator and gearbox bearings also.

The critical speed for the combined turbine and generator shall be sufficiently away from the rated speed to avoid any adverse effect on the operation of the unit over the range of operating speeds.

The plant will be provided with air cooled condenser for condensing the steam from the TG. The exhaust of the TG will be connected to the condenser through large steam piping. The condensate will be pumped back from the condensate storage tank to the deaerator of the boiler.

Electrically operated EOT crane with a span of about 13.0 Meters, with the main hook lifting capacity of 30 Tons shall be provided to facilitate erection and maintenance of the Turbogenerators and their auxiliaries. The crane travel will cover the entire length of the Turbogenerator building.

The requirement of compressed air for instruments and the control systems of the proposed power plant will be supplied by two (2) instrument air compressors with one(1) working and the other standby. Each of the compressors shall be rated for 150 NCu.m/ hr at 7 kg/sq.cm (g). The air compressor shall be provided with accessories like Inter cooler, after cooler, moisture separators, air driers, air receivers and control panel.

The main plant control room housing the controls for the boilers and the Turbogenerator shall be air conditioned with window mounted air-conditioners. A dry bulb temperature of 24 ^{o}C + 1.5 ^{o}C and a relative humidity of 60 % will be maintained in the control rooms.

The turbogenerator station building will be provided with a forced ventilation system. Most of the areas will be ventilated with exhaust fans mounted on the walls or on the roof.

2.6 UTILITIES/AMENITIES

Fuel

The proposed facility will have a capacity to process 1300 TPD of MSW to generate about 433 MT of RDF. The MSW shall be supplied to the facility by MCD. The boiler will consume about 16.27 TPH of RDF Fluff for power generation..

Water

The proposed power plant will be provided with air cooled condenser for condensing the exhaust steam from turbo generator. The usage of air cooled condenser reduces water requirement to a large extent. The water requirement for the proposed project would be met from Kondli Sewage Treatment Plant. It is proposed to have a water treatment plant of capacity 500m^3 /day for the tertiary treatment of the water received from Kondli Sewage Treatment Plant. The domestic water requirements will be met through municipal water supply.

Power

The total RDF used will be about 16.27 tonnes per hour in both boilers for the generation of 10 MW of power. The boiler will generate about 50 TPH of steam. The total power generated after in house power use will be stepped upto 66kv through 12.5 MVA generator transformer to 66 kV bus at Kondli substation of BSES located at about 1.5 km from project site.

Fire Fighting Facilities

Fire protection system will be provided as per LPA (Loss Prevention Association) norms. For every 100-m^2 area of plant, one DCP type and one CO_2 type fire extinguisher will be provided. "No Smoking" and hazard / danger warning stickers will be put up at appropriate places. All personnel deployed for the construction, erection and operation of biogas plant will be given proper training for fire drill. Emergency numbers will also be put up at appropriate places. Empty fuel drums / tanks and other inflammable material will be put in an earmarked place and removed from the premises as soon as possible. Storage yard for chemicals and fuel lubricants will also be provided with fire extinguishers and sand bucket racks.

Road & site drainage

All roads in the plant area will be well-designed bitumen roads and will be of 4 m wide with 1m wide berm on each side. For effective storm water drainage, final finished road will have a camber of 1 in 60 and water bound macadam surface will have a camber of 1in 40.

Surface drainage will be designed based on the maximum rainfall intensity prevalent in the area over last 50 years. All the building would be provided with a plinth protection all round, sloped towards the side drain. The side drain will be connected to the main drain on either side of the road.

MSW storage area will be provided with a slope to drain the water collected to a sump from where it will be pumped to the effluent treatment plant.

3.0 LEGAL AND ADMINISTRATIVE FRAME WORK

3.1 INTRODUCTION

The 1972 United Nation Conference on Human Development at Stockholm influenced the need for a well-developed legal mechanism to conserve resources, protect the environment and ensure the health and well being of the people in India. Over the years, the Government of India has framed several policies and promulgated number of Acts, Rules and Notifications aimed at management and protection of the environment. As a result, our country now has a fairly comprehensive set of environmental legislation aimed at ensuring that the development process meets the overall objective of promoting sustainability in the long run.

Moreover, the Indian Constitution has also incorporated specific articles to address environmental concerns through the 42nd Constitutional Amendment of 1976. As stated in the Constitution of India, it is the duty of the state (Article 48 A) to *'protect and improve the environment and to safeguard the forests and wildlife of the country'*. It imposes a duty on every citizen (Article 51 A) 'to protect and improve the natural environment including forests, lakes, rivers and wildlife'. Reference to the environment has also been made in the Directive Principles of State Policy as well as the Fundamental Rights.

3.2 ENVIRONMENTAL POLICIES

Several environment policy statements have been formulated in the last few decades as a part of the Governments' approach to integrate environmental and developmental aspects of planning. The policies reflect a gradual shift in emphasis from pollution abatement and control to proactive and voluntary approaches for pollution prevention in keeping with global paradigm shifts and trends in environment management.

Following are some of the key policies that have been laid down by the Central Government:

- National Forest Policy, 1988;
- National Conservation Strategy and Policy Statement on Environment and Development, 1992;
- Policy Statement on Abatement of Pollution, 1992.

Despite these policy documents, a need for a comprehensive policy statement had been evident for some time in order to infuse a common approach to the various sectoral and cross-sectoral, approaches to environmental management. As a result, a National Environment Policy (NEP, 2006) has been drawn up as a response to our national commitment to a clean environment, mandated in the Constitution in Articles 48 A and 51 A (g), strengthened by judicial interpretation of Article 21.

3.3 LEGAL PROVISIONS FOR ENVIRONMENT

The principal environmental regulatory agency in India is the Ministry of Environment and Forests (MoEF), New Delhi. MoEF formulates environmental policies and accords environmental clearance for the projects.

It is important to note that the Central Government framed 'umbrella legislation', called the Environment (Protection) Act, 1986 to broadly encompass and regulate an array of environmental issues. The overall purpose of EPA is to establish an overall coherent policy and provide a basis for the coordinated work of various government agencies with operational responsibility for the environment and natural resources. This legislation also invests authorities with regulatory powers to address specific issues affecting the environment. The Act does not allow any person to establish an industry, operation or process that discharge or emit any environmental pollutant in excess of standards prescribed under specific rules and notifications.

The Acts, Rules and Notifications applicable to environmental aspects of the construction and operational phases of proposed project is summarized in **Table 3.1** and briefly described in the following sections.

TABLE 3.1: SUMMARY OF ENVIRONMENTAL LEGISLATION FOR PROPOSED PROJECT

Legislation	Areas / Activities Covered
Environment (Protection) Act, 1991 (as amended) with Rules.	Overall Environment Protection Compliance to environmental (Air, Water, Noise) Standards issued under EPR
Air (Prevention and Control of Pollution) Act, 1987 (as amended) with Rules.	Protection of Air Quality Consent to Establish (NOC) for establishing and Consent to Operate (CTE) for activities causing air pollution from DG sets from SPCB Compliance to National Ambient Air Quality Standard
Water (Prevention and Control of Pollution) Act, 1974 with Rules.	Protection of Water Quality Discharge of sewage from proposed project Obtaining Consent to Establish (NOC) for establishing and Consent to Operate (CTE) for activities causing water pollution from SPCB
Water Cess Act, 2003 (as amended)	Paying Water Cess to Local Body for sourcing of domestic water
Noise Pollution (Regulation and Control) Rules, 2006 (as amended)	Compliance with Ambient Noise Standards in accordance to land use of the area
The Municipal Solid Waste (Management and Handling) Rules, 2000	Establish consistent regulations governing collection, segregation, transportation, and disposal of all types of municipal solid wastes
The Public Liability Insurance Act, 1992 (as amended)	An Act to provide public liability- insurance for the purpose of providing immediate relief to the persons

Legislation	Areas / Activities Covered
	affected by accident while handling any hazardous substance and for matters connected therewith or incidental thereto
Manufacture, Storage and Import of Hazardous Chemicals Rules, 2000 (as amended)	Notifying regulatory authority (in this case, the State Factories Inspectorate) of storage of hazardous substances like Waste Oil, etc Follow guidance on such storage, maintain updated MSDS, submit annual Safety Report to authority Prepare Onsite Emergency Plan
State Groundwater Regulation	Conform to restriction for drawing of groundwater Arrange for recharge through Rainwater Harvesting Schemes (as applicable)
Siting Guidance	Follow Siting Guidance as far as practicable Avoid sites which are environmentally sensitive
National Policy on Resettlement and Rehabilitation	Resettlement and Rehabilitation issues of project affected people
Ancient Monuments and Archaeological Sites and Remains Act, 1958	No development activity (including building, mining, excavating, blasting) is permitted within radii of 100m (protected area), and 300m (controlled area) without prior permission of the Archaeological Survey of India (ASI) or State Department of Archaeology.

The MoEF has the overall responsibility to set policy and standards for the protection of environment along with Central Pollution Control Board (CPCB). This includes air, stack emissions, noise, wastewater and hazardous waste standards. The relevant standards, which are of significance to the proposed project, are given below:

3.3.1 SITING OF PROJECTS

The siting of developmental projects in India is managed by Siting Guidelines for activities and projects delineated by the MoEF and the CPCB. The overall purpose of the guideline is to aid proponents in judiciously selecting project sites, keeping in mind various environmental sensitivities. However, the guidelines for siting are not legally enforceable except for areas, which are ecologically fragile (as notified by certain specific notifications) or are located in the Coastal Regulation Zone as demarcated by the Coastal Regulation Zone Notification, 1991 and subsequent amendments. Additionally, State Governments sometimes formulate State wide siting guidelines for development planning.

3.3.2 ENVIRONMENTAL CLEARANCE

The requirement involved in the setting up of selected development projects (projects with potential to cause significant environmental impacts) in India is through the Environmental Clearance (EC) Process on the basis of an Environmental Impact Assessment study/filling up

of necessary forms. The EC process is mandated by the EIA notification dated September 14, 2006.

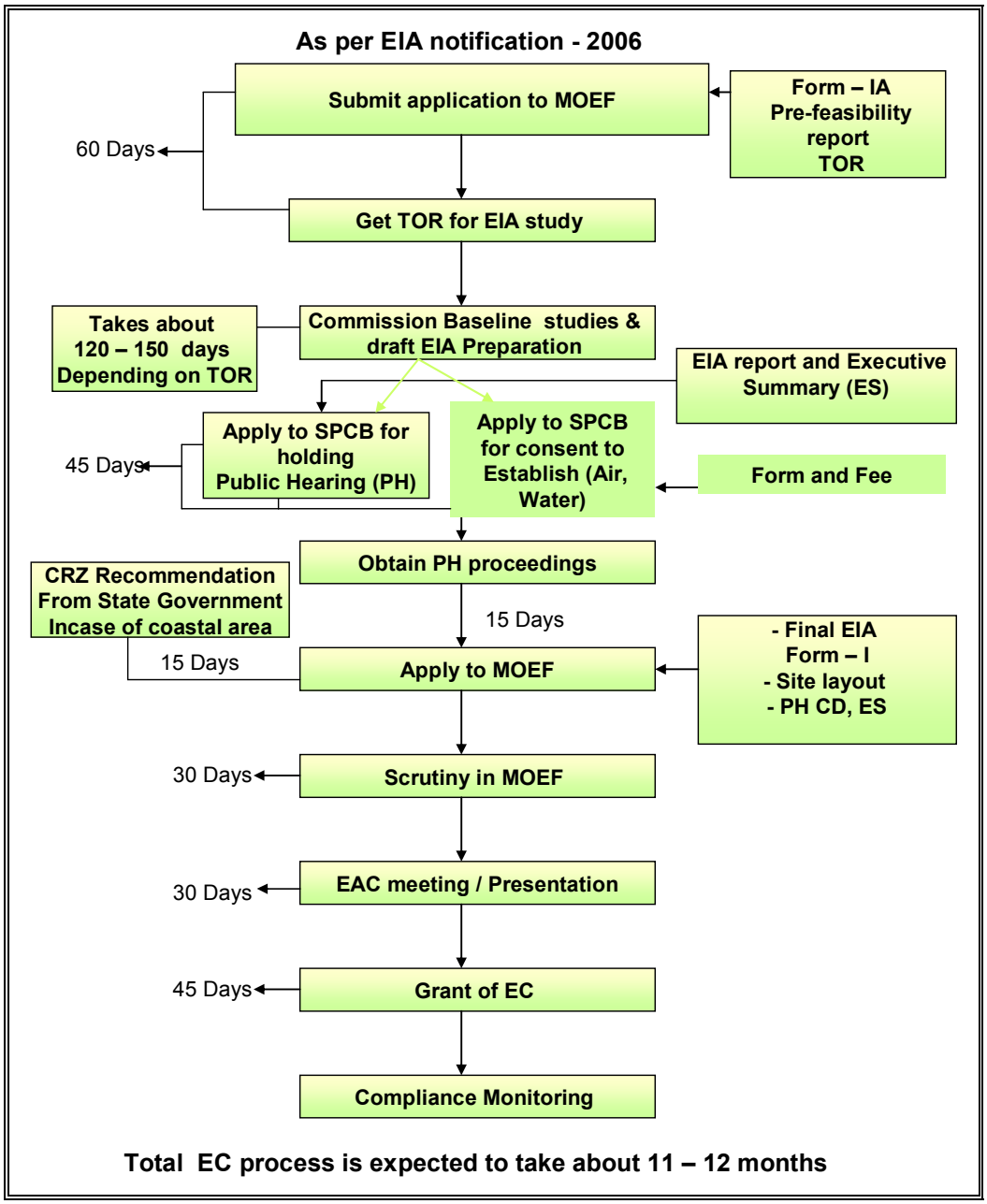
The project have been categorized under Item 7(i) as per MoEF Notification dated September 14, 2006

This proposed project is a Designated Project under Schedule and will fall under category A of the Environmental Impact Assessment (EIA) Notification due to the General conditions (interstate boundary) and requires Environmental Clearance from the Ministry of Environment and Forests (MoEF).

3.3.3 PROCEDURE FOR SEEKING PRIOR ENVIRONMENTAL CLEARANCE (EC) FROM MOEF

Typical EC procedure, as applied as per EIA Notification, 2006, consists of the actions given in **Figure 3.1**.

FIGURE 3.1: ENVIRONMENTAL CLEARANCE (EC) PROCESS



3.3.4 USAGE OF WATER & WATER POLLUTION

The use of water resources and the discharge of polluted water (sewerage) are primarily regulated by the Water Cess Act, 1977 and the Water (Prevention and Control of Pollution) Act, 1974.

The Water (Prevention and Control of Pollution), Cess Act, 1977 including Rules 1978 and 1991 provides for levy and collection of Cess on water consumed by the local authorities and by persons carrying on certain industries with a view to generate resources for prevention and control of water pollution. It also covers specifications on affixing of meters, furnishing of

returns, assessment of Cess, interest payable for delay in payment of Cess and penalties for non-payment of Cess within the specified time. The proposed project will fall under the Act only if they source water from water supply schemes of urban municipalities and corporations and these bodies levy such cess as some form of water tax to the proposed project.

The Water (Prevention and Control of Pollution), Act, 1974 including Rules, 1975 (as amended up to 1988) provides for the prevention and control of water pollution and maintaining or restoring good water quality for any establishment. The Act assigns functions and powers to the CPCB and SPCBs for prevention and control of water pollution and all related matters.

The liquid wastewater discharge limit from the proposed project as per CPCB norms are given in **Appendix II.**

Of late, with rapid depletion of groundwater resources in several areas of the country, efforts have been initiated to regulate the use of groundwater resources. The focus of such acts and rules (many of which are still in draft form) is to provide for mechanisms that would lead to replenishment of groundwater reserves through techniques like ground water recharging.

3.3.5 AIR QUALITY

The Air (Prevention and Control of Pollution) Act, 1981 including Rules 1982 and 1983 was enacted to prevent, control and reduce air and noise pollution. According to Section 21 of the Act, no person shall establish or operate any activity, which can cause air pollution without obtaining Consent to Establish (CTE) as per the Air Act.

The Act also lays down National ambient air quality standards for common pollutants like Suspended Particulate Matter (SPM), Sulphur dioxide (SO_2), Oxides of Nitrogen (NO_x), Carbon monoxide (CO) and Lead (Pb) with the intent of managing air quality for different category of areas (residential, industrial and sensitive). The Environment Protection Rules (EPR) also specifies source emission standards determined on the basis of the impact of pollutants on human health, vegetation and property for activities, which can pollute the air. The National Ambient Air quality standards are presented in **Appendix III.**

It may be noted that normally the CTE for the Air and Water Act is provided in the form of a No Objection Certificate (NOC) to the project proponent when the project falls under the 1-8 categories of activities covered by the EIA notification. Grant of NOC is independent of EC process.

3.3.6 NOISE QUALITY

With the objective of regulating ambient noise level in the environment, the Central Government has notified the Noise Pollution (Regulation and Control) Rules, dated February 14, 2000 under the EPA.

The EPR also lays down equipment specific noise emission standards for DG Sets, Air conditioners and Construction Equipment, which would be in use for the proposed project. Specific standards for control of noise from DG sets and measures to be taken for reduction of noise by using acoustic enclosures, acoustic treatment of rooms or exhaust muffler have also been specified through the Environment (Protection) Second Amendment Rules, 2002 notified through notification GSR 371 (E) on 17th May, 2002.

3.3.7 FLY ASH UTILIZATION

Ministry of Environment and Forest notification of ash utilization dated September 14, 1999 and its amendment dated April 3, 2007 stipulates that new power stations will have to utilize ash to the extent of 30% in 3 years of commissioning and to attain 100% utilization by 9th year. All efforts would be made for utilization of fly ash so as to protect the environment through conserving topsoil and other non-renewable resources used in construction activities.

As per this notification every person engaged in any activity involving building construction shall use building materials composed wholly or partially of fly ash instead of other corresponding material made wholly of construction material such as clay, top soil, limestone, sand and other material.

As per fly ash utilization notification dated 3rd April 2007, owners of Thermal (including captive and/or coal/ignite based) Power Plant:

- May dispose of fly ash through competitive bids to the best advantage of the owners.
- Shall not at any time store more than three months ash generation in their storage and / or ash pond.
- Shall maintain a record of all sale and/or disposal of the fly ash

3.3.8 THE MUNICIPAL SOLID WASTE (MANAGEMENT AND HANDLING) RULES, 2000

The Municipal Solid Waste (Management and Handling) Rules, 2000 (MSW Rules) establish consistent regulations governing collection, segregation, transportation, and disposal of all types of municipal solid wastes throughout India. The MSW Rules apply equally to every municipal authority regardless of its size.

TREATMENT AND DISPOSAL OF MUNICIPAL SOLID WASTE

The MSW Rules seek to minimize the burden on landfills for the disposal of municipal waste by adopting appropriate waste segregation and treatment technologies. Municipalities have the responsibility to implement appropriate strategies and systems to minimize disposal volumes based on the following criteria:

- Processing of biodegradable wastes by using composting, vermi-composting, anaerobic digestion or any other appropriate biological processing for stabilization of waste. The objective is to minimize disposal volumes and generate a valuable end product. It must be ensured that compost or any other end product shall comply with standards specified in MSW Rules.
- Mixed waste should be sorted to remove recoverable materials prior to disposal.
- Incineration, with or without energy recovery, including pelletization can be used for processing wastes in specific cases.
- Alternative, state-of-the-art technologies may also be applied provided that the Municipal Authority or Private Operator obtains authorization from the Central Pollution Control Board.

The MSW Rules restrict landfill disposal to non-biodegradable, inert, and other wastes that are unsuitable for either recycling or biological processing. Residues of waste processing facilities, as well as pre-processing rejects, should be land filled. Land filling of mixed waste should only be permitted in situations where the waste stream is unsuitable for alternative processing or when additional time is required to establish appropriate waste diversion and treatment programs and technologies.

3.3.9 INSTITUTIONAL FRAMEWORK

Whereas the legislative branch of the government (Parliament) is responsible for the enactment of environmental law and the judiciary for its enforcement in the case of transgression, it is the function of the executive branch (ministries, regional and local authorities) to determine policies and administer environmental law in actual practice. Also, since an environmental dimension has now become a part of all economic activities, an effective mechanism of coordination and control is the responsibility of the central environmental agency so that environmental policies can be translated into action.

The Government of India took a major step in 1972 when it constituted the National Committee on Environmental Planning and Coordination (NCEPC). Later in 1980, the Government of India established a new Department of Environment on the recommendation of a committee constituted by the Indian Parliament. The Central and State Pollution Control Boards were set up and entrusted with the task of air and water pollution control in 1974.

3.3.9.1 Ministry of Environment and Forests (MoEF)

In view of the growing importance of environmental affairs, the Government of India set up a Department of Environment in November 1980 under the portfolio of the Prime Minister. The Department, later renamed as the Ministry of Environment and Forests (MoEF) plays a pivotal role in environmental management for sustained development and for all environmental matters in the country. The major responsibilities of MoEF include:

- Environmental resource conservation and protection, including environmental impact assessment of developmental projects;
- Co-ordination with the other ministries and agencies, voluntary organisations and professional bodies on environmental action plans;
- Policy-planning;
- Promotion of research and development, manpower planning and training and creation of environmental awareness;
- Liaison and coordination with international agencies involved in environmental matters.

Developmental project proponents are also required to submit Environmental Impact Statements/Assessments to establish that preventive measures are planned by installing adequate pollution control and monitoring equipment, and that effluent discharged into the environment will not exceed permissible levels. The MoEF appraises these statements/assessments and approves the project from the environmental angle. The respective State Pollution Control Board is to give a No Objection Certificate (NOC).

3.3.9.2 Central and State Pollution Control Boards

The Central Pollution Control Board is directly responsible for pollution control throughout the national territory. In addition to the control of air, noise and water pollution it is also responsible for ensuring effective control on disposal of hazardous wastes and storage and handling of hazardous chemicals and substances.

Additionally, with the enactment of air and water pollution laws, states have set-up their own Pollution Control Boards (SPCBs) to monitor industrial emissions and effluents and to approve the operation of new industries after careful scrutiny. The functions of the SPCBs include:

- The planning of comprehensive state programs for the prevention and control of air and water pollution and to ensure the implementation thereof;
- Inspection of control equipment, industrial plants, etc.;
- Establishing norms in consultation with the Central Board and having regard to national air quality standards, gaseous emission standards from industrial plants, automobiles, etc. Different emission standards may be laid down for different industrial plants, having regard to the quantity and composition of emissions into the atmosphere from such plants and the general pollution levels in the area;
- Advising the State Government on siting of new polluting industry.

4.0 BASELINE ENVIRONMENTAL STATUS

4.1 INTRODUCTION

This chapter describes the existing environmental settings in the study area and is based upon the secondary information collected from the published sources, reconnaissance survey, primary socio-economic survey and environmental monitoring of air, noise, soil, ground water and surface water in the study area. The major purpose of describing the environmental settings of the study area is:

- To assess the existing environmental quality, as well as study the environmental impacts due to the proposed project.
- To identify environmentally significant factors or geographical areas that could preclude any future development.

Additional purposes of the baseline studies is to provide sufficient information so that decision makers unfamiliar with the general location can develop an understanding of

- The project need
- Environmental characteristics of the study area

The objective of the present study is to assess environmental impacts due to proposed Integrated Municipal Waste Processing Complex at Ghazipur comprising of RDF plant (1300 TPD mixed waste), Water Treatment Plant (500 m^3/day), Effluent Treatment Plant and a Power Plant (10 MW) at Ghazipur Biogas plant site in trans Yamuna area of Delhi. The current environmental quality status around the identified project site represents the baseline status for the proposed project.

The methodology adopted for conducting baseline studies is described in following sections.

4.2 METHODOLOGY OF CONDUCTING BASELINE STUDY

The guiding factors for the present baseline study are the requirements laid down by the Central Pollution Control Board (CPCB), and guidelines as per the Environmental Impact Assessment notification and TOR assigned by MoEF vide letter No.-10-74/2007-IA-III dated 6th September, 2007

For the purpose of the EIA study, the impact zone for the proposed implementation shall confine within a radius of 10 km from the center of the project site. This study being a rapid EIA, only one season (post-monsoon), 2007 data was collected.

The studies were conducted by considering the following:

- Various environmental attributes were divided into primary and secondary studies. Primary attributes such as micro-meteorology, air environment, water, soil, noise,

traffic, flora and fauna and socio-economic aspects were assessed by conducting field studies and on-site monitoring and review of the past studies conducted; and

- Secondary attributes such as land use studies, geology, physiological characteristics, have been assessed by literature review of studies conducted in the past and by various government publications.

Map depicting the 10 km radius from the site showing the various environmental attributes of the area has been shown in **Figure 2.3 in Chapter 2.0.**

The scoping and the extent of data generation were formulated with interdisciplinary team discussions, criteria questions and professional judgment also keeping in view of TOR assigned by MoEF. The baseline studies started with reconnaissance survey and site visits in the study area for fixing the monitoring locations for collection of the primary data. Various Government, Semi-Government departments were approached for getting information for the secondary data generation.

The various parameters surveyed and studied for the baseline study are discussed in the following sections components:

- Air Environment
- Noise Environment
- Water Environment
- Land Environment
- Ecological Environment
- Socio-Economic Environment

4.3 AIR ENVIRONMENT

Air pollution can cause significant effects on the environment, and subsequently on humans, animals, vegetation and materials. It primarily affects the respiratory (e.g. by fine dust), circulatory (e.g. by carbon monoxide) and olfactory (e.g. by odors) systems in humans. In most of the cases, air pollution aggravates pre-existing diseases or degrades health status, making people more susceptible to other infections or the development of chronic respiratory and cardiovascular diseases. Environmental impacts from air pollution can include acidic deposition and reduction in visibility.

Various activities proposed for the project will primarily emit suspended particulate matter (SPM), nitrogen oxides (NO_x), carbon monoxide (CO) and sulphur dioxide (SO_2).

During the construction phase of the project, the following pollutant is anticipated:

- SPM from all construction activities.

During the operational phase of the project, the following pollutants are anticipated:

- Fugitive emissions from rotary trommel, dryer discharge chute, discharge chute of rotary trommel (secondary), coarse fluff discharge chute, secondary cyclone discharge duct of the RDF plant
- Boiler flue gases containing SPM, NO_x , SO_2, HCl and other gases
- Air emission from hot air generator comprising of SPM, CO and CO_2
- Fugitive dust generation from material handling and processing
- Emission from vehicular activities on site.

4.4 METEOROLOGY

Site specific meteorological conditions prevailing within the study area play an important role in determining its existing air quality and environmental conditions. Climate, seasons and other meteorological parameters influence and alter site-specific activities and operations. Therefore, the meteorology of the area is described in detail in the subsequent sections.

