



दिल्ली मेट्रो रेल कॉर्पोरेशन लिमिटेड
DELHI METRO RAIL CORPORATION LTD.

**REVISED ENVIRONMENTAL IMPACT ASSESSMENT
FOR
PHASE IV PRIORITY CORRIDORS OF DELHI METRO**



August 2020



दिल्ली मेट्रो रेल कॉर्पोरेशन लिमिटेड
DELHI METRO RAIL CORPORATION LTD.
(भारत सरकार एवं दिल्ली सरकार का संयुक्त उपक्रम)
(A JOINT VENTURE OF GOVT. OF INDIA AND GOVT. OF NCT DELHI)

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ABBREVIATIONS

| | | |
|--------|---|--|
| AFC | - | Automatic Fare Collection System |
| AMASR | - | Ancient Monuments and Archaeological Sites and Remains |
| ASI | - | Archaeological Survey of India |
| ATO | - | Automatic Train Operation |
| ATP | - | Automatic Protection System |
| BIS | - | Bureau of Indian Standards |
| CATC | - | Continuous Automatic Train Control |
| CGWB | - | Central Ground Water Board |
| CPCB | - | Central Pollution Control Board |
| CRRRI | - | Central Road Research Institute |
| CTE | - | Consent To Establishment |
| DAMEP | - | Delhi Airport Metro Pvt. Ltd. |
| DMRC | - | Delhi Metro Rail Corporation |
| DPCC | - | Delhi Pollution Control Board |
| DPR | - | Detailed Project Report |
| DTC | - | Delhi Transport Corporation |
| DTL | - | Delhi Transco Limited |
| EIA | - | Environmental Impact Assessment |
| EMP | - | Environmental Management Plan |
| EPA | - | Environmental Protection Act |
| EPR | - | Extended Producer Responsibility |
| ETP | - | Effluent Treatment Plant |
| FIRR | - | Financial Internal Rate of Return |
| GHG | - | Green House Gas |
| GSDP | - | Gross State Domestic Product |
| IMD | - | Indian Meteorological Department |
| JBIC | - | Japan Bank for International Cooperation |
| JICA | - | Japan International Cooperation Agency |
| KLD | - | Kilo Liter Per Day |
| MCD | - | Municipal Development Corporation |
| MGD | - | Million Galan Per Day |
| MoEFCC | - | Ministry of Environmental Forest and Climate Change |
| MRTS | - | Mass Rapid Transit System |
| NCR | - | National Capital Region |
| NCT | - | National Capital Territory |
| NGO | - | Non Government Organization |
| NHAI | - | National Highway Authority of India |
| NOC | - | No Objection certificate |
| NSDP | - | Net State Domestic Product |
| OHE | - | Over Head Equipment |
| PAP | - | Project Affect People |
| PIU | - | Project Implementation Report |
| R & R | - | Rehabilitation and Resettlement |
| SPCB | - | State Pollution Control Board |
| SPM | - | Suspended Particulate Matter |
| STP | - | Sewage Treatment Plant |
| TBM | - | Tunnel Boring Machine |
| VVVF | - | Variable Voltage Variable Frequency |
| WHO | - | World Health Organization |

CHAPTER 0 EXECUTIVE SUMMARY

0.1 INTRODUCTION

Objective and Scope

The scope of Environmental Impact Assessment (EIA) included establishing environmental baseline, assess impacts resulting from pre-construction, construction and operation phases and propose safeguard measures for protection of environment. An environmental management plan was developed to mitigate the adverse impacts during construction and operation phases of the project. Cost of implementing the EMP and post-implementation environmental monitoring has been estimated. Rehabilitation and Resettlement is presented as part of a separate Social Impact Assessment (SIA) Report.

The Ministry of Environment Forests and Climate Change (MoEFCC), Government of India, Notification of 14th September 2006 and its amendment dated 1st December 2009 list projects that require environmental clearance. As per this Notification a metro rail project does not require environmental clearance from MoEFCC.

0.2 PROJECT DESCRIPTION

The study area for the EIA study is the area along the metro corridors. The priority corridors comprise 27.083 km underground section and 38.017 km elevated section and 44 total stations. The depots facility for these priority corridors will be utilized from existing depots.

0.3 ANALYSIS OF ALTERNATIVES

In the present phase IV metro project, out of six corridors, three priority corridors of the proposed Delhi Metro Phase IV project have been finalized after taking into account of environmental and social concerns, considerations of traffic, integration with the existing system and importantly, the overall economic and financial viability.

Long Term Scenario “With” and “Without” Project: Qualitative analysis of the long-term scenarios likely to occur “with” and “without” project scenario is presented in details in Chapter 3.. The “with” project scenarios will, however, occur only if the recommendations provided in mitigation measure and EMP for the construction stage will be followed and all construction activities will be carried out according to principles of Environment-Friendly Construction.

Alternative Scenarios for Three Corridors: This section deals with the rationales behind the preferred choice. The final proposed alignment option at the DPR Stage is named as Alternative 1, while the other alternate alignments which were studied at planning stage are named as Alternative 2 and Alternative 3. For each corridors three different alternatives has been studied. It is evident from all the three alternatives have some advantage and disadvantage in terms of cumulative impact-environmental, social etc. On the assessment of the advantages and disadvantages of the three alternatives and certain limitation, it is considered that Alternative 1 is the most preferred option.

Limited analysis of alternatives was done due to the limited option for the metro route. However, the alignment of the three corridors are so selected that they will serve the maximum population, will entail less private land acquisition, least demolition of private and government structures, least tree cutting and will avoid impact on archaeological and historical structures.

0.4 ENVIRONMENTAL BASELINE DATA

The Environmental baseline data collected for EIA study includes Physiography, geology and soils, ground water hydrology, flora and fauna, meteorology, air pollution and noise.

0.4.1 Land Environment

Physiography: The physiography of Delhi is dominated by the river Yamuna, the Aravalli range and the plains in between and the Delhi Ridge and its four sections. The Delhi and Noida drains into the Yamuna River. The average gradient is of the order of 1 to 4 m/km. Delhi area is generally flat. The Yamuna River is Delhi's source of drinking water.

Soil: The geology of Delhi is of mix type containing various soil deposits. It consists of quartz rock and extends from south part to west bank of the Yamuna River for about 35 km. The soil textures in Delhi are alluvial and quartz type. The soils of the Delhi area are mostly light with subordinate amount of medium texture soils. The light texture soils are represented by sandy, loamy and sandy loam types; whereas medium texture soils are represented by loam silty loam.

In order to know the characteristic of soil, soil samples were collected and analyzed. Test results shows that soil is tending to become alkali except at Janakpuri West and Roop Nagar where it is neutral. Calcium and Organic Matter is low. Conductivity is normal; Nitrogen is high, at all locations. Potassium is medium at all location except at Mangolpuri west where it is low. Soil is sandy loam at all locations.

Seismicity: Delhi is located in Seismic Zone IV.

0.4.2 Water Environment

Water Resources: Delhi gets its water from the Ganga Canal, the western Yamuna canal, the Bhakra Canal and the river Yamuna. The water availability of river Yamuna at 90% dependability during different seasons in a year is as follows: Monsoon 10.0 Mm³/day, Post monsoon 1.2 Mm³/day, Winter 0.8 Mm³/day, Summer 0.1 Mm³/day. Delhi receives average yearly rainfall of 611.8 mm. The utilized rainwater runoff is 193 Mm³ per year.

Ground Water: A decline in water table of 4 m has been observed in Delhi for last few decades. The Depth to water level recorded in NCT Delhi ranges from 1.20 to 67.73 mbgl. The deeper water levels are mostly found in south and south west districts of NCT Delhi, while the shallower water levels are found in central, northern and eastern part of Delhi. The Yamuna flood plain in NCT Delhi has depth to water level in the range of 2-5 mbgl.

0.4.3 Meteorology and Air Environment

Meteorology: Delhi has an extreme climate, which is very cold in winter and hot in summer. The climatic conditions in project area are characterized by a rainy season (July-October), winter (November-March) and Summer (April-June). Delhi has a monsoon climate with an average yearly rainfall of 611.8 mm of which 81% is received during rainy season. The relative humidity at Delhi varies almost throughout the year but seldom drops below 30%.

Maximum temperature varies between 38 deg Celsius to 45 deg Celsius, minimum temperature varies from 5 deg Celsius to 14 deg Celsius.

Air Quality: Air quality monitoring was carried out at 13 locations near to the corridors. PM_{2.5}, PM₁₀ and Ozone were found to exceed permissible limits.

0.4.4 Noise Environment

Ambient noise levels were monitored at 13 locations. Levels were found to exceed respective day and night permissible limits for residential areas.

0.4.5 Ecological Environment

The main species are Pipal, Neem, Kikar, Eucalyptus, Ashok, Ficus and Bakaan, etc. About 10,438 trees will have to be felled. The domestic animals in the project area consist of cows, bullock, sheep, goat, cat and dogs. No rare or endangered species have been reported in the project area. Some of the portion of the tunnel and stations of Aerocity to Tughlakabad corridor having 10.27 Ha land is coming in the Ridge Area which falls under reserved forest. No wildlife has been observed within the project area or its surroundings. The proposed Tughlakabad-Aerocity corridor passes through the Eco-Sensitive Zone (ESZ) of the Asola Bhatti Wildlife Sanctuary at a few places. However, the proposed alignment is underground and is quite far away from the core area of the wildlife sanctuary. The area, where the proposed alignment is within the ESZ, is surrounded by human settlements and utility infrastructures. The places where the alignment is within the ESZ is underground and therefore no direct or indirect impacts on the flora and fauna of the sanctuary are envisaged.

0.4.6 Archaeological Sites or structures

The ASI protected archaeological structures along the corridors are as follows.

| Sl. No. | Name of the monument | Corridor | Distance in m |
|---------|----------------------|----------------------------|---------------|
| 1. | Tughlakabad Fort | Aerocity - Tughlakabad | 212 |
| 2. | Ghiyasuddin Tomb | | 168 |
| 3. | Nai-ka-kot | | 179 |
| 4. | Adilabad Fort | | 135 |
| 5. | Tomb of Shah Alam | Mukundpur - Maujpur | 108 |
| 6. | Tripolia Gate | RK Ashram – Janakpuri West | 138 |
| 7. | Roshnara Bagh | | 130 |

0.4.7 Riverbed Scoring and River Bank Protection

A study was carried out through M/s. CWPRS Pune to ascertain suitability Bridge site from hydraulic considerations, assess orientation of the bridge required for free and smooth flow conditions, assess the afflux on upstream and its effects on the structures upstream and downstream of existing bridges and assess the maximum expected scour based on the maximum intensities of flow assessed from the model studies.

0.5 NEGATIVE ENVIRONMENTAL IMPACTS

Negative impacts likely to result from the proposed development are as follows: Impacts due to Project Location; Impacts due to Project Design; Impacts due to Construction; and Impacts due to Project Operation.

0.5.1 Impacts due to Project Location

Project Affected People (PAPs): Details have been presented in the Social Impact Assessment (SIA) report.

Change in Land Use: The project shall require the acquisition/transfer of 73.69 ha of land. Out of the total land, 73.2 ha is government land and 0.49 ha is private land. Out of the total government land, 17.89 ha for permanent use and 55.81 ha is identified for temporary use.

Loss of Forests/Trees: There are approximately 10,438 trees along the alignment. Two existing depots will be used for these priority corridors so that no loss of trees will be there. With removal of these trees, CO₂ absorption is likely to decrease by 2,42,438 kg/year and Oxygen production is likely to decrease by 5,11,462 kg/year on their maturity.

Utility/Drainage Problems: The alignment will cross drains, large number of sub- surface, surface and utility services, viz. sewer, water mains, storm water drains, telephone cables, overhead electrical transmission lines, electric pipes, traffic signals etc.

Impact on Archaeological Monuments/sites: Impact on archaeological Monuments / sites is summarized in Section 0.3.6.

0.5.2 Impacts due to Project Design

Impacts due to project design are seen in following ways:

Station Planning: The Elevated station is generally located on the road median. All the stations are two-level stations. The concourse is planned along the whole length of the platform with staircases leading from either side of the road. Passenger facilities and operational areas are provided at the concourse level. Minimum vertical clearance is 5.5m under the concourse. The typical underground station is a two-level station with platforms at the lower level and concourse on the upper level. Structure of the underground station is essentially a concrete box about 22-m wide, 14.6-m high and 240 to 260 m long. Provision has been made for staircases and escalators from street to concourse and to platforms. Lifts have been provided for elderly and disabled.

Ventilation and Lighting: The platform and concourse areas will be air-conditioned. Ancillary spaces such as Staff Room, Equipment Room, will be mechanically ventilated or air conditioned

Risk Due to Earthquake: The project area lies in Seismic Zone IV. Structures shall be suitably designed.

0.5.3 Impact due to Project Construction

The most likely negative impacts related to the construction works are mostly of temporary in nature. The likely impacts due to construction are;

Soil Erosion, Pollution and Health Risk: Run off from unprotected excavated areas, can result in excessive soil erosion, especially when the erodability of soil is high. In general, construction works are stopped during monsoon season. Ventilation, dust generation, noxious gasses and Air Cooling in underground work may be health hazard for the workers.

Noise Pollution: When Dump Truck, Excavator and Pneumatic Tool is working simultaneously at site, person working near the equipment will be exposed to maximum noise levels Leq 93.3 dB(A) and Lmax 94.9 at 5m. Therefore additional protective measures may not be required.

Vibration: Vibration level of more than one inch/second is found to impact humans and structures.

Impact due to Land Subsidence: Land subsidence is anticipated at stations which will be constructed by cut and cover method as well as in tunnelled sections.

Risk at Labour camps: Improper disposal of municipal solid waste generated by labour camps can pollute surface water bodies and groundwater. Burning of waste can cause air pollution. Construction workers are more prone to infectious diseases due to unsafe sexual activity and lack of sanitation facilities (water supply and human waste disposal) and insect vectors. Problems could arise due to cultural differences between workers from outside and local residents.

Traffic Diversions: During construction period, complete/partial traffic diversions on road will be required, as most of the construction activities are on the road.

Risk to Existing Buildings: Construction involves cut and cover, tunneling and piling. As part of pre-construction/construction activities building condition survey will have to be conducted, cost of which is not included in EMP.

Muck Disposal: Construction activities will generate about 3.4 Mm³ of soil. Out of this, about 1.02 Mm³ is likely to be reutilized in backfilling in underground stations. The balance 2.38 Mm³ shall be disposed off in environment friendly manner.

Pollution due to Transportation of Construction Material and Soil: During the period of construction emission due to truck movement on account of transportation of civil construction material and disposal/backfill of earth is estimated to be as follows: the total dust emission/pollution would be 7 kg/day, 1.27 kg/day of particulate matter, 28.42 kg/day of CO, 1.27 kg/day of HC, 59.03 kg/day of NO_x and 3668.70 kg/day of CO₂.

Particulate pollution occurs due to excavation, loading and unloading of construction materials, construction equipment emission and emission from the DG sets etc. Resulting pollution is short term.

Increased Water and Energy Demand: The demand for water and energy will increase during construction phase.

Impact on Ground and Surface Water: Ground water contamination can take place if chemical substances get leached by precipitation of water and percolate to the ground water table. Dumping of construction materials which could result in hazardous leachate percolating into ground water; dumping of used water from the RMC plant; oils and greases from construction sites and labour camp are sources of water pollution.

Impact due to Construction of Bridges on Yamuna: Impact on water flow in river will be minimised based on detailed hydrological and water flow modelling. Dropping of material during in-situ construction will be minimised.

Impact due to Supply of Construction Material: Poor choice of source and quarrying operations cause dust pollution and wastage of natural resources.

Utility/Drainage Problems: The alignment will cross a number of utilities which will be supported and kept functional.

0.5.4 Impacts due to Project Operation

The project may cause the following negative impacts during operation.

Noise Pollution: Metro noise level will be in range of 80-85 dB(A) at 10 m distance, 74-81 dB(A) at distance of 20m and 72-78 dB(A) at 30m. Metro corridor is underground in congested residential areas where noise levels will come down due to reduction of vehicles. There are certain sensitive receptors like Hospitals, schools and colleges near to elevated section where noise barrier will be required.

Vibration: Based on Delhi Metro's previous experience, the intensity of vibration varies from 65 VdB to 90 VdB. As per International guidelines, humans start perceiving vibration from 65 VdB and it becomes an annoyance from 72 VdB. If any building especially residential building falls within 25 meters on either side from central line of the tunnel precautionary measures need to be taken to mitigate the effect of ground borne vibration. In the case of sensitive building such as archaeological buildings it is safe to keep a minimum horizontal distance of 60 meters from the tunnel.

Water Supply at Stations: Estimated water demand at stations is 2047 KLD.

Solid waste at stations: As per the available data from Delhi Metro Phase I and II, about 28 cum of solid waste will be generated from underground stations and 38.25 cum from elevated/ at grade stations from Phase IV.

0.5.5 Impact Due to Depots

The likely impacts due to strengthened by augmenting facilities at existing depots at Mukundpur and Sarita Vihar are;

Water Demand: Estimated water demand for car washing in year 2041 is 1498 KLD at Mukundpur Depot and 108 KLD for Sarita Vihar Depot.

Effluent Generation: About 1348 KLD at Mukundpur Depot and 97 KLD for Sarita Vihar Depot will be generated.

Oil Pollution: Oil spillage during change of lubricants, cleaning and repair processes, in the maintenance depot cum workshop for maintenance of rolling stock, is very common. If discharged it can contaminate water sources.

Noise Pollution: The main source of noise from depot is the operation of workshop. The roughness of the contact surfaces of rail and wheel and train speed is the factors, which influence the magnitude of rail - wheel noise.

Solid Waste: It is estimated that municipal solid waste of about 0.18 ton per month will be generated from each of the depot sites.

0.6 POSITIVE ENVIRONMENTAL IMPACTS

Employment Opportunities: In post-construction phase, about 2710 people will be employed for operation and maintenance of the system. Thus, the project would provide substantial direct employment and consequent indirect employment.

Benefits to Economy: These corridors will yield benefits in terms of growth in economic activity due to better accessibility, savings in fuel consumption, corresponding reduction in cost of road construction and maintenance, reduction in vehicle operating costs, savings in travel time,

improvement in quality of life and reduction in loss of productivity due to health disorders resulting from pollution and accidents.

It is estimated that 102 persons will be saved from death due to traffic accidents due to operation of metro.

Direct Benefits to Passengers: The project will result in direct benefits to users of Metro and other modes: reduction in vehicle operating costs, savings in travel time, improvement in quality of life, reduction in loss of productivity due to health disorders resulting from pollution and reduction in road accidents.

Reduced Fuel Consumption: It is estimated that about 3.486 million litres of diesel, 10.912 million litres of petrol and 14.846 million kg of CNG gas will be saved in year 2021. These reductions will increase to 5.683 million litres of diesel, 17.790 million litres of petrol and 24.203 million kg of CNG gas in year 2041. It is estimated that savings will be of Rs 1258.921 million in year 2021, Rs 1647.490 million in year 2031 and Rs 2052.486 million in year 2041.

Reduced air pollution: There are significant reductions of air pollutants due to proposed metro corridors. The reduction in PM, CO, HC, NO_x and CO₂ will be expected as 30 ton/year, 1296 ton/year, 662 ton/year, 901 ton/year and 139665 ton/year respectively in year 2041.

Traffic Noise Reduction: Reduction in traffic volume of 10% & 50% reduces noise at the tune of 0.5 dB & 3.0 dB respectively.

Carbon Credit: Reduction of CO₂ emissions (tCO₂eq) due to modal shift are 27462 in 2021, 108940 in 2031 and 138172 in 2041.

0.7 ENVIRONMENTAL MANAGEMENT PLAN

The impacts will be mitigated or reduced by incorporating environmental management plan into the project cycle i.e. due to location & design, during construction and during operation are as follows:

0.7.1 Management Plan for Location and Design

Flora and Fauna:

Compensatory Plantation: About 10,438 trees are likely to be lost. Hence 1,04,380 trees need to be planted. Estimated compensatory afforestation cost is about **Rs 5949.66 Lakh** considering Rs 57,000/- per tree. In addition to this the same amount of **Rs 5959.66 Lakh** will be given to the Forest Department, Delhi as security deposit. Therefore, the total cost of the compensatory plantation is Rs 11,899.32 lakh. The 1,04,380 trees on maturing will absorb about 2,275 ton of CO₂ per year and will release 5,114 ton of Oxygen per year meeting oxygen demand of 17,820 persons per year.

Compensatory Afforestation: Permission for use of 10.27 ha reserve forest land will be obtained under the Forest Conservation Act, 1980. An equivalent area will be made available to the forest department for carrying out compensatory afforestation. The total cost for the compensatory afforestation is estimated at Rs 701.75 Lakhs.

Sensitive Species within the Asola Bhatti WLS ESZ: The proposed Tughlakabad-Aerocity corridor passes through the Eco-Sensitive Zone (ESZ) of the Asola Bhatti Wildlife Sanctuary at a few places. However, the proposed alignment is underground and is quite far away from the core area of the wildlife sanctuary. The area, where the proposed alignment is within the ESZ, is surrounded by human settlements and utility infrastructures. The places where the alignment is within the ESZ is underground and therefore no direct or indirect impacts on the flora and fauna of the sanctuary are

envisaged.

Use of Energy and Water: Requirement of electrical energy for climate control, lighting and other facilities at stations shall be optimized by proper use of natural day/night light and design of passenger flow inside stations and on streets outside stations. Rain water harvesting shall be implemented in stations and Depot where feasible.

Risk Due to Earthquake: Engineering design and construction shall be done so as to meet codal provisions. Station design shall be done to facilitate quicker emergency evacuation.

0.7.2. Management Plan during Construction

Measures to mitigate impacts observed during construction shall be implemented by Contractor and duly monitored by Owner in accordance with approved method statements. Their cost is part of engineering and track cost.

Construction Material Management and Housekeeping: Procedures for storage, handling and transport of construction material shall be prescribed in SH&E method statement approved for construction.

Hazardous Waste Management: It shall be stored and disposed of by the Contractor as per Hazardous and Other Wastes (Management, Handling & Trans-boundary movement) Rules 2016.

Construction and Demolition Waste Management: The construction contractor is required to take the following measures in accordance with Construction and Demolition Waste Management Rules 2016.

Energy Management: The contractor shall use and maintain equipment and employ recommended practices so as to conserve energy.

Labour Camp and Workplace Facilities: The following facilities shall be provided by the Contractor: Water supply, waste water and sewage treatment, Solid Waste Management Shelter at Workplace, Canteen Facilities, First aid facilities, Day Crèche Facilities, Health care awareness and clinics.

Welfare and Safety of Labour: Construction works shall be executed as laid down in the Safety Health and Environment (SH&E) as per Conditions of Contract document prepared by the Contractor and approved by the Implementing Agency.

Utility Plan: The proposed Metro alignment run along major roads of the city and is required to negotiate sub-surface, surface and overhead utility services. Prior to the execution of work at site, detailed investigation of all utilities will be undertaken and plans for their retention in situ with precautions or temporary/permanent diversions prepared and got approved by respective agencies.

Air Pollution and Noise Pollution Control: Mitigation measures as per SH&E manual shall be adopted during the construction period. Capital and operating cost are included in engineering cost and therefore is not included in EMP.

Vibration Control: Vibration can be reduced by system maintenance, improving track geometry, elastic fastenings, and separation pads. At locations where the alignment is close to sensitive

structures, the contractor shall prepare a monitoring scheme prior to construction at such locations.

Traffic Diversion/Management: Measures such as road widening, traffic segregation, one-way movements, traffic diversions, acquisition of service lanes, etc. will be employed.

Soil Erosion Control: Excavation shall be limited; temporary berms and use of temporary mulches, fabrics, mats, seeding, or other control devices or methods shall be implemented.

Muck Disposal: Mitigation measure proposed are cleaning of disposal sites and then treated so that leached water does not contaminate the ground water, controlling the height from which soil will be dropped, stockpiling of earth in the designated locations with suitable slope, sufficient equipment, water and personnel shall be available on dumping sites at all times to minimise dust suppression, filling of muck in dumping site in layers and compacted mechanically.

Dewatering of Underground works and Drainage: Dewatering should be ensured as prescribed in the construction method statement.

Underground Tunneling Work: Excavation tunnel tubes will made be as per the tunneling Method Statements. All working areas in a free air tunnel are provided with ventilation system as approved by the Director General and the fresh air supplied in such tunnel is not less than 6 m³/min for each worker employed in tunnel as per Rule 153 of BOCWR.

Construction of bridge on river Yamuna: The mitigation measures like spillage of materials into the river, ready mix concrete for concreting, non polluting polymer in the pile foundation etc will be done. Prevention of river bed scoring and protection of river bank erosion

0.7.3 Management Plan during Operation

Noise management: In addition to track-related measures, parabolic noise barriers are proposed on each side of the track. Noise barriers shall be placed along the curved portion of the viaduct and at stations during operation. The estimated cost of noise barriers is about **Rs 1217.76 Lakh** for all priority corridors.

Water Supply and Sanitation at Stations: Water supply for drinking, washing of stations, air conditioning and other uses will be procured from municipal authorities. Wastewater from station will be discharged to the existing sewage network. Non- hazardous solid waste generated in stations will be collected and transported to local municipal bins for onward disposal to disposal site by municipality. Municipal water supply will be supplemented by rain water harvesting along viaduct and at elevated stations.

Rain Water Harvesting: To conserve and augment the storage of groundwater, it has been proposed to construct roof top rainwater harvesting structure of suitable capacity at the elevated stations and in the elevated alignment. The annual rainwater harvesting potential of elevated stations and elevated section is estimated as 1,65,605 cubic meter per year.

Training: The training for engineers and managers will be imparted by DMRC on regular basis to implement the environmental protection clauses of the tender document and to implement the best environmental practices during the construction phase. Apart from training, such programme should include guidelines for safety, methods of disaster prevention, action required in case of emergency, fire protection, environmental risk analysis etc. The estimated cost is Rs 25.50 Lakh.

Disaster Management and Emergency Plans: Disaster management and emergency plans will be prepared by the Contractor and approved by the IA. To ensure proper disaster management, an Emergency Action Committee shall be constituted, consisting of Station Master concerned, Police Officer of the area, Home Guard representative, Fire Brigade representative, Health Department representative, Department of Information and Publicity, and Non-Governmental Organization of the area. Emergency measures will include: Emergency Lighting, Fire Protection, Ventilation Shafts, Emergency doors.

0.7.4 Management Plan for Depot

Water Demand: Water will be required during operation of depots due to augmenting facilities which will be sourced from the existing tube wells.

Effluent Treatment: The effluent that will be generated from depot will be treated in the existing ETP up to the level so that it could be used for horticulture purpose in the campus. The existing ETP will easily cater the increased quantity of the effluent, another ETP may be constructed in future if needed. Waste water from ETP will be recycled for horticulture. The remains from the ETP will be transported and disposed at a licensed waste reciting/disposal facility.

Rain water Harvesting: The rain water harvesting will be done and cost of this is included in the civil cost.

Oil Pollution Control: Oil spilled in Depot will be trapped in oil and grease trap and disposed of to authorised collectors so as to avoid any underground/ surface water contamination. Oil that is mixed in water shall be removed in the ETP. Capital and operating cost are included in engineering cost and therefore is not included in EMP.

Solid Waste Disposal: The solid waste generated from the Depot will be taken by the cleaning contractor weekly and disposed to the municipal waste disposal sites in accordance with relevant National and State laws and regulations. Cost is not included in EMP.

0.8 ENVIRONMENTAL MONITORING PLAN

During construction and operation stages environmental monitoring will be carried out for air quality, noise levels, vibration, water quality and ecology. The estimated environmental monitoring cost during construction and operation phases is Rs 157.59 Lakh.

Establishment of Environmental Division

Environment Division shall be strengthened to supervise and coordinate studies, environmental monitoring and implementation of environmental mitigation measures. The estimated cost of its establishment and operation is Rs 239.07 Lakh.

0.9 INFORMATION DISCLOSURE AND PUBLIC CONSULTATIONS

DMRC's information disclosure strategy includes wide dissemination of project-related information, in print and electronic media regarding significant project details. Such dissemination is carried out both during construction and operation by DMRC's Public Relations Department and is aided by interviews and public discussions in which very senior DMRC management participate. The Public consultations had been carried out in three stages during the initial planning stage in 2013 and design and final design stages between 2019 and 2020.

0.10 ESTIMATED TOTAL COST

Estimated cost of environmental management and monitoring plan is **Rs 15458.75 Lakh.**

1. INTRODUCTION

Delhi, the capital of India has a strong historical background. It was ruled by some of the most powerful emperors in Indian history. The history of the city is as old as the epic Mahabharata. The town was known as Indraprastha, where Pandavas used to live. In due course eight more cities came alive adjacent to Indraprastha: Lal Kot, Siri, Dinpanah, Quila Rai Pithora, Ferozabad, Jahanpanah, Tughlakabad and Shahjahanabad.

Delhi has been a witness to the political turmoil for over five centuries. It was ruled by the Mughals in succession to Khiljis and Tughlaqs. In 1192 the legions of the Afghan warrior Muhammad of Ghor captured the Rajput town, and the Delhi Sultanate was established (1206). The invasion of Delhi by Timur in 1398 put an end to the sultanate; the Lodis, last of the Delhi sultans, gave way to Babur, who, after the battle of Panipat in 1526, founded the Mughal Empire. The early Mughal emperors favoured Agra as their capital, and Delhi became their permanent seat only after Shah Jahan built (1638) the walls of Old Delhi.

From Hindu Kings to Muslim Sultans, the reins of the city kept shifting from one ruler to another. The soils of the city smell of blood, sacrifices and love for the nation. The old 'Havelis' and edifices from the past stand silent but their silence also speaks volumes for their owners and people who lived here centuries back. In the year 1803 AD, the city came under the British rule. In 1911, British shifted their capital from Calcutta to Delhi. It again became the centre of all the governing activities. But, the city has the reputation of over throwing the occupants of its throne. It included the British and the current political parties that have had the honour of leading free India.

After independence in 1947, New Delhi was officially declared as the Capital of India. It was made a Union Territory in 1956. Lying in the northern part of the country, Delhi is surrounded by Haryana on all sides except the east, where it borders with Uttar Pradesh. The 69th Constitutional amendment is a milestone in Delhi's history, as it got a Legislative Assembly with the enactment of the National Capital Territory Act, 1991. New Delhi houses important offices of the Federal Government, including the Parliament of India, as well as numerous national museums, monuments, and art galleries.