Micrometeorological parameters are responsible for dispersion and diffusion of pollutants in the atmosphere. The characterization of the existing meteorological conditions in the vicinity of a source of pollutants is, therefore, a critical aspect of assessing air quality.

Meteorological Data

A micro-meteorological station was installed at the project site to record hourly meteorological parameters. On site meteorological data was collected in respect of wind speed, direction, temperature, humidity and rainfall.

Climatological data is used for devising baseline ambient air quality monitoring plans. Long-term climate trend data is obtained for the years (1951-1980), from the closest surface Indian Meteorological Department (IMD), located at Safdarjung Airport, New Delhi. The surrounding area is plain except for a ridge, which surrounds New Delhi in a semicircle. The river Yamuna flows to the north and the east of the city. Wind instruments are located on the roof of the main building at a height of 16 m, with satisfactory exposure (IMD, 1999).

The meteorological parameters can change dramatically from one hour to another hour or from one day to the next day in response to the local weather condition. Hourly-based recorded meteorological data is further employed for dispersion modeling for air quality impact assessment.

A) Long Term Climate Trends – Safdarjung Airport

The climate of New Delhi is influenced by its inland location and is characterized by extreme dryness with intensely hot summers and cold winters. Only in the monsoon season (July,

August and September) do air masses of oceanic origin reach New Delhi resulting in increased humidity, cloudiness and precipitation.

New Delhi's winter begins in late November and lasts until the beginning of March when the summer begins and extends until the end of June, followed by the monsoon season, which lasts until the end of September. October and November are a transition period between monsoon and winter. Climatological summary for New Delhi is presented in **Table 4.1**.

TABLE 4.1: CLIMATOLOGICAL SUMMARY FOR (1951-1980)

Month	Total Rainfall (mm)	Mean Wind Speed (km/h)	Mean Temperature (°C)		Predominant wind direction
			Max	Min	
January	20.3	8.3	21.1	7.3	NW
February	15.0	10.1	24.2	10.1	NW
March	15.8	10.7	30.0	15.4	NW
April	6.7	11.2	36.2	21.5	NW
May	17.5	12.8	39.6	25.9	NW
June	54.9	13.7	39.3	28.3	NW
July	231.5	9.9	35.1	26.8	E
August	258.7	8.3	33.3	25.9	E
September	127.8	8.9	33.9	24.4	NW
October	36.3	6.1	32.9	19.5	NW
November	5.0	6.1	28.3	12.3	NW
December	7.8	7.4	23.0	8.2	NW
Annual Total or Average Mean	**797.3**	**9.5**	**31.4**	**18.8**	**-**

Source: Government of India, Indian Meteorological Department, Climatological Tables (1951-1980)

Rainfall

The average annual rainfall for New Delhi is 797.3 mm with 81% of the rainfall occurring in the monsoon months of July, August, and September. The rainfall amounts vary significantly from year to year.

Temperature

New Delhi is situated in the Gangetic Plains, far inland from the Bay of Bengal and the Arabian Sea. The distance from the oceans/seas results in extreme temperatures as the moderating effect of the seas is not present. January is typically the coldest month in Delhi. During the winter months (December, January, February, and March) cold waves occur due to snowfall in the Himalayan ranges, located approximately 300 km to the north. After February, the temperatures begin to rise and generally peak in June, which is the hottest month of the year. With the monsoon arriving in July, the daytime temperatures drop while the nights remain warm. After the monsoon (i.e. October onwards) the daytime temperatures

remain as in the monsoon months but the nighttime temperatures begin to drop. In late November, the temperatures begin to drop rapidly as winter sets in.

Relative Humidity

The relative humidity of Delhi is governed by the monsoon, which is the source of moisture. As can be seen in Table 4.5, the air is generally dry, with the relative humidity rising during the monsoon (June - September), after which the moisture in the air decreases. The summer months are the driest part of the year when the relative humidity drops to 20%, particularly in the afternoons.

Wind Speeds and Direction

Wind direction is reported as the direction from which the wind blows and is based on surface observations. Over the course of a year, wind usually blows in all directions with varying frequencies. Certain directions, which occur more frequently than others, are known as the predominant wind directions. Climatological trend of wind direction envisages winds are generally light during the post monsoon and winter months. The winds increase during the summer and monsoon months. Except during the two monsoon months (July and August), the winds are predominantly from the Northwest directions. Calms are reported at an annual average of approximately 12%.

Pollutant concentrations typically decrease with increasing wind speed as a result of dispersion. However, when wind speeds are high, while there is good dispersion of gases and particles, there is more potential for re-suspending surface dusts. Wind speed near zero, indicating low turbulence may lead to very high pollutant concentrations near the ground. Wind speed increases with height as surface friction reduces. Ground level pollutant concentration is inversely proportional to the wind speed. Hence, during the higher wind speed month, the ground level pollutant concentration would be less and vice-versa.

Atmospheric Stability

The amount of turbulence in the ambient air has a major effect upon the rise and dispersion of air pollutant plumes. The amount of turbulence can be categorized into defined increments or "stability classes". The most commonly used categories are the Pasquill stability classes A, B, C, D, E, and F. Class A denotes the most unstable or most turbulent conditions and Class F denotes the most stable or least turbulent conditions. The frequency of stability classes during the monitoring period is provided in **Table 4.2**.

TABLE 4.2: FREQUENCY OF STABILITY CLASSES

Stability class	Frequency (%)
A – Extremely Unstable	16.7
B – Unstable	21.7
C – Slightly Unstable	3.3
D – Neutral	0.4
E – Slightly Stable	7.1
F – Stable to Extremely Stable	50.8

The data indicate that during the monitoring period, the site exhibited trends of primarily stable conditions. Stable conditions exhibit poor vertical mixing, and low levels of contaminant dispersion. Use of this stability data for modeling purposes will produce higher concentrations of pollutants at a given receptor (i.e. more conservative results).

Mixing Height

Mixing Height (MH) is the vertical extent through which the contaminant plume can be mixed. Forecasting of mixing height is done with the aid of the vertical temperature profile. The MH is a function of stability. In unstable air the MH is higher and in stable air the MH is lower. With a lower MH, there is a smaller volume of air in which the pollutant can be dispersed, resulting in higher concentrations in the ambient environment. There is a seasonal variation of MH. During summer daylight hours, MH can be few thousands feet whereas for winter it can be a few hundred feet. It varies also in the course of a day. It is lowest at night and increases during the day. Secondary information has been used to determine the mixing height over Delhi and it varies from 50-2500 meters (CPCB, 2002).

Meteorological Station Data

Table 4.3 provides averages of temperature, rainfall, and wind speed over the seasonal monitoring period at the site. **Figure 4.1** presents a wind rose for the post-monsoon season.

TABLE 4.3: METEOROLOGICAL MONITORING DATA

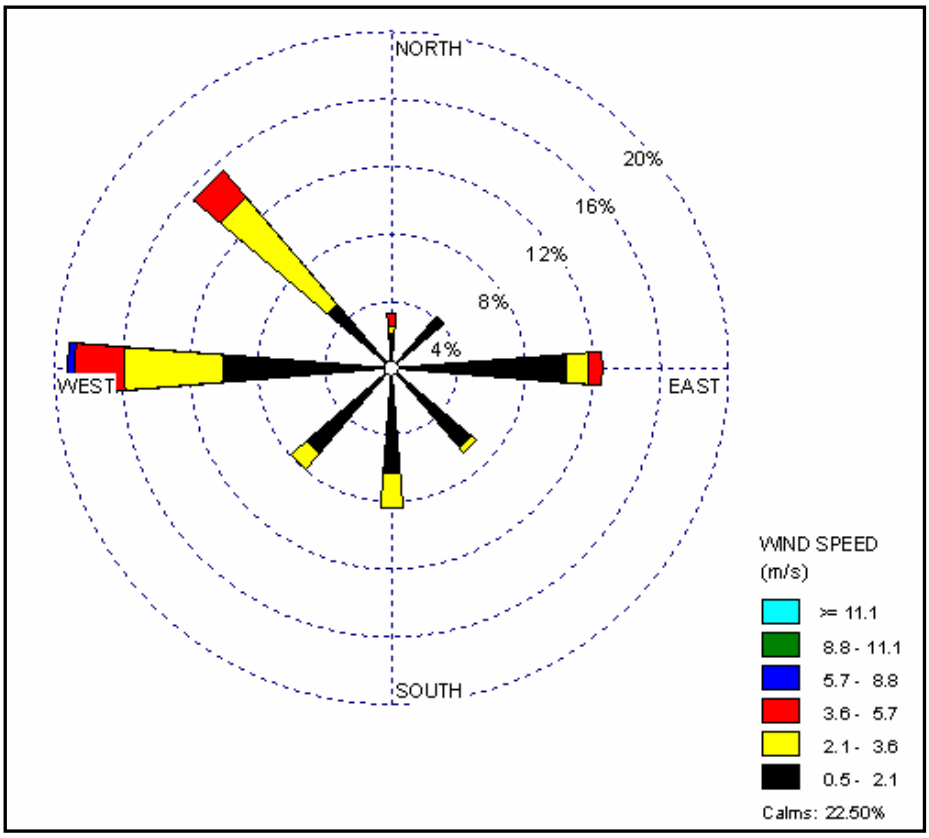
Season	Maximum temp	Minimum temp	Average wind speed	Rainfall
Post Monsoon, 2007	32^0C	11^0C	1.5 ms^{-1}	Nil

Wind Rose

The *wind rose* denotes a class of diagrams designed to display the distribution of wind direction experienced at a given location over a period of time-long for a climatological

record of prevailing winds or short to show wind character for a particular event or purpose. Wind rose summarizes a considerable amount of wind frequency information into a single graphic and is shown in **Figure 4.2** below during the monitoring period (Post-Monsoon - 2007) at the proposed site.

FIGURE 4.1: WIND ROSE FOR METEOROLOGICAL MONITORING DATA (POST-MONSOON 2007)



During the monitoring period, the direction of the wind is frequently observed from west. The average wind speed during the monitoring period was observed as 1.5 m s^{-1}.

4.4.1 AMBIENT AIR QUALITY

An assessment of baseline air quality was undertaken to (a) establish the status of exposure of the major sensitive receptors, and (b) to identify the major air pollution sources and their impacts on the area surrounding the project site.

This assessment was accomplished by reviewing historical ambient air quality data, examining sources of air emissions within 10 km radius of the proposed site (i.e. the impact zone), and by conducting a site-specific background-sampling program. In this manner, background data collected was expected to be representative of all meteorological conditions.

The baseline concentration values to be used in the modeling exercises were conservatively identified from the site-specific measurements.

The baseline studies for air environment covers reconnaissance, identification of specific air pollutants expected to have significant impacts from the proposed project and assessing their prevailing levels in ambient air at representative locations within the impact zone around the project site. The baseline status of air environment in this study has been assessed through reconnaissance in project area and a systematic air quality surveillance programme in post-monsoon season.

An assessment of baseline air quality was undertaken to establish the status of exposure of the major sensitive receptors and to assess the background air quality at the project location.

This assessment was accomplished by reviewing historical ambient air quality data, examining sources of air emissions around the proposed site (i.e. the impact zone), and by conducting a site–specific background–sampling program. In this manner, background data collected was expected to be representative of all meteorological conditions. Historical and site–specific data were compared to the applicable National Ambient Air Quality Standards (NAAQS), where appropriate. The baseline concentration values to be used in the modeling exercises were conservatively identified from the site–specific measurements.

4.4.2 SOURCES OF AIR EMISSIONS SURROUNDING THE SITE

The major source of air pollution is the vehicular emission from heavy traffic on Kondli road. The impacts from these sources are expected to be captured in the levels of pollutants measured in the site-specific background air quality monitoring study conducted within the impact zone.

4.4.3 SITE–SPECIFIC BACKGROUND AIR QUALITY MONITORING PROGRAM

A site–specific background air quality monitoring program was conducted for the existing project site during the post-monsoon season, 2007. Background data was collected for SPM, RSPM, SO_2, NO_x and CO.

The basic considerations for designing air quality monitoring programme include:

(i) Topography
(ii) Physical Features
(iii) Micro-meteorology of the region
(iv) Representation of regional background
(v) Proper representation of upwind and downwind directions
(vi) Ecologically Sensitive Locations within 10 km

Keeping the historical meteorological conditions, topography, physical features, sensitive locations and current and anticipated pollution loads in mind, and based on the reconnaissance survey of the project area, a monitoring framework for air quality in the study area (10 km radius) was drawn. Five air quality-monitoring stations were set up in and around the proposed project site. Following are the details of the monitoring locations that are proposed for ambient air quality monitoring **(Table 4.4).**

Two air quality monitors (AQ2, AQ3) in the upwind direction, 2 air quality monitors (AQ4, AQ5) in the downwind direction, one at project site (AQ1) were considered adequate to provide the baseline air quality.

TABLE 4.4: AIR MONITORING LOCATIONS

Location Code	Description	Dist. from center of site (km)	Upwind /Downwind
AQ1	Onsite	-	-
AQ2	Hasanpura Nangla	2.3	Upwind (NW)
AQ3	Hasanpura Bhuapur	2.2	Upwind (N)
AQ4	Kalyanpuri	0.8	Downwind (SW)
AQ5	Khora	2.9	Downwind (NE)

The parameters to be monitored, frequency and number of samples to be taken at each station are as follows **(Table 4.5):**

TABLE 4.5: DETAILS OF MONITORING PROGRAM FOR AMBIENT AIR QUALITY

Particulars	Details
Frequency	24hrs, 2 times a week x 8 weeks
Parameters	RSPM, SPM, SO_2, NOx, CO, HC
Duration	24 hrs for SPM & RSPM, NOx and SO_2, 8 hrs Grab Samples for CO

Monitors were placed at sensitive receptors (i.e. within nearby villages), where safety and power were provided. Monitors were placed on one-storey dwellings, away from major roads and nearby flow obstructions (i.e. trees). Each sampler maintained a volumetric flow rate between 1-1.2 m^3/min. Analysis of pollutants was done as per standard IS codes. The ambient air quality monitoring locations are as given in **Figure 4.2.**

FIGURE 4.2: AIR MONITORING LOCATIONS

Observations: Monitoring results (observed levels and ranges) of SPM, RSPM, SO_2, NO_x, and CO are presented in the **Table 4.6A to Table 4.6E** where the exceedances are highlighted.

TABLE 4.6A: MONITORING PROGRAM RESULTS – AQ1 (PROJECT SITE)

Units: $\mu g/m^3$

Parameter	Monitoring Results			NAAQS for Residential, Rural & Other Areas
	Maximum	Minimum	Average	
SPM	**460**	**378**	**400**	200
RSPM	**134**	**105**	**117**	100
NO_x	26	18	24	80
SO_2	21	15	18	80
CO	**2200**	1867	**2037**	2000

TABLE 4.6B: MONITORING PROGRAM RESULTS – AQ2 (HASANPURA NANGLA)

Units: $\mu g/m^3$

Parameter	Monitoring Results			NAAQS for Residential, Rural & Other Areas
	Maximum	Minimum	Average	
SPM	**380**	**234**	**307**	200
RSPM	**110**	78	94	100
NO_x	24	16	20	80
SO_2	18	10	14	80
CO	1287	1060	1174	2000

TABLE 4.6C: MONITORING PROGRAM RESULTS – AQ3 (HASANPURA BHUAPUR)

Units: $\mu g/m^3$

Parameter	Monitoring Results			NAAQS for Residential, Rural & Other Areas
	Maximum	Minimum	Average	
SPM	**318**	**236**	**277**	200
RSPM	**110**	76	93	100
NO_x	18	12	15	80
SO_2	12	6	9	80
CO	1268	966	1117	2000

TABLE 4.6D: MONITORING PROGRAM RESULTS – AQ4 (KALYANPURI)

Units: μg/m^3

Parameter	Monitoring Results			NAAQS for Residential, Rural & Other Areas
	Maximum	Minimum	Average	
SPM	**343**	192	**268**	200
RSPM	95	65	80	100
NO_x	25	16	21	80
SO_2	18	11	15	80
CO	1240	1045	1143	2000

TABLE 4.6E: MONITORING PROGRAM RESULTS – AQ5 (KHORA)

Units: μg/m^3

Parameter	Monitoring Results			NAAQS for Residential, Rural & Other Areas
	Maximum	Minimum	Average	
SPM	**201**	158	180	200
RSPM	82	56	69	100
NO_x	18	10	14	80
SO_2	15	5	10	80
CO	1267	1023	1145	2000

Analysis: With respect to pollutants, the results of the monitoring program indicate the following:

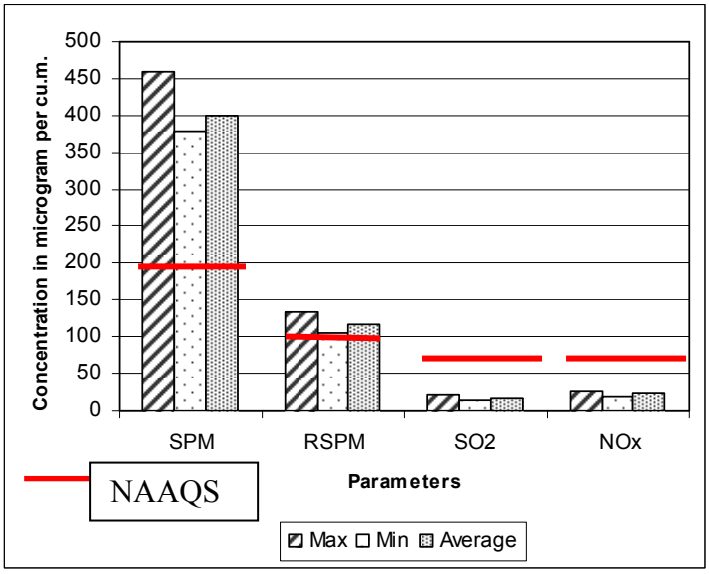
- Observed concentration of SPM exceed NAAQS at all the identified locations
- Observed concentration of RSPM exceed NAAQS at three out of five locations
- Observed concentration of NO_x & SO_2 are within the specified standards for rural areas i.e. 80 μg / m^3 at all the identified locations.
- Observed concentration of CO exceed NAAQS at one location AQ1 (Project site)

The high concentration of SPM is mainly due to vehicular traffic and dust emissions from unpaved areas.

The baseline conditions at each of the air quality monitors are described below with NAAQS standards indicated on each graph.

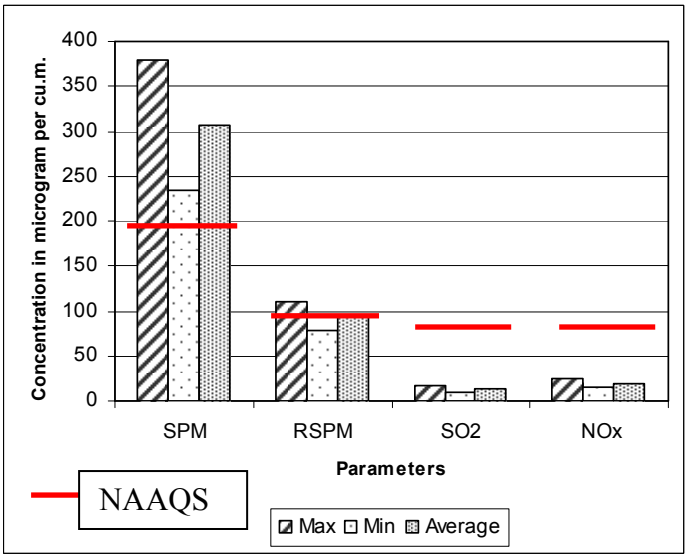
AQ-1: The monitor was placed at project site. Monitored SPM and RSPM levels are higher with a maximum value of 460µg/m^3 and 134µg/m^3. High concentration of SPM and RSPM is attributed to wind blown dust from unpaved roads. All other parameters are well within the prescribed limits **(Figure 4.3).**

FIGURE 4.3: BASELINE AIR QUALITY AT STATION AQ1 (PROJECT SITE)



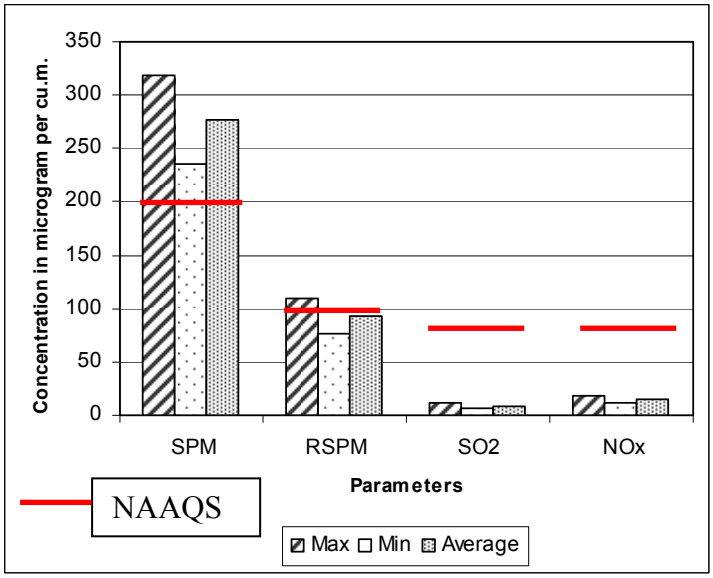
AQ-2: The monitor was placed at Hasanpura Nangla. Monitored SPM and RSPM levels are higher with a maximum value of 380µg/m^3 and 110µg/m^3. High concentration of SPM and RSPM is attributed to wind blown dust from unpaved roads. All other parameters are well within the prescribed limits **(Figure 4.4).**

FIGURE 4.4: BASELINE AIR QUALITY AT STATION AQ2 (HASANPURA NANGLA)



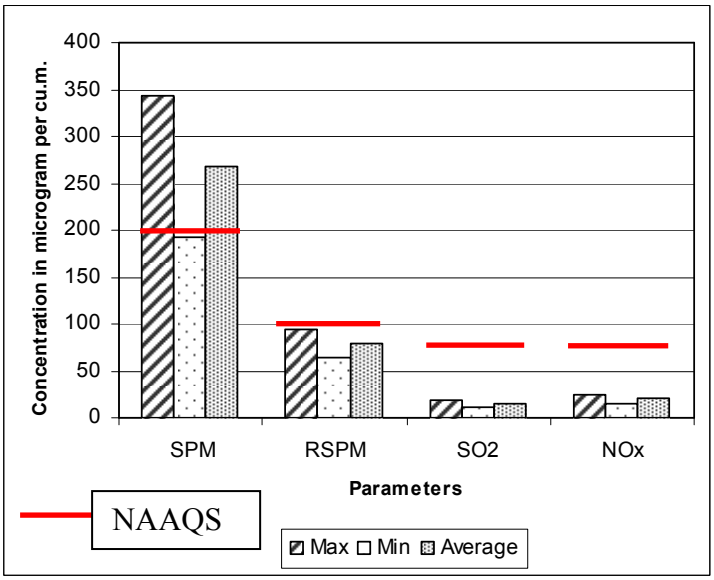
AQ-3: The monitor was placed at Hasanpura Bhuapur. Monitored SPM and RSPM levels are higher with a maximum value of 318µg/m^3 and 110µg/m^3. High concentration of SPM and RSPM is attributed to wind blown dust from unpaved roads. All other parameters are well within the prescribed limits **(Figure 4.5).**

FIGURE 4.5: BASELINE AIR QUALITY AT STATION AQ3 (HASANPURA BHUAPUR)



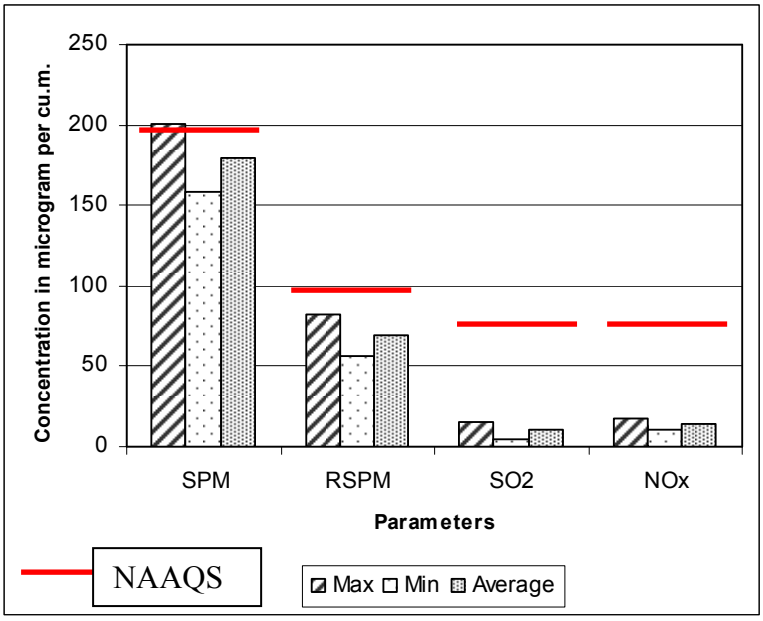
AQ-4: The monitor was placed at Kalyanpuri. Monitored SPM levels are higher, with a maximum value of 343µg/m^3. High concentration of SPM is attributed to wind blown dust from unpaved roads. All other parameters are well within the prescribed limits **(Figure 4.6).**

FIGURE 4.6: BASELINE AIR QUALITY AT STATION AQ4 (KALYANPURI)



AQ-5: The monitor was placed at Khora. Monitored SPM levels are higher, with a maximum value of 201 µg/m^3. High concentration of SPM is attributed to wind blown dust from unpaved roads. All other parameters are well within the prescribed limits **(Figure 4.7).**

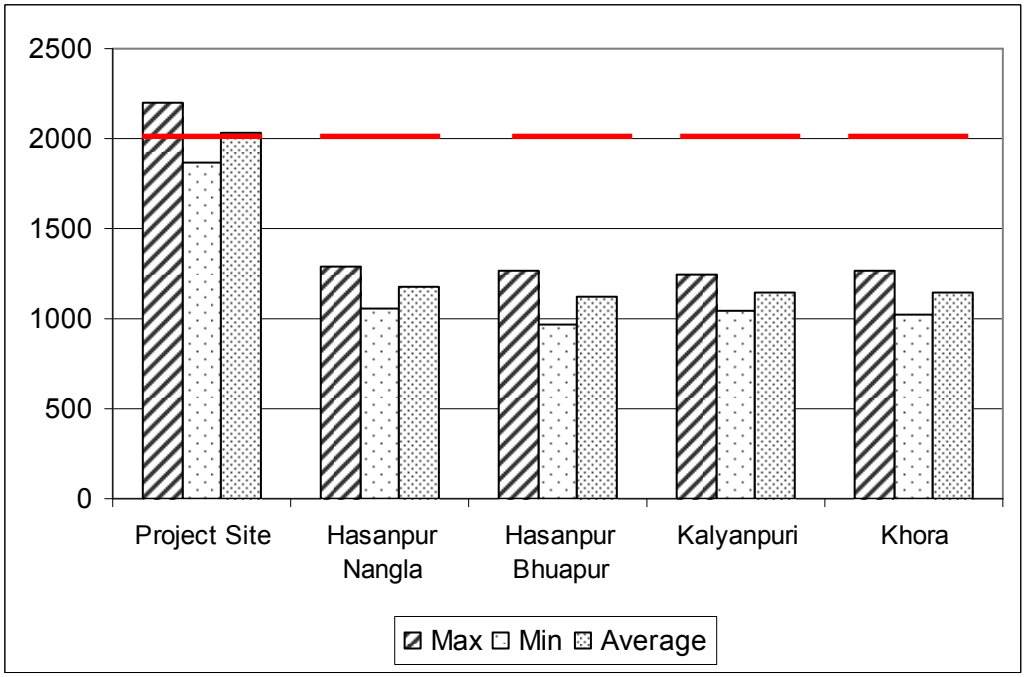
FIGURE 4.7: BASELINE AIR QUALITY AT STATION AQ5 (KHORA)



CO Concentration

Concentration of CO is well below the prescribed NAAQS at all the monitoring locations except at AQ1 (Project site).