The National Capital Region (NCR) in India is a name for the conurbation or metropolitan area which encompasses the entire National Capital Territory of Delhi as well as urban areas ringing it in neighbouring states of Haryana, Uttar Pradesh and Rajasthan. The National Capital Territory of Delhi lies central to the National Capital Region. It includes the city of Delhi and New Delhi. This region has largest concentration of population in whole of the NCR.

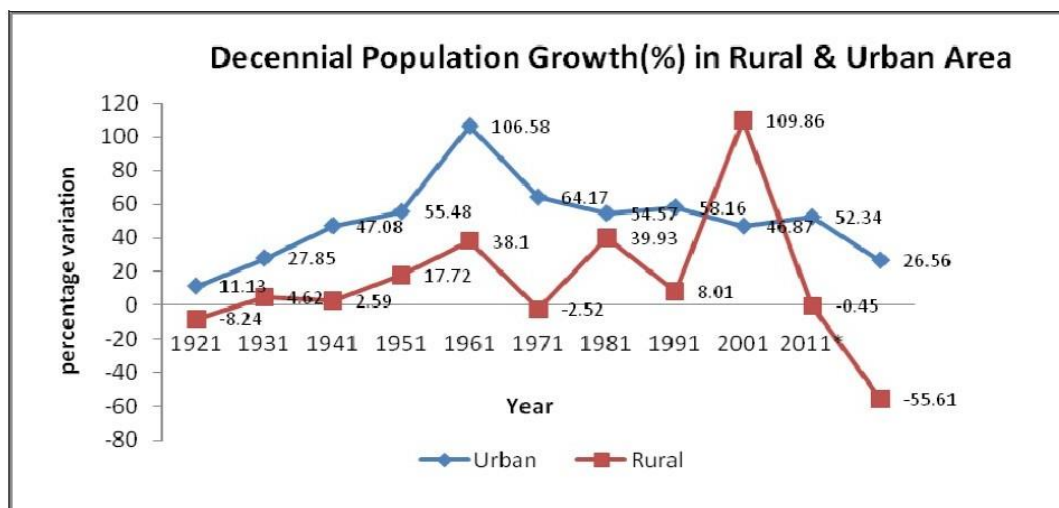
Delhi, the capital of India is the largest metropolis by area and the second-largest metropolis by population in India. It is the eighth largest metropolis in the world by population. According to 2011 census, the population of Delhi was 16.78 millions as against 13.85 millions in 2001. Area and population figures of Delhi are given in **Table 1.1**. North – East district and New Delhi district of Delhi have the highest and lowest population density of 36,155 and 4,057 person per square km respectively. According to Census 2011, the density of population in Delhi is worked out at 11,320 persons per sq. km. as against 9,340 persons in 2001. The density of population in Delhi is highest in the country.

Table 1.1: Population of Delhi

| Region | Area (Sqkm) | Population | | Sex Ratio (females per 1000 males) | | Density of population/Sqkm | |
|--|-------------|--------------------|--------------------|------------------------------------|------------|----------------------------|---------------|
| | | 2001 | 2011 | 2001 | 2011 | 2001 | 2011 |
| New Delhi Municipal council | 42.74 | 3,02,363 | 2,57,803 | 825 | 838 | 7,074 | 6032 |
| Delhi cantonment Board | 42.97 | 1,24,917 | 1,10,351 | 647 | 731 | 2,907 | 2568 |
| Delhi Municipal corporation Urban Rural and Census towns | 1397.29 | 1,34,23,227 | 1,64,19,787 | 822 | 869 | 9,607 | 11,751 |
| Total | 1483 | 1,38,50,507 | 1,67,87,941 | 821 | 868 | 9,340 | 11,320 |

Source: Statistical handbook of Delhi 2014

Figure 1.1: Decennial Population Growth (%) Rural & Urban of Delhi



1.1 TRANSPORT

Delhi is well connected by roads, rail and air with all parts of India. It has three airports - Indira Gandhi International Airport for the international flights, Palam Airport for domestic air services and Safdarjung Airport for training purposes. It has three important railway stations - Delhi Junction, New Delhi Railway Station and Nizamuddin Railway Station. Delhi has three inter-state bus terminals at Kashmeri Gate, Sarai Kale Khan and Anand Vihar.

Delhi has significant reliance on its transport infrastructure. The city has developed a highly efficient public transport system with the introduction of the Delhi Metro which is undergoing a rapid modernization and expansion. Vehicle population in Delhi is highest among all metropolitan cities (Mumbai, Kolkata, Delhi and Chennai). The phenomenal population growth in Delhi has been accompanied by an equally rapid increase in vehicle population. There are 83,92,283 registered vehicles in the city as of 30th June 2014, which is the highest in the world among all cities most of which do not follow any pollution emission norm (within municipal limits). Therefore serious efforts, including a number of transport infrastructure projects, are under way to encourage usage of public transport in the city. Delhi roads are India’s most dangerous. **Table 1.2** shows the details of private and commercial registered vehicles in Delhi as on 30th June 2014.

Table 1.2: Registered Vehicles In Delhi Up To 30th June 2014

| S.No. | Vehicle Type | Number |
|-----------------------------------|---------------------------|------------------|
| Private 2-Wheeler * | | |
| 1. | Moped | 100277 |
| 2. | Motor Cycle | 2695148 |
| 3. | Motor Cycle (Imp.) | 742 |
| 4. | Motor Cycle With Side Car | 10 |
| 5. | Scooter | 2588247 |
| 6. | Scooter With Side Car | 729 |
| Total | | 53,85,153 |
| Private 4-Wheeler * | | |
| 1. | Invalid Carriage | 410 |
| 2. | L.M.V. (CAR) | 2516200 |
| 3. | L.M.V. (IMP.) | 8513 |
| 4. | L.M.V. (JEEP) | 67894 |
| 5. | L.M.V. (VAN) | 74257 |
| 6. | Omni Bus (Private Use) | 5 |
| 7. | Three Wheeler (Passenger) | 2 |
| 8. | Three Wheeler Private | 33 |
| 9. | Tractor (Agriculture) | 40 |
| Total | | 26,67,354 |
| Comm. Passenger Vehicles # | | |
| 1. | Bus | 19688 |
| 2. | Cab Scheme | 3896 |
| 3. | Eco Friendly Sewa | 628 |
| 4. | Economy Radio Taxi | 4103 |
| 5. | Gramin Sewa | 6153 |
| 6. | Light Pass. Vehicle | 11285 |
| 7. | Light Passenger (Taxi) | 3509 |
| 8. | Light Passenger(Imp) | 60 |
| 9. | Local Taxi | 7205 |
| 10. | Maxi Cab | 134 |
| 11. | Maxi Cab-(School Cab) | 10305 |
| 12. | Motor Cab-(School Cab) | 1640 |
| 13. | Phatphat Sewa | 38 |
| 14. | Radio Taxi | 6006 |
| 15. | Three Wheeler(Passenger) | 78967 |
| 16. | Tourist Taxi | 29111 |
| 17. | Tourist Taxi Deluxe | 820 |
| 18. | Tourist Taxi Dlx (Imp) | 2130 |
| Total | | 1,85,678 |
| Comm. Goods Vehicles # | | |
| 1. | Ambulance | 1478 |
| 2. | Ambulance(Imp.) | 35 |
| 3. | Heavy Goods Veh.(Imp) | 11 |
| 4. | Heavy Goods Vehicle | 6338 |
| 5. | Light Goods (3 Wheeler) | 60477 |
| 6. | Light Goods Veh.(Imp) | 10 |
| 7. | Light Goods Vehicle | 77539 |

| | | |
|--------------------|------------------------|------------------|
| 8. | Medium Goods Veh.(Imp) | 8 |
| 9. | Medium Goods Vehicle | 6511 |
| 10. | Mobile Service Van | 10 |
| 11. | Tractor | 1612 |
| 12. | Utility Van | 69 |
| Total | | 1,54,098 |
| Grand Total | | 83,92,283 |

* (Excl. NOC taken/Converted vehicles)

(Excl. NOC taken/Converted/Replaced/Age >15 Yrs. vehicles) Source: Delhi Transport Department website

1.2 OBJECTIVE AND SCOPE OF THE STUDY

The objective of the study is to carry out EIA study and preparation of EIA report as per requirement of regulatory or funding agency. The scope of EIA includes the impacts resulting from pre-construction, construction and operation phases of Phase IV Metro priority corridors and sub-stations. DMRC plans for funding for the proposed priority corridors of Delhi Metro Phase IV from Japan International Cooperation Agency (JICA). It also proposed to establish environmental baseline and safeguard measures for protection of environment for sustainable development during project cycles. The MoEFCC, Government of India, Notification of 14th September 2006 and its amendment dated 1st December 2009 enlist projects in Schedule that require environmental clearance. However as per the said notification Metro Projects does not require environmental clearance from MoEFCC.

The scope of the study is framed as per JICA guidelines for Environmental and Social considerations. The objectives of the JICA guidelines are to encourage Project proponents to have appropriate consideration for environmental and social impacts, as well as to ensure that JICA's support for examination of environmental and social considerations are conducted accordingly.

JICA Requirement

In its confirmation of environmental and social considerations, JICA places importance on dialogue with all involved partners (e.g. the host country, local governments, borrowers and project proponents) regarding environmental and social considerations. Transparent and accountable processes, as well as active participation of key stakeholders (e.g. local residents and local NGOs affected by the project) in all stages of the project are highly considered. JICA make clear in their "Guidelines for Environmental and Social Considerations" that these are mandatory to receive JBIC's funding. JICA guidelines are formulated based on the World Bank Operational Policy (OP 4.01).

BOX 1.1 EIA Categorization System in JICA Systems

Category A Projects are likely to have significant adverse impacts on the environment and society. It includes projects in sensitive sectors or with sensitive characteristics and projects located in or near sensitive areas.

Category B Projects are ones with potential adverse impacts on the environment and society less adverse than those of Category A projects.

Category C Projects have minimal or little adverse impacts on the environment and society.

According to JICA Guidelines for confirmation of Environmental and social Considerations, the current project is classified as Category A as it is likely to have significant environmental impacts on the environment. Category A includes sensitive sectors such as “Roads, railways and bridges” which is similar to that of the metro lines or located in or near sensitive areas such as areas of cultural, historical or archeological value.

1.3 LEGAL, POLICY AND INSTITUTIONAL FRAME WORK

Keeping the pace with international laws, the Ministry of Environment Forest and Climate Change enacted Environmental Protection Act in 1986. 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. During last three decades an extensive network of environmental legislation has grown and presently it has a fairly complex body of environmental legislation aimed at ensuring that the development process meets the overall objective of promoting sustainability in the long run. The available legal Acts and Legislation referred during the study are:

- ❖ The Environment (Protection) Act, 1986, amended 1991.
- ❖ The Environment (Protection) Rules, 1986.
- ❖ The Water (Prevention and Control of Pollution) Act, 1974 (Amendment 1988).
- ❖ The Water (Prevention and Control of Pollution) Cess Act 1977, (Amendment), 2003.
- ❖ The Water (Prevention and Control of Pollution) Cess Rules, 1978, 1991.
- ❖ The Air (Prevention and Control of Pollution) Act 1981, amended 1987.
- ❖ The Air (Prevention and Control of Pollution) (Union Territories) Rules, 1982, 1983
- ❖ Noise Pollution (Regulation and Control) Rules, 2000 amendment 2002, 2006.
- ❖ Solid Waste Management Rules, 2016 and The Hazardous and other wastes (Management and Handling and Trans-boundary Movement) Rules, 2016
- ❖ The Indian Forest Act, 1927.
- ❖ Forest (Conservation) Act, 1980, amended 1988.
- ❖ Forest (Conservation) Rules, 2003.
- ❖ The Wildlife (Protection) Act 1972, Amendment, 2002
- ❖ The Ancient Monuments and Archaeological sites and Remains Act, 1958 amended in 2010
- ❖ Fly ash utilization notification, Sept 1999 and its subsequent amendments
- ❖ Construction and Demolition Waste Management Rules 2016
- ❖ E-Waste (Management) Rules 2016
- ❖ Plastic Waste Management Rules, 2016

The EIA is conducted as per “Guidelines for Environmental and Social considerations” of JICA. These guidelines are formulated based on the World Bank Operation Policy (OP – 4.01).

1.3.1 Water and Water Pollution

The use of water resources and also the discharge of polluted water (sewerage) are primarily regulated by the Water (Prevention and Control of Pollution) Act, 1974 amended in 1988. The Water Cess Act, 1977 amended in 1992 and 2003, including Rules 1978 and 1991 provides for levy and collection of Cess on water consumed with a view to generate resources for prevention and control of water pollution. The Act assigns functions and powers to the Central Pollution

Control Board (CPCB) and State Pollution Control Board (SPCBs) for prevention and control of water pollution.

The Environment (Protection) Act 1986 amended in 1991 and Rules also lays down specific standards for quality of water effluents to be discharged into different type of water bodies (sewers, surface water bodies like lakes and rivers, marine discharge). Additionally, the water supplied to users for drinking shall also conform to the National Drinking Water Standard, IS-10500 (2012) (**Annexure 1.1**). **Annexure 1.2** summarizes the general standards for discharge effluent in Inland Surface Water Bodies. To ascertain and categorize the existing water quality, the results of the analysis of water quality need to be compared with the water quality standards given in **Annexure 1.3**.

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 is to provide for mechanisms that would lead to replenishment of groundwater reserves through techniques like rain water harvesting. The Central Ground Water Board, (CGWB) the statutory authority set up by the Central Government has also restricted the drilling of tube wells and bore wells in certain water scarce areas in the country.

1.3.2 Air Quality

The Air (Prevention and Control of Pollution) Act, 1981 and amended in 1987 including Rules 1982 and 1983 was enacted to prevent, control and reduce air 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 pollutants like PM₁₀, PM_{2.5} Sulphur dioxide, Nitrogen dioxide, Carbon monoxide, Lead, Ozone, Ammonia, Benzene and Benzo pyrene, Arsenic and Nickel with the intent of managing air quality for different category of areas (Industrial, Residential, Rural & Ecological sensitive areas). Ambient Air Quality Standards have been notified by the CPCB vide Gazette Notification dated 16th November 2009, refer **Annexure 1.4**.

The Extended Producer Responsibility (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 SPCBs, on a case to case basis, can also make the emission standards more stringent on the considerations of the carrying capacity of a specific air shed and the existing pollution levels of ambient air quality.

1.3.3 Noise Quality

With the objective of regulating ambient noise quality in the environment, the Central Government has notified the Noise Pollution (Regulation and Control) Rules, 2000 amended in 2002 and 2006 under the EPA. The noise standards for different category of areas are based on the weighted equivalent noise level (Leq). The EPR also lays down equipment noise standards for DG sets, Air conditioners and Construction Equipment, which would be in use for the project. Ambient Noise level standards have been notified by the MoEFCC vide Gazette Notification dated 26th December 1989 and also in the Schedule III of the Environmental (Protection) Rules 1986. It is based on the 'A' weighted equivalent noise level (L_{eq}). These are presented in **Annexure 1.5**.

The ground borne vibration is not a common phenomena which are experienced in everyday life like that of air borne noise. The background vibration level in residential area is 50 VdB or lower, well below the threshold perception level of 65 VdB. The background vibration is of concern in

case of electron microscope and high resolution photolithography. The indoor vibration within the building is caused by operation of mechanical equipments, movement of people or slamming of doors. While outdoor vibration is due to construction equipment, steel wheeled trains and traffic on rough roads. If the road surface is smooth, perceptible vibration is rarely observed. The range of vibration from 50 VdB to 100 VdB is of interest. Generally vibration in the range of 75 VdB to 80 VdB is annoying. Transportation and Construction Vibration Guidance Manual, September 2013 published by Caltrans (California Department of Transportation) describes the vibration damage potential threshold criteria as given in **Annexure 1.6**

1.3.4 Solid Waste Management

Project construction and operation generates solid waste at site. The DMRC would be responsible for collection and handling of solid waste as per the provisions of the Solid Waste Management Rules, 2016. The Hazardous and other wastes (Management and Handling and Trans-boundary Movement) Rules, 2016 require facilities to classify wastes into categories, manage them as per the prescribed guidelines and obtain prior authorization from the SPCB for handling, treatment, storage and disposal of Hazardous Wastes.

1.3.5 The Ancient Monuments and Archaeological sites and Remains Act, 1958 amended in 2010

The Ancient Monuments and Archaeological Sites and Remains (Amendment and Validation) Act, 2010 has been enacted to amend the Ancient Monuments and Archaeological Sites and Remains Act, 1958 and to make provision for validation of certain actions taken by the Central Government under the said Act. The act has come into force on January 23, 2010.

The act states that the limits of prohibited area and regulated area around the monuments, archaeological sites and remains declared by the Central Government as protected have been specified in the principle Act as 100 m and 200m respectively. The limits so fixed may be further extended on the basis of gradation and classification of the monuments, archaeological sites and remains to be done by the National Monuments Authority, which is to be constituted by the Central Government by virtue of the Amendment in the principle Act. The Act defines regulated area and prohibited area as follows:

Prohibited Area: It is the areas of the protected monuments or protected areas, declared as of national importance, which has been defined as every area, beginning at the limit of the protected area or the protected monument, as the case may be, and extending to a distance of 100 m in all directions from the periphery of protected area. There is also a provision in the Act to further extend the prohibited area beyond 100 m having regard to the classification of any protected monument or protected area on the recommendation of National Monument Authority by the Central Government

Regulated Area: It is the area beginning at the limit of the prohibited area in respect of every ancient monument and archaeological site and remains and extending to a distance of 200 m in all directions from the periphery of protected area. This two hundred meters regulated area could further be extended having regard to the classification of any protected monument or protected area on the recommendation of National Monument Authority by the Central Government. The regulated area has extent not only horizontally but also vertically and covers even below the surface.

The amendment act provides that none other than an archaeological officer can carry out any construction in any prohibited area. The acts provides that no permission, including carrying out any public work or project essential to the public or other constructions, shall be granted in any

prohibited area on and after the date on which the Ancient Monuments and Archaeological Sites and Remains (Amendment and Validation) Act, 2010 comes in to force. This provision does not include cleansing of drains and drainage works and of public latrines, urinals and similar conveniences, or, the construction and maintenance of works meant for providing supply of water for public, or the construction or maintenance, extension, management for supply and distribution of electricity to the public or provision for similar facilities for public.

This provision has barred all construction activities in the prohibited area to be taken up by all public bodies even if the purpose is related to public works or project essential to the public. There is no provision for grant of any relaxation in this regard by any authority.

Permissions are granted by Competent Authority as per Ancient Monuments and Archaeological Sites & Remains (Validation and Manedment) Act 2010 and Rules made therunder, for any repair, renovation, construction and reconstruction. Within 100 m of prohibited area around any centrally protected monument or site, permissions for repair and renovation are granted for buildings/structures constructed before 1992 or constructed after 1992 with approval from Director-General of ASI. Within 100-300 m of Regulated area around any centrally protected monument or site, permissions for repair, renovation, construction and reconstruction are granted for buildings/structures.

Procedure for Application:

In Delhi any application for repair and renovation in prohibited area and repair, renovation, construction and reconstruction in regulated area can be submitted to the Competent Authority in Form I.

After an application is submitted, it is scrutinized to find whether the information and attachments have been duly provided. Thereafter site inspection is conducted by an officer authroised by Competent Authority and the proposal is forwarded to the Secretary, National Monuments Authority at 24, Tilak Marg, New Delhi. On approval from the National Monuments Authority (NMA), the Competent Authority, as the case may be, issues a permission or refusal to the owner.

1.3.6 Various Environment Permissions Required

Various permissions related to environment required for the project during Pre- construction, Construction and Operation phase of the project. The key permissions required for the project are listed in **Table 1.3**.

Table 1.3: Key Environment Clearances Required

| Permission/ Clearance/Permit | ACTS/RULES | Concerned Agency | Stage |
|--|---|-----------------------------------|--------------|
| Consent to establish and consent to operated for batching plants | The Water (Prevention and Control of Pollution) Act, 1974, amended 1988 and The Air (Prevention and Control of Pollution) Act 1981, amended 1987 | Delhi Pollution Control Committee | Construction |

| | | | |
|---|---|---|--|
| Consent to establish and operation of STP and ETP | The Water (Prevention and Control of Pollution) Act, 1974, amended 1988 | Delhi Pollution Control Committee | Operation |
| Generation, storage and transportation hazardous waste | Hazardous and Other Wastes (Management & Transboundary Movement) Rules, 2016 | Delhi Pollution Control Committee | Construction and operation |
| Permission for construction within the regulated/prohibited zone | The Ancient Monuments and Archaeological Sites and Remains (Amendment and Validation) Act, 2010 | Department of Archaeology | Pre- Construction/ Construction |
| Permission for extraction of ground water during construction and operation | Environment (Protection) Act, 1986 | Delhi Jal Board/NDMC | Before Construction and during operation |
| Permission for felling of trees | Delhi (Prevention) of tree act 1994 | Department of Forest, Govt. of NCT | Before Construction |
| Pollution Under Control Certificate | Central Motor and Vehicle Act 1988 Vehicular Exhaust Norms, CPCB 2007 | Department of Transport, Delhi | Construction |
| Waste management Plan | Construction & Demolition Waste Management Rules, 2016 | Local Authority (Municipal Corporation) | Before construction |
| Use of forest land | Forest (Conservation) Act 1980, 1988 | Forest Department, Delhi | Before Construction |

1.4 INSTITUTIONAL FRAMEWORK

The Ministry of Environment Forest and Climate Change (MoEFCC) is the nodal agency in the administrative structure of the central government for planning, promotions, co-ordination and overseeing the implementation of India's environmental and forestry policies and programs. The major responsibilities of MoEFCC include:

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

1.4.1 Central and State Pollution Control Boards

The Central Pollution Control Board is responsible for pollution control throughout the country. In addition to the control of air, noise and water pollution it is also responsible to ensure effective control of disposal of hazardous wastes and storage and handling of hazardous chemicals and substances. With the enactment of air and water pollution laws, states have set-up their own State 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 pollution control equipment/ plants for monitoring of their efficiency

The SPCB in consultation with the Central Pollution Control Board may establish norms for air quality, gaseous emission and noise level etc.

1.5 APPROACH AND METHODOLOGY

The environmental study is carried out for the three priority corridors of DMRC Phase IV project. The approach is to follow the sequence of steps adopted in an EIA study. The basic concept is to ascertain the existing baseline conditions and assess the impacts as a result of construction and operation of the project. The changes likely to occur in different components of the environment viz. physical, biological / ecological, environmental and socio-economic etc. have been studied, analyzed and quantified, wherever possible. The baseline data has been documented for various parameters of physical (physiographic and soils), ecological, and environmental pollution (air, water, noise, and solid waste). The impacts are assessed for various phases of project cycle namely:

- ❖ Impacts due to project location,
- ❖ Impacts due to project design,
- ❖ Impacts due to project construction, and
- ❖ Impacts due to project operation.

The impacts are categorized as negative and positive. The cost of management and monitoring programs were estimated and budgeted for. The approach for the study is presented in **Figure-1.2**.

The standard **methodology** for the data collection, impact assessment and formulation of management plans is adopted. The National Acts, Legislation and Laws along with **JICA** and **World Bank** guidelines were consulted with a view to ensure compliance with various requirements. The consultant collected and compiled the environmental baseline data for environmental attributes from primary and secondary sources. The primary sources include site visits, visual inspection, field studies, monitoring and analysis. The secondary sources include the books, reports, maps, websites and documents from various government and non-government organizations on subject matter. The methodology proposed to be adopted for data collection, impact analysis, preparation of environmental management and monitoring plans is highlighted in brief, in the following paragraphs. However, more elaborate methodology is present in the main text in the relevant sections.

1.5.1 Data Collection

The existing **land-use** pattern of the area has been identified mainly as urban human settlements, roads, trees and water bodies. The **Soils** parameters are studied from the field surveys conducted during this study.

Water Resources in the project were considered in terms of precipitation and quality of water. These will facilitate to decide sources of water for uses such as drinking, construction etc.

Air and Noise quality is an important consideration during construction and operation phases. Ambient air quality and noise levels were monitored in an around project area to develop present baseline levels in the area.

Terrestrial **Ecology** was studied. The vegetation types were documented through the visual inspection, past research and filed investigations.

1.5.2 Environmental Impact Assessment

The objective of the study is to assess the impacts as a result of construction of the priority corridors DMRC Phase IV metro project along with sub-stations. The changes likely to occur in different components of the environment were studied and analyzed. The core area of study is to be 200 m on either side of proposed alignment and 25 m for sensitive receptors. Based on project particulars and the existing environmental conditions, potential impacts were identified that are expected to be affected as a result of the proposed project and wherever possible, these are quantified. Both positive and negative impacts are evaluated to have an idea about resultant impacts. These impacts were assessed for various phases of project cycle namely, location, design, construction and operation. The standard methodology was adopted for impact prediction and assessment. The environmental impact of the project includes changes in land use, soil, erosion, water quality, air quality and noise levels etc. The impact on water quality in the water bodies was evaluated with the help of water quality analysis. More details on Environmental Impact Assessment are available in **Chapter 5**.

1.5.3 Environmental Management Plan

The project will provide higher living standard, better quality of life, less travel time, better connectivity and transport facilities. The management plans are essential to ensure that stress/ loads on the systems are within carrying capacity. The management plan aims at maintaining the environmental quality of project area at-least in pre-project stage. An environmental management strategy/ plans were developed to mitigate the adverse impacts. Efforts are made to enhance the quality of environmental attributes.

1.5.4 Environmental Monitoring

It is necessary to monitor during various phases of project cycles the environmental attributes. Monitoring would indicate any environmental problem, which has come up due to an ongoing activity. This will facilitate to assess the effectiveness of management / mitigation measures. The consultant has designed a post project environmental monitoring program for implementation. The cost estimates for environmental monitoring and management have been included in the project estimates.

1.6 LESSONS LEARNED

As is the case with Phase-IV, in the previous phases also Environmental Impact Assessment (EIA) and Social Impact Assessment (SIA) including land acquisition were carried out as per the existing rules, regulations and laws. Since both studies were carried as per rules there was no scope for deviation in procedure and process, as both EIA and SIA including Land Acquisition require significant involvement of district and state administrations. Close co-ordination with local and state and national administration is crucial for successful implementation of EMP and R&R. However, under the present circumstances due to the COVID-19 pandemic and the subsequent nationwide lockdown, the district and the state machinery have been involved in primarily containing the impact of the pandemic. This may or may not have an impact on the project execution, however, it is beyond the control of DMRC project team.

The only major difference from Phase-III is the introduction of the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 in place of the Land Acquisition Act 1894 amended in 1984. In previous phases, land acquisition and resettlement and rehabilitation were carried out as per the provisions of the Land Acquisition Act, 1894 and the National Resettlement and Rehabilitation Policy 2007. In light of the recent act, in Phase-IV the Entitlement Matrix has been prepared as per the new law.

Other than the issues discussed above, the project is not prone to have significant impacts which could have a bearing on the project implementation. Based on the experience from previous phases, necessary consideration has been given in the current project to overcome issues like traffic management/diversion, noise and vibration, resettlement & rehabilitation etc.

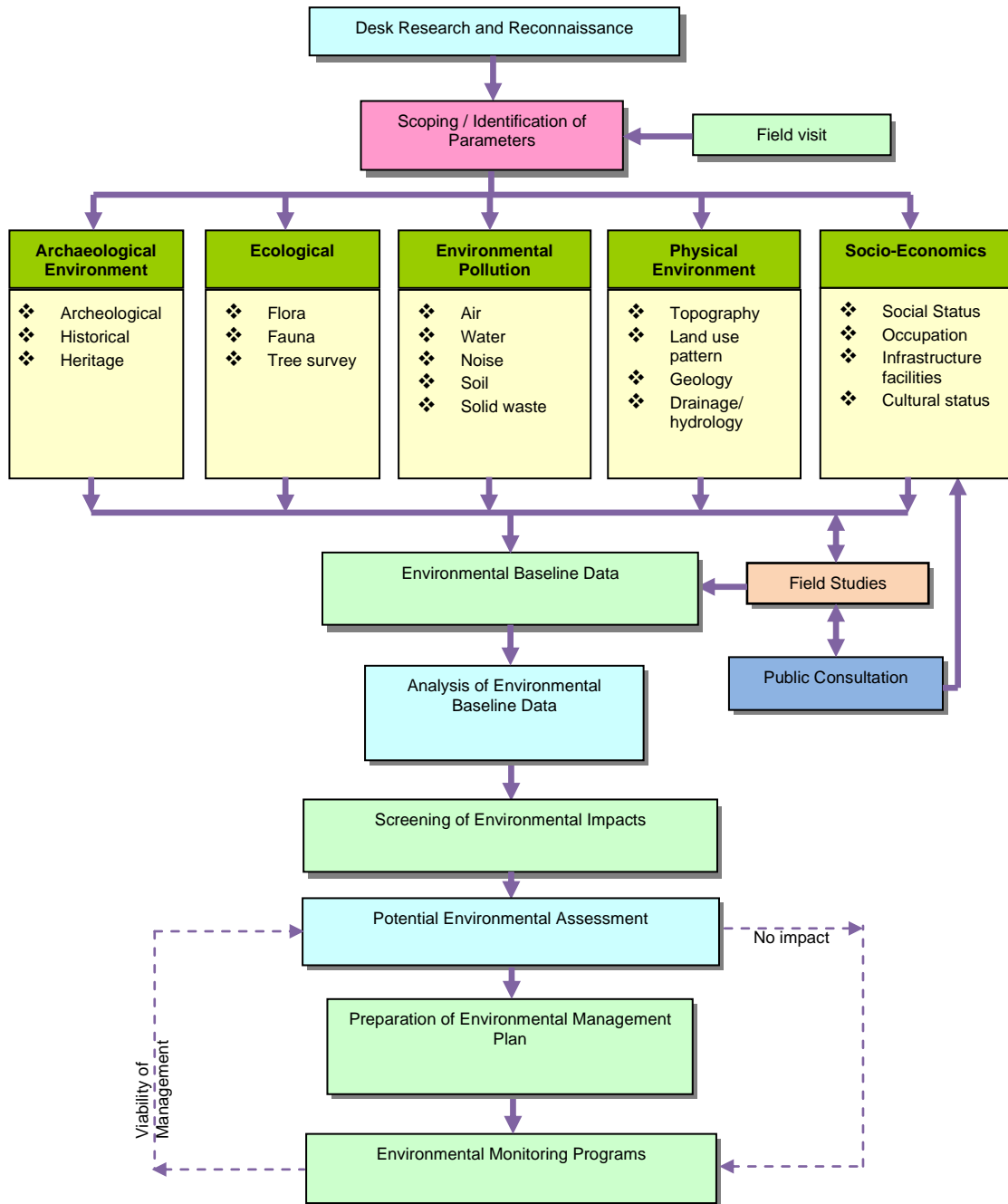
1.7 FORMAT OF THE REPORT

The main elements of the study are as follows: In **Chapter-2** a concise documentation is given on current and planned activities. Analysis of alternative has been described in **Chapter 3**. **Chapter-4** summarizes environmental baseline conditions including physical, biological and socio-economic parameters and pre-project environmental constraint such as air pollution, problems related to public health and traffic congestion. Potential negative and positive impacts are presented in **Chapter-5 and Chapter-6** respectively. These include issues such as loss of land, rehabilitation and resettlement, disposal of soil, loss of trees, noise and vibration, disruption of utilities/ facilities, and other problems due to the development of proposed Mass Rapid Transport System Phase-IV in Delhi.