FIGURE 4.8: CONCENTRATION OF CO AT DIFFERENT LOCATIONS



4.5 NOISE ENVIRONMENT

Unpleasant sounds are classified as noise pollution. Sound possesses three definite properties: intensity, frequency and duration. Intensity is the loudness of a sound, or the pressure it exerts through the ear. It is measured in decibels (dB). In assessing noise, an empirical measure called "dBA" indicates damage to hearing. The higher the dB (A) number, the greater is the risk of damage to hearing.

Loud noise may adversely affect people in many ways. For example, noise may interface with sleep, speech, communication and can cause annoyance and other physiological problems. Occupational noise exposure is also the most common cause of Noise-Induced Hearing Loss (NIHL), threatens the hearing of individuals exposed to noise pollution for longer periods, at a less intense level. For example, repeated exposure to noise pollution at a construction site can cause NIHL to construction workers, an effect that cannot be reversed.

During the construction of the site, vehicles carrying construction material and operation of construction machinery and equipments at site are expected to generate noise.

During the operational phase of the site, the following sources of noise pollution are expected:

- Increase in transport noise from within the site and from Kondli road.

Table 4.7 provides potential primary sources and effects of noise pollution during the construction and operational phases of the site.

TABLE 4.7: PRIMARY EFFECTS OF NOISE POLLUTION FROM CONSTRUCTION & OPERATION ACTIVITIES OF THE SITE

Pollutant	Source	Primary Effects
Noise	Construction activities Transport Human activities	Annoyance Interference with communication NIHL Interference with sleep Aural pain, nausea & reduced muscular control Performance effects Effects on social behavior

Source: *http://www.epa.nsw.gov.au/soe/97/ch1/15_3.htm*

Major sources of noise pollution during the construction and operational phases of the site will be from construction equipment and diesel generator sets respectively.

4.5.1 AMBIENT NOISE QUALITY

An assessment of baseline noise quality was undertaken to establish the status of exposure of the major sensitive receptors, and provide the background levels of noise at the project site area.

This assessment was accomplished by conducting a site-specific background-monitoring program. Site-specific data were compared to the applicable Ambient Air Quality Standards in Respect of Noise (AAQSRN), where appropriate.

The baseline concentration values to be used in the modeling exercises were conservatively identified from the site-specific measurements.

4.5.2 SOURCES OF NOISE EMISSIONS SURROUNDING THE SITE

The sound environment surrounding the site is characterized by an urban hub primarily due to residential activity and high levels of traffic.

The impacts from these sources are expected to be captured in the levels of noise measured in the site-specific background noise monitoring study.

4.5.3 SITE-SPECIFIC BACKGROUND NOISE QUALITY MONITORING

Noise monitoring was conducted at five locations within the impact zone wherever possible including the project site and residential areas. The background-monitoring program was done in accordance with the requirements of an EIA study. Sound pressure level (SPL) measurements were automatically recorded to give the noise level for every hour continuously for 24 hours in a day.

Accordingly one full day (i.e. 24 hourly values) of data was collected at each of the five monitoring locations. The monitoring locations are provided in **Table 4.8**.

TABLE 4.8: NOISE MONITORING LOCATIONS

Monitoring Station	Description of Location	Distance from Site (km)	Land Use Categorisation
N1	Project site	-	Residential Area
N2	Hasanpur Nangla	2.3	Residential area
N3	Hasanpur Bhuapur	2.2	Residential area
N4	Kalyanpuri	0.8	Residential area
N5	Khora	2.9	Residential area

The parameters to be monitored, frequency and the methodology for sampling are presented in **Table 4.9**.

TABLE 4.9: DETAILS OF MONITORING PROGRAM FOR AMBIENT NOISE QUALITY

Particulars	Details
Frequency	Continuous monitoring for one day at each station on working / non working day
Parameters	Instantaneous Noise Levels
Methodology	Instantaneous Noise levels to be recorded for each hour at 10 minute intervals on location and analyzed to calculate the equivalent day and night time noise levels

Table 4.10 gives the prescribed noise standards by CPCB whereas **Table 4.11** provides equivalent noise levels viz., L_{eqday} and $L_{eqnight}$, at the noise monitoring location. L_{eq} was calculated using the following equation:

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

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

The background-monitoring program was performed in accordance with the requirements of an EIA study. Sound pressure level (SPL) measurements were automatically recorded to give the noise level for every hour continuously for 24 hours in a day.

TABLE 4.10: AMBIENT NOISE QUALITY STANDARDS

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

1. Daytime shall mean from 6.00 a.m. to 10.00 p.m.
2. Nighttime shall mean from 10.00 p.m. to 6.00 a.m.
3. Silence zone is defined as an area comprising not less than 100 meters around hospitals, educational institutions and courts. The silence zones are zones, which are declared as such by the competent authority.
4. Mixed categories of areas may be declared as one of the four above-mentioned categories by the competent authority.

TABLE 4.11: MONITORING PROGRAM RESULTS – NOISE

Location	Day Time		Night Time	
	L_{eq} dB (A)	Limit L_{eq} dB (A)	L_{eq} dB (A)	Limit L_{eq} dB (A)
N1	**57.6**	55	**60.5**	45
N2	**62.2**	55	**57.1**	45
N3	**58.3**	55	**54.2**	45
N4	**65.5**	55	**51.7**	45
N5	**61.4**	55	**56.3**	45

- Daytime shall mean from 6.00 a.m. to 10.00 p.m.
- Nighttime shall mean from 10.00 p.m. to 6.00 a.m.

The results of the monitoring program indicated that levels of noise exceed NAAQSRN at all the five locations monitored, both the daytime and night time, most likely due to high levels of traffic noise and other commercial and social activities.

4.6 WATER ENVIRONMENT

This section documents the baseline scenario of the water environment in the study area and discusses both water resources and quality. These details include water availability, the quality of ground & surface water, utilization pattern of water resources for various activities in the study area. The data has been collected from various secondary sources mainly CGWA and primary survey carried out in the impact zone.

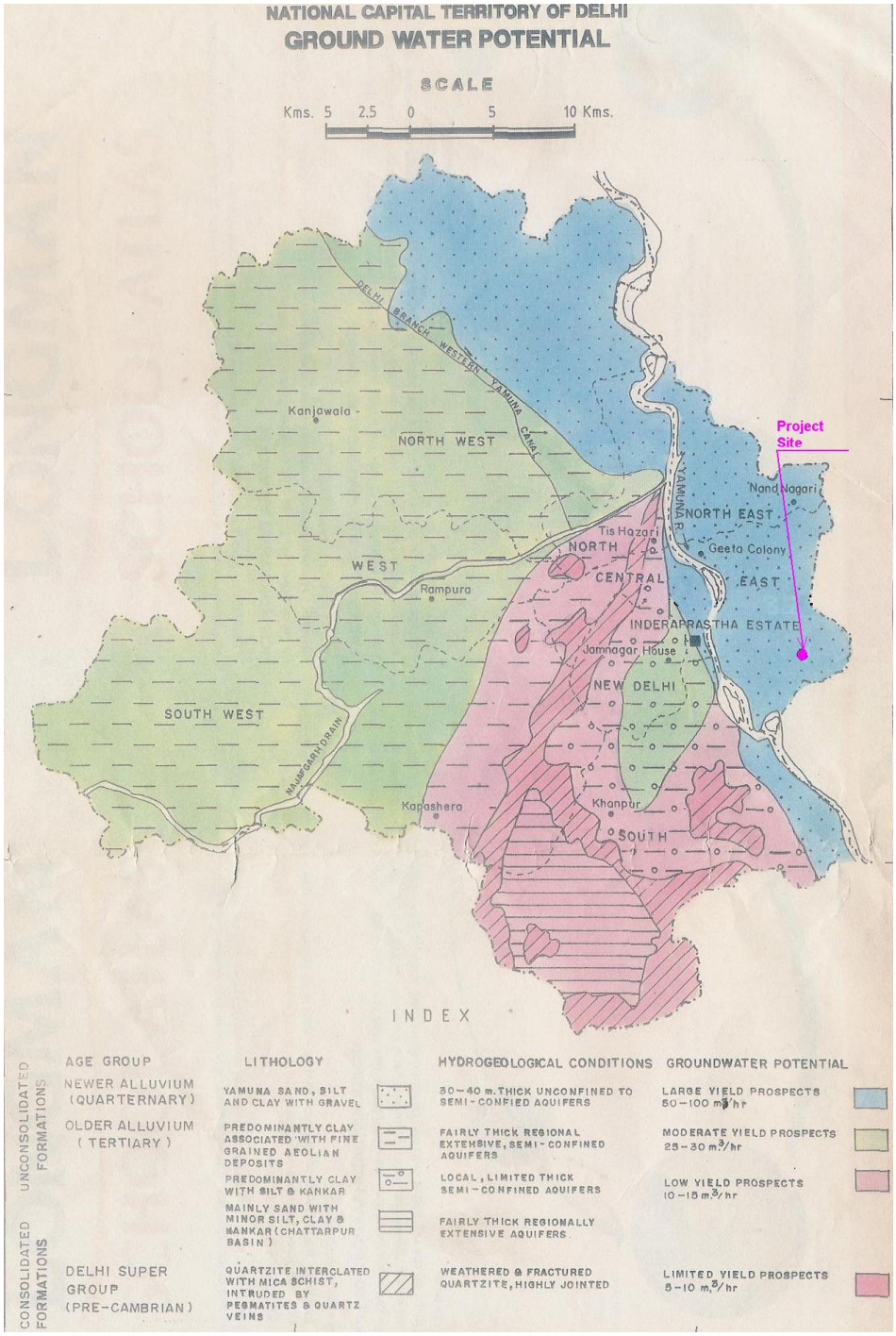
4.6.1 SURFACE WATER RESOURCES

Ghazipur drain and Hindon cut are the nearest surface water resources around the project site.

4.6.2 HYDRO-GEOLOGY AND GROUNDWATER RESOURCES

The Dehi ridge is the northernmost extension of Aravali Mountain consisting of quartzite rocks and extends from southern part of the territory to the western bank of Yamuna for about 35 km. The proposed site falls in Shahadra block which consists of alluvial formation. The basement or hard rock occurs at greater depth around 100 m below ground level. The block of 79 sq.km area has total replenishable groundwater resources of 12.5 MCM and the total withdrawal in the tune of 110.5 MCM. The proposed project is located in the area with high ground water yield.

FIGURE 4.9: GROUND WATER POTENTIAL MAP SHOWING THE PROJECT SITE

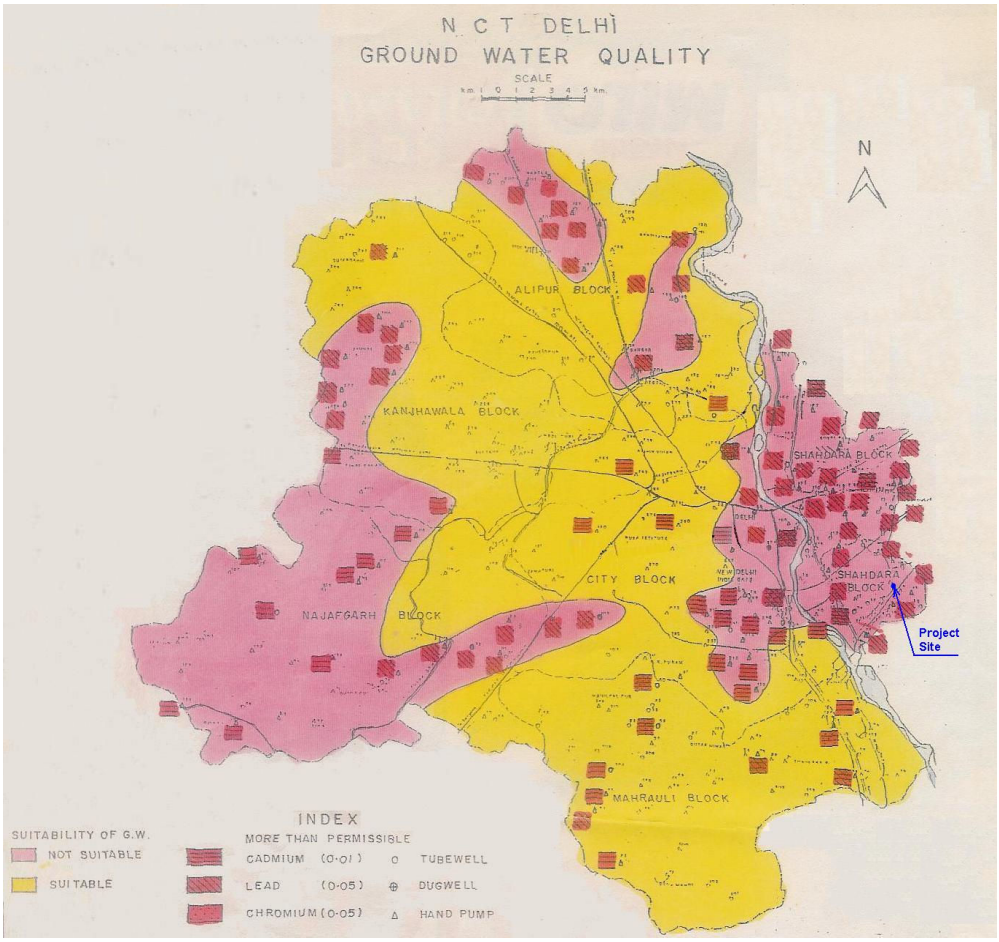


Source: Central Ground Water Board

4.6.3 WATER QUALITY

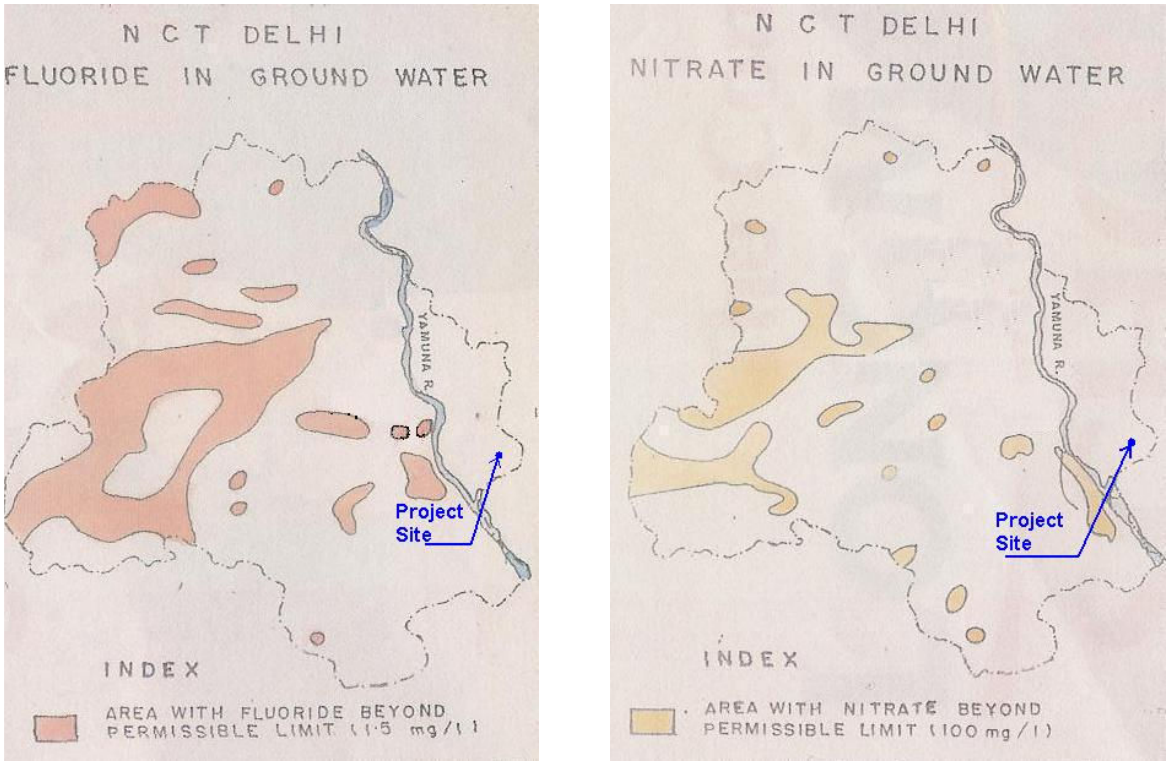
Depth wise ground water quality reveals that fresh water is available at all levels in this region. Electrical conductivity is a function of ionic concentration and is used for assessment of dissolved substances in the water. The importance of EC is its measure of salinity, which greatly affects the taste. The **Figure 4.10** indicates quality of ground water around the project site. It can be seen from the figure that ground water quality at project site in not suitable for drinking as per CGWB data. **Figure 4.11** indicates that project area is free of nitrate and fluoride concentration.

FIGURE 4.10: GROUND WATER QUALITY IN THE AREA



Source: Central Ground Water Board

FIGURE 4.11: MAP SHOWING FLUORIDE AND NITRATE CONTENT IN GROUND WATER



Source: Central Ground Water Board

Water sampling has been done to determine the existing quality of water around the project area and to assess the impact from the proposed project. Sampling has been done following standard guidelines for physical, chemical and bacteriological parameters. Analysis has been done as per methods prescribed in "Standard Methods for the Examination of Water and Wastewater (20th Edition)". Samples were collected from surface water sources and tube wells located near project site. **Table 4.12** gives the details of the ground water / surface water sampling locations.

TABLE 4.12: WATER QUALITY MONITORING LOCATIONS

Station No.	Description	Approximate Distance from Project Site (in km)	Approximate Direction from Project Site
GW-1	Project Site	--	--
GW-2	Kinauni	6.8	NE
GW-3	Parthala	8	SE
GW-4	Makanpura	2.5	SE
GW-5	Arthala	9	NE
GW-6	Khora	2.8	E
GW-7	Pasaunda	9	NE
GW-8	Kondli	0.8	S
GW-9	Raipurakhader	8.7	S
GW-10	Kethwara	9.3	NW
SW-1	Ghazipur Drain	0.25	W
SW-2	Hindon Cut	1	E

Table 4.13A shows the physicochemical characteristics of ground water samples collected from different sources as compared with the standard (IS 10500: Indian Standards/Specifications for Drinking Water) reference values. **Table 4.13B** shows the physicochemical characteristics of surface water sampling as compared with the CPCB standards for Class 'C' water i.e. water to be used for drinking after conventional treatment followed by disinfection.

TABLE 4.13A: WATER QUALITY IN THE STUDY AREA

S. No.	Test Parameters	Unit	Result										Desired limit as per IS: 10500	Permissible limit in the absence of alternate source as per IS: 10500
			GW1	GW2	GW3	GW4	GW5	GW6	GW7	GW8	GW9	GW10		
01	Colour	Hazen	<5	<5	<5	<5	<2	<2	<2	<5	<2	<2	5	25
02	Odour	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Unobjectionable	Unobjectionable
03	Turbidity	NTU	1.4	0.06	0.08	0.08	0.4	2.2	0.2	0.20	0.06	0.08	5	10
04	pH	-	7.31	7.8	7.6	7.90	8.5	8.1	7.65	7.63	7.8	7.6	6.5-8.5	6.5-8.5
05	Taste	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
06	Total Dissolved Solids	mg/L	**1290**	480	**640**	340	405	**1375**	**910**	450	**1760**	**1287**	500	2000
07	Total Hardness ($CaCO_3$)	mg/L	**495**	290	**441**	191	**442**	195	**580**	244	**324**	218	300	600
08	Iron as Fe	mg/L	0.15	ND	0.21	ND	0.32	0.14	0.04	0.16	0.28	0.21	0.3	1.0
09	Chloride	mg/L	**423**	17	51	24	41	130	**280**	67	**560**	**441**	250	1000
10	Residual free Chlorine	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.2	0.2
11	Nitrate	mg/L	8.0	0.2	2.0	0.4	1.5	ND	2.5	1.2	0.31	2.5	45	100
12	Fluoride	mg/L	0.4	0.12	0.24	0.28	0.3	0.8	0.2	ND	0.16	0.24	1.0	1.5
13	Lead as Pb	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.05	0.05
14	Arsenic as As	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.05	0.05
15	Cadmium as Cd	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.01	0.01
16	Calcium	mg/L	73	**78**	**138**	58	74	**140**	52	68	**138**	**114**	75	200
17	Magnesium	mg/L	75	18	36	20	16	32	26	17	228	31	NS	NS
18	Hexavalent Chromium	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.01	0.05
19	Phenolic Compounds	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	N.S.	N.S.
20	Zinc as Zn	mg/L	1.5	0.09	0.15	0.28	0.06	0.16	0.47	0.72	0.17	0.28	5	15
21	Copper as Cu	mg/L	0.008	0.008	0.026	0.048	0.03	0.02	0.05	0.05	0.019	0.014	0.05	1.5

S. No.	Test Parameters	Unit	Result										Desired limit as per IS: 10500	Permissible limit in the absence of alternate source as per IS: 10500
			GW1	GW2	GW3	GW4	GW5	GW6	GW7	GW8	GW9	GW10		
22	Aluminium as Al	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.03	0.2
23	Manganese as Mn	mg/L	0.015	0.062	0.048	0.007	0.06	0.04	0.03	0.008	0.006	0.012	0.1	0.3
24	Boron	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1	5
25	Mercury	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.001	NS
26	Total Coliform	MPN/100ml	150	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	NS	NS

ND – Not Detectable, NS – Not Specified
GW1: Ground water sample from the Project Site
GW2: Ground water sample from Kinauni
GW3: Ground water sample from Parthala
GW4: Ground water sample from Makanpura
GW5: Ground water sample from Arthala
GW6: Ground water sample from Khora
GW7: Ground water sample from Pasaunda
GW8: Ground water sample from Kondli
GW9: Ground water sample from Raipurakhader
GW10: Ground water sample from Kethwara

TABLE 4.13B: SURFACE WATER QUALITY IN THE STUDY AREA

SN	Test Parameters	Unit	SW1	SW2	CPCB standards for Class 'C' Water
01	Colour	Hazen	18	<15	300
02	pH value	-	6.78	7.57	6.5-8.5
03	Total Dissolved Solids	mg/L	3060	440	1500
04	Total Hardness	mg/L	804	125	N.S
05	Total Suspended Solids	mg/L	346	76	N.S
06	Chloride (as Cl^-)	mg/L	173	33	600
07	Sulphate as (SO_4^{2-})	mg/L	154	60	400
08	Oil & Grease	mg/L	ND	ND	N.S
09	Sodium (as Na)	mg/L	128	18	N.S
10	Potassium (as K)	mg/L	18	4	N.S
11	DO	mg/L	4.1	3.8	4
12	BOD_3 at 27°C	mg/L	43	46	3
13	COD	mg/L	173	180	N.S
14	Iron as Fe	mg/L	0.33	0.27	50
15	Lead (as Pb)	Mg/L	ND	ND	0.1
16	Arsenic (as As)	mg/L	ND	ND	0.2
17	Chromium (as Cr)	mg/L	ND	ND	N.S
18	Cadmium (as Cd)	mg/L	ND	ND	N.S
19	T. Coliform	MPN/100ml	210	>2400	5000
20	Faecal coliform	MPN/100ml	10	920	N.S

NS: Not Specified, ND: Not Detectable
SW1: Ghazipur Drain
SW2: Hindon Cut

Above table indicates that Total Dissolved Solids (TDS) in groundwater samples exceeds the desired limit as per IS: 10500 at 6 locations (Project site, Parthala, Khora, Pasaunda, Raipurakhader and Kethwara), Total Hardness exceeds the desired limit for drinking water as per IS-10500 at 5 locations (Project site, Parthala, Arthala, Pasaunda and Raipurakhader)

Chloride exceeds the desired limit at 4 locations (Project site, Pasaunda, Raipurakhader and Kethwara) while calcium exceeds the desired limit at 5 locations (Kinauni, Parthala, Khora, Raipurakhader and Kethwara)

Surface water sample from Ghazipur drain and Hindon cut shows presence of total Coliform and faecal Coliform. Presence of coliform bacteria in water is an indication of organic contamination. This water sample was compared against CPCB standards for Class 'C' Water i.e. water to be used for drinking purpose after conventional treatment followed by disinfection. Surface water quality results indicate that DO level of the water samples is good (4.1 mg/l & 3.8 mg/l in comparison to minimum 4 mg/l) whereas BOD level is very high (43 mg/l and 46

mg/l in comparison to maximum 3 mg/l) than the prescribed standards. Both these sample show organic contamination, hence are not fit for drinking even after conventional treatment and disinfection.