Based on the anticipated negative impacts, the project may bring about an environmental management strategy, which has been outlined in **Chapter-7**. **Chapter-8** includes post project environmental monitoring programme. This programme aims at signalling any potential environmental problem during construction and operation of the project and it should allow for timely implementation of corrective measures. Information disclosure and public consultations are given in the **Chapter 9**. Finally, a summary of the costs of the environmental management and monitoring programmes falling under the responsibility of the project is presented in **Chapter-10**.

The revised SIA report along with resettlement and rehabilitation plan for the priority corridors of DMRC Phase IV project has been submitted in February 2020.

Figure 1.2: Flow Chart of The EIA Study



2. PROJECT DESCRIPTION

2.1 EXISTING SYSTEMS

With the fast expansion of urban area in the NCT of Delhi the transportation network has also expanded with many new features. The mega cities with population of more than 10 million need to maintain their Public Transport System in view of the requirement of linkages between work place and residence, educational institutions and residence, trade and cultural centers and residence besides linkages with inter-city transportation terminals of rail, road and air.

The intra-city traffic volume in Delhi necessitated needs a full-fledged integrated multi modal mass rapid passenger system. In view of this, the then Delhi Government entrusted the task to RITES for conducting a Feasibility Study in 1990-91 for an 'Integrated Multi-Modal Mass Rapid System'. The Feasibility Report submitted by RITES, a Govt agency, recommended a three-tier transport system comprising of Rail corridors (elevated & at-grade), Metro corridors (underground) and dedicated bus way. The recommended Metro network in the 'Revised Metro Master Plan for 2021', prepared by RITES, totaled to a length of 413.83 km and was slated for completion latest by the year 2021 in four phases. Accordingly, on the basis of traffic and transport studies conducted by the authorized agencies, various corridors had been identified in Phase-I, II & III of Delhi Metro Project. All the corridors of Phase-I, Phase-II and Phase III are also fully operational.

2.1.1 Existing Metro System

Following are the corridors of Delhi Metro under Phase-I, II and Phase-III.

First Phase of Delhi Metro Project

| | | | |
|------|--|----------|-----------------|
| i) | Shahdara-Rithala | - | 22.00 km |
| ii) | Vishwa Vidyalaya-Central Secretariat | - | 11.00 km |
| iii) | Barakhamba Road-Dwarka | - | 22.80 km |
| iv) | Barakhamba Road-Indraprastha | - | 2.80 km |
| v) | Extension of Line-3 into Dwarka sub-city | - | 6.50 km |
| | Sub-total (Phase-I) | - | 65.10 km |

Second Phase of Delhi Metro Project

| | | | |
|-------|--|----------|------------------|
| i) | Vishwa Vidyalaya-Jahangirpuri | - | 6.36 km |
| ii) | Central Secretariat-Qutab Minar | - | 12.53 km |
| iii) | Shahdra-Dilshad Garden | - | 3.09 km |
| iv) | Indraprastha-New Ashok Nagar | - | 8.07 km |
| v) | Yamuna Bank-Anand Vihar ISBT | - | 6.17 km |
| vi) | Kirti Nagar-Mundka (with operational Link to Line-1 at Inderlok) | - | 18.46 km |
| vii) | Dwarka Sec.9-Sec.21 | - | 2.76 km |
| viii) | Qutub Minar-Arjan Garh (Delhi portion) | - | 7.42 km |
| ix) | Central Secretariat-Badarpur | - | 20.01 km |
| x) | Airport Link | - | 19.20 km |
| xi) | Dwarka Sec.21-Airport | - | 3.50 km |
| | Sub-total (Phase-II) | - | 107.57 km |

In addition, the following extensions of Delhi Metro Phase-II to NCR have also been implemented and already operational:-

| | | | |
|------------------|-----------------------------------|---|-----------------|
| (a) | New Ashok Nagar-Noida City Centre | - | 7.00 km |
| (b) | Arjan Garh-Sushant Lok | - | 7.05 km |
| (c) | Anand Vihar ISBT-Vaishali | - | 2.57 km |
| Sub-total | | - | 16.62 km |

Third Phase of Delhi Metro Project (under implementation)

| | | | |
|------------------------------|-----------------------------------|---|------------------|
| i) | Jahangirpuri-Badli | - | 4.49 km |
| ii) | Central Secretariat-Kashmiri Gate | - | 9.37 km |
| iii) | Mukundpur- Yamuna Vihar | - | 55.70 km |
| iv) | Janakpuri-Kalindi Kunj | - | 33.50 km |
| v) | Shiv Vihar Extension | - | 2.70 km |
| vi) | Najafgarh Extension | - | 5.50 km |
| Sub-total (Phase-III) | | - | 111.25 km |

In addition, the following extensions of Delhi Metro corridors to NCR are also being implemented in phase III:-

| | | | |
|---|--|---|------------------|
| (d) | Faridabad Extension | - | 13.88 km |
| (e) | Mundka –Bahadurgarh | - | 11.18 km |
| (f) | Kalindikunj to Botanical garden | - | 3.96 km |
| (g) | Dilshad Garden to New Bus Adda Ghaziabad | - | 9.60 km |
| (h) | Escorts Mujesar to Ballabhgarh | - | 3.20 km |
| (i) | Noida City Centre – Noida Elec. City | - | 6.68 km |
| Sub-total | | - | 48.50 km |
| Total Phase-I, II, III & Extensions to NCR | | - | 349.88 km |

Even with the fully operational of Phase III, Delhi would still lag behind in terms of having adequate coverage by metro network to meet the transport requirements of its population. Hence the need to plan Phase IV has arisen. The total length for Phase-IV as approved by the Central Government is approximately 61.66 kms for three priority corridors and is planned for completion by 2025.

2.1.2 Proposed Phase IV Metro Corridors

While sanctioning Phase-III of Delhi Metro, Empowered Group of Ministers (EGoM) desired that the under mentioned corridors should be examined and brought to them for sanction:

1. Yamuna Vihar to Shiv Vihar
2. Dwarka to Najafgarh
3. Mundaka to Bahadurgarh
4. Rithala to Bawana
5. Sec-21 Dwarka to IFFCO Chowk
6. Shiv Vihar to Mukundpur (modified as Maujpur to Mukundpur)

7. Bawana to Rithala

In addition to above, DMRC was also directed to come up with proposal for Phase IV of Delhi Metro. Following corridors were proposed by DMRC to be taken up in Phase IV of Delhi Metro.

Table 2.1: Phase – IV Corridors

| S. No. | Corridors | Total (km) |
|--------------|------------------------------|---------------|
| 1. | Yamuna Bank To Loni Border | 11.97 |
| 2. | Rithala To Bawana. | 12.50 |
| 3. | Janak Puri West To Mukundpur | 18.74 |
| 4. | Mukundpur to Dilshad Garden | 17.54 |
| 5. | Kirti Nagar to Dwarka Sec-28 | 18.17 |
| 6. | Badarpur to Delhi Aero City | 20.79 |
| 7. | Lajpat Nagar to Madangir | 7.33 |
| 8. | Azadpur to R.K.Ashram | 8.90 |
| Total | | 115.94 |

However, in between, Delhi Govt. got prepared DPR for Trilokpuri to Shastri Park to be taken up as Monorail corridor and hence the same will not be part of Phase-IV Metro. The traffic study done by M/s. RITES brought out that under mentioned corridors are having the requisite traffic and to be considered for implementation as part of Phase IV:

1. Janakpuri (W) – Mukundpur – R.K. Ashram (28.92 km)
2. Trilokpuri to Loni Border (20 km): The part of this corridor, as mentioned above, is already decided to be taken up as Monorail corridor and hence will not be part of Phase-IV Metro but entire corridor may have Monorail.
3. Tughlakabad to Aerocity – (20.2 km)
4. Lajpat Nagar to Saket G Block (7.96 km)
5. Inderlok to Indraprastha (12.58 km)
6. Rithala –Bawana –Narela (21.73 km):
7. Maujpur to Mukundpur (12.54 km): (i.e. Maujpur-Yamuna Vihar – Mukundpur)

The total of length of above corridors comes to 103.93 Km. However, following 3 priority corridors have been identified for implementation under Phase-IV-Part A of Delhi Metro.

Table 2.2: Proposed Phase – IV Corridors

| S. No. | Corridors | Total (km) |
|--|-------------------------------|---------------|
| PHASE-IV – PART A METRO RAIL PRIORITY CORRIDORS | | |
| 1 | Janak Puri West to R.K.Ashram | 28.920 |
| 2 | Mukundpur to Maujpur | 12.588 |
| 3 | Aero City to Tughlakabad | 23.622 |
| Total for Metro Rail Corridors | | 65.100 |

2.1.3 Description of Route Alignments

Aero City-Tuglakabad Corridor: This corridor originates from Aero City; adjacent to an existing station on the Airport expresses line; crosses National Highway-8; leads in southeast direction as underground section under Mahipal Pur village up to km 1.4. There after it aligns along the Abdul Gaffar Khan Marg leading towards Andheria Mor and runs along it up to Kisangarh. Here it turns left passes under Vasant Kunj and Mehrauli by the side of Bhul Bhulliya and aligns along Mehrauli – Badarpur Road. It emerges out from underground section to elevated section between km 11.715 and km 11.866. First elevated station is Saket. Alignment continue to run along the Mehrauli – Badarpur road as elevated section upto km 18.55. Here it further changes from elevated section to underground section and remains underground till Tughlakabad.

Janakpuri West To Ram Krishna Ashram Marg Corridor: This corridor is an extension of alindi Kunj-Janakpuri West Corridor of Phase-III of Delhi Metro. From Janakpuri West (underground station) this corridor takes left turn to fall on Dr. Hedgewar Marg (outer ring road) and becomes elevated through ramp near Anand Kunj red light on outer ring road. Then up to Ashok Vihar, the corridor is elevated corridor and passes through many prime locality like Krishna Park, Vikas Puri, Keshopur, Meera Bag, Sunder Vihar, Peeragarhi, Mangolpuri, West Enclave, Pushpanjali Enclave, Deepali, Rohini, Saraswati Vihar, Madhuban Chowk, Pitampura, Prashant Vihar, Badali Mor, Makaraba Chowk, Jahangir Puri and Bhalaswa Gaon. From Derawal Nagar onward, the alignment becomes underground and generally passes under G.T.Road. The underground alignment passes through Rajpura, Ghanta Ghar, Subji Mandi, Pulbangesh, Sadar Bazar, Motia Khan and finally terminates at Ram Krishna Ashram Marg where it has passenger interchange with existing Ram Krishna Ashram Marg Station of Line-3.

Mukundpur - Maujpur Corridor (Via Burari, Khajuri Khas): This corridor is an extension of Mukundpur- Rajouri Garden-INA- Nizamuddin- Anand Vihar - Maujpur Corridor of Phase-III of Delhi Metro. From Maujpur this corridor runs along Road no-66 and near Yamuna Vihar takes left turn to fall on Mangal Pandey Marg. Then upto Wazirabad Bridge, the corridor is elevated corridor and remains on Mangal Pandey Marg and passes through many prime locality like Yamuna Vihar, Gokulpuri, Bhajanpura, Khajurikhas etc. After crossing Wazirabad Bridge, it reaches Soorghat and then takes a right turn to fall on Dr Hedgewar Marg (outer ring road). Further, it remains on same road and passes through Jagatpur, Burari and finally at Mukundpur Red Light on Dr Hedgewar Marg (outer ring road), it turns left to terminate at Majlis Park Station of Phase-III.

Figure 2.1: Index Plan for Aero City to Tughlakabad

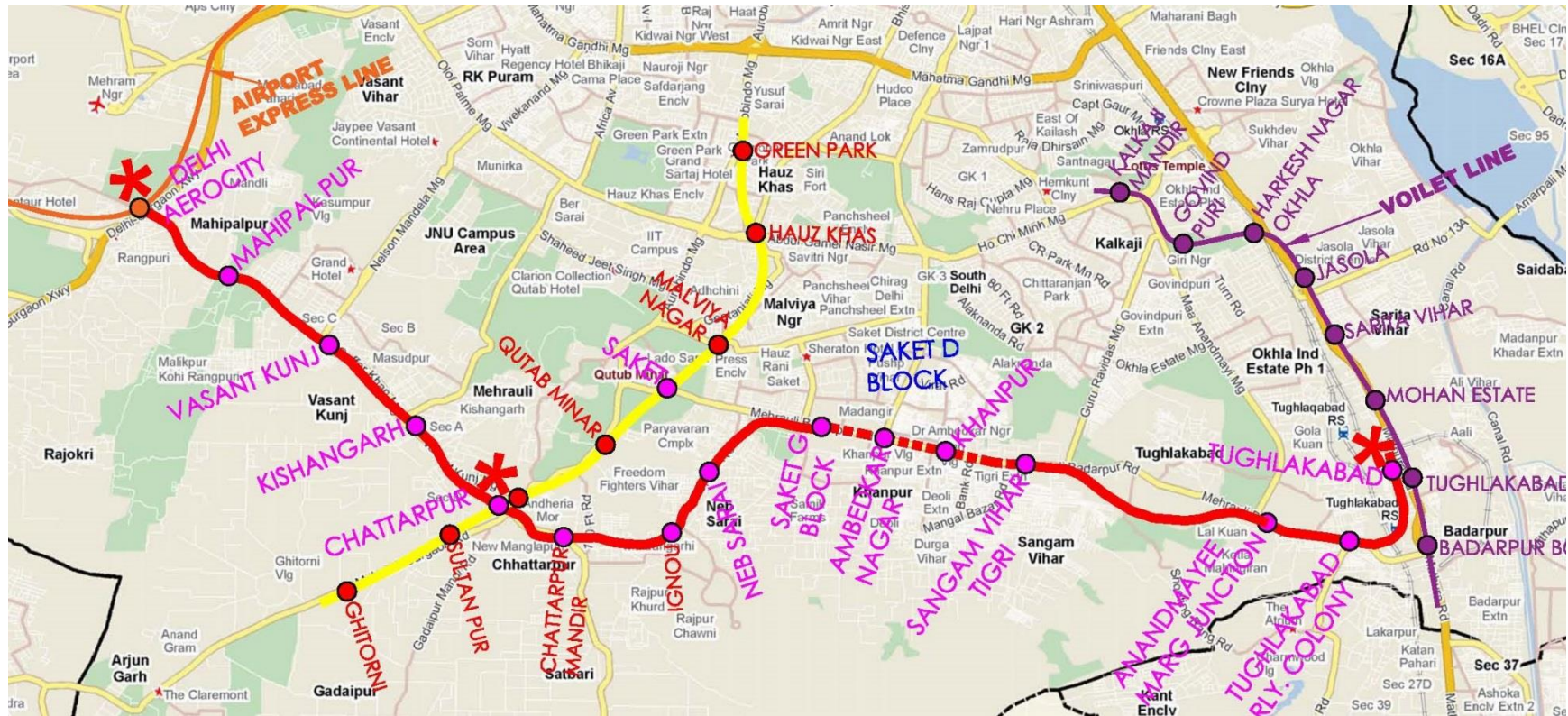


Figure 2.3: Index Plan for Mukundpur To Maujpur



Table 2.3: Details of Phase IV Part A (Priority) Corridors

| S.No. | Corridor | Under-ground | Elevated /at Grade | Total Length (km) | Stations (Nos) | | |
|--------------|-------------------------------|---------------|--------------------|-------------------|----------------|-----------|-----------|
| | | | | | Under-ground | Elevated | Total |
| 1.0 | Aerocity to Tughlakabad | 19.343 | 4.279 | 23.622 | 11 | 4 | 15 |
| 2.0 | Janakpuri West to R.K. Ashram | 7.740 | 21.180 | 28.920 | 7 | 14 | 21 |
| 3.0 | Mukundpur-Maujpur | 0.000 | 12.558 | 12.558 | 0 | 8 | 8 |
| Total | | 27.083 | 38.017 | 65.100 | 18 | 26 | 44 |

2.2 RIDERSHIP ON PHASE IV

Daily ridership on the phase IV corridors of metro system in 2021 is expected to be 5.22 lakh passengers with 10 lakh boarding's. The average trip length with full system up to Phase-IV is 16.8 km in year 2021. Phase IV corridor wise total daily boarding and trips for the years 2021, 2031 and 2041 are shown in **Table 2.4**.

Table 2.4: Corridor wise Daily Ridership On Phase-IV Delhi Metro Corridors

| S No. | Name | Daily Boarding (including Interchanges) | | | Daily Trips (Passengers) | | |
|---|---|---|----------------|----------------|--------------------------|---------------|----------------|
| | | 2021 | 2031 | 2041 | 2021 | 2031 | 2041 |
| 1 | Janakpuri West to RK Ashram | 550719 | 757503 | 1026359 | 275579 | 528054 | 776060 |
| 2 | Mukundpur to Maujpur | 178631 | 270411 | 329894 | 96198 | 188503 | 249442 |
| 3 | Tughlakabad / Lajpat Nagar to Aero City | 279176 | 357867 | 478131 | 150345 | 249468 | 361529 |
| Grand Total Daily Boarding's / Trips | | 1008526 | 1385781 | 1834384 | 522122 | 966025 | 1387031 |

The increment in daily trips due to implementation of phase-IV of Delhi Metro corridors is expected to be 5.22 Lakh, 9.66 Lakh and 13.8 Lakh passengers in the years 2021, 2031 and 2041 respectively as shown in the **Table 2.5** below.

Table 2.5: Incremental Daily Trips (Passengers) Due To Phase IV Part A Of Delhi Metro

| Year | Daily Trips | | Incremental Trips Due to Ph IV |
|------|-----------------------|--------------------------|--------------------------------|
| | With Phase I,II & III | With Phase I,II,III & IV | |
| 2021 | 4,055,753 | 4,577,875 | 522,122 |
| 2031 | 5,184,850 | 6,150,875 | 966,025 |
| 2041 | 6,516,690 | 9,903,721 | 1,387,031 |

2.3 ROLLING STOCK

Following are the salient features of rolling stock

- ❖ Running of services for 19 hours of the day (5 AM to Midnight) with a station dwell time of 30 seconds,
- ❖ Make up time of 5% with 8% coasting.

Scheduled speed has been assumed as below:-

- (a) Tughlakabad to Aerocity Corridor: 35 kmph
- (b) Janakpuri West to R K Ashram (Botanical Garden to R. K. Ashram Corridor): 35 kmph
- (c) Mukundpur to Maujpur : 35 kmph

Table 2.6: Salient Features of Standard Gauge (3.2 M Wide Stock) Cars

| S. No. | Parameter | Standard Gauge (3.2 m wide stock) Cars |
|--------|--|---|
| 1 | Gauge (Nominal) | 1435mm Standard Gauge |
| 2 | Traction system | |
| 2.1 | Voltage | 25 KV AC |
| 2.2 | Method of current collection | Overhead Current Collection System |
| 3 | Train composition | |
| 3.1 | 6 car: | DMC+TC+MC+MC+TC+DMC |
| 4 | Coach Body | Stainless Steel |
| 5 | Coach Dimensions | |
| 5.1 | Height | 3.9 m |
| 5.2 | Width | 3.2 m |
| 5.3 | Length over body (approx) | |
| | - Driving Motor Car (DMC) | 21.81 m |
| | - Trailer Car (TC) | 21.34 m |
| | - Motor Car (MC) | 21.34 m |
| | Maximum length of coach over couplers/buffers: | 22 to 22.6 m (depending upon Kinematic Envelop) |
| 5.4 | Locked down Panto height | 4048 mm |
| 5.5 | Floor height | 1100mm |
| 6 | Designed - Passenger Loading | |
| 6.1 | Design of Propulsion equipment | 8 Passenger/ m ² |
| 6.2 | Design of Mechanical systems | 10 Passenger/ m ² |
| 7 | Carrying capacity- @ 6 standees/sqm | |
| 7.1 | Coach carrying capacity | |
| | DMC | 300 (seating - 50 ; standing - 250) |
| | TC | 300 (seating - 50 ; standing - 250) |
| | MC | 300 (seating - 50 ; standing - 250) |
| 7.2 | Train Carrying capacity | |
| | 6 car train | 1800 (seating - 300 ; standing - 1500) |
| 8 | Weight (Tonnes) | |
| 8.1 | Tare weight (maximum) | |
| | DMC | 42.502 |

| | | |
|--------|---|---|
| | TC | 40.852 |
| | MC | 42.104 |
| 8.2 | Passenger Weight in tons | @ 0.065 T per passenger |
| | DMC | 19.50 |
| | TC | 19.50 |
| | MC | 19.50 |
| 8.3 | Gross weight in tons | |
| | DMC | 62.002 |
| | TC | 60.352 |
| | MC | 61.604 |
| 9 | Axle load(T)(@ 8 persons per sqm of standee area) | 17 |
| | | System should be designed for 17T axle load |
| 10 | Maximum Train Length (approx.) | 135.6 m |
| 11 | Speed | |
| 11.1 | Maximum Design Speed | 95 Kmph |
| 11.2 | Maximum Operating Speed | 85 Kmph |
| 11.3 | Scheduled Speed | 35 kmph |
| 12 | Wheel Profile | UIC 510-2 |
| 13 | Noise Limits (ISO 3381 and 3095 - 2005) | |
| 13.1 | Stationary (Elevated and at grade) | |
| 13.1.1 | Internal (cab and saloon) | LpAFmax 65 dB(A) |
| 13.1.2 | External (at 7.5 mtr from centre line of track) | LpAFmax 68 dB(A) |
| 13.2 | Running at 85 kmph (Elevated and at grade) | |
| 13.2.1 | Internal (cab and saloon) | LpAeq,30 72 dB(A) |
| 13.2.2 | External (at 7.5 mtr from centre line of track) | LpAFmax 85 dB(A) |
| 13.3 | Stationary (Underground) | |
| 13.3.1 | Internal (cab and saloon) | LpAFmax 72 dB(A) |
| 14 | Traction Motors Ventilation | Self |
| 15 | Acceleration on level tangent track | 1.0 m/sec ² |
| 16 | Deceleration on level tangent track | 1.1 m/sec ² (>1.3 m/sec ² during emergency) |
| 17 | Type of Bogie | Fabricated |
| 18 | Secondary Suspension springs | Air |

| | | |
|------|---|--|
| 19 | Brakes | <p>An electro-pneumatic (EP) service friction brake</p> <p>An electric regenerative service brake</p> <p>Provision of smooth and continuous blending of EP and regenerative braking</p> <p>A fail safe, pneumatic friction emergency brake</p> <p>A spring applied air-release parking brake</p> <p>The brake actuator shall operate a Tread brake</p> <p>Brake Electronic Control Unit (BECU)</p> <p>Independent for each car</p> |
| 20 | Coupler | |
| | Outer end of 2-car/3-car Unit (except driving cab ends) | Automatic coupler with mechanical, electrical & pneumatic coupling (between two 'DM+T+M' units) |
| | Between cars of same Unit | Semi-permanent couplers (between 'M' car and 'T' car and 'DM' car and 'T' car) |
| | Driving Cab end of cars (DMC) | Automatic coupler with mechanical & pneumatic coupling but without electrical coupling head |
| 21 | Detrainment Door | Front |
| 22 | Type of Doors | Sliding |
| 23 | Passenger Seats | Stainless Steel |
| 24 | Cooling | |
| 24.1 | Transformer | Forced |
| 24.2 | CI & SIV | Self/Forced |
| 24.3 | TM | Self ventilated |
| 25 | Control System | Train based Monitor & Control System (TCMS/TIMS) |
| 26 | Traction Motors | 3 phase VVVF controlled |
| 27 | Temperature Rise Limits | |
| 27.1 | Traction Motor | Temperature Index minus 70 deg C |
| 27.2 | CI & SIV | 10 deg C temperature margin for Junction temperature |
| 27.3 | Transformer | IEC specified limit minus 20 deg C |
| 28 | HVAC | <p>Cooling, Heating & Humidifier (As required)</p> <p>- Automatic controlling of interior temperature throughout the passenger area at 25°C with 65% RH all the times under varying ambient conditions up to full load.</p> |
| 29 | PA/PIS | Required |

| | | |
|----|-------------------------------|--|
| 30 | Passenger Surveillance (CCTV) | Required |
| 31 | Battery | Ni-Cd |
| 32 | Headlight type | LED |
| 33 | Coasting | 8% (Run time with 8% coasting shall be the 'Run Time in All out mode plus 8%') |

2.4 MAINTENANCE DEPOTS

In priority corridors of Delhi MRTS Phase – IV, Construction of New Depot is not planned. Existing depot at Mukundpur will be strengthened by augmenting facilities to serve the extension of Line – 7 (Maujpur – Mukundpur) and Line – 8 (Janakpuri West – R.K. Ashram) corridors. The existing depot of Line – 6 at Sarita Vihar will be used for Tughlakabad – Aerocity Corridor.

2.5 TRACTION SYSTEM

Existing system of electric traction on all the corridors of Delhi Metro constructed in Phase – I, Phase – II and adopted in Phase – III is at 25kV ac single phase. This is based on techno economic studies for Delhi.

- (a) The same traction system for the proposed Phase-IV corridors has been considered, viz 25 kV 50 Hz ac single phase.
- (b) Alternatively study is also being carried out for 2x25 kV AC single Phase traction system which has benefits in terms of the following:-
- (i) RSS requirement is reduced to half.
 - (ii) Do away with the BT/RC system as no electromagnetic interference mitigation is required in 2x25 kV system.
 - (iii) Reduced transmission losses in the system.

In the open area at grade and on elevated structures flexible over head equipment (OHE), similar to the existing corridors has been considered and to be provided or if 2x25 kV system is adopted will need additional feeder wire to be taken and the design shall be finalized accordingly.

The underground sections will have rigid overhead catenary system, similar to that provided for the underground sections constructed in Phase – I, Phase – II and adopted in Phase – III of Delhi metro and in case of 2x25 kV system it will be finalized similar to Sin - Bundang line of Seoul Metro.

2.6 AUXILIARY SUPPLY

The auxiliary supply and general electrical services of the elevated and above ground portion shall generally follow the system design of 33 kV ring main adopted for corresponding sections of Phase – II with some modifications based on techno-economic study being done and same may be adopted in phase-III.

2.7 SOURCES OF POWER SUPPLY

Since Delhi metro has adopted 25kV ac single phase overhead catenary traction system or planning for 2 X 25 kV traction system, therefore the power supply at 66 kV or 220kV level only has to be taken from the Grid Sub Stations of Delhi Transco Limited (DTL) on technical consideration of short circuit level etc. Following will be the sources as tabulated in **Table 2.7**.

Table 2.7: Traction System*

| Corridor | | Location of source of power |
|--|---|---|
| Janakpuri West to R. K. Ashram Corridor (28.83 km, 25 Stations of which 7 Underground stations). | 1 | Feed extension from Janakpuri West station of phase-III supply. |
| | 2 | At 66 kV from proposed Sanjay Gandhi Transport Nagar 220 kV GSS. |
| | 3 | At 66 kV from Park Street 220 kV GSS. |
| Aerocity to Tughlakabad Corridor (20.20 km, 15 Stations of which 10 Underground Stations) | 1 | At 66 kV from Vasant Kunj 220 kV GSS or proposed Rangpuri 220 KV GSS. |
| | 2 | At 66 kV from Tughlakabad 220 kV GSS. |
| Mukundpur –Burari- Maujpur | | Mukundpur and Yamuna Vihar RSS |

* In case of 2 x 25 kV system being adopted no of RSS required will be by fifty percent and there may be need of Auto Transformers posts (ATP).

In Phase – IV, the corridors described above, are passing through the densely populated areas of Delhi and will be having underground stations and tunnels. The availability of power from the existing grid sub-station in these areas is scarce and, therefore, innovative methods are to be “thought – of” for providing reliable power at high voltage based on techno economic considerations.

The locations of the RSS – cum – TSS to be constructed in Phase – IV will be finalized during detailed design stage keeping in view the location of Delhi Transco Limited's supply sources (GSS) in the vicinity and the availability of land for RSS.

2.8 POWER DEMAND ASSESSMENT

(a) Traction Power:-

The traction power system is designed for the ultimate 6-car train operation at headway of 90-seconds corresponding to 40 trains per hour for corridors Janakpuri West to R.K.Ashram, Aerocity to Tughlakabad, Indraprastha to Inderlok and Lajpat Nagar to saket G Block.

(b) Auxiliary Power:-

i) Elevated Stations:-

The demand of power at each elevated station is expected to be about 200 kW in the initial years and is likely to reach 500kW later. In addition there will be some additional requirement for other property development loads at stations. The limited requirement of load due to property development within the footprints of the station can be met either from the spare capacity in the station transformers or by adding one additional transformer of 630 kVA capacity in the station ASS for which provision for space will be made during design stage. This may be feasible depending upon the diversity of station loads and property development loads.

For larger property development loads (above capacity of transformers of 630 kVA), the power transformer at RSS and the corresponding cable network may need an up gradation for which the expenditure is to be charged to property development.

ii) Underground Stations:-

The demand of power at each underground station is assessed at connected load of 2.8 MW with a load factor of 0.8 of 3.5 MVA for 6 car.

The additional peak demands of power for the corridor for the year 2021, 2031 and 2041 have been indicated in **Table 2.8**. Peak power demand for the designed headway of 90 seconds with 6-car train operation has also been indicated in this table.