4.7 LAND ENVIRONMENT

4.7.1 GEOLOGY OF THE AREA

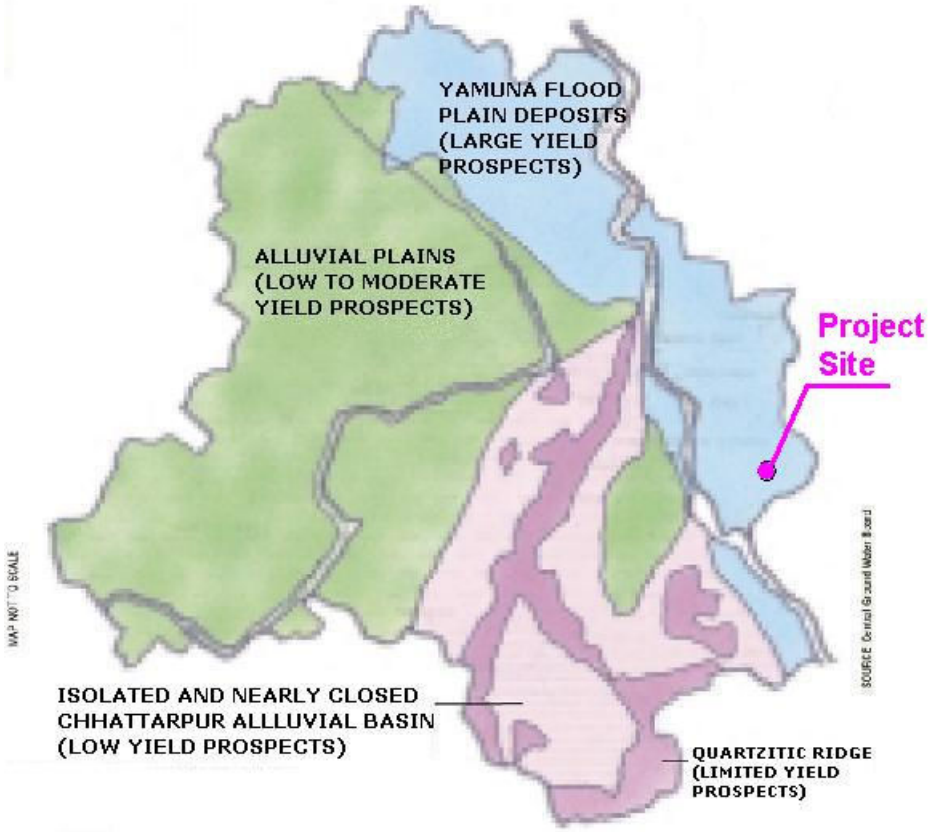
The area around the project site is occupied by older alluvium of Pleistocene age. The stratigraphy of Delhi region rock formation is presented in the **Table 4.14**.

TABLE 4.14: STRATIGRAPHIC SUCCESSION OF DELHI

Period	Formation	Description
Quaternary	Newer Alluvium	Unconsolidated interbedded lenses of sand, silts, gravel and clay confined to the flood plains of Yamuna river
	Older Alluvium	Unconsolidated interbedded, inter –fingering deposit sand clay and kankar. Moderately sorted Thickness variable at places more than 300 m
Pre Cambrian	Alwar quartzite	Well stratified, thick bedded brown to buff colored, hard and compact intruded locally by pegmatite and quartz veins interbeded with mica schist

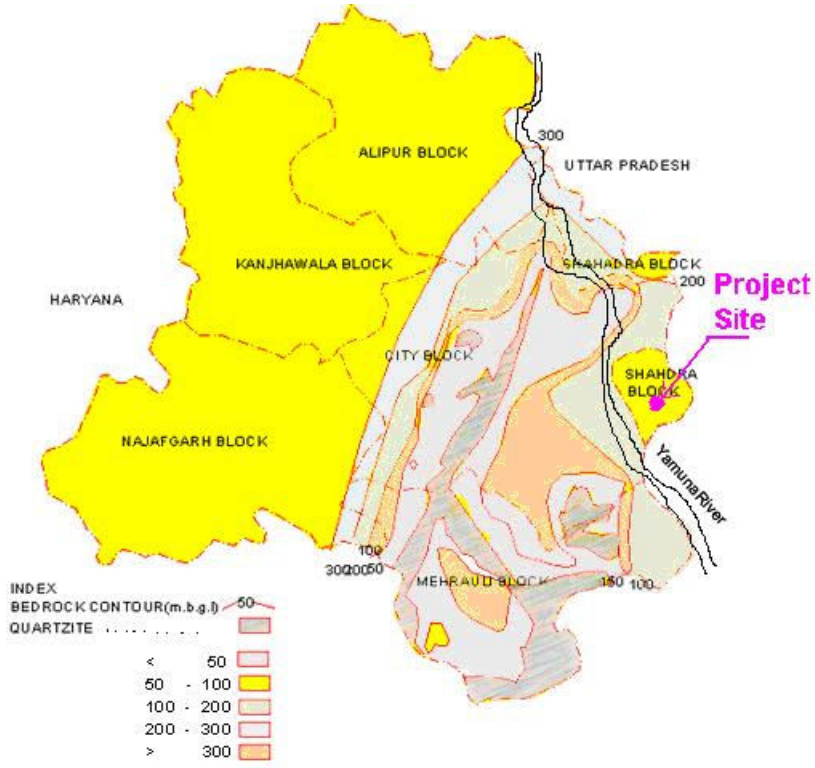
The proposed site is a part of Alluvial plain on eastern sides of the Delhi ridge, which is the northernmost extension of Aravalli Mountain consisting of quartzite rocks and extends from southern part of the territory to the western bank of Yamuna for about 35 km. The alluvial deposits of Quarternary age mainly composed of unconsolidated clay, silt, sand with varying proportions of gravel and kankar. The general geological feature of the Delhi region is shown in **Figure 4.12**.

FIGURE 4.12: GEOLOGICAL MAP OF THE AREA SHOWING THE PROJECT SITE



Lithological studies conducted by Central Ground Water Authority (CGWA) indicate that the alluvial deposit in this region belongs to older alluvium and comprises of sediments deposited as a result of past cycles of sedimentation of pliestocene age. This is comprised of inner bed lenticular, and interfingering deposits of clay, silt and sand ranging in size from very fine to very coarse with occasional gravels. The older alluvium around the site is predominantly clayey in nature with silt and Kankar. The exploratory borehole data exhibits that the depth of bedrock in this region is less than 50 m, which is generally sandy in nature. The bed rock contour of the Delhi is represented in **Figure 4.13**.

FIGURE 4.13: BED ROCK CONTOURS OF DELHI SHOWING THE PROJECT SITE



Source: Central Ground Water Board

4.7.2 SEISMO-TECTONIC APPRAISAL OF THE AREA

Project area is located in Zone IV of the Bureau of Indian Standards (BIS) 2000, seismic zone map for India (**refer Figure 4.14**). Zone IV is defined as having a maximum expected intensity of around MSK VIII. This zone is second in severity to zone V (the highest). Zone IV is also referred to as the *High Damage Risk Zone*.

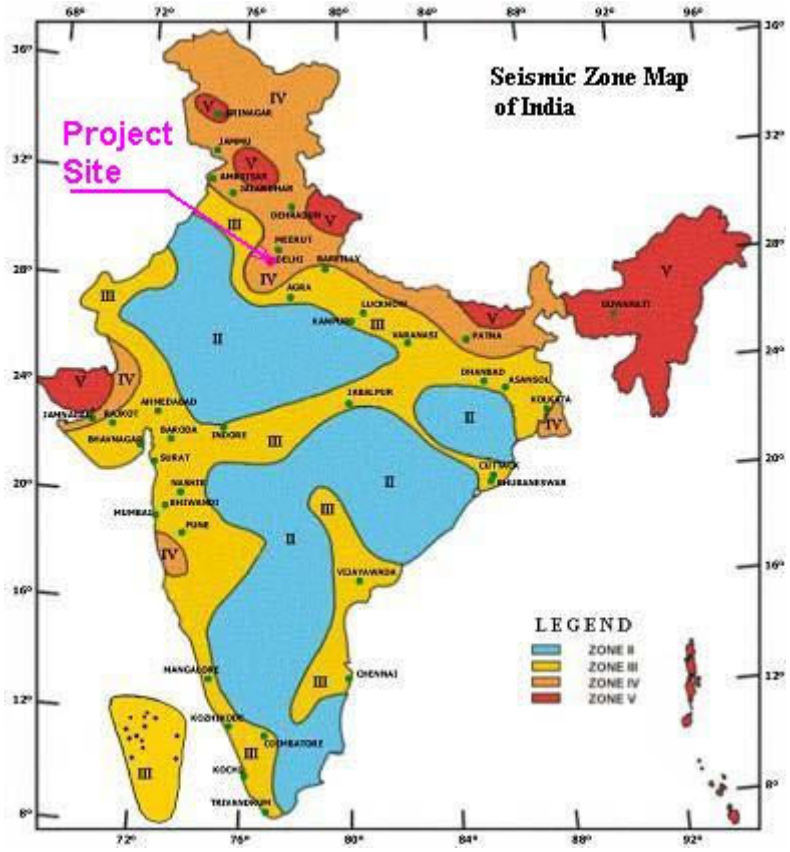
Earthquakes are highly probable in this area and are primarily attributed to plate tectonics and fault rupture induced by continuing drift of Indian plate towards the Asian plate. The earthquake history of Delhi region indicates fairly high seismicity. The most active area of the region is considered to be the trijunction of the Delhi-Haridwar ridge, Lahore-Delhi ridge and axis of Delhi folding[1].

Numerous faults, fractures and shears, the trends, which varied from NNE-SSW to ENE-WSW, dissect the area. The important faults west of the ridge area are Rajendra Nagar Fault, MES- Depot –East Patel Nagar Fault, Anand Parbat West Patel Nagar fault and Inderpuri fault. The notable faults east of the ridge are Kishan garh fault, a WNW-ESE trending fault

[1] Source: GIS development .net; Subsurface map of Delhi; Y. Pandey and R. Dharmaraju

between Qutab Minar and Mehrauli and Lado Sarai fault. The tectonic elements of the area are considered capable of generating an earthquake of magnitude 7 on Richter scale1

FIGURE 4.14: SEISMOLOGICAL MAP OF INDIA SHOWING THE PROJECT SITE

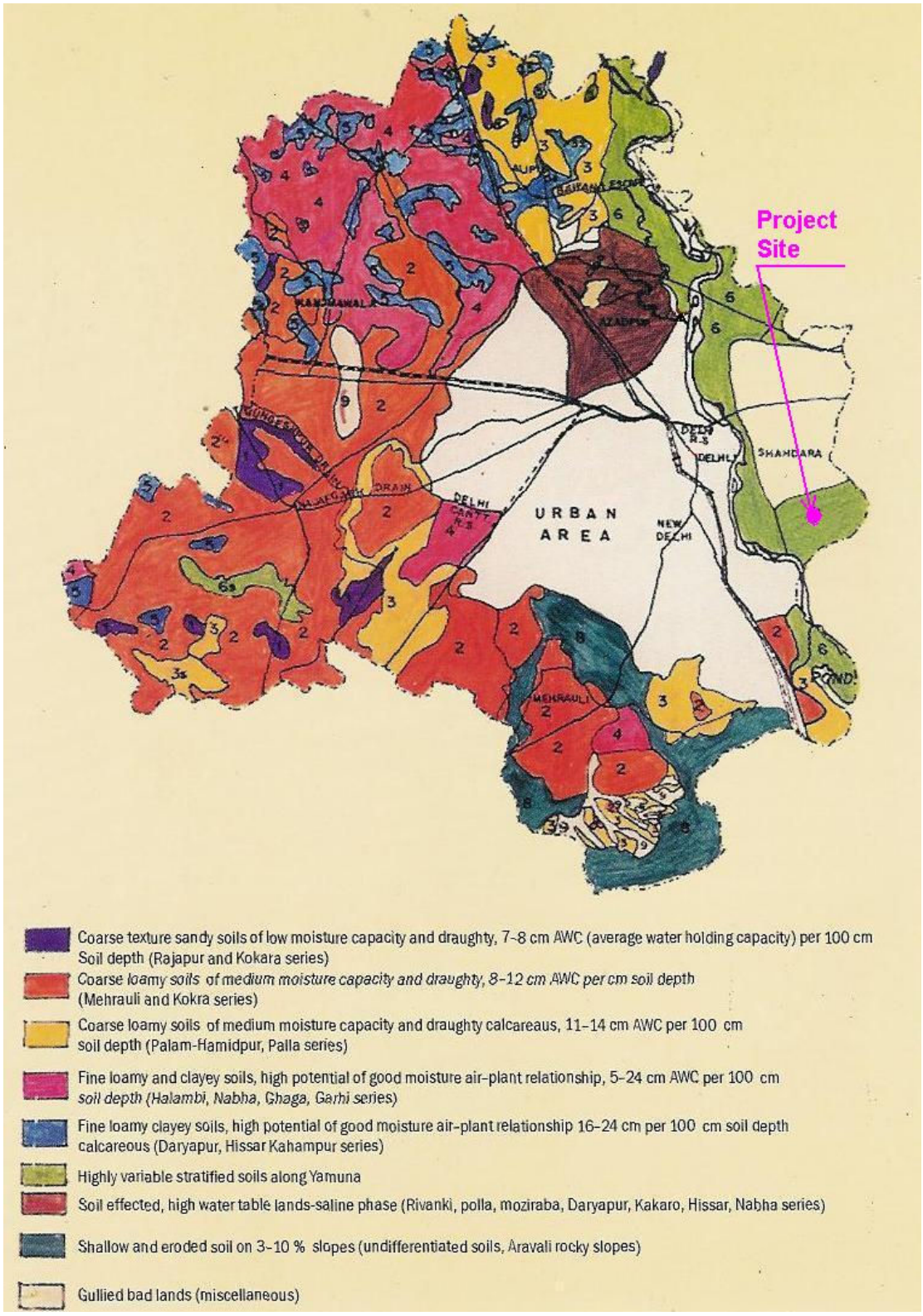


4.7.3 SOIL

Physiography of the project area within 10 km radius consists of alluvium soil extending into the Yamuna flood Plain. Majority of the areas is covered by fine to coarse loamy soils with different levels of moisture retention capacity. The soils of the project area are mostly light with subordinate amount of medium texture soils. The light texture soils are represented by sandy, loamy, sand and sandy loam; whereas medium texture soils are represented by loam silty loam.

Highly variable stratified soils in the study area and are depicted in the **Figure 4.15**.

FIGURE 4.15: SOIL DETAILS OF DELHI SHOWING THE PROJECT SITE



Source: NEERI, 1995

Soil sampling was done to further establish the baseline characteristics and to assess the anticipated impacts due to proposed project. Soil samples from project site were collected using auger from a depth of 60 cm. Details of the soil sampling location is shown in **Table 4.15**.

TABLE 4.15: SOIL SAMPLING LOCATION

Station Code	Sampling location	Distance from proposed site
SQ1	Project Site	-

A quantitative assessment of the particle size distribution in the soil was made by wet sieve analysis and sedimentation analysis using hydrometer, as per procedures laid down in IS: 2720 Part IV. The particle sizes were designated according to the scale given in IS: 1498, which is given in **Table 4.16**.

TABLE 4.16: PARTICLE SIZE DISTRIBUTION

SN	Soil Type		Particle Size Range	Percentage composition (%)
1	Gravel		4.75 – 20 mm	3.78
2	Sand	Coarse	2.0 – 4.75 mm	2.21
		Medium	0.425 – 2.0 mm	4.97
		Fine	0.075 – 0.425 mm	61.25
3	Slit & clay		Less than 0.075 mm	5.93

Based on the particle size distribution obtained from the soil analysis, the texture of soil at the project site is sandy silt. The physical and chemical characteristics of the soil samples collected are shown in **Table 4.17**.

TABLE 4.17: SOIL CHARACTERISTIC IN THE STUDY AREA

SN	Parameters	Unit	SQ1
1	pH	-	7.82
2	Texture	-	Sandy silt
3	Electrical Conductivity	μsiemens/cm	244
4	Cation Exchange Capacity	meq /100 gm	12.14
5.	Potassium as K	meq/100gm	0.315
6	Sodium Absorption Ratio	-	0.70
7	Permeability	cm/sec	0.06
8	Porosity	-	0.99

SN	Parameters	Unit	SQ1
9	Water Holding Capacity (%)	%	46
10	Phosphorous	mg/kg	0.450
11	Copper	g/kg	ND
12	Zinc	g/kg	0.0129
13	Particle size distribution		
	Mesh size	**Mesh**	
	1.68 mm	+10	47.0121
	841 micron	+20	1.3548
	500 micron	+30	4.9101
	354 micron	40	0.7599
	250 micron	+60	14.1695
	149 micron	+100	10.3751
	105 micron	+150	8.3933
	74 micron	+200	4.7390
	53 micron	+300	7.2038
	37 micron	400	-

The result shows that the moisture retention capacity of the soil is 46 %, which is good. Soil of the area is slightly basic with a pH of 7.82. Most crops grow best if the soil pH is in between 6.0-7.5.

Positively charged ions known as cations include nutrients such as ammonium, calcium, magnesium, potassium, and sodium. These are attracted to negatively charged soil particles. The measure of the soil's ability to hold cations is the Cation Exchange Capacity (CEC). The greater the CEC of a particular soil, the greater is the soil's ability to retain nutrients and the more fertile the soil is. The addition of biosolids can improve a soil's CEC value because biosolids are high in organic matter. Organic matter contributes to high CEC values. The CEC analysis of the soil sample is 12.14 meq /100 gm, which is low and it, can be concluded that the soil is sandy.

The Sodium Absorption Ratio (SAR) measures the relative proportion of sodium ions in a water sample to those of calcium and magnesium. The SAR is used to predict the sodium hazard of high carbonate waters especially if they contain no residual alkali. High concentration of sodium disperses soil colloidal particles, rendering the soil hard and resistant to water penetration. The potential of sodium hazards increases in soil with higher SAR values. The analysis of the sample shows SAR for the soil sample is 0.70.

The permeability of a soil is a measure of the soils hydraulic conductivity or the ease that water will pass through the soil when exposed to a pressure gradient. It determines the rate at which water will migrate through an aquifer towards wellheads. The analysis of the sample shows that permeability of the soil is 0.06.

4.8 ECOLOGICAL ENVIRONMENT

The ecological survey has been done to establish the baseline ecological conditions of the study area (area within 10 Km radius of the project site), to assess the potential ecological impacts of the proposed project on ecology, to develop adequate and feasible mitigation measures (via inputs to project design and layout, working practices, or compensate where appropriate) to keep residual ecological impacts within acceptable limits, and also to develop ecological monitoring parameters. This section of report presents ecological baseline of the area.

4.8.1 HABITAT ASSESSMENT

The term "habitat" has been used in broad sense for the general land cover and physiognomy rather than *sensu stricto* for a particular species. The information on prevailing baseline in proposed project site is important because project activities might lead to loss of the ecological resources, if existing. The information will further enable to evaluate the feasibility and efficacy of the mitigation options that are being proposed by environmentalist and conservationist to incorporate conservation concerns in mitigating the impacts of developmental project.

As far as the ecological sensitive receptors are concerned (within 15 km radius from the proposed site), the Reserved Forests near Civil lines which fall under the Northern Ridge lies at a distance of 13 km and Budh Jayanti Park R.F which fall under Central Ridge lies at a distance of 14 km from the proposed project site. The Protected Forest near Madangir area is located at a distance of 14 km from the proposed project site. Busy network of roads, heavy traffic, human settlements and large-scale commercial activities (dairy farms/slaughter houses) are the features around the site. Water bodies such as Yamuna, Hindon rivers and Hindon Cut are the three permanent water bodies flowing at 5.5 km, 6.9 km and 0.1 km from the proposed project site respectively.

The project site does not fall within an existing or proposed ecological sensitive zone known for providing habitat and movement corridors for either endangered or non-endangered animal species. No threatened or endangered plant or animal species are known to exist in and around the site.

4.8.1.1 TERRESTRIAL ECOLOGY

a) FLORAL PROFILE

Delhi falls under the biogeographic province 4A- Semi arid Punjab plains. During the survey, the existing landscape and land use pattern was found as un-favorable to support any significant flora or vegetation type and faunal species to sustain. The vegetation compositions in the above mentioned forest areas (Budh Jayanti Park R.F, Madangir and Garhi Mendhu PFs) are usually represented by common tree species such as *Prosopis juliflora, Acacia nilotica, Prosopis cineraria*, *Salvadora persica*, *Carissa carandas*, *Tectona grandis, Dalbergia sissoo, Ficus infectoria, Eucalyptus spp., Azadirachta indica, Butea monosperma, Pongamia pinnata, Tamarindus indica, Pongamia glabra, Terminalia arjuna etc*. The under storey is usually covered by shrubs/herbs such as *Calotropis procera, Zizyphus nummularia, Datura metel, Ipomoea carnea, Croton achnocarpus, Cassia occidentalis;* grass/sedges namely *Elausine indica, Digitaria decumbens, Cyperus bulbosus* and climbers like *Dioscorea* spp and *Cuscuta reflexa*.

During floristic survey within the proposed project site, a total of 34 floral species were collected during the field survey, Out of these 12 were tree species, 12 herbs, one shrub and 7 grass/sedges and 2 climbers. Common afforested tree species such as *Azadirachta indica, Melia azaderach, Pongamia pinnata, Parkinsonia aculeata*, *Leucaena leucocephala,* were recorded around in the study area. Besides, the ground storey was represented by herbs and shrubs like *Datura metel, Ipomoea carnea, Cassia occidentalis, Jatropha gossypifolia, Calotropis procera, Abuliton indica, Aerva sp, Chenopodium sp, Sida acuta, Solanum indicum, Solanum xanthocarpum, Amaranthus caudatus, Cyperus bulbosus, Cynodon dactylon* and *Phalis minor* etc. No threatened, endangered and endemic flora found or reported to occur in or near to the proposed site.

Phytosociological data revealed that *Cannabis sativa, Cyperus sp, Digitaria decumbens, Elausine indica* had the highest frequency followed by *Croton achnocarpus, Ahyranthes aspera, Urena lobata, Cleome gynanndra* and *Chenopodium sp* etc.

(b) FAUNAL PROFILE

(i) Mammal

Small mammalian species such as mongoose and palm squirrel were recorded from the site premises. No other wild animal was sighted or any indirect evidence was collected / found about their presence in and around the proposed site.

(ii) Avifauna

During a walk through survey and observation, breeding and nesting habitat of bird species were mainly studied. A few common bird species were recorded during the survey from the study area. These include house sparrow (*Passer domesticus*), house crow (*Corvus splendens*), Pariah kite *(Milvus migrans govinda*), Black drongo (*Dicrurus adsimilis*), Babbler (*Turdoides caudatus*), Pied wagtail (*Motacilla alba*), Common myna (*Acridotheres tristis*) etc. The pariah kites were found in large numbers because of the existing landfill site. No endangered, threatened or rare bird species were recorded from the study area.

(iii) Butterflies

A few butterfly species were recorded during the survey and these include Psyche (*Leptosia nina nina*), Plain tiger (*Danaus chrysippus*), tawny coster (*Acraea violae)*, Yellow grass (*Eurema hecabe)*, Common crow (*Euploea core)*

(iv) Reptiles

Two species of reptiles' viz., garden lizard (*Calotes sp*.) and skink (*Scincilla sp*.) were recorded in the project site during the survey. No snake was encountered or indirect evidences were found about their presence in and around the project site.

4.8.1.2 AQUATIC ECOLOGY

Yamuna and Hindon rivers and Hindon cut are the three permanent water bodies flowing at 5.5 km, 6.9 km and 0.1 km from the proposed project site respectively. All the water bodies are considered to be highly polluted due to the existing anthropogenic pressure. In the past, the river was used as drinking water and for irrigation purpose. Now the water bodies are converted into city sewers. As far as ecological resources are concerned, all the water bodies are found to be insignificant.

4.9 SOCIO ECONOMIC ENVIRONMENT

This section discusses the baseline scenario of the socio-economic environment in the study area and the anticipated impacts of the proposed project on the socio-economic environment. The issues under focus in this section are demographic structure, economic activity, education, and literacy profile and infrastructure resources. The assessment attempts to predict and evaluate the anticipated impacts of project on people, their physical and psychological health and well being, their economic facilities, cultural heritage, lifestyle and other value system.

4.9.1 IMPACT ZONE

The study area for socio economic assessment was defined as an area within 10 km radius around the proposed project site as per the statutory requirement of the Ministry of Environment & Forest. Designation of impact zone is based on the EIA guidelines considering the size and operation of the project. The baseline study focuses on East zone {Ward 218-Mandawali [Gazipur Dairy] and Ward 227-IP Extension [Gazipur Village] of Delhi. The complete area falls under Municipal Corporation of Delhi (MCD).

4.9.2 DEMOGRAPHIC STRUCTURE

The baseline data for the population of the surrounding area is significant for the study as it enables to predict the population which may be affected by the project. It also enables us to appreciate the scenario emerging due to the increase in population and the impacts arising due to the interface with the various project activities.

Based on 1991 and 2001 census, decadal percentage increase of population in East Zone is 43.05% and for Delhi is 46.31%. **Table 4.18** shows the decadal growth of population.

TABLE 4.18: DECADAL GROWTH OF POPULATION

Study Area	1991	2001	2011
East Delhi	1023078	1463583	1904088
Delhi	9420644	13850507	18280370

The total area of NCT of Delhi is 1483 sq. km. As per population census 2001, the area of NCT of Delhi has remained the same. However, its rural-urban composition has undergone change. According to provisional results released by directorate of census operations, Delhi, rural-urban break-up of N.C.T. of Delhi is given below:

- As per population census 1991, its rural and urban composition is given below:

Rural area: 797.66 sq. Km
Urban area: 685.34 sq. Km

- As per population census 2001, its rural and urban composition is given below:

Rural area: 591.91 sq. Kms.
Urban area: 891.09 sq. Kms.

The wards within the districts (east zone) are scattered at a distance of 1.5 to 10 km from the proposed site.

TABLE 4.19: AREA, HOUSEHOLDS & POPULATION

Study Area	Area in sq. km	Number of households	Population 2001	Population 1991
East Delhi	64.65	287638	1463583	1023078
Delhi	1483	2733383	13850507	9420644

Source: Census of India, (1991 and 2001)

Density of population is one of the important indicators to study population concentration and it is defined as number of persons living in per square kilometer. According to census 2001, the density of population for Delhi has worked out at 9339 persons per sq. km as against 6352 persons in 1991 as shown in **Table 4.20**

TABLE 4.20: DENSITY OF POPULATION

Study Area	2001	1991
East Delhi	22637	15986
Delhi	9339	6352

Source: Census of India, (1991 and 2001)

Sex ratio is a very important demographic indicator to study socio economic characteristics of population. National average of sex ratio (number of females against 1000 males) is 933 in 2001.

The sex ratio for east zone of Delhi is 843, as against the state average of 822. The low sex ratio for the area can be attributed to large-scale migration of males to Delhi in search of work. Estimated percentage of migration in Delhi was 50.42 % in 2000 whereas percentage of natural growth in 2000 was 49.58%. The percentage of scheduled caste (SCs) population is 7% and no scheduled tribes (STs) are found to inhabit the study area.