Table 2.8: Power Demand Assessment (in MVA)

| Year | Corridor | Traction | Auxiliary | Traction | Auxiliary | Total |
|--------|--------------------------------|----------|-----------|----------|-----------|-------|
| 2021 | Janakpuri West to R. K. Ashram | 12.32 | 23.59 | 24.43 | 54.7 | 79.13 |
| | Aerocity to Tughlakabad | 7.11 | 28.91 | | | |
| | Mukundpur-Burari-Maujpur | 5.00 | 2.20 | | | |
| 2031 | Janakpuri West to R. K. Ashram | 14.57 | 28.29 | 30.86 | 64.21 | 95.07 |
| | Aerocity to Tughlakabad | 8.89 | 32.92 | | | |
| | Mukundpur-Burari-Maujpur | 7.40 | 3.00 | | | |
| 2041 | Janakpuri West to R. K. Ashram | 19.57 | 35.21 | 40.54 | 76.46 | 117 |
| | Aerocity to Tughlakabad | 11.67 | 37.55 | | | |
| | Mukundpur-Burari-Maujpur | 9.30 | 3.70 | | | |
| Design | Janakpuri West to R. K. Ashram | 59.13 | 35.21 | 119.44 | 76.46 | 195.9 |
| | Aerocity to Tughlakabad | 41.71 | 37.55 | | | |
| | Mukundpur-Burari-Maujpur | 18.60 | 3.70 | | | |

2.9 POWER DEMAND

Power demand has been worked out for the proposed corridors accordingly and is given in the table below:-

Table 2.9: Power Demand

| S. No | Corridor | Power Demand in MVA | | | |
|-------|--------------------------------|---------------------|-------|-------|---|
| | | 2021 | 2031 | 2041 | Designed Headway of (6-car train at 90 sec) |
| 1. | Janakpuri West to R. K. Ashram | 35.92 | 42.86 | 54.87 | 94.33 |
| 2. | Aerocity to Tughlakabad | 36.02 | 41.81 | 49.22 | 79.26 |
| 5. | Mukundpur to Maujpur | 7.2 | 10.4 | 13.0 | 22.30 |

2.10 CONSTRUCTION METHODOLOGY

Elevated corridor

It is proposed to provide single box-shaped girders as super structure for the viaduct as adopted in various sections in phase-I, II & III. As the alignment passes through sufficiently wide roads, no difficulty is envisaged during construction. However, at some locations, there will be a need of providing special spans to be finalized at the stage of detailed design. Typical Drawings are presented in **Annexure-2.1**.

Elevated Stations

Elevated stations will normally of two types (concourse under the platform and concourse on both sides of alignment provided in towers and inter connection between two through a FOB) as adopted in Phase I, II & III. The construction methodology shall remain the same as adopted for respective type of stations in phase- I, II & III. Typical Drawings are presented in **Annexure -2.1**.

Underground Section

Construction of the underground section shall be done by “cut and cover” as well as by “bored” tunneling method (TBM). Cut and cover methodology for various sections of proposed corridor will be the same as already done in phase- I, II & III. Typical Drawing is presented in **Annexure -2.1**.

Underground Station

All the underground stations have been proposed to be constructed by cut and cover with top- down method. The diaphragm walls for such station constructions would be 80 to 100 cm thick and will function as a permanent side wall of the station. By resorting to top-down method the surface could be restored quickly and further excavations and construction of the station will not hamper the surface activity. Cut and Cover mainly consists of following steps:

1. Diversion of utilities
2. Construction of support walls
3. Excavation between the support walls along with the installation of struts between the two walls to keep them in position.
4. Construction of tunnel/structure and removal of temporary struts.
5. Back filling and restoration of the surface

2.11 CONSTRUCTION STRATEGY

Civil works

It is proposed that whole corridor can be subdivided into smaller stretches. Each stretch can be 5 to 6 km long. These can be termed as Contract Packages. Each Contract Package will include even Metro stations falling in that particular stretch.

Sources of procurement of construction material will be decided by the Contractor, but it will be from existing licensed suppliers. Typical materials and their source are provided in **Table 2.10**.

Table 2.10: Construction Materials

| S.No. | Material | Source (with Approximate distance) |
|-------|------------------|---|
| 1 | Coarse aggregate | Kotputli, Rajasthan (180 km) |
| 2 | Fine aggregate | Bazpur (250 Km), Patankot, (480 km,) |
| 3 | Cement | Shambupura (600km), Neemach (650Km) etc |
| 4 | Steel | Raipur (1200 km), Patratu, Jharkhand (Approx 1188 km) |
| 5 | Bricks | Dadri (80 km), Mahilpalpur, Delhi |
| 6 | Granite | Karnataka (>1000km), Madurai, Tamilnadu (Approx 2584.8 Km), Jaipur, Rajasthan (300km) |

Large numbers of pre-cast segments are required for construction of elevated/underground structures for which a large open area is required for setting up of casting yards. As far as possible, this area will be close to the site, easily accessible and away from habitation. The Contractor will construct temporary batching plant near the construction sites. The location of the temporary construction facilities will be decided with the Contractor, but it will be located in open land to avoid any displacement. The site for Casting yard and Batching plant has not been finalized and site will be provided by land owning agency subjected to availability of land before the start of project. Fresh concrete will be supplied from new concrete batching plants constructed specifically for this Project.

Power Supply & Electric Traction Works

Detailed Designs of 'Power Supply & Electric Traction' works will mostly be done in-house. For detailed designs of a few specialized items DDCs will be engaged. These works will be got executed through 'construct' contracts. Cables and other materials required in bulk will be procured by DMRC itself and supplied to the 'construction' contractors. This strategy of mostly doing the detailed design work in-house, getting the works executed through construction contracts, procuring cable and other bulk materials and supplying the same to the construction contractors will enable DMRC to reduce the cost of these works. Entire Power Supply & Electric Traction works can be carried out through a single contract for each corridor respectively.

Track Work

Detailed design of ballastless / ballasted track will be done in-house by DMRC. Track work shall be got executed through 'construct' contract. Material like rails, sleepers, track fittings, turnouts, etc. will be procured by DMRC and supplied to the construction contractors. It is proposed to have one track work contract for approximately 15 kms long alignment.

Signalling & Telecommunication works

These will be split into separate Signalling contracts & Telecommunication contracts. Signalling works will be got executed through 'Design, Construct, installation, testing, & commissioning' basis. It is proposed to have one Signalling contract for entire stretch for each corridor respectively.

Telecommunication works will be got done through 'construct' contract with detailed designs being done in-house. DDCs may also be engaged for specialized items where necessary. Most of the materials required for telecommunication works like cable etc. will be procured by DMRC and supplied to the construction contractors. Entire Telecommunication works can be carried out through

a single contract for each corridor respectively.

Automatic Fare Collection (AFC) System

Installation of AFC system will be got done by DMRC through 'construct' contracts. Hardware and software required for the AFC system will, however, be procured by DMRC and supplied to the contractors. Entire AFC works can be carried out through a single contract for each corridor respectively.

Tunnel Ventilation and Air-conditioning System

Design work of this system will be done in-house but execution will be done through 'construct' contracts. SES analysis, however, may be got done through a DDC. Bulk of materials required for ventilation and Air-conditioning system will be procured by DMRC and supplied to the construction contractors. Entire Tunnel ventilation and Air-conditioning works can be carried out through a single contract for each corridor respectively.

Rolling Stock

Rolling Stock required for the project will be procured on design, manufacture, supply, testing and commissioning basis.

2.12 CONSTRUCTION PERIOD

As per the acquired experience, total work can be completed in 60 months period from date of start. The work has been started by December 2019, and various sections can be opened in phases by March 2025. Project completion date is subject to land required for the project is made available to DMRC within 6 months period from date of sanction of project.

2.13 CONSTRUCTION MACHINERY

Metro construction is machine intensive. Various types of construction equipments are going to be used for construction of elevated and underground sections. The different machineries that are going to be used are presented in Table 2.11.

Table 2.11: Construction Machinery

| S. No. | Construction Machinery |
|---------------|-------------------------------|
| 1. | Tunnel Boring Machine |
| 2. | Auger Drill |
| 3. | Backhoe |
| 4. | Bar Bender |
| 5. | Blasting |
| 6. | Jack Power Unit |
| 7. | Chain Saw |
| 8. | Clam Shovel (dropping) |
| 9. | Concrete Batch Plant |
| 10. | Concrete Mixer Truck |
| 11. | Concrete Pump Truck |
| 12. | Concrete Saw |

| | |
|-----|------------------------------|
| 13. | Crane, Dozer |
| 14. | Drill Rig Truck |
| 15. | Drum Mixer |
| 16. | Dump Truck |
| 17. | Excavator |
| 18. | Flat Bed Truck |
| 19. | Front End Loader |
| 20. | Generator |
| 21. | Grader |
| 22. | Hydra Break Ram |
| 23. | Jackhammer |
| 24. | Pavement Scarafier |
| 25. | Paver, Pickup Truck |
| 26. | Pneumatic Tools |
| 27. | Rivit Buster/chipping gun |
| 28. | Rock Drill |
| 29. | Roller |
| 30. | Sand Blasting |
| 31. | Shears (on backhoe) |
| 32. | Slurry Plant |
| 33. | Slurry Trenching Machine |
| 34. | Tractor |
| 35. | Vacuum Excavator (Vac-truck) |
| 36. | Ventilation Fan |
| 37. | Vibrating Hopper |
| 38. | Vibratory Concrete Mixer |
| 39. | Vibratory Pile Driver |
| 40. | Warning Horn |

2.14 MAINTENANCE ACTIVITIES DURING OPERATION

During operation phase, train maintenance activities will be carried out in the main depot cum workshops where the overhaul and corrective maintenance facilities for whole fleet are planned. The maintenance workshops will be managed by a team of managers who will plan, coordinate and manage various activities in depot to ensure that the trains are well maintained and cleaned for daily passenger service. The main activities that will be taking place in maintenance depot will be train washing, filter cleaning, HVAC filter cleaning, bogie cleaning, internal train cleaning, roof wash, heavy train cleaning, evaporator cleaning and condenser cleaning.

2.15 COST ESTIMATES

Project Cost estimates for the DMRC's Phase-IV Part A metro network has been prepared covering civil, electrical, signalling and telecommunication works, rolling stock, environmental protection, rehabilitation, considering 25 kV AC traction at January 2019 price level, both for Capital and Operation & Maintenance costs.

In order to arrive at realistic cost of various items, costs have been assessed on the basis of accepted/completion rates in various contracts, awarded for similar works by DMRC in Phase-II, Phase-III. A suitable escalation factor has been applied to bring these costs to January 2019 price level. Taxes & Duties such as Customs Duty, Excise Duty, Sales Tax, Works Tax, VAT, etc, wherever applicable, have been worked out on the basis of prevailing rates and included in the cost estimates separately.

The overall Capital Cost for the DMRC's Phase-IV metro of priority corridors at January 2019 price level works out to **Rs. 22,493 Crores** including applicable Taxes & Duties and also including the cost of rolling stock for the additional induced traffic on Botanical Garden-Janakpuri West Corridor due to Phase IV Part A, as tabulated hereunder

Table 2.12: Corridor-Wise Details of Capital Cost

| S.No. | Corridor | Capital Cost (Rs. Crore) | Taxes & Duties (Rs. Crore) | Total (Rs. Crore) |
|--------------|--|-----------------------------|-------------------------------|----------------------|
| 1. | Aerocity - Tughlakabad | 7293 | 938 | 8231 |
| 2. | RK Ashram – Jnakpuri West | 8394 | 955 | 9349 |
| 3. | Mukundpur-Maujpur | 1943 | 247 | 2190 |
| 4 | Additional Rolling Stock including augmentation of depot | 2339 | 384 | 2723 |
| Total | | 19969 | 2524 | 22493 |

3. ANALYSIS OF ALTERNATIVES

The purpose of analysis of alternatives (AoA) is to find the most effective way of meeting the need and purpose of the project, either through enhancing the environmental benefits of the proposed activity and or through reducing or avoiding potentially significant negative impacts, so that project will become environment as well as people-friendly. The primary objectives of an analysis of alternatives are to identify alternate project options at a systemic (technology, route or alignment, *etc.*), and as well as engineering (materials, construction methods, operating practices, *etc.*) levels. An analysis of alternatives, conducted early into the project design and planning stage, helps identify more cost-effective alternatives, reduce adverse impacts and risks, improve performance and validate the appropriateness of the selected option.

In the present phase IV metro project, out of six corridors, three priority corridors of the proposed Delhi Metro Phase IV project have been finalized after taking into account of environmental and social concerns, considerations of traffic, integration with the existing system and importantly, the overall economic and financial viability. The underlying principles for evaluation for each corridor, without affecting the overall usefulness of the corridor, are:

- ❖ Minimum private land acquisition,
- ❖ Least disturbance to properties,
- ❖ Minimum disturbance to people and
- ❖ Minimum disturbance to existing trees and plans/localized ecology and biodiversity.

The 'with' and 'without' project scenarios are analyzed concerning the development of the metro routes by the backdrop of the requirement of reliable quality infrastructure for safe and faster travel. With project, it will provide better, safe and faster connectivity and will ensure that people from areas covered by the project can move in and out of the areas more efficiently.

Without this project, it is expected that there will be an increase in air pollution and exhaust emission due to slow-moving heavy traffic and congestion. Travel will take longer thus impacting productivity and reducing the economic growth of the area. Overloading of existing transport infrastructure will also affect safety and lead to loss of human life due to the increase in accidents.

3.1. LONG TERM SCENARIO "WITH" AND "WITHOUT" PROJECT

Qualitative analysis of the long-term scenarios likely to occur "with" and "without" project scenario is presented in Table 3.1. The "with" project scenarios will, however, occur only if the recommendations provided in mitigation measure and EMP for the construction stage will be followed and all construction activities will be carried out according to principles of Environment-Friendly Construction.