TABLE 4.21: POPULATION – MALE, FEMALE AND SEX RATIO

Study Area	Total population 2001	Male population	Female population	Total SC	Total ST	Sex ratio [no. of females against 1000 males]
East Delhi	1463583	794074	669509	238984	0	843
Delhi	13850507	7607234	6243273	2154877	0	822

Source: Census of India, (2001)

4.9.3 ECONOMIC ACTIVITY AND LIVELIHOOD PATTERN

The relevance of economic activity and livelihood pattern is important in the context of the study. One of the most likely direct benefits of the proposed project is creation of various job opportunities during construction and operation phase. Depending on existing situation, the nature of workforce; skill sets and resources available in the zones/wards, one can predict the likely impacts of the project activities, i.e. the economic opportunity created by the proposed project on the livelihood pattern and the general benefits to the whole community.

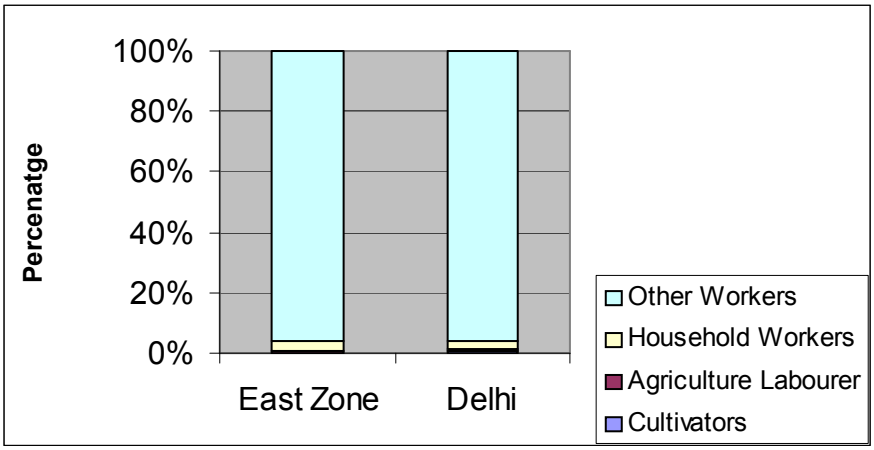
Insignificant population of female work force is found in the zones. In all the zones maximum number of people are found to be engaged as "other workers" in economic activity like Government/Private service, teachers, factory workers, those engaged in trade, commerce, business, transport, banking, construction, political or social work, priests, entertainment artists, etc. negligible population is involved in agricultural activities.

As seen in **Table 4.22** and **Figure 4.17**, other workers are found to be highest. Refer (**Appendix IV, Table 2**) for break up of each activity.

TABLE 4.22: EMPLOYMENT PATTERN OF THE STUDY AREA

Study Area	Cultivators	Agriculture Laborer	Household Workers	Other Workers
East Zone	1116	692	15978	457524
Delhi	37431	15773	140032	4351998

FIGURE 4.16: EMPLOYMENT PATTERN



4.9.4 EDUCATION AND LITERACY PROFILE

An understanding of education and literacy profile in the region is relevant in order to understand whether jobs created due to the proposed project could tap on the existing pool of human resource in the area. Study area literacy rate is tabulated in **Table 4.23**

Literacy rate for east zone is 84.9% as against the literacy rate of Delhi at 81.7% in census 2001. Delhi is equipped with adequate government, private schools and also institutions for higher education.

TABLE 4.23: DISTRICT WISE EDUCATION FACILITY & LITERACY RATE

Study Area	Male	Female	Literacy rate (%)
Delhi	5700847	3963917	81.7
East Delhi	613061	455078	84.9

Source: census of India, (1991 and 2001)

4.9.5 PRIMARY SURVEY OF LOCAL COMMUNITY

Primary survey was conducted based on scientifically designed questionnaires covering various socio-economic attributes so as to know the baseline condition and assess the impact due to proposed project. The subsequent section discusses the socio-economic status of the residents based on the primary survey.

4.9.5.1 PRIMARY SURVEY

A. East Delhi

East Delhi is located on the other side of river Yamuna or in the trans-Yamuna area. It is bounded by the border of Uttar Pradesh comprising of Noida and Ghaziabad. It has an average elevation of 204 meters above sea level. It falls on the east of national capital territory of Delhi at 28° 37' north latitude and 77° 19' east longitude. Total population of the East Delhi district is 1463583 as per 2001 census. Delhi shares its borders with Haryana, Rajasthan, Uttar Pradesh and Punjab, which influence the life-styles and language of the people. Migrations from various parts of India have led to pockets of diverse culture coming together in various parts of Delhi - including East-Delhi. For example, Mayur Vihar phase-III has a concentration of South Indians**,** while Mayur Vihar phase-I and Mayur Vihar phase-II have a concentration of Bengalis as well as Christians**.** Old-Seelampur in Gandhi Nagar sub-division has a high concentration of Muslims. Almost 80% of the residents of Geeta Colony

in Gandhi Nagar sub-division are Sikhs & Punjabis**.** The amalgamation of various cultures, traditions, and religions has painted East-Delhi in colour, which is brought from all over India.

This part of Delhi is located on the eastern bank of the mighty river Yamuna and is also commonly referred to as "Trans Yamuna". It is well connected to the rest of Delhi through a network of bridges. It is one the most densely populated areas of Delhi. It has some of the busiest commercial areas like Vikas Marg, Gandhi Nagar, Laxmi Nagar, Preet Vihar and Shahadra**.** It borders the industrial township of Ghaziabad in Uttar Pradesh.

The district of East Delhi falls under the 04-east Delhi parliamentary constituency**.** There are 20 assembly constituencies in 04-east Delhi parliamentary constituency, out of which 8 falls under the district of east Delhi and the rest 12 falls under the district of northeast Delhi.

Ghazipur Village

Ghazipur village is located in east Delhi. The village comes under ward 227 of IP Extension. A ward in Delhi is divided with roughly 50000-60000 population. This area is densely populated due to tenants from U.P and Bihar who are staying together in groups and working in Industrial areas of Noida, East Delhi and Okhla.

The health care facilities in the area are inadequate. The village is not equipped with any government dispensary and nearest one is at Karkardooma, Vikas marg extension. For advanced facilities residents visits Dr Hedgewar Hospital in Karkardooma and Lal Bahadur Shastri Hospital in Kichripur.

Water is available through Delhi Jal Board and is available almost 24 hours. There are hand pumps also installed in the colony to supplement the water requirement. Electricity is available for 22 to 24 hours. Sanitation is poor with open drains normally lying clogged and waste is also littered in corners of the streets and on roads.

The area is equipped with a primary school and a senior secondary school. For higher education students prefer to go to colleges in Sahadra, Mayur Vihar and other institutes in East Delhi, Ghaziabad and Noida. Even though formal education has become quite common, dropouts at different stages continues due to common belief that why to go for higher education when other avenues for income and employment are available in factories, Dairy Farm, shops, etc. Without adequate education, the possibility of white-collar jobs remains a distant reality for most, boys and girls

Ghazipur Dairy Farm

Gazipur Dairy Farm is located in east Delhi adjoining to NH-24 and Hindon cut with Asia's biggest Fish and Poultry market. This area comes under ward no 218; Mandawali. This area also consists of dairy farms, which were relocated from all over Delhi. There are DDA Janta flats in which a mix of population from all over India resides.

The health care facilities are inadequate within the area. For health problems people visit nearby govt. hospitals like Lal Bahadur Shastri Hospital. There is one veterinary hospital. The colony has a primary school and for higher education students go to Kalyanpuri, Vindopuri and IP Extension schools. Water is available through Delhi Jal Board but the residents face acute shortage. Electricity is available for 20-22 hours. Sanitation is poor with open drains normally lying clogged and all the waste from dairies flowing into common drains.

4.9.6 PERCEPTION OF THEPROJECT BY THE COMMUNITY

Consultations were held in the study area to determine the perception and concerns of the locals with regard to the proposed Waste-Processing complex. The locals were of the general view that proposed project would be benefiting them as well as residents of adjoining colonies and East Delhi in following ways:

- Development of project is likely to create additional new jobs during construction and operation phase.
- Development of project will improve overall environmental conditions of the vicinity which includes border areas of Noida and Ghaziabad.
- Approach roads, street lighting and other infrastructure will improve.

5.0 ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

This chapter focuses on identification of pollution sources due to the proposed project activity. The pollutants generated during operation phase will be assessed and quantified to estimate the level of impact and thus formulate environment management measures to mitigate theses impacts.

Chapter 4 provided the information on the baseline environmental conditions at the project site for various parameters. This chapter discusses the various pollution loads and stressors that could impact the environment and the incremental environmental impacts on the environmental parameters during the operation phase of the project.

5.1 IMPACT IDENTIFICATION

The potential impacts arising due to construction and operational activities of proposed facility have been identified in **Table 5.1**.

TABLE 5.1: IDENTIFICATION OF IMPACTS DURING CONSTRUCTION AND OPERATION PHASE

SN	Components	Aspect	Potential Impact
CONSTRUCTION PHASE			
1.	Ambient Air Quality	Dust emissions from site preparation, excavation, material handling and other construction activities at site.	Minor negative impact inside plant premises. No negative impact outside plant site. Short term
2.	Noise	Noise generation from construction activities, construction equipment and vehicular movement	Minor negative impact near noise generation sources inside premises. No significant impact on ambient noise levels at sensitive receptors. Short term
3.	Water quality	Surface runoff from project site Oil/fuel and waste spills. Improper debris disposal	No significant negative impact. However hazardous chemicals should be handled properly Short term
4	Landuse and Aesthetics	Land development	Positive impact. Currently most of the land is used for dumping of waste. Development of integrated plant will increase the aesthetics of the area.
5	Topography and Geology	Site development	No Significant Impacts
6.	Soils	Construction activity leading to topsoil removal and erosion.	No impact as plant site is currently being used for dumping of waste. Soil of the area is already degraded.
7.	Ecology Flora and Fauna	Habitat disturbance during construction activity	No impact as the area is devoid of any vegetation.

SN	Components	Aspect	Potential Impact
8.	Socio-economy	Increased job opportunity for locals	Overall positive impact
9.	Traffic Pattern	Haul Truck/construction vehicle movement	Minor negative impact
OPERATIONAL PHASE			
1.	Ambient Air Quality	Particulate emissions from RDF plant, Boiler, material handling.	Minor negative impact
2.	Noise	Noise from plant operation and vehicular movement	Minor negative impact
3.	Water Quality	Oil/fuel and waste spills. Wastewater from plant processes Discharge of waste water and contaminated storm water from site	No significant adverse impact as storm water and other waste water generated from the plant site will be treated and then disposed.
4.	Water usage	Use of ~ 500 m^3/day of treated water from Kondli STP.	No negative impact
5	Soils	Storage of solid wastes Fuel and material spills	No negative impact
6.	Ecology Flora and Fauna	Land use change	No negative impact
7.	Traffic Pattern	Slight increase in traffic on NH-24 (Hapur Bypass)	No negative impact due to proposed plant as increase in traffic is insignificant in comparison to the vehicles currently plying on the NH-24

5.2 IMPACT EVALUATION

Prediction of environmental impacts is the most important component in the impact assessment study as it provides quantitative information related to projection of impacts from the proposed project based on the estimated pollution loads during the operation phase of the plant. Several mathematical/statistical techniques and methodologies are available for predicting impacts due to proposed project on physico-chemical, ecological and socio-economic components of environment. The results obtained from the predictions will be superimposed over the baseline status (pre-project) of environmental quality to derive the ultimate (post-project) scenario of environmental quality status in the impact zone around the plant site. The quantitative impacts derived from predictions are also essential to delineate pragmatic environmental management plan, especially pollution mitigation measures for implementation in detailed engineering stage and thus during operation phases of the proposed project for minimizing the adverse impacts on the surrounding environment.

5.3 IMPACTS ON AIR ENVIRONMENT

Prediction of air environmental impacts is the most important component in the impact assessment study as it provides quantitative information related to projection of impacts from the proposed project based on the estimated pollution loads during the operation phase of the plant. Several mathematical/statistical techniques and methodologies are available for predicting impacts due to proposed project. The impact on the air environment for the proposed project has been carried out using U.S. EPA approved model and is discussed in subsequent sections. The results obtained from the predictions have been superimposed over the baseline status (pre-project) of environmental quality to derive the ultimate (post-project) scenario of environmental quality status in the impact zone around the plant site. The quantitative impacts derived from predictions are also essential to delineate pragmatic environmental management plan, especially pollution mitigation measures for implementation in detailed engineering stage and thus during operation phases of the proposed project for minimizing the adverse impacts on the surrounding environment.

5.3.1 AIR EMISSIONS & NOISE

Air emissions have no boundaries and can migrate from one place to another place depending upon the wind direction and speed. The sources of air emission can be grouped into three categories of point, area and line sources:

- A pollutant source that can be treated in a dispersion model as though pollutants were emitted from a single point that is fixed in space. Example: the mouth of a smoke stack.

- An array of pollutant sources, so widely dispersed and uniform in strength that they can be treated in a dispersion model as an aggregate pollutant release from a defined area at a uniform rate. Such sources may include vehicles and other small engines, small businesses and household activities, or biogenic sources, such as a forest, that release hydrocarbons.

- An array of pollutant sources along a defined path that can be treated in dispersion models as an aggregate uniform release of pollutants along a line. Example: the sum of emissions from individual cars traveling down a highway can be treated as a line source.

5.3.2 PREDICTED AIR EMISSIONS FROM THE SITE

The following section details the potential emissions from the construction/operational activities due to proposed project.

A) CONSTRUCTION PHASE

During the construction phase, SPM is expected to be the main pollutant associated with on-site roads (paved and unpaved), stockpiles and material handling. The proposed activities during construction phase would primarily involve development of site and construction of new plant.

During the construction phase, pollution emission sources shall be distributed throughout the project site and shall fall under the category of area source. The project area is flat, so extensive formation work is not expected during this phase. In addition, due to the confined nature of heavy construction activity during this limited period, tailpipe emissions from construction equipment are assumed to be negligible.

In the absence of information regarding the quantity and type of construction equipment to be deployed at any particular time, emission factors for construction activities were used for emissions estimates. Overall SPM emissions were estimated using the emission factor of 1.2 tons SPM/month of activity/acre as per AP-42 Section 13.2.3.3 (U.S.EPA, 1995). This emission factor is most useful for developing estimates of overall emissions from construction throughout a geographical area and most applicable to construction operations with medium activity level, moderate silt contents, and semiarid climate (U.S. EPA, 1995). The derivation of the factor assumes that construction activity occurs 30 days per month, making the above estimate somewhat conservatively high for total suspended particulate (U.S. EPA, 1995).

The total area of the site is approximately 5.278 acres. The entire site will not be simultaneously under heavy construction, with different sections of the site generating SPM in a progressive manner. Thus, it is conservatively assumed that the SPM emission would not be significantly high to warrant any impact prediction.

B) OPERATIONAL PHASE

During the operational phase, the major source of pollution will be boiler stack for which modeling exercise has been performed. The proposed project will not result in significant increase in traffic and vehicular activity on the NH-24 for transportation of waste to the project site. However it is estimated that about 300-325 additional trips would be made from the project for transportation of rejects to disposal sites.

The vehicular traffic generated due to the proposed project is negligible as compared to the total traffic on NH- 24 road, hence the contribution due to proposed project is negligible, Modeling therefore has not been done for the tailpipe emissions (i.e. CO, NO_x and SPM) for vehicles traveling along this road.

The stack inventory and pollutant emission limits are provided in **Table 5.2**.

TABLE 5.2: STACK INVENTORY & POLLUTANT EMISSION RATES

Source	Description	Source Data					Emission Data	
		Stack Gas Flow Rate (Nm^3/s)	Stack Gas Velocity (m/s)	Stack Gas Temperature (degree C)	Stack Diameter (m)	Stack Height above ground (m)	Pollutants	Emission Limit
PS	Boiler Stack	57 m^3/s	15 m/s	150°C	2.2 m	65 m	SPM	50 mg/Nm^3
							SO_2	100 mg/Nm^3
							NO_x	200 mg/Nm^3

5.3.3 AIR QUALITY IMPACT PREDICTION

For air quality impact assessment, the air emission sources were examined for proposed project. The air impact assessment was performed with the help of USEPA approved atmospheric dispersion model and is discussed in subsequent sections.

AIR DISPERSION MODEL USED

Air dispersion modeling exercise can be used to predict atmospheric concentrations of pollutants at specific locations (receptors) over specific averaging times (i.e. annual, daily, and hourly). An atmospheric dispersion model accounts for the emissions from a source; estimates how high into the atmosphere they will go, how widely they will spread and how far they will travel based on temporal meteorological data; and outputs the pattern of concentrations that will occur for various exposure periods, thereby providing the exposure risks for different receptors.

The U.S. EPA Industrial Source Complex 3 (ISCST3) air dispersion model was used to predict ground level concentrations (GLCs) of the contaminants emitted from the point source at the Plant site.

In order to model contaminants the ISCST3 model required:

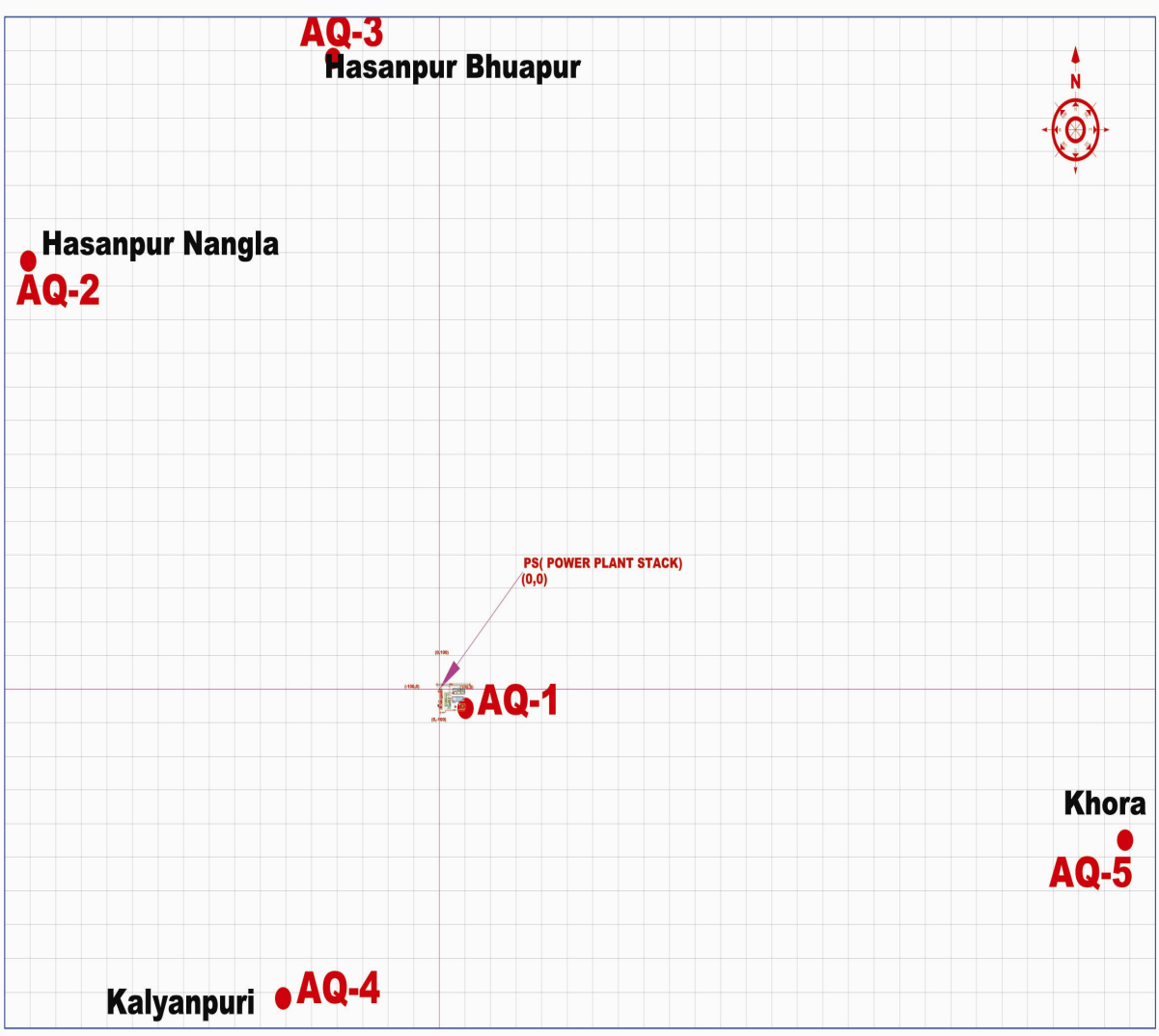
- Hourly meteorological data.
- The source description including emission rates of the various contaminants, type of source (i.e. area, and point), and source emissions characteristics
- The location of sources
- The receptor grid (i.e. the locations at which the model determines concentrations).

Predicted concentrations were calculated for the significant pollutants (SPM, SO_2 and NO_x) assessed in this study, over appropriate averaging time (24 hours) in accordance to the applicability of the NAAQS standard.

ESTIMATION OF GROUND LEVEL CONCENTRATIONS

The results of the air dispersion modeling exercises performed using ISCST3 are presented with respect to the maximum predicted concentration along with the predicted concentrations at five discrete receptors (AQ1 through AQ5, which represent the location on which background air quality was monitored) and the NAAQS standards. The spatial distributions of the pollutants released from the concerned source are also shown graphically to assess the air quality around the project site. The modeling grid and receptors (AQ1-AQ5) locations are shown in **Figure 5.1**.

FIGURE 5.1: MODELING GRID AND RECEPTORS LOCATION



Tables 5.3, 5.4 and 5.5 provide 24 hours average predicted concentrations of pollutants SPM, SO_2 and NO_x respectively. **Figures 5.2, 5.3 & 5.4** show 24 hours average spatial ground level concentrations distribution of SPM, SO_2 and NO_x pollutants respectively due to 24 hours continuous operation of power plant.

TABLE 5.3: SPM GROUND LEVEL AT DIFFERENT LOCATIONS (24 HOURS AVG. IN µg/m^3)

Concentration (µg/m^3)	Maximum 24 Hour GLC	AQ1	AQ2	AQ3	AQ4	AQ5
	(400, 600)	(102,-57)	(-1608, 1273)	(-416,1876)	(-611, -916)	(2681,-449)
SPM Contribution from Site	0.54	0.00	0.16	0.20	0.04	0.19
SPM Baseline (Maximum)	460	460	380	318	343	201
Total SPM	460.54	460.00	380.16	318.20	343.04	201.19
SPM Contribution from Site to Maximum SPM	0.12%	0.00%	0.04%	0.06%	0.01%	0.09%
NAAQS	**200 µg/m^3**					

The predicted SPM concentrations at all the discrete receptors are very low causing minimal increment in background SPM levels. However, the resultant maximum SPM concentration (460.54 µg/m^3) and the resultant concentrations at all the discrete receptors exceed the permissible limit. The high concentration is attributed to the high background level observed at these receptors. The predicted maximum contribution due to the proposed plant is only about 0.12% to the background concentration. The maximum 24 hours average predicted concentration of SPM is only 0.54 µg/m^3 due to proposed project and occurs outside the plant premises at location (400, 600) in the northwest direction from the power plant source location (0, 0).

FIGURE 5.2: PREDICTED 24 HOURS AVERAGE GLC (µg/m^3) OF SPM WITH NO CONTROL SET

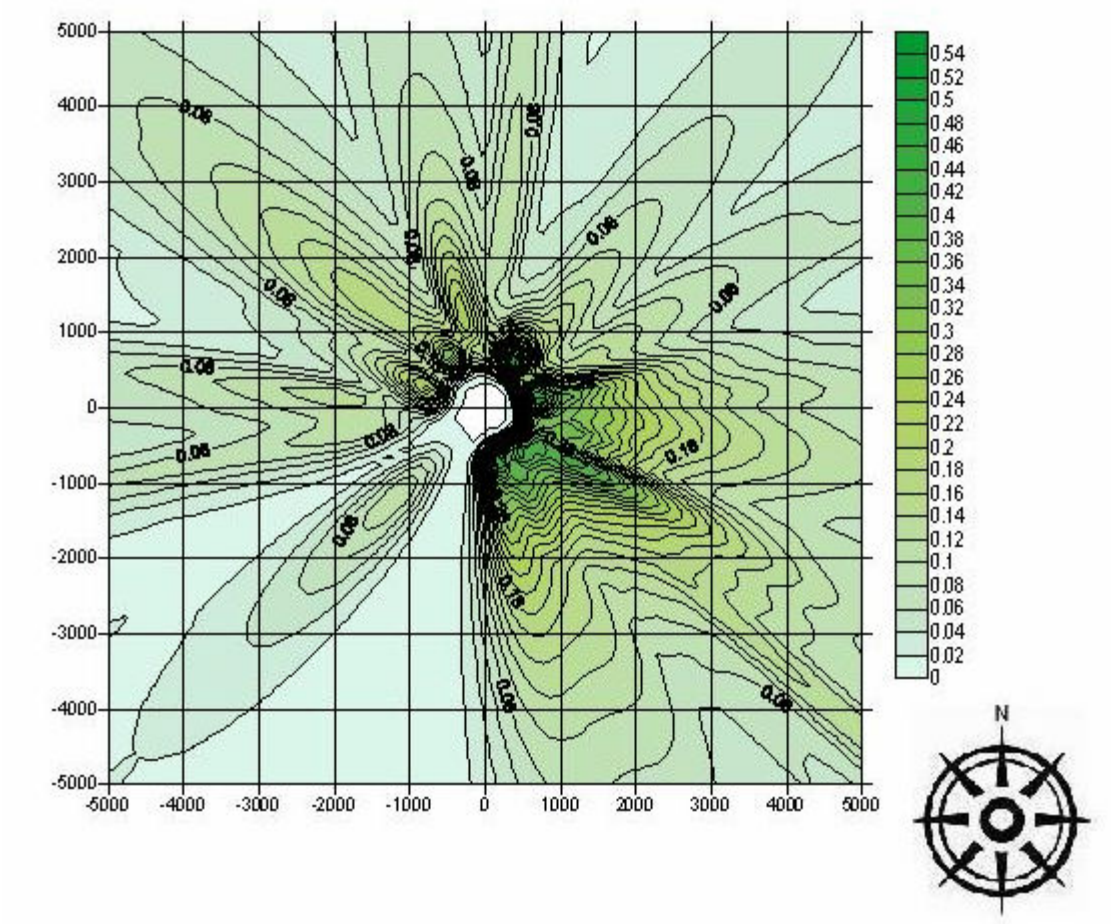


TABLE 5.4: SO2 GROUND LEVEL AT DIFFERENT LOCATIONS (24 HOURS AVERAGE IN µg/m^3)

Concentration (µg/m^3)	**Maximum 24 Hour GLC**	**AQ1**	**AQ2**	**AQ3**	**AQ4**	**AQ5**
	(400, 600)	**(102,-57)**	**(-1608, 1273)**	**(-416,1876)**	**(-611, -916)**	**(2681,-449)**
SO_2 Contribution from Site	1.04	0.00	0.31	0.39	0.07	0.11
SO_2 Baseline (Maximum)	21	21	18	12	18	15
Total SO_2	22.04	21.00	18.31	12.39	18.07	15.11
SO_2 Contribution from Site to Maximum SO_2	4.95%	0.00%	1.72%	3.25%	0.39%	0.73%
NAAQS	**80 µg/m^3**					

Based on the observed meteorological condition, the maximum 24 hours average predicted concentration of SO_2 is 1.04µg/m^3 and occurs outside the plant premises at location (400, 600) in the northeast direction from the project site. The contribution of maximum predicted concentration towards the background concentration is only about 5%. The resultant

maximum SO_2 concentration (22.04µg/m^3) is well within the prescribed limit. The predicted SO_2 concentration at all the discrete receptors (AQ1 to AQ5) is very low causing minimal increment in background SO_2 level. The resultant concentrations at these receptors are also well within the permissible limit.

FIGURE 5.3: PREDICTED 24 HOURS AVERAGE GLC (µg/m^3) OF SO_2 WITH NO CONTROL SET

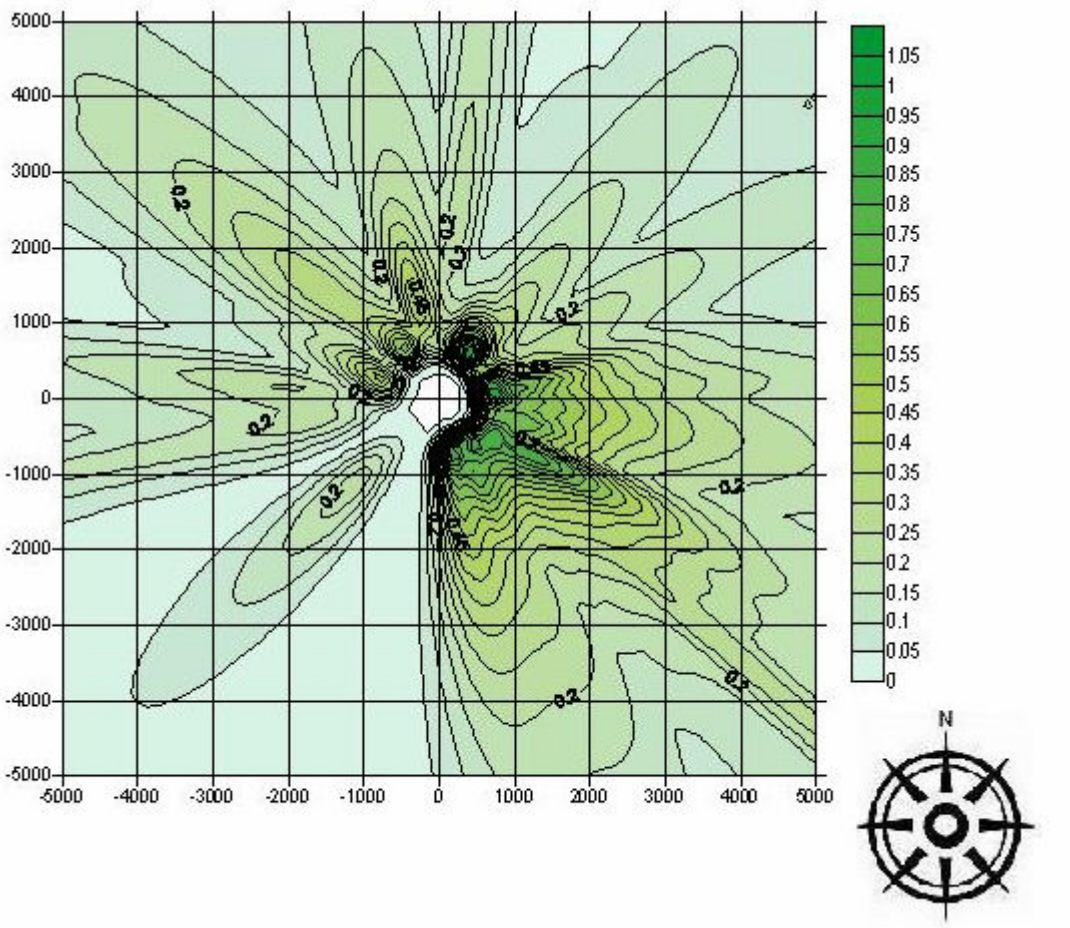
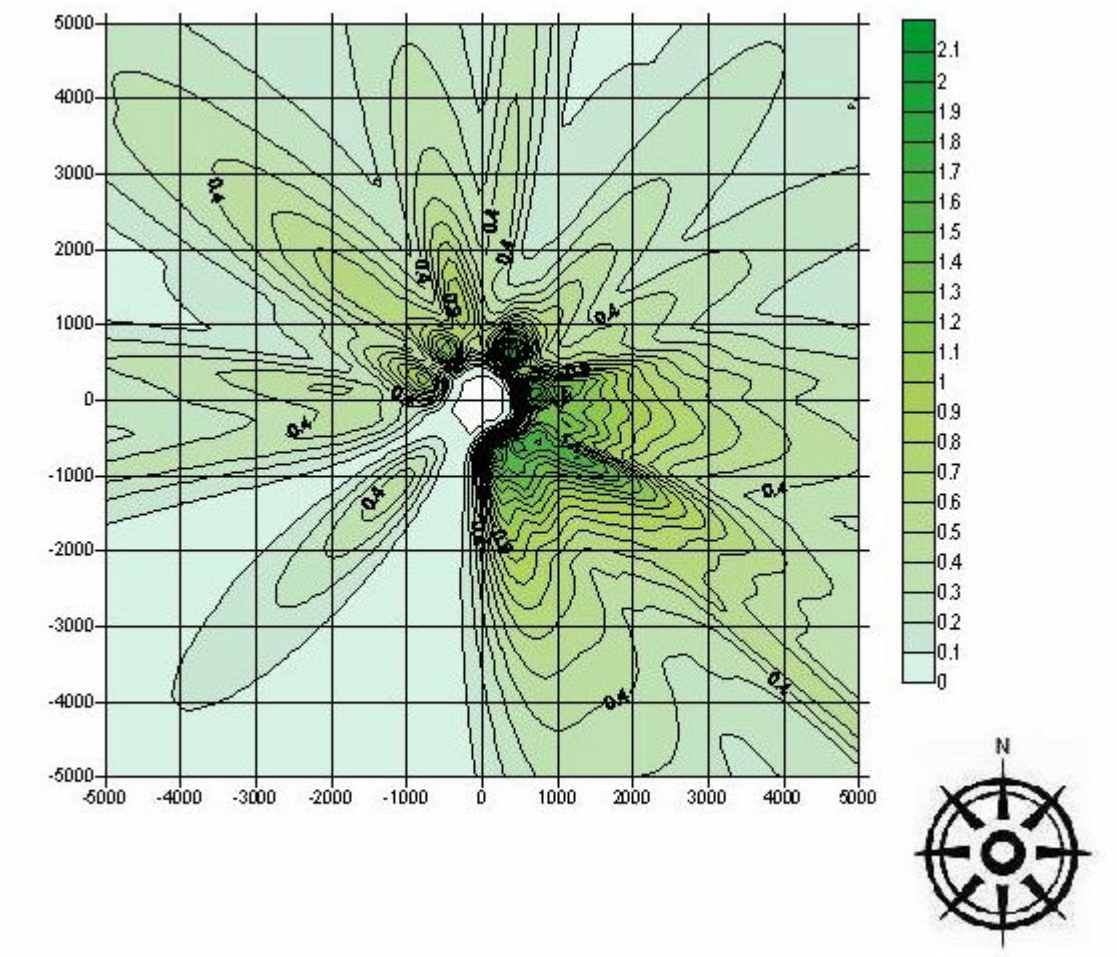


TABLE 5.5: NOX GROUND LEVEL AT DIFFERENT LOCATIONS (24 HOURS AVERAGE IN µG/M^3)

Concentration (µg/m^3)	**Maximum 24 Hour GLC**	**AQ1**	**AQ2**	**AQ3**	**AQ4**	**AQ5**
	(400, 600)	**(102,-57)**	**(-1608, 1273)**	**(-416,1876)**	**(-611, -916)**	**(2681,-449)**
NO_x Contribution from Site	2.11	0.00	0.64	0.80	0.15	0.75
NO_x Baseline (Maximum)	26	26	24	18	25	18
Total NO_x	28.11	26.00	24.64	18.80	25.15	18.75
NO_x Contribution from Site to Maximum NO_x	8.12%	0.00%	2.67%	4.44%	0.60%	4.17%
NAAQS	**80 µg/m^3**					

Based on the observed meteorological condition, the maximum 24 hours average predicted concentration of NO_x is 2.11µg/m^3 and occurs outside the plant premises at location (400, 600) in the northeast direction from the project site. The contribution of maximum predicted concentration towards the background concentration is only about 8%. The resultant maximum NO_x concentration (28.11µg/m^3) is well within the prescribed limit. The predicted NO_x concentration at all the discrete receptors (AQ1 to AQ5) is very low causing minimal increment in background NO_x level. The resultant concentrations at these receptors are also well within the permissible limit.

FIGURE 5.4: PREDICTED 24 HOURS AVERAGE GLC (µG/M^3) OF NO_X WITH NO CONTROL SET



5.4 NOISE EMISSION SOURCES

The assessment of the impacts of noise on the surrounding community depends upon:

- Characteristics of noise source (instantaneous, intermittent, or continuous in nature, with the latter contributing the least to noise pollution);
- Time of day at which noise occurs; and
- Location of noise source with respect to noise sensitive receptor.

For the purposes of predicting noise emissions impacts from the site, the noise emission sources were examined during construction and operational phases.

A) CONSTRUCTION PHASE

Sources of noise emissions are expected from various construction machineries/equipments. General noise levels generated from the operation of equipment and machinery are provided in **Table 5.6** below:

TABLE 5.6: NOISE LEVELS GENERATED FROM CONSTRUCTION EQUIPMENT

Name of Source	Noise Level at 16 m (50 ft) from Source in dB (A)	Noise Level at 1m from source (calculated) in dB (A)
Air Compressor	87	111
Back Hoe/Loader	81	105
Concrete Mixer Truck	85	109
Concrete Pumper	70	94
Concrete Vibrators	77	101
Cranes - mobile	81	105
Dump Truck	83	107
Generator	Not considered	75 (as prescribed by CPCB)
Hammering	86	110
Jackhammer	88	112
Pile Driver	100	124
Radial Arm Saw	80	104

Source: www.gvrd.bc.ca/education/pdf04/ColumbiaWorkshop1-ConstructionNoise.pdf

Since the construction phase is expected to be minor in nature, hence the possibility of all the equipments working together is ruled out. Hence, the noise generated is not anticipated to be high.

B) OPERATIONAL PHASE

During the operational phase, the major sources of noise are:

- Noise from blowers, shredders of RDF plant
- Noise from turbo generator, compressor and other rotating equipments of the power plant
- Noise due to vehicular movement inside the plant premises and on the NH-24 Hapur bypass road

All the noise producing equipments such as blowers, shredders, turbo generator, and compressors would be housed in an acoustic enclosure; hence the ambient noise is not anticipated to be very high. The noise level outside the acoustic enclosure for different

equipments would not exceed the prescribed standards (75 dB(A) at 1 m distance from the equipment). Equipment will be statically and dynamically balanced to eliminate any vibration that can lead to noise generation. Blow off valves, discharge pipes, relief valves and other noise producing static equipment will be equipped with silencers. Pipelines will be suitably sized to avoid excess velocities that can lead to noise generation. Wherever necessary, insulation will be provided for reducing noise pollution. The above abatement measures will ensure that noise levels are kept below standards for the rotating equipment. To reduce the occupational impact on the employees working in the close vicinity of the equipments, suitable ear protection devices would be provided. Hence, the overall noise impact because of project activities is not very high.

5.5 WATER ENVIRONMENT

This section describes the potential impacts on the water resource due to the proposed project. The potential impacts during construction and operation phase are assessed based on the various project activities.

A) CONSTRUCTION PHASE

Construction activities for the proposed development can have minor impact on hydrology and water quality of the area as the construction waste will not be leached into ground or any surface water body. Potential impacts on the hydrology and water quality have been discussed as under.

- Soil runoff from the site leading to off-site contamination (particularly during rainy season).
- Improper disposal of construction debris leading to off-site contamination of water resources.
- Unaccounted disposal of domestic wastewater from temporary labour camps.
- Spillage of oil and grease from the vehicles and wastewater stream generated from on-site activities such as vehicles washing, workshop etc.

Construction and Development of site

Development of the proposed site could lead to stockpiling and excavation activity on site, thereby causing erosion of base soil. The run off from the site may contain high quantity of suspended solids (SS). The impact of runoff may not be very significant except during rainy season. Further construction of garland drains will reduce the runoff from the stockpiles.

Labour Activities

During construction phase, wastewater shall be generated from labour activities on site. Wastewater generated would be characterized by high levels of BOD, SS, Nitrogen and E. Coli.

Significant water quality impact will occur, if the sewage is disposed without any prior treatment. Since most of the people would be deployed locally, impact from labour colony is not anticipated to be very high. Temporary soak pits and septic tanks shall be constructed on the site during construction phase to mitigate the impact.

The project implementation would involve various construction activities. The following section summarizes the water requirement, its sources and management of wastewater.

B) OPERATIONAL PHASE

Water Requirements

During the operation phase of the project, water would be required for the following activities:

- Domestic consumption and service requirement
- In RDF Plant, for aspirators, dust washers, boilers etc
- Air cooled condensers shall be provided to reduce the water consumption

The water demand for the proposed facility has been estimated as 471 m^3/day. The details of water requirements are presented in **Table 5.7.**

TABLE 5.7: ESTIMATED WATER REQUIREMENT

S.N	Activities	Water Requirement
1	RDF Plant	100
2	Service Water	10
3	Cooling Tower make up Water	196
4	Boiler make up Water	68
5	R.O Rejects	85
6	R.O Backwash rejects	4
7	D.M. Plant Regeneration water	8
	Total	471

Approximately 471 m^3/day of treated wastewater from Kondli STP will be utilized for plant operation. The main source of process water available for the project will be treated sewage water from Kondli sewage treatment plant. City water supply from Delhi Jal Board (DJB) would be used for drinking water and other service requirement.

Effluent Generation

During the operation phase, wastewater will be generated from the following activities

- RDF Plant - Blow down water from aspirators and dust washers
- Effluent from Water Treatment Plant
- Domestic sewage water

Approximately 171.8 m^3/day of effluent will be generated due to the proposed plant. The details of treatment facilities are given below:

Effluent from RDF Plant: Effluent generated from the process include blow down water from the aspirator and dust washer. Wastewater from the process would be recirculated back to the RDF plant. Spill over from the process would be collected and treated prior disposal.

Effluent from Power Plant: For the power plant, liquid effluent generated from the RO rejects, MB unit regeneration waste and boiler blow down will be discharged into drain after suitable treatment. Filter backwash water and cooling tower blow down will be discharged into drain after treatment.

Leachate: The municipal waste arriving at the site will be unloaded in to two 9 M deep pit, which will be covered. The small quantities of leachate generated will be collected in the sump and treated in Effluent Treatment Plant.

5.5.1 WATER BALANCE

The water balance and effluent balance diagram for the proposed facility is depicted in **Figure 5.5**.and **Figure 5.6 respectively**

FIGURE 5.5: WATER BALANCE FOR THE POWER PLANT

FIGURE 5.6: EFFLUENT BALANCE DIAGRAM FOR THE POWER PLANT

5.6 LAND ENVIRONMENT

5.6.1 IMPACTS ON LANDUSE & AESTHETICS

The proposed project will be developed on the existing waste disposal site; hence, no change in the landuse of the site due to the proposed project is anticipated. With the development of the proposed plant, green belt would be developed and other aesthetic changes would be made to the plant site, there by creating overall positive impact on the aesthetics of the site.

5.6.2 IMPACTS ON TOPOGRAPHY & GEOLOGY

The proposed site being plain land, hence the topography as well as geology is not anticipated to change due to proposed project. No additional environmental stresses will be imposed by the project on these parameters and hence no significant impacts are expected.

5.6.3 IMPACTS ON SOILS

A) CONSTRUCTION PHASE

Impact on soil owing to the project construction activity includes soil erosion, compaction, physical and chemical desegregations and pollution of soil in case of waste discharge on land. The proposed plant will be developed on the existing waste dumping site, hence no negative impact due to the development is anticipated.

B) OPERATION PHASE

No significant impact is expected on the soils on and around the site, due to the following management measures:

- All solid wastes and hazardous wastes from the plant complex are collected properly collected, stored and disposed.
- The entire plant site area is well drained and thus there is no leaching of any substances in case of spills, which are well confined and decontaminated.
- Reject Treatment

Hence, no negative impact on soil quality on the project site is expected due to the proposed project activities.

5.6.4 IMPACTS DUE TO WASTE DISPOSAL

A) CONSTRUCTION PHASE

During the construction phase, the typical solid waste will be generated from the project includes waste from land clearing activities and construction waste. Impact from construction waste may arise owing to storage on site, transportation, workshops, etc. Proposed mitigation plan suggest maximum reuse/recycle of construction waste on site or removal of waste at the site and proper disposal, which would reduce the impact significantly.

B) OPERATION PHASE

The details of solid waste generated and proposed disposal options during the operational phase are detailed in **Table 5.8**.

TABLE 5.8: EXPECTED WASTE CHARACTERISTICS & LOAD – OPERATIONAL PHASE

S. No.	Source of Waste	Components	Quantity (MT/day)	Disposal Option
RDF Plant				
1	Segregation Level I and II	Organic woody shell, textile etc	120	Used as fuel in HAG
		Sanitary wares		Crushed and sold
		Stones		Crushed and sold
		Others		Appropriate disposal
2	Tromel I,	Sand /grit Soil +Fine Bio Mass	130	Will be sold for filling of low lands during urban development activities and presently fetches a price of Rs. 20-30 per m^3 at site
3	Hot Air Drying	Fine and lighter particles produced during primary shredding, removed from the exit gases by cyclones and bag filters.	10	Disposed along with rejects from Tromel I.
4	Tromel III	Soil +Fine Bio Mass	60	Excellent soil conditioner and can be sold to nearby pulverized coal based power plants- at a price of Rs. 20-30 per m^3.

S. No.	Source of Waste	Components	Quantity (MT/day)	Disposal Option
5	Ballastic rejects	Stone	250	Sold as Soleing Material
		Brick Bats		Sold to building industry
		Leather		Sold for shredded filler
		Rubber		Rubber reclaim industry
		Sanitary wares		Insulator industry
		Others		Appropriate disposal
6	HAG Ash	Inert Ash	31	Will be sold for use in construction industry
Power Plant				
1	Boiler ash	Boiler	77	Will be sold at market at Zakhira for use in construction industry
2	Fly ash	ESP	45	Supply to the existing Brick making Units
3	Solid waste	ETP	85	Disposal to Landfill Site

The proposed project will not have significant impacts, owing to the following measures:

- Unloading of incoming municipal waste in a 9 M deep covered pit
- Spray of Herbal pesticide in the receiving pits for reducing odour, pest and rodents
- The small quantities of leachate generated, will be collected in the sump and treated before disposal.
- Appropriate management of solid rejects (approx 34% of the total waste) from different processing activity
- Fly ash generated from the plant will be supplied to the existing brick making units
- Bottom ash will be used for onsite and offsite construction activities.
- The solid waste generated (Sand and Silt) from the ETP would be disposed off at a landfill site.
- Providing ultrasonic hooters will mitigate bird menace around the project site

5.7 IMPACTS ON ECOLOGICAL ENVIRONMENT

Potential primary and secondary impacts from the proposed project on the biological environment have been identified and the significant ecological impact is evaluated based on:

- Habitat Quality
- Species affected

- Size/abundance of habits/organisms affected
- Duration of Impacts
- Magnitude of environmental changes

However, this being rapid EIA impacts is ranked here as "minor", "moderate" or "severe", although in a few cases a ranking may be minimal. The ranking of a given impact will vary based on the criteria used. For example, an impact might be ranked as "minor" if it affected only common species and habitat, or if it affected small number of individuals or small area, whereas it might be ranked as "severe" if it affected rare species or habitat of large number of individuals or large area.

(A) CONSTRUCTION STAGE

The potential impacts of project construction on terrestrial ecological potential sources include:

5.7.1 TERRESTRIAL ECOLOGY

Site formation: The existing land cover and physiognomy support plant species typical of habitats and having a low plant diversity and simple structure. Due to commonness of the species recorded and small area of habitats for herbs and shrubs to be lost, potential impacts to flora are considered minor. During the construction stage; removal of understorey (shrubs and herbs) will reduce the habitat for a few faunal species. It will be temporary and suitable alternatives are available in nearby areas. The proposed peripheral greenbelt will provide a much better habitat for those species than earlier.

Noise, Air Pollution and other Disturbances: Air, noise and visual disturbance may be generated during the site development that can affect the behavior of fauna (especially bird, butterflies and other insects, reptiles and very small mammalian species) of the adjacent habitats. Small mammalian species such as mongoose and palm squirrel were recorded from the site premises. These species will be temporarily affected and may be migrated to nearby areas. However, alternative habitats are available in nearby areas, and disturbance is going to confine to the construction period only. Besides, these activities and the resulting impact on the existing ecology would be suitably compensated and mitigated adopting comprehensive EMP. Hence; the potential impacts to faunal groups from this source are ranked minor.

5.7.2 AQUATIC ECOLOGY:

Yamuna river flows at a distance about 5.5 km from the project site. The project authority is neither drawing water from the river for construction purposes nor discharging any kind of

sewage and debris into it, hence no impact is anticipated from the construction related activities.

(B) OPERATION STAGE

This section of the report considers the potential impacts of project during the operation on terrestrial ecology and potential sources of impact include air, noise pollution, wastewater and other disturbances.

Potential impacts of project operation on terrestrial ecology include long-term air and noise pollution and disturbance generated by area lighting and traffic. Based on the limited fauna community and important flora observed in the buffer zone and the existing land use pattern of the surroundings, potential impacts to fauna from this source are ranked as minimal.

Since most terrestrial fauna recorded or reported to occur in the study area are disturbance tolerant and some are dwellers of typical rural setting hence, operational impacts are ranked as minimal. In addition, a green belt will be included in the development plan. This will provide habitats for a few faunal groups. No impact on the local ecology is expected from the background sources during the operational stage.

5.8 IMPACTS ON SOCIO-ECONOMIC ENVIRONMENT

This section discusses the project activities and the extent of the potential impacts anticipated from these. Based on the nature and type of impacts, the assessment has been divided into three category i.e. positive, negative and negligible impacts. For example, the positive impacts are: job creation for men and women, better utilization of land, preservation of environment, and infrastructure development. Long term impacts have taken into account i.e. demography, aesthetics, accessing utilities and impact on archeological sites. Negative impacts include adverse impacts on health, air pollution including noise, road safety and odor. Matrix relating project stage to social impact assessment variables is provided in **Table 5.2**.

A) POSITIVE IMPACTS

Job Opportunity: During the social impact assessment process, locals raised the question regarding more job opportunities. The occupational profile of the region is such that the locals can be good sources of labour during construction phase specially the one's residing in the nearby locality and villages and can look forward to benefit due to more jobs availability. The benefit relate to the direct employment associated with the construction.

During the operations phase, one of the project activities would comprise of manual segregation of waste. The locals inhabiting the neighbouring colony of Ghazipur Dairy farm

and villages, who have been performing the task of informal waste collection, can be harnessed for this specific activity during the operational phase.

The plant would therefore provide employment opportunities during construction and operation phase. Thus, the impact on employment due to construction and operation of the plant can be considered as "significantly positive".

Benefits to women / poor section: The proposed facility would generate jobs for the women laborers / poor section during construction as well as operation phase. Women are also likely to get job during construction phase. This will considerably reduce their travel time and therefore enable them to attend to their children and other household chores.

B) NEGATIVE IMPACTS

Traffic and Transport: With the construction of the plant, the traffic in the area is likely to increase, particularly during the construction phase. The increase in traffic may create congestion, potential delays and inconvenience for pedestrians and residents accessing the localities like Ghazipur Dairy farm. This probability of inconvenience faced due to the movement of trucks during construction phase would be negligible, since the trucks would be allowed to transport construction material during night and non-peak hours. Furthermore, the traffic study and Transportation Management Plan being developed for the project would further reduce the negative impact of the traffic increment.

Transient Labour population: Labours for the project would be from Delhi and surrounding areas. A maximum of 400 labours would be working on the site and most of them would be locals. No significant pressure on local infrastructure is envisaged if a small percentage of labourers settle in and around the site during construction phase.

Health: Health impacts are envisaged during the operations phase, particularly the effects of air pollutants on the employees working within the plant and the effects of release of certain polluting components in the localities surrounding the plant. However, inbuilt precautions have been designed for the same. Since adequate measures have been envisaged in the project design, this is unlikely to happen and therefore no likely adverse impact on people's health is predicted. Therefore, the impact significance of the operation stage vis-à-vis public health is very low. Public consultations were conducted in order to inform them about the proposed project. Locals were also communicated about the safety aspects incorporated in the project design.

Noise: The noise levels expected from the planned operating conditions are likely to be within acceptable levels.

Odor: Odor is one of the main concerns of those staying in close vicinity to the plant. Considering this, the design of the facility would be such that the odor will be contained within the boundaries of the facility. Therefore, there is little possibility of odor.

C) NEGLIGIBLE IMPACTS

Demography: During construction phase, a maximum of 400 workers could be deployed. Majority of the labour is likely to be recruited locally and only skilled workers would be from outside, which is anticipated to be very small and will not alter the existing demographic profile of the area. During the operation phase also, the facility would not lead to migration or relocation of any group to the proposed site. A very small fraction of people working in the complex may come and settle near the site. Therefore, the project is not likely to significantly alter the existing demographic profile and the existing population density. Therefore, the impact on demography due to construction and operation of the proposed integrated waste management facility can be considered as "no impact".

Impact on accessing utilities: Utilities include the supply of water, electricity and sewage facilities. Residents in the neighborhood would not face bottlenecks in accessing utility services such water supply, electricity or sewage facilities due to upcoming of the project in the area. Hence, impact on existing utilities due to construction and operation of the proposed waste management facility can be considered as "no impact".

Impact on Historical, Archeological and Architectural Sites: There are no historical or archeological monuments of significance within the study area and hence no negative impact in this regard is anticipated

TABLE 5.9: MATRIX RELATING PROJECT STAGE TO SOCIAL IMPACT ASSESSMENT VARIABLES

Social Impact variable	Implementation/construction	Operation/maintenance
Population characteristics		
Population change	No noticeable change	No noticeable change
Influx/outflow of temporary workers	Majority of unskilled workers will be from the surrounding localities like Hazi Colony, Noor Nagar and Harikesh Nagar	Outflow of temporary workers
Community and institutional structures		
Voluntary association	-	-
Interest group activity	NGOs in the region may raise concerns about the facility in the region.	
Size and structure of local government	No change	No change
Employment/ income characteristics	Employment to construction labour and support staff.	Employment to specialists, support staff within the facility
Industrial/commercial diversity	Sourcing of material and services for design and construction	Sourcing of material and services for operation of the facility
Individual and family changes		
Displacement/relocation concerns	No relocation /displacement	No relocation/ displacement
Residential stability	Would not be altered	Shall not be altered
Attitudes towards policy/project	Would generate goodwill if creates employment opportunities and if community can be assured that the facility shall not create health problems for the community.	Would generate goodwill if creates employment opportunities and if community can be assured that the facility shall not create health problems for the community.
Social well being	Project shall provide employment opportunities to people at various levels hence shall empower them to access facilities for their well-being.	Project shall provide employment opportunities to people at various levels hence shall empower them to access facilities for their well being
Community resources		
Change in community infrastructure	No change	No change
Land use patterns	No noticeable change in the vicinity	No change

6.0 ENVIRONMENT MANAGEMENT PLAN

Environment Management Plan (EMP) is a site specific plan developed to ensure that the project is implemented in an environmental sustainable manner. EMP also ensures that project implementation is carried out in accordance with design by taking appropriate mitigation measures to minimize impacts on the environment during construction and operational phase. EMP will outline Environmental aspects of concern as well as their level of risk and environmental protection measures to diminish this risk. It emphasizes how the development may impact on relevant environmental factors and how these impacts may be mitigated and managed so as to be environmentally acceptable.

Environment Management Plan (EMP) plays a vital role in safeguarding the environment and ensures, where all contractors and subcontractors including consultants, understand the potential environmental risks arising from the proposed project. Environmental monitoring, mitigation program and implementation arrangements are also dealt with in the subsequent section.

6.1 EMP FOR AIR ENVIRONMENT

(A) CONSTRUCTION PHASE

During construction phase, the main air emissions anticipated is dust. To mitigate effects of dust as SPM the following measures are recommended for implementation.

- A dust control plan
- Procedural changes to construction activities.

The most cost-effective dust suppressant is water, because a source of water tends to be readily available on a construction site. Water can be applied using water trucks, handheld sprays and automatic sprinkler systems. Furthermore, incoming loads could be covered to avoid loss of material in transport, especially if material is transported off-site. It is also suggested to follow the following procedural changes to construction activities:

Idling Time Reduction - Construction equipment is commonly left idling while the operators are on break or waiting for the completion of another task. Emissions from idling equipment tend to be high, since catalytic converters cool down, thus reducing the efficiency of hydrocarbon and carbon monoxide oxidation. Existing idling control technologies, which automatically shut the engine off after a preset time can reduce emissions, without intervention from the operators.

Improved Maintenance - Recognizing that significant emission reductions can be achieved through regular equipment maintenance, contractors will be asked to provide maintenance

records for their fleet as part of the contract bid and at regular intervals throughout the life of the contract. A monetary incentive/disincentive provision will be established to encourage contractors to comply with regular maintenance requirements.

Reduction of On-site Construction Time - Rapid on-site construction would reduce the duration of traffic interference and therefore, reduce emissions from traffic delay. Off-site fabrication of structural components can also enhance the quality of work, as the production takes place in controlled settings and external factors such as weather and traffic do not interfere.

B) OPERATION PHASE

Air emission standards envisaged for the project are far more superior to the applicable National Standards, resulting in better air quality management. The potential sources of air pollution are likely to occur from the boiler and fugitive emissions during material handling and processing.

i) Fugitive Dust and Odour from waste handling and processing

The unloading as well as processing of the waste would generate dust and odours. These activities will be carried out under covered areas with proper ventilation, which are under negative pressure as well.

To control the odour and also for convenient uploading of MSW from trucks to the processing plant, the waste will be dropped into one of the two specially designed pits and immediately on unloading the fresh lot , MSW will be sprayed with a herbal insecticide through fogging nozzles. This confinement of MSW, thus exposing its minimum surface area will produce much less smell and the herbal spray felicitates its elimination by discouraging further decomposition of MSW. These pits will be sheltered inside the building and to enable the unloading of MSW from trucks each pit will be provided with a separate mechanized collapsible shutter. These shutters will be opened only during the unloading of MSW.

Furthermore, the entire process building will be kept under negative pressure which will allow fresh air to enter the building and the inside air along with any residual odour will be taken outside the building and will be passed through filters/water washed before it is allowed to escape into the atmosphere. Wherever logistically possible, this exhaust air will be put into boiler or Hot Air Generator (HAG) to destroy its volatile organic vapours causing odour. In addition, the process operation has been so designed that raw MSW is not allowed to stay in the storage pits for not more than 12 hours.

Once the material is dried after segregation and homogenization and thermally treated with simultaneous deposition of tar particulate present in hot flue gases, MSW gets totally sterile with no further onset of its decomposition.

ii) Emissions from RDF plant

The Rotary dryer in the RDF plant will have a Hot Air Generator (HAG) in which biomass segregated from MSW will be combusted to generate hot air. The following pollution control equipment will be installed:

a) Chimney with height of 65 meters.
b) The dust discharge from dryer will be collected by cyclones, dust settling chamber and final cleaning of air will be carried out in bag filters. The air from ballistic separator cyclone will also be sent to the dust filtration system.
c) Secondary shredder will be provided with bag filters before air is let out to atmosphere
d) The dust collection will be carried out at the following points:
    - Rotary Trommels
    - Dryer solids discharge chute
    - Discharge chute of Rotary Trommel (Secondary)
    - Coarse fluff discharge chutes
    - Secondary cyclone discharge duct
    - All material transfer points

Air from these points will be directed to cyclone for primary collection and air bag filters. Emission rates are much below the norms as the gases are scrubbed with water.

iii) Emissions from Power Plant

a) SPM

The power plant boiler will be provided with electrostatic precipitator, which will remove most of the dust content and the clean flue gas will be discharged through chimney of minimum height 65 Meter. The SPM emission from boiler will be controlled to less than 50 mg/Nm^3. Number of fields in ESP will have one spare field, so that even in case of one field down condition SPM levels are maintained at 50 mg/Nm^3.

b) Oxides of Sulphur (SO_2)

According to the CPCB norms the Chimney height of the boiler is calculated using the formula $Height = 14 \times Q^{1/3}$, where Q= Qty of Sulphur Dioxide in kg/hr. The stack height for the boiler will be 65 m to assimilate any contaminants.

c) Oxides of Nitrogen

The formation of Nitrogen Oxide is controlled by admission of secondary air and maintaining temperature balance in the boiler.

d) Carbon Monoxide

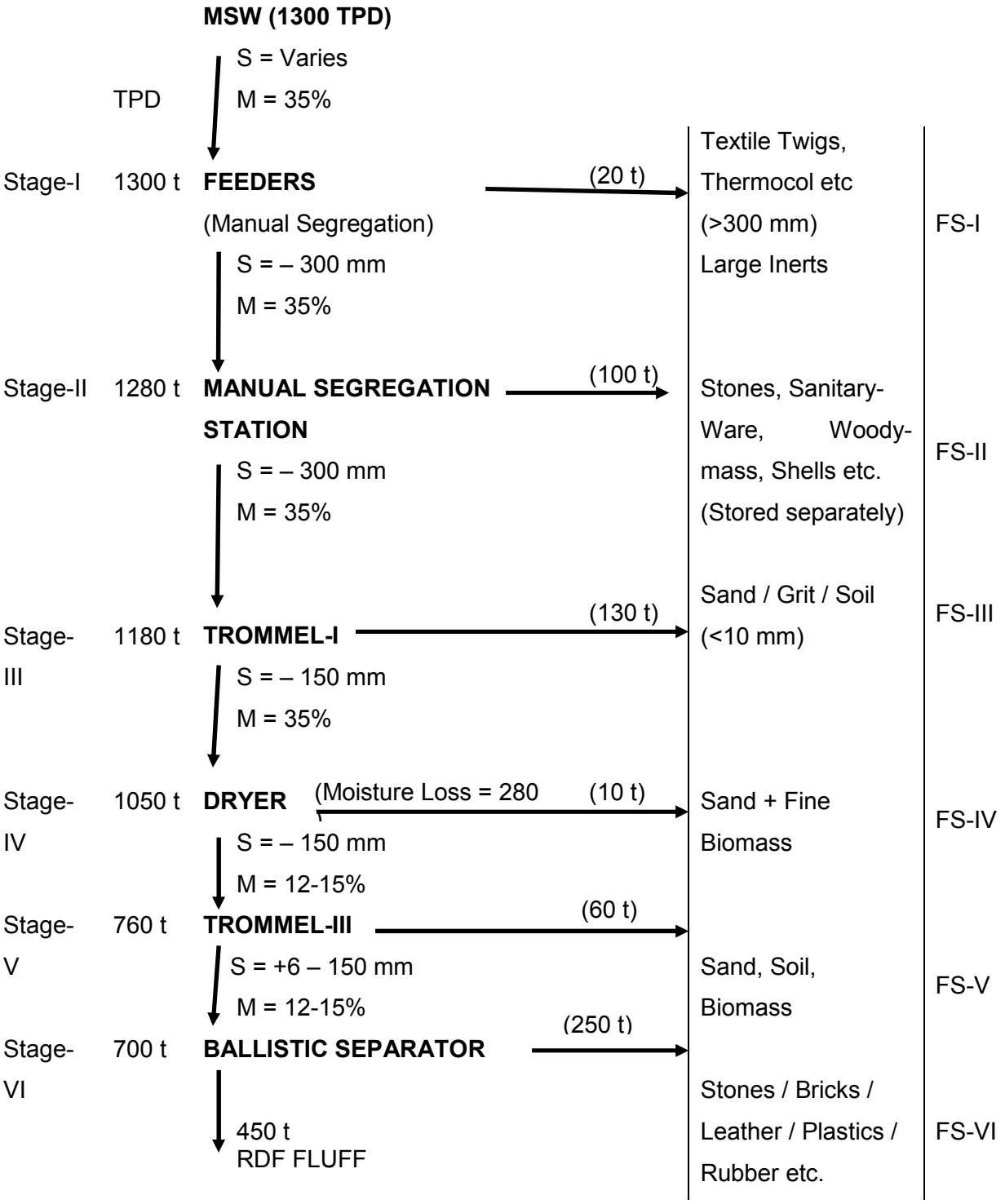
The Boiler will have a Gas recirculation system to recirculate the flue gas thus enabling the reduction in unburnt carbon, reduction in the excess air required. Thus, provision of a gas recirculation system will increase the Boiler efficiency. The correct proportion of primary and secondary air will reduce CO formation.

e) Dioxin and Furans

The dioxin and furans emission is controlled in three stages in the entire project flow:

- Extensive segregation techniques to remove all plastic and other chlorinated compounds such as PVC, rubber, etc. so that it doesn't form part of the RDF. This reduces the dioxins/furans production substantially in the boiler flue gases. The schematic flow of segregation system is provided in **Figure 6.1**.
- Controlling the SPM levels to further control any potential emission of dioxins and furans, as a large extent of dioxins and furans are adsorbed onto the surface of SPM. The SPM level will be maintained at 50 mg/Nm^3 which is much below the national standards will control of dioxins/furans to a great extent.
- Furnace design at with 2 sec retention and temperature of 850 ^oC after secondary air injection will ensure further destruction of any Dioxin formed.

FIGURE 6.1: SCHEMATIC FLOW OF THE SEGREGATION SYSTEM



S = Size M = Moisture

The above measures will reduce the dioxins and furans emission and the levels will be negligible. However, to reduce any chances of dioxin and furan emissions, a dioxin and furan emission control system is proposed. Due to unavailability of dioxin and furan control

equipment manufacturer in India, it is proposed to install High Performance Dioxin Removal Device (Activated Carbon Pack Column) manufactured by Furukawa Company in Japan. The details if the system is provided below:

High-Performance Dioxin Removal Device (Activated Carbon Packed Column)

The object of this device is dioxin included in the exhaust gas, which is mainly discharged from waste incinerators. The outline of this device is as follows: dioxin is sucked into the activated carbon charge layers on two floors in a vertical tower and so the dioxin density can be lowered in a stable condition even if the dioxin production quantity is sharply changed.

Two floors are provided. Each floor consists of several pieces, is reversible and ventilated. Particle activated carbon is uniformly put in layers on each floor. Exhaust gas flows into the suction tower from its bottom or top. While the exhaust gas has been passing through the activated carbon layers on two floors, the harmful gas components including dioxin are sucked and removed.

Activated carbon is supplied to the suction tower as follows: activated carbon is carried by the supply conveyor from receiving hopper to the top of suction tower and is supplied to the upper floor by the throwing seal valve. While the activated carbon is being dropped into the upper floor, the dispersing device arranges it in a uniform thickness. When the supply to the upper floor has just been completed, the upper floor is reversed to move the activated carbon into the lower floor. The upper floor is made horizontal again and activated carbon is supplied into it again. This sequence is executed without blowing gas.

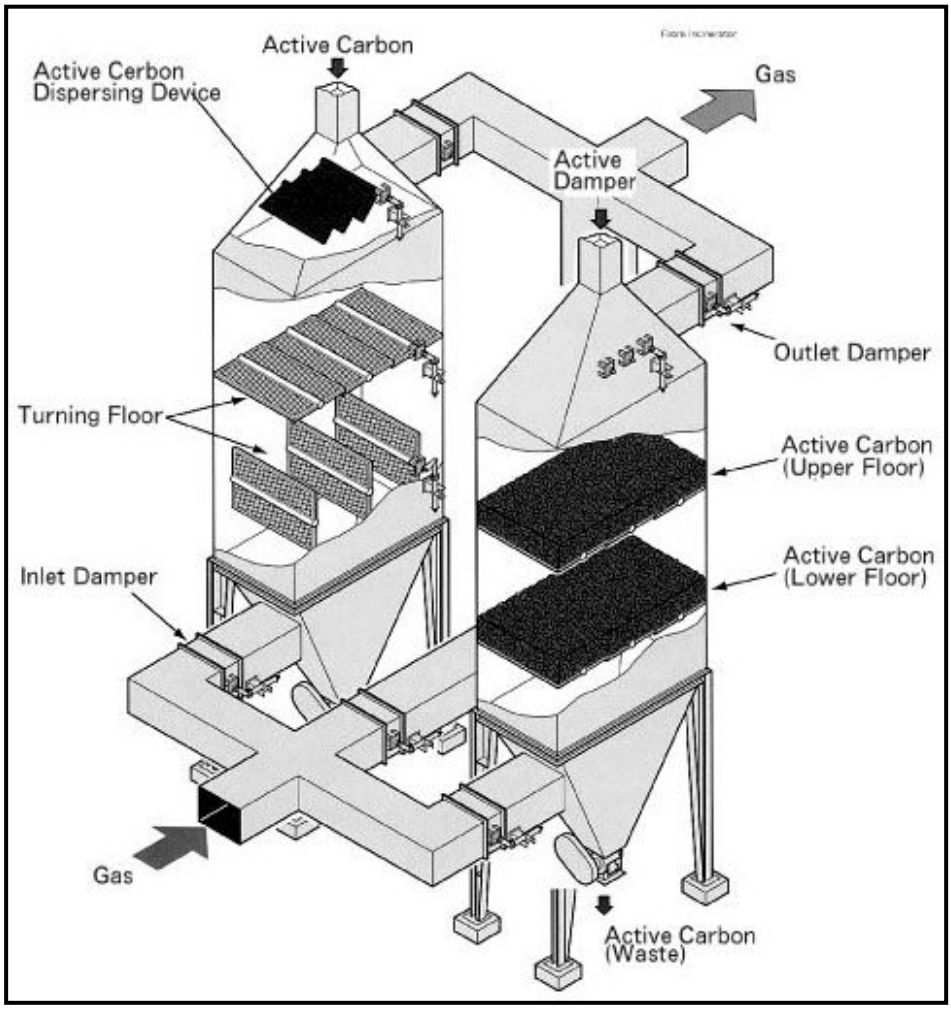
A safety system is provided to prevent the activated carbon from ignition. This system always monitors the temperature in the suction tower inlet gas and in the activated carbon layers. If the temperature at one of these places is abnormal, the emergency cutoff/nitrogen gas fire extinguishing system is actuated. A representative picture of the system showing various components is provided in **Figure 6.2**. The system maintains dioxin density at the outlet within 0.1ng-TEQ/m^3N levels even if the density at the inlet is changed. It means that this device meets the strictest exhaust standard correctly.

The salient features of the system are:

- Because the fixed layer type is employed, dust, which is generated by breaking the activated carbon while gas is being blown, is reduced.
- Because of the vertical gas flow, the installation area can be reduced.
- Stable removal efficiency can be obtained even if the dioxin density at the inlet is changed.
- This device can easily be installed after an existing dust collector.
- There is no operating unit while gas is being blow and so mechanical trouble is reduced.

- An emergency fire extinguishing system, which supplies nitrogen gas, is provided against an ignition trouble of activated carbon.

FIGURE 6.2: HIGH-PERFORMANCE DIOXIN REMOVAL DEVICE



6.2 EMP FOR NOISE ENVIRONMENT

To mitigate the impact of noise from construction equipment during the construction phase the following measures are recommended for implementation:

Noise Shields - Construction equipment producing the maximum noise level should be fitted with noise shields.

Time of Operation **-** Noisy construction equipment should not be permitted during night hours.

Job Rotation and Hearing Protection **–** Working hours of the workers employed in high noise areas will be rotated. Earplugs/muffs, or other hearing protective wear will be provided to those working very close to the noise generating machinery.

During operation phase, there are a number of sources of noise pollution such as truck traffic, blowers, and shredders. Where necessary, enclosures would be provided to ensure that noise levels do not exceed the prescribed standards (85 dBA at 1 m distance from the equipment). For the workers' safety, earplugs would be provided and equipments would be maintained to ensure optimum working conditions.

In the power plant, major noise producing equipment such as turbo generator, compressors will be provided with suitable noise abatement enclosures. Equipment will be statically and dynamically balanced to eliminate any vibration that can lead to noise generation. Blow off valves, discharge pipes, relief valves and other noise producing static equipment will be equipped with silencers. Pipelines will be suitably sized to avoid excess velocities that can lead to noise generation. Wherever necessary, insulation will be provided for reducing heat loss and noise pollution. The above abatement measures will ensure that noise levels are kept below standards from the rotating equipment.

Further, green belt development around the project will further reduce noise pollution, and the following species can be used in a greenbelt to serve as noise breakers:

- *Butea monosperma* (Palash);
- *Leucana leucocephala* (Subabual);and
- *Dalbergia Sissoo* (Shisham).

6.3 EMP FOR WATER ENVIRONMENT

A) CONSTRUCTION PHASE

To prevent degradation and maintain the quality of the water source, adequate control measures have been proposed to check the surface run-off, as well as uncontrolled flow of water in the surrounding areas and nearby water bodies like Ghazipur drain and Hindon cut. Following management, measures are suggested to protect the water quality during the construction phase.

- Avoid excavation during monsoon season
- No discharge of wastewater to soil and ground water body
- Check dams will be provided to prevent construction runoff from the site to the surrounding water bodies.
- Pit latrines and community toilets with temporary soak pits and septic tanks will be constructed on the site during construction phase to prevent wastewater from entering the ground water or surrounding water bodies.
- To prevent surface and ground water contamination by oil/grease, leak proof containers will be used for storage and transportation of oil/grease. The floors of oil/grease handling area will be kept effectively impervious.
- All stacking and loading areas should be made impervious and provided with proper garland drains equipped with baffles to prevent run off from the site to contaminate surface or ground water resources.

B) OPERATION PHASE

The project will not use any ground or surface water resources. The main water requirement for the project will be met through treated sewage from Kondli STP and only domestic requirement will be met through supply from Delhi Jal Board.

***Storm Water Management*:**

Adequate storm water will be generated from the project site. Contamination of storm water is possible from the following sources:

- Leachate generated from the waste.
- Diesel and oil spills in the Diesel Power Generator & fuel storage area.
- Waste spills in the solid/ hazardous waste storage area.
- Oil spills and leaks in vehicle parking lots and washing area.

A detailed "Storm Water Management Plan" will be developed after considering the above sources. The plan incorporates best management practices which includes the following:

- Regular inspection and cleaning of storm drains.
- Cover waste storage areas.
- Avoid application of pesticides and herbicides before wet season.
- Secondary containment and dykes in fuel/oil storage facilities.
- Conducting routine inspections to ensure cleanliness.
- Preparation of spill response plans, particularly for fuel and oil storage areas.
- Good housekeeping in the above areas.

Effluent Treatment

Effluent from RDF Plant:

Effluent generated from the process include blow down water from boiler blow down, cooling tower blow down, R.O. rejects etc. About 172 m^3/day of waste water per day would be generated from the process. Waste water from the process would be recirculated back to the RDF plant.

Effluent treatment plant: secondary treated sewage water taken from Kondli STP will be further treated to make the water fit for process use. Processes followed for treatment will be as follows:

a) Chlorine dosing: For Disinfection
b) Coagulant dosing: for reduction in suspended solids content.
c) Lime dosing: for pH control
d) Polymer dosing: for sedimentation and clarification process.

Effluent from Power Plant

- For the power plant, liquid effluent generated from the RO rejects, MB unit regeneration waste and boiler blow down will be send to ETP for pH correction,
- Filter backwash water and cooling tower blow down will be treated in effluent treatment plant for discharge in public sewerage

6.4 SOLID WASTE MANAGEMENT

The three main streams of waste generation in the project are:

- Sludge from Effluent Treatment Plant
- Inerts and rejects from the waste segregation system/ RDF plant
- Fly and bottom ash from the power plant and HAG

Rejects from Waste Segregation System/ RDF plant:

It is estimated that of the total MSW received at the facility, around 560 TPD of rejects and inerts will be generated. The strategy for utilization of rejects is provided in **Figure 6.3**.

Inerts from Power Plant:

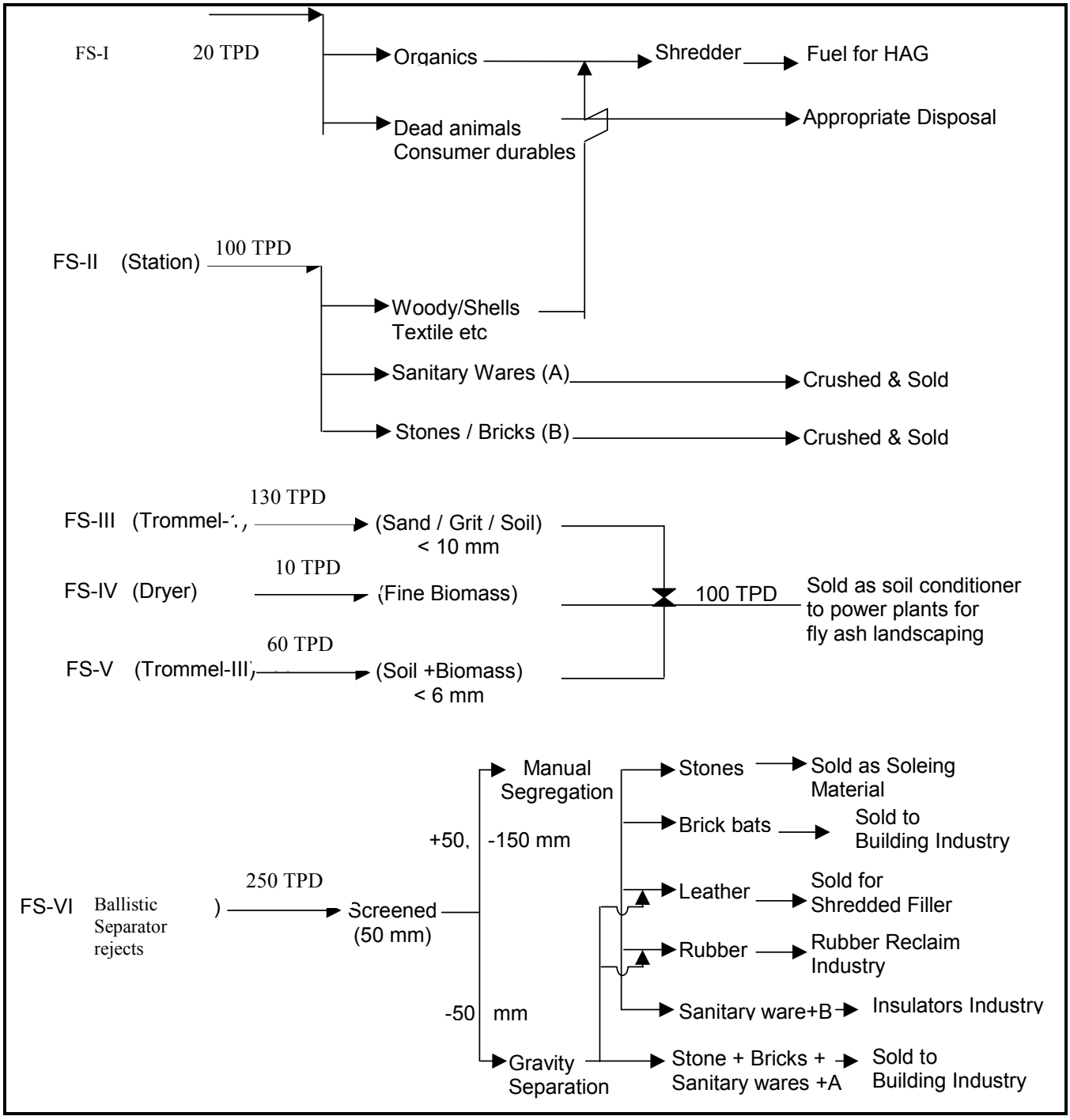
Other inerts that are generated are mainly ash after burning of RDF in boiler and hot air generator. Their envisaged quantities are:

- Boiler bottom ash = 77 TPD
- Fly ash from ESP = 45 TPD
- HAG bottom ash = 31TPD

Fly Ash: Quantity of fly ash generated is too small to support an independent commercial viable plant. As on date, Rajghat Fly Ash Brick Plant in Delhi is lifting the fly ash from Indraprastha Power Plant disposal site. One more plant is being installed at IP Plant disposal site. This will be operational within next 6 months. It is likely that there will be shortage of fly ash. However, distribution of fly ash free of cost is an issue and may take some time before it is sorted out. It will have to be disposed off and the best option is to supply it to the existing brick plant.

Bottom Ash: The bottom ash from Power plant and HAG may not be difficult to dispose. It is understood that there is a big market in Zakhira for utilization of bottom ash. Its low bulk density makes it a preferred material in low cost housing. (It is being used in bathrooms & toilets as soleing material). Alternately, the ash generated and the amount unutilized will be sent to new identified landfill sites at Bhatti mines or Jaitpur.

FIGURE 6.3: PROPOSED TREATMENT OF SEGREGATES AND STRATEGIES FOR THEIR UTILIZATION



6.5 EMP FOR ECOLOGICAL ENVIRONMENT

6.5.1 PERIPHERAL GREENBELT AND LANDSCAPING

Selection of the plant species will be based on their adaptability to the existing geographical conditions and the vegetation composition of the forest type of the region.
During the development of the green belt within the project area, it has to be emphasized that those native plant species should be planted which are having good ornamental values and are fast growing with excellent canopy cover.

6.5.2 GREENBELT DEVELOPMENT

A green belt is provided to mitigate various emissions. Green belts are wide strip of trees and shrubs planted in rows to reduce air velocity there by facilitating settling of the particles on the leaf surfaces and allowing absorption of the pollutant gases. It also serves to cool the atmosphere by transpiration from the leaf surface and also provide habitat for birds, reptiles and insects. The advantages of a green belt are given below:

Greenbelts are important habitats for birds and animals, which add to the aesthetic value of the environment. Generally, birds prefer to make their habitat, nest, on trees. Further trees provide shade and hiding places to wild life.
• Greenbelt helps to restore the ecological balance.
• Greenbelt helps in prevention of soil erosion.
• Greenbelt helps to improve the aesthetics in the area.
• The greenbelt also diminishes noise pollution by absorbing high degree of noise due to their spongy foliar crown.

Selection criteria of Plant species for Green belt development

The selection of plant species for the development depends on various factors such as climate, elevation and soil. The list of plant species that can be suitably planted and having significant importance are provided in **Table 6.1.** The plants should exhibit the following desirable characteristic in order to be selected for plantation.

1. The species should be fast growing and providing optimum penetrability.
2. The species should be wind-firm and deep-rooted.
3. The species should form a dense canopy.
4. As far as possible, the species should be indigenous and locally available
5. Species tolerance to air pollutants like SPM, SOx and NOx should be preferred.
6. The species should be permeable to help create air turbulence and mixing within the belt.

7. There should be no large gaps for the air to spill through.
8. Trees with high foliage density, leaves with larger leaf area and hairy on both the surfaces.
9 Ability to withstand conditions like inundation and drought.
10. Soil improving plants (Nitrogen fixing, rapidly decomposable leaf litter).
11. Attractive appearance with good flowering and fruit bearing.
12. Bird and insect attracting tree species.
13. Sustainable green cover with minimal maintenance

TABLE 6.1 SUGGESTED TREES FOR PERIPHERAL GREEN BELT DEVELOPMENT

SN	Scientific Name	Standard Name	Time when flowering-fruiting occurs
1.	*Ailanthus excelsa*	Maharuk	January-March
2.	*Albizia lebbeck*	Sirish	January-March
3.	*Albizia procera*	Safed Sirish	January-March
4.	*Azadirachta indica*	Neem	June-July
5.	*Bauhinia variegata*	Kanchan	May-June
6.	*Butea monosperma*	Palash	February-April
7.	*Cassia fistula*	Amaltas	March-June
8.	*Emblica officinalis*	Amla	January
9.	*Erythrina indica*	Dadap	July-August
10.	*Grevillea robusta*	Silver oak	February-April
11.	*Leucaena leucocephala*	Subabul	February-May
12.	*Mangifera indica*	Aam	April-July
13.	*Nyctanthes arbortristis*	Harsingar	Throughout the year
14.	*Pongamia pinnata*	Karanj	February-May
15.	*Syzygium cumini*	Jamun	June-July
16.	*Terminalia arjuna*	Arjun	April-July

6.6 MANAGEMENT PLAN FOR SOCIO-ECONOMIC ENVIRONMENT

The social management plan has been designed to take proactive steps and adopt best practices, which are sensitive to the socio-cultural setting of the region.

SOCIAL INVESTMENT STRATEGY

The project envisages addressing the wider goal of environmental protection through a social investment strategy for the communities around the proposed project. By investing in social projects in the neighboring community, seeks to increase the benefits to the local population and contribute towards meeting community's expectation of benefits from the project.

These are taking into perspective concerns of the local community and requirement of the overall population of East Delhi.

a) Proper disposal of Municipal Solid waste
b) Water treatment
c) Demand for employment opportunities
d) Training Rag pickers and low level workers at plant

6.6.1 EMPLOYMENT OPPOTUNITIES

Project will provide job opportunities to those people from adjoining areas during construction and operation phase that fulfills the desired requirements on preferential basis.

6.6.2 TRAINING TO RAGPICKERS AND WORKERS

The waste received at the project site is a mixed waste, which reduces the efficiency of the proposed power plant thus it is necessary to make people aware of the benefits of the segregated waste. So it is planned to carry out awareness campaigns on segregation of waste at source from time to time for the residents of East Delhi and training will be provided to rag pickers operating in the nearby areas for safe handling of waste.

Workers involved in non-mechanical work at plant will be trained and provided with protective gears.

Informal recyclers and dismantlers will also be taken into loop and they will be educated to adopt scientific methods and safe technology to recycle.

6.7 ENVIRONMENTAL MANAGEMENT SYSTEM AND MONITORING PLAN

For the effective and consistent functioning of the project, an Environmental Management System (EMS) should be established at the site. The EMS should include the following:

- An Environmental management cell
- Environmental Monitoring
- Personnel Training
- Regular Environmental Audits and Corrective Action
- Documentation – Standard operating procedures Environmental Management Plans and other records

6.7.1 ENVIRONMENTAL MANAGEMENT CELL

Apart from having an Environmental Management Plan, it is also necessary to have a permanent organizational set up charged with the task of ensuring its effective implementation of mitigation measures and to conduct environmental monitoring. The major duties and responsibilities of Environmental Management Cell shall be as given below:

- To implement the environmental management plan,
- To assure regulatory compliance with all relevant rules and regulations,
- To ensure regular operation and maintenance of pollution control devices,
- To minimize environmental impacts of operations as by strict adherence to the EMP,
- To initiate environmental monitoring as per approved schedule.
- Review and interpretation of monitored results and corrective measures in case monitored results are above the specified limit.
- Maintain documentation of good environmental practices and applicable environmental laws as ready reference.
- Maintain environmental related records.
- Coordination with regulatory agencies, external consultants, monitoring laboratories.
- Maintain of log of public complaints and the action taken

6.7.2 ENVIRONMENTAL MONITORING

The purpose of environmental monitoring is to evaluate the effectiveness of implementation of Environmental Management Plan (EMP) by periodically monitoring the important environmental parameters within the impact area, so that any adverse affects are detected and timely action can be taken.

In consultation with the Delhi Pollution Control Committee (DPCC), the EDWPCL will monitor ambient air quality, noise levels, groundwater quality, and solid wastes in accordance with an approved monitoring schedule. The monitoring protocol and location selection will have to done carefully. The monitoring sampling program should be discussed and approved by DPCC. A suggested monitoring protocol, based on the predicted impacts, is given in **Table 6.2**.

TABLE 6.2: SUGGESTED MONITORING PROGRAM

Sr. No.	Type	Locations	Parameters	Period and Frequency
1.	Ambient Air Quality	Project Site	Criteria Pollutants: SO_2, NOx, SPM, CO, HCl	24-hr average samples every quarter during operation
2.	Stack emission monitoring	Stack of Boiler and HAG	SO_2, NOx, SPM, CO, HCl	24 hr average every quarter.
3.	Ambient Noise	NH-24 near the site Project site main gate	dB(A) levels	Hourly Day and Night time Leq levels every quarter during operation phase.
4.	Treated sewage water quality	WTP	Parameters as per standard	Every quarter
5.	Waste Characterization	Rejects	Physical and Chemical composition	Annual

6.7.3 RECORD KEEPING AND REPORTING

Record keeping and reporting of performance is an important management tool for ensuring sustainable operation of the proposed facility. Records should be maintained for regulatory, monitoring and operational issues. Typical record keeping requirements for the proposed facility is summarized in **Table 6.3**.

TABLE 6.3: RECORD KEEPING REQUIREMENTS

Parameter	Particulars
Solid Waste Handling and Disposal	• Daily quantity of waste received • Daily quantity treated and recycled • Daily quantity sent for landfill
Waste Water	• Daily quantity of treated sewage received • Daily quantities of treated effluent disposed • Quantity and point of usage of treated wastewater • Treated wastewater quality
Regulatory Licenses (Environmental)	• Environmental Permits / Consents from DPCC
Monitoring and Survey	• Records of all monitoring carried out as per the finalized monitoring protocol.

Parameter	Particulars
Accident reporting	• Date and time of the accident • Sequence of events leading to accident • Chemical datasheet assessing effect of accident on health and environment • Emergency measure taken • Step to prevent recurrence of such events
Other	• Log book of compliance • Employee environmental, health and safety records • Equipment inspection and calibration records, where applicable • Vehicle maintenance and inspection records

6.7.4 ENVIRONMENTAL AUDITS AND CORRECTIVE ACTION PLANS

To assess whether the implemented EMP is adequate, periodic environmental audits will be conducted by EDWPCL. These audits will be followed by Corrective Action Plans (CAP) to correct various issues identified during the audits.

7.0 RISK ASSESSMENT AND DISASTER MANAGEMENT PLAN

As part of the Integrated Municipal Waste Processing project, it is important to identify associated safety hazards and carry out a basic risk assessment. The main safety hazards arise due to boiler hazard. RDF will be the dedicated fuel for Boiler from the hazard standpoint. Other "mechanical" and 'electrical" hazards pertaining to heavy lift equipment, electrical fires, electrical shocks, trips and falls and other standard occupational hazards also play role in the overall hazard profile of the project. Basic emergency response actions for the identified scenarios are described later.

Release consequence analysis pinpoints the nature and seriousness of the release. It must be understood that these studies only perhaps project part of the picture- other critical aspects include safety culture, training and awareness, relationships and training of contractor staff and many others.

In spite of the safety measures, possibility of accidents either due to human errors and/ or due to equipment/ system failure cannot be ruled out. The imperative need of a disaster management and response plan is to minimize the adverse impacts due to an unfortunate incident. Disaster Management aspects are described later.

BOILER HAZARDS: RDF will be used as a heating fuel in boilers.

7.1 CONSEQUENCE ANALYSIS

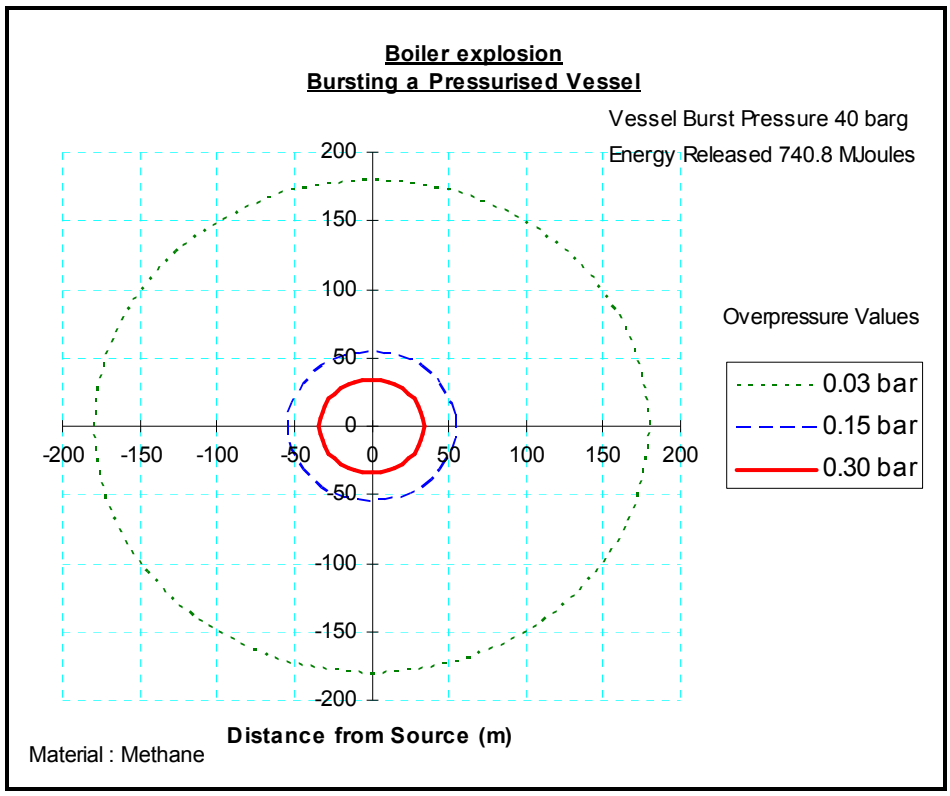
The boiler explosion damage details along with the distance are given in Table -

7.1.1 SUMMARY OF CONSEQUENCE ANALYSIS RESULTS

SCENARIO	
Boiler explosion- See **Figure 7.1**	0.3 bar overpr. (heavy damage)-----33 m 0.15 bar overpr. (Moderate damage)- 55m 0.03 bar overpr. (Light damage)----180 m

Major results are displayed graphically in Figure 7.1

FIGURE 7.1: BOILER EXPLOSION



As can be seen from the results, the area of concern is primarily is a radius of about only 8.5 meters is likely to be vulnerable in the event of the jet fire scenario. Materials and equipment falling within this distance could be vulnerable to secondary fires.

For the Flash fire scenario, the affected distance is nil as the flash fire scenario is not likely to sustain and the gas concentration will not be within flammable limits.

In the case of a boiler explosion, a radius of 33 m is highly vulnerable-this could include equipment within the radius and persons working in the boiler area. Up to 180 meters radius could be affected in terms of light damage. Structural inspections are necessary subsequent to such an explosion.

Largely, the affected distances are all within the complex and may be managed by the Onsite emergency plan of the complex.

7.1.2 ESTIMATED PROBABILITIES

The releases from pipelines can be from a number of sources and can vary in leak size. The categories that are usually considered are small leaks and large or catastrophic leaks. Generic

failure rate base data is available from many sources- some typical values suggested are described below:

PROCESS PIPING, 4'' TO 11'' (INCLUSIVE)

Type	Size, %	Frequency/ year
Base Frequency		3.60E-05
Minor Leak	5	1.44E-05
Significant Leak	22	5.40E-06
Major Leak	45	1.80E-06
Catastrophic Failure	100	3.60E-07

VALVES

Type	Size, %	Frequency/ year
Base Frequency		2.30E-04
Minor Leak	5	8.05E-05
Significant Leak	10	2.76E-05
Major Leak	20	1.38E-05
Catastrophic Failure	100	2.30E-06

7.2 SAFEGUARDS TAKEN IN DESIGN STAGE

Some of the important safeguards provided for the project include those mentioned below.

The main feature of the facility is the safe design of the equipment and pipelines. Equipment is designed, inspected stage wise, tested and certified by an independent third party in accordance with relevant codes and standards. Intrinsic safety is largely built in into the design itself through use of time tested standards and codes, which inherently incorporate a good margin of safety. Apart from the equipment design and selection (only well known, reputed vendors with proven safe and trouble free track record in similar service will be selected), there are other features related to safety in the layout, operation, and shutdown systems etc. that are provided.

Fire fighting system:

Fire protection system will be provided as per LPA (Loss Prevention Association) norms. For every 100-m^2 area of plant, one DCP type and one CO_2 type fire extinguisher will be provided. "No Smoking" and hazard / danger warning stickers will be put up at appropriate places. All personnel deployed for the construction, erection and operation of biogas plant will be given proper training for fire drill. Emergency numbers will also be put up at appropriate places. Empty fuel drums / tanks and other inflammable material will be put in an earmarked place and removed from the premises as soon as possible. Storage yard for chemicals and fuel lubricants will also be provided with fire extinguishers and sand bucket racks.

7.3 DISASTER MANAGEMENT PLAN

Emergency prevention through good design, operation, maintenance and inspection are essential to reduce the probability of occurrence and consequential effect of such eventualities. However, it is not possible to totally eliminate such eventualities and random failures of equipment or human errors, omissions and unsafe acts cannot be ruled out. An essential part of major hazard control has therefore, to be concerned with mitigating the effects of such Emergency and restoration of normalcy at the earliest.

The overall objective of a disaster management plan is to make use of the combined resources at the site and outside services to achieve the following:

1. To localize the emergency and if possible eliminate it;
2. to minimize the effects of the accident on people and property;
3. effect the rescue and medical treatment of casualties;
4. safeguard other people;
5. evacuate people to safe areas;
6. informing and collaborating with statutory authorities;
7. provide authoritative information to news media;
8. initially contain and ultimately bring the incident under control;
9. preserve relevant records and equipment for the subsequent enquiry into the cause and circumstances of the emergency;
10. investigating and taking steps to prevent reoccurrence

The DMP has therefore to be related to the identification of sources from which hazards can arise and the maximum credible loss scenario that can take place in the concerned area. The plan takes into account the maximum credible loss scenario - actions that can successfully mitigate the effects of losses/ Emergency need to be well planned so as they would require less effort and resources to control and terminate emergencies, should the same occur.

7.3.1 ACTUATION OF THE PLAN

Any emergency starts as a small incident that may become a major accident if not controlled in time. At the initial stages, the fire organization chart (would be prepared separately for each facility) shall need to be put into action. If the incident goes beyond control, the Main Incident Controller will need to actuate the on-site plan at the appropriate stage as considered necessary. During idle shift/ holidays, the security personnel will combat the incident as per the fire organization chart below and at the same time inform various emergency controllers for guidance and control the situation.

An organogram needs to be drawn once the site is operational by appointing key personnel and defining their specific duties that will be handy in emergency.

7.3.2 EMERGENCY EQUIPMENT

The site controller will maintain a list of emergency handling equipment including details of fire extinguishers, protective clothing, and personal protective equipment for emergency handlers etc. Details of fire management services of Delhi city and neighboring hospitals will be available with site controller in his operating checklist.

7.3.3 EMERGENCY RESPONSE

A) DANGEROUS SITUATIONS

These are defined as the following:

- Any fire or explosion in the facility
- Any fire in the service buildings
- Fire or explosion in the boiler area
- Fire in the RDF storage area
- Exercise fire drill.

Actions in the Event of Fire:

- Basic actions as detailed above.
- Extinguishing fires: A small fire at a point of leakage should be extinguished by enveloping with a water spray or a suitable smothering agent such as CO_2 or DCP. Fire fighting personnel working in or close to un-ignited vapor clouds or close to fire, must be protected continuously by water sprays. Fire fighters should advance towards the fire downwind if possible- BE CAREFUL TO AVOID H_2S EXPOSURE.
- In case the only valve that can be used to stop the leakage is surrounded by fire, it may be possible to close it manually. The person attempting the closure should be continuously protected by water sprays, fire entry suit, water jet blanket and SCBAs etc. The person must be equipped with a safety belt and a manned lifeline. In case of rapid increase in decibel level, evacuate the area, as there would have been over pressurization.

C) RESPONSE SEQUENCE FOR DANGEROUS SITUATIONS

1. Person noticing the fire should attempt to isolate and extinguish the fire with the available equipment and Inform or arrange to inform the leader/ senior representative regarding the
    - Location of the fire
    - What is burning
    - The extent of fire
    - Callers name and number

DO NOT DISCONNECT UNLESS THE PERSON ON THE OTHER SIDE REPEATS THE MESSAGE OR ACKNOWLEDGES IT.

2. Security on duty co-ordinators will
   (i) Respond to the scene of the incident
   (ii) Arrange to send the necessary fire fighting equipment to the scene of the incident
   (iii) Extinguish the fire with the available equipment.

3. Security Officer will:
   (i) Sound the Siren as per the Siren Code
   (ii) Inform the Site Main / Incident Controller and act as per his instructions
   (iii) To ensure closure of gates immediately to regulate traffic in such a way that free movement of outside assistance like fire tenders, ambulance etc is available.

4. Security should cordon off the area and local city fire fighting staff should be notified. The facility will have the fire fighting water system but may not be equipped with staff to operate it. Local fire fighters may need to be notified.

5. All Other Management / Asst./ Labour Staff on hearing the siren, should STOP their operations/ work, switch off lights, fans, engines, air conditioners etc., close all doors, pipeline valves and line up in front of their working places and meet at a pre-arranged location. These people will assist in evacuating the residents if necessary.

D) POST EMERGENCY FOLLOW UP

- All cases of fire occurrence, no matter how small, must be reported promptly to the Coordinator for follow up.
- Under no circumstances should fire extinguishing equipment once used be returned to its fixed location before it is recharged/ certified fit by the Fire chief/ Safety Manager.
- Used fire extinguishers must be laid horizontally to indicate that they have been expended.

E) EARLY WARNING / ALARM SYSTEM

An audible electric alarm (siren) should be located in the main gate. The different sounds that should be generated by the alarm are:

SMALL FIRE :	No Siren
MAJOR FIRE:	A wailing Siren for two minutes. Sirens will be sounded three times for thirty seconds with an interval of 15 seconds in between

EMERGENCY:	Same type of Siren as in case of major fire but the same will be sounded for three times at the interval of two minutes.
ALL CLEAR (For Fire):	Straight Run Siren for two minutes.
TEST :	Straight run Siren for two minutes.

7.3.4 EMERGENCY CONTROL CENTRE (ECC)

The Control Room will be nominated as the ECC. At the time of the emergency On-site Controller assisted by other designated coordinators shall take position to perform their duties. The security office at the gate shall be the standby. The Emergency Control Center will be the focal point in case of an emergency from where the overall operations to handle the emergency are directed and coordinated. It will be located outside the area of potential hazards and easily approachable.

The Emergency Control Center should have the following resources available:

- Copies of the DMP
- Layout Plan of the complex.
- Information regarding Safety Equipment, Fire Fighting material
- A list of telephones of key and essential staff of the company along with their residential numbers.
- Copies of the local Telephone Directories.
- A list of important telephone numbers like those of neighboring industries, Fire Brigade, Hospitals etc.
- Personal Protective Equipment.
- First – Aid Kit.
- Communication equipment – Internal and External telephones and other communication equipment.
- Requisite stationary items.
- Personnel to act as messengers.

The communication equipment is checked periodically to ensure that they are functional. The ECC is capable of being activated within a few minutes upon declaration of an emergency.

7.3.5 MEDICAL RESOURCES

The medical management for the possible emergency situations essentially consists of treatment for burns and maybe some asphyxiation cases. They could cause burns injuries.

Material Safety Data Sheets and other relevant information would also be available at the facility to enable ready treatment of any casualty, should the unfortunate need arise. It is also

proposed to circulate any important Health and Toxicology material available through the latest research to all Doctors.

7.3.6 RESPONSE EVALUATION, TESTING AND UPDATING OF THE PLAN

Formulation of a Disaster Management Plan cannot possibly be an end by itself. It needs to be tested by holding of periodical mock emergency simulation and drill. Any shortcomings revealed during such exercise should thereafter be corrected by amending the plan. The plan should be for times to come; hence, it must be reviewed at periodic intervals. The plan should be also reviewed and updated when:

- Major alteration or extension of plant is carried out.
- Major change in habitation or land use of the neighborhood takes place.
- Important telephone numbers used are altered, facilities are changed.

Mock drills activating the Disaster Preparedness Plan will be conducted periodically for ensuring its efficiency during emergency as well as for refinement and up-dation. These drills based on the plan will help achieve its objectives.

APPENDIX I
TOR

APPENDIX II
WASTE WATER DISCHARGE STANDARDS

Table: Quality of treated effluent

S.No	Parameters	Unit	Quality
1	pH	-	6.8-8.5
2	Total Suspended Solids	mg/l	<100
3	Oil & Grease	mg/l	<20
4	Free available chlorine	mg/l	<0.5
5	Copper	mg/l	<1.0
6	Iron	mg/l	<1.0
7	Zinc	mg/l	<1.0
8	Chromium	mg/l	<0.2
9	Phosphate	mg/l	<5.0

APPENDIX III
NATIONAL AMBIENT AIR QUALITY STANDARDS

Table 1: National Ambient Air Quality Standards

Pollutants	Time-weighted average	Concentration in ambient air		
		Industrial Areas	**Residential, Rural & Other Areas**	**Sensitive Areas**
Sulphur Dioxide (SO_2)	Annual Average*	80 µg/m^3	60 µg/m^3	15 µg/m^3
	24 hours**	120 µg/m^3	80 µg/m^3	30 µg/m^3
Oxides of Nitrogen as NO_2	Annual Average*	80 µg/m^3	60 µg/m^3	15 µg/m^3
	24 hours**	120 µg/m^3	80 µg/m^3	30 µg/m^3
Suspended Particulate Matter (SPM)	Annual Average*	360 µg/m^3	140 µg/m^3	70 µg/m^3
	24 hours**	500 µg/m^3	200 µg/m^3	100 µg/m^3
Respirable Particulate Matter (RPM) (size less than 10 microns)	Annual Average*	120 µg/m^3	60 µg/m^3	50 µg/m^3
	24 hours**	150 µg/m^3	100 µg/m^3	75 µg/m^3
Lead (Pb)	Annual Average*	1.0 µg/m^3	0.75 µg/m^3	0.50 µg/m^3
	24 hours**	1.5 µg/m^3	1.00 µg/m^3	0.75 µg/m^3
Ammonia	Annual Average*	0.1 mg/m^3	0.1 mg/m^3	0.1 mg/m^3
	24 hours**	0.4 mg/m^3	0.4 mg/m^3	0.4 mg/m^3
Carbon Monoxide (CO)	8 hours*	5.0 mg/m^3	2.0 mg/m^3	1.0 mg/m^3
	1 hour**	10.0 mg/m^3	4.0 mg/m^3	2.0 mg/m^3

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

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

APPENDIX IV
SOCIO ECONOMIC DATA

Table 1: Decadal growth of population

Study Area	1991	2001	2011
East Delhi	1023078	1463583	1904088
Delhi	9420644	13850507	18280370

Table 2: Number of workers engaged in various economic activities

Study Area	Cultivators	Agriculture Labourer	Household Workers	Other Workers
East Zone	1116	692	15978	457524
Delhi	37431	15773	140032	4351998