Table 3.1: "With" and "Without" Project Scenarios.

| Scenario type | Long-Term Scenario "With" Project | Long-Term Scenario "Without" Project |
|-----------------------------|--|--|
| Environment | | |
| Physical Environment | | |
| Atmosphere and Climate | Travel time and traffic congestion will reduce as a result of the proposed new metro corridor. Overall, an insignificant level of air pollution. Due to the small section of the route, no change in climatic condition is anticipated | Congested road will consume more travel time and will increase air pollution/exhaust emission. No change in climatic condition |

| Scenario type | Long-Term Scenario <i>"With"</i> Project | Long-Term Scenario <i>"Without"</i> Project |
|--|---|---|
| Noise and vibration | Noise will reduce due to the underground routes, but localized vibration will slightly increase | Both noise and vibration will deteriorate further |
| Soil and drainage | No major impact on existing soil conditions. There is a significant change in underground drainage pattern due to the proposed route which will adversely impact the localized environmental condition. | As it is there are no changes in present problems associated with inadequate drainage. |
| Geology and Seismology | No significant Impact envisages on seismology however, the geology will get impacted but as compared to the project benefit it will be negligible. | No change as it is |
| Ecological Environment | | |
| Flora | Due to proposed project around 11, 121 trees will be felled. However, 11,12,100 saplings will be planted (@1:10). | No change in vegetation and the number of trees. No change in present land use |
| Fauna | Due to proposed alignment, there is no impact on fauna | Continued, and possibly increased disturbance to the localized fauna |
| Social and Cultural Environment | | |
| Social and Cultural Environment | <p>Increased comfort and safety while travelling. An improved business environment for those living along the project corridor. Once the project becomes operational, it will result in the reduction of GHG emission. Significant reduction in fuel consumption due to expected modal shift in vehicles</p> <p>The proposed project will cause a permanent land acquisition of about 19.12 Ha.</p> <p>Due to the construction of the tunnel will save the impact on the archaeological site. Following archeological sites are within the regulated zone and the alignment in these areas is underground and construction is proposed by TBM except Tomb of Shah Alam where alignment is proposed as elevated.</p> <ol style="list-style-type: none"> 1. Tughlakabad Fort, 2. Ghiyasuddin Tomb, 3. Nai-ka-kot, 4. Adilabad Fort, 5. Tomb of Shah Alam, 6. Tripolia Gate, 7. Roshnara Bagh | <p>Travelling may increase time, thereby transportation costs will increase. Reduction in comfort and safety due to congestion and deterioration in road condition. Business opportunities remain largely the same as before.</p> <p>No reduction in GHG emission reduction. Higher fuel consumption due to the increased number of private vehicles.</p> |
| Connectivity | Improve the connectivity between the various interlinked center | No change |
| Institutional Requirements | | |

| Scenario type | Long-Term Scenario <i>“With”</i> Project | Long-Term Scenario <i>“Without”</i> Project |
|---------------------------|--|---|
| Training of PIU | Training needs to be provided to relevant PIU officials to improve their environmental monitoring capacity during and after project construction. More staff will need to be recruited at the PIU office to enable smooth flow of all paperwork with regard to implementation of environmental policies and regulations as per the MOEFCC and JICA guidelines | No institutional strengthening is required. |
| Economic Situation | | |
| Financial Implications | Higher capital costs for underground routes and using Environmentally Friendly techniques during civil work. Costs will also be incurred for the training of PIU officials if required. | No capital costs. However, increasing road maintenance and vehicle operating costs as road deteriorates and as travel times increase. |
| Development | Surrounding the project more development will take place | No change |
| Overall | | |
| | Long term improved socio-economic and environmental conditions but an increase in expenses for project activities during project construction. However, with project scenario have lots of positive impacts like –reduced travel cost, reduced travel time, reduced exhaust emission, reduced fuel consumption , reduced GHG emission, also enhancing employment and economic growth of the area. | Small deteriorations in environmental conditions, no increase in economic opportunities and increased expenses associated with maintenance. |

In case the phase IV of Delhi Metro is not constructed, the city will be deprived of the following benefits:

- ❖ Employment Opportunities,
- ❖ Enhancement of Economy,
- ❖ Mobility,
- ❖ Safety,
- ❖ Traffic Congestion Reduction, Reduction in Number of Buses,
- ❖ Reduced Fuel Consumption,
- ❖ Reduced Air Pollution,
- ❖ Carbon Dioxide and Green House Gases (GHG)Reduction,
- ❖ Saving in Road Infrastructure.

Since the positive impacts are more than a few localized short term negative impacts, consideration of ‘no development alternative’ is a non-starter and has thus not merited any further consideration.

Without the project, congestion constrains the long-term attractiveness and potential impact of the regular bus service and with project scenario avoiding congestion problems appear to be an excellent alternative for public transport. The construction of the project will offer more equitable access to transport choices for passengers wishing to access employment, education or commercial facilities.

Development of new high capacity, high-frequency public metro route system from Aerocity to Tughlakabad, Janakpuri West to R.K. Ashram and Mukundpur-Maujpur corridors have the potential to cater for existing and future passenger demand and will relieve congestion on the road corridor and the existing public transport network. Besides, this form of public transport will significantly benefit the

environment. The project will, therefore, be of benefit to the population in the project area.

3.2. ALTERNATIVE SCENARIOS FOR MUKUNDPUR – MAUJPUR CORRIDOR

This section deals with the rationales behind the preferred choice. The final proposed alignment option at the DPR Stage is named as Alternative 1, while the other alternate alignments which were studied at planning stage are named as Alternative 2 and Alternative 3.

Alternative 1—This corridor is an extension of Mukundpur- Rajouri Garden-INA- Nizamuddin - Anand Vihar–Shiv Vihar Corridor of Phase-III of Delhi Metro. The complete corridor is elevated and has eight stations. The corridor starts at Maujpur and terminates at Majlis Park station of Phase-III. In this case, alignment was changed from Yamuna Vihar to Khajuri Khas to save private property demolition and to meet the curve of 200m. Also, water pipeline under service road was saved by changing the alignment. Alignment from Soorghat to Burari was on the right side of the road to maximize the ridership. In the final alignment, location of Soorghat Station was shifted as it was coming within the 100 m periphery of Shah Alam Tomb. No new depot has been proposed for this corridor. The existing depot at Mukundpur will be augmented to fulfill the requirements from this corridor.

Alternate 2 - This alternative is the second alignment selected at the planning stage. This alignment is similar to Alternative 1 from Maujpur to Sonia Vihar station. In this option also, the corridor starts at Maujpur and terminates at Majlis Park. However, in this alternative scenario, Soorghat to Burari section of the alignment was on the left side of the road which had a negative impact in terms of ridership. In this scenario also the corridor was completely elevated and had eight stations.

Alternative 3 - This alternative is the initial alignment selected at the planning stage. In this option also, the corridor starts at Maujpur and terminates at Majlis Park. However, alignment was through the service road from Yamuna Vihar to Khajuri Khas resulting in demolition of several private buildings. The Khajuri Khas station was coming on the O-Zone. The rest of the alignment from Khajuri Khas to Majlis Park was on the left-hand side of the outer ring road. The alignment was passing through the prohibitory zone of ASI monument “Shah Alam Tomb”. In this scenario also the corridor was completely elevated and had six stations.

Comparison of Alternatives

It is evident from the above that all the three alternatives have some advantage and disadvantage in terms of cumulative impact-environmental, social etc. On the assessment of the advantages and disadvantages of the three alternatives and certain limitation, it is considered that **Alternative 1** is the most preferred option. Since land acquisition is very less as compared to other options and also it will serve for more people. Cost of project is also low, however more trees are getting impacted as compare to other 2 options which will be compensated under compensatory afforestation so that impact on localized ecological balance will be negligible. The comprehensive comparison of three alternatives is summarized and presented in Table 3.2.

Table 3.2: Comprehensive Comparison of Three Alternatives

| Sl. No. | Issues | Alternative 1 | Alternative 2 | Alternative 3 |
|---------|---|--------------------------|-------------------------|-------------------------|
| 1. | Length and no. of stations | 12.558 km and 8 stations | 12.54 km and 8 stations | 12.54 km and 6 stations |
| 2. | Length of elevated section and no. of elevated stations | 12.558 km and 8 stations | 12.54 km and 8 stations | 12.54 km and 6 stations |
| 3. | Length of underground section and no. of underground stations | Nil | Nil | Nil |

| | | | | |
|-----|--|---|---|---|
| 4. | No.of Depots | 0 | 0 | 0 |
| 5. | Safety | High Safety Standard | High Safety Standard | High Safety Standard |
| 6. | Permanent Land requirement | 0.62 Ha | 6.3 Ha | 6.57 Ha |
| 7. | No.of trees to be felled | 1,990 | Approx. 1100 | Approx. 990 |
| 8. | No. of ASI protected archaeological structures within the 100m periphery (prohibitory zone) of the alignment | Nil (Shah Alam Tomb – 108m) | Nil (Shah Alam Tomb – 108m) | 1 (Shah Alam Tomb – within 100m prohibitory zone) |
| 9. | Construction duration | 30 months | 30 months | 30 months |
| 10. | Impact on the Environment | <ul style="list-style-type: none"> - No station construction on Yamuna Riverbed - C&D waste disposal - Cutting of 1990 trees | <ul style="list-style-type: none"> - No station construction on Yamuna Riverbed - C&D waste disposal - Cutting of approx. 1100 trees | <ul style="list-style-type: none"> - Station construction on Yamuna Riverbed - C&D waste disposal - Cutting of approx. 990 trees |
| 11. | No. of structures affected | 0 | Approx. 2 | Approx. 50 |
| 12. | Issues of noise and vibration | Issue of noise during construction and operation | Issue of noise during construction and operation | Issue of noise during construction and operation |
| 13. | Approx. cost | Rs. 2190 Cr | Rs. 2897 Cr | Approx. Rs. 2500 Cr |
| 14. | Conclusion | This is the most desirable plan. | This plan is inferior to ALT1. | This plan is inferior to ALT1 and ALT2. |

3.3. ALTERNATIVE SCENARIOS FOR AEROCITY–TUGHLAKABAD CORRIDOR

The final proposed alignment option at the DPR Stage is named as Alternative 1, while the other alternate alignments which were studied at planning stage are named as Alternative 2 and Alternative 3.

Alternative 1 – This corridor originates from Aero City; adjacent to an existing station on the Airport Express line and passes through Mahipalpur, Vasant Kunj D-Block, Masoodpur, Kishangarh, Chattarpur, Chattapur Mandir, IGNOU, Neb Sarai, Saket G-Block, Khanpur, Tigri, Anandmayee Marg and terminates at Tughlakabad where it has passenger interchange with existing Tughlakabad Station of Line-6. This stretch is partially elevated and partially underground. From Aerocity till Saket-G Block the alignment is underground. It emerges out from underground section to elevated section after Neb Sarai Station. The first elevated station is Saket-G Block. Alignment continues to run along the Mehrauli – Badarpur road as elevated section till Anandmayee Marg Station. Here the alignment further changes from elevated section to the underground section and remains underground till Tughlakabad. The corridor has eleven underground stations and four elevated stations. No new depot has been proposed for this corridor. The existing depot at Sarita Vihar will be augmented to fulfil the requirement from this corridor. This alignment completely excludes the Mehrauli Archaeological area and the Tughlakabad archaeological area.

Alternative 2 -This alternative is the first alignment selected at the planning stage. In this option also, corridor originates from Aero City; adjacent to an existing station on the Airport Express line and passes through Mahipalpur, Vasant KunjD-Block, Masoodpur, Kishangarh, Mehrauli, Ladoo Sarai, Saket, Saket G-Block, Khanpur, Tigri, Anandmayee Marg and terminates at Tughlakabad where it has

passenger interchange with existing Tughlakabad Station of Line-6. In this alternative also, no new depot was proposed. Like alternative-1 the alignment was partially elevated and partially underground. However, unlike alternative-1, this alignment was planned to pass through Mehrauli and Tughlakabad archaeological areas. Major Archaeological Survey of India (ASI) protected monuments along the corridor included Bhul Bhulliya, Qutub Minar and Tughlakabad Fort.

Alternative 3 -This alternative is the second alignment selected at the planning stage. This alignment is similar to Alternative-2 except for one major difference that a new depot was proposed at Rangpuri Pahari area. It is about 1.2 km away from Vasant Kunj D-block Station. Depot connectivity was planned from Vasant Kunj D-block Station.

Comparison of Alternatives

It is evident from the above that all the three alternatives have some advantage and disadvantage in terms of cumulative impact-environmental, social etc. On the assessment of the advantages and disadvantages of the three alternatives and certain limitation, it is considered that **Alternative 1** is the most preferred option. Since land acquisition is less and very less structures are affected as compared to other options. It will also serve for more people. There are very less archeological structures compare to other options. However more trees are getting impacted as compare to alternative 2 which will be compensated under compensatory afforestation so that impact on localized ecological balance will be negligible or insignificant. The comprehensive comparison of three alternatives is summarized and presented in Table 3.3.

Table 3.3: Comprehensive Comparison of Three Alternative

| Sl. No. | Issues | Alternative 1 | Alternative 2 | Alternative 3 |
|---------|---|--|---|--|
| 1. | Length and no. of stations | 23.622 km and 15 stations | 20.234 km and 15 stations | 21.34 km and 15 stations |
| 2. | Length of elevated section and no. of elevated stations | 4.29 km and 4 stations | 5.72 km and 5 stations | 6.83 km and 5 stations |
| 3. | Length of underground section and no. of underground stations | 19.343 km and 11 stations | 14.52 km and 10 stations | 14.52 km and 10 stations |
| 4. | No. of Depots | 0 | 0 | 1 |
| 5. | Safety | High Safety Standard | High Safety Standard | High Safety Standard |
| 6. | Permanent Land requirement | 7.1 Ha | 8.851 Ha | 28.851 Ha |
| 7. | No. of trees to be felled | 5,302 | Approx. 823 | Approx. 6000 |
| 8. | No. of archaeological structures | 4 (non with in prohibitory zone) | 15 | 15 |
| 9. | Construction duration | 36 months | 42 months | 48 months |
| 10. | Impact on the Environment | <ul style="list-style-type: none"> - Loss of trees (5302) - C&D waste management - No impact on Fauna | <ul style="list-style-type: none"> - Loss of trees (approx. 823) - C&D waste management - No impact on Fauna | <ul style="list-style-type: none"> - Loss of trees (approx. 6000) - C&D waste management - No loss on Fauna - Construction in Ridge area |
| 11. | No. of structures affected | 47 | 272 | 272 |

| | | | | |
|-----|-------------------------------|--|--|--|
| 12. | Issues of noise and vibration | Noise pollution in elevated corridor and vibration issue in underground corridor | Noise pollution in elevated corridor and vibration issue in underground corridor | Noise pollution in elevated corridor and vibration issue in underground corridor |
| 13. | Approx. cost | Rs. 8231 Cr | Rs. 7359Cr | Approx. 10,000 Cr |
| 14. | Conclusion | This is the most desirable plan. | This plan is inferior to ALT1. | This plan is inferior to ALT1 and ALT2. |

3.4. ALTERNATIVE SCENARIOS FOR JANAKPURI WEST - R K ASHRAM CORRIDOR

The final proposed alignment option at the DPR Stage is named as Alternative 1, while the other alternate alignments which were studied at planning stage are named as Alternative 2 and Alternative 3.

Alternative 1 – This corridor is an extension of Kalindi Kunj-Janakpuri West Corridor of Phase-III of Delhi Metro. From Janakpuri West (operational underground station of Phase-III) this corridor takes left turn to fall on Dr. Hedgewar Marg (outer ring road) and first station in this corridor is Krishna Park Ext. The alignment becomes elevated after Krishna Park station and runs parallel to the outer ring road. From Mukundpur Red Light on outer ring road, this alignment takes a right turn towards Azadpur and passes through Majlis Park, Panch Vati and Gopal Nagar Area. Up to Ashok Vihar the corridor is elevated. After Ashok Vihar, the alignment becomes underground and generally passes under G.T. Road. The underground alignment passes through Model Town, Derawal Nagar, Ghanta Ghar, Subji Mandi, Pulbangesh, Sadar Bazar, Motia Khan and finally terminates at Ram Krishna Ashram Marg where it has passenger interchange with existing Ram Krishna Ashram Marg Station of Line-3. No new depot has been proposed for this corridor. The existing depot at Mukundpur will be augmented to fulfill the requirement from this corridor. From the planning stage alignment has been modified between Derawal Nagar and Ghanta Ghar to avoid ASI monument Tripolia Gate. Rajpura station proposed in the planning stage has also been done away with. Another Major change is Krishna Park station has been changed from elevated to underground.

Alternative 2 – This alternative is the first alignment selected at the planning stage. Like alternative-1 the alignment was partially elevated and partially underground. However, monument Tripolia Gate. An underground station was proposed at Rajpura and Krishna Park unlike alternative-1, this alignment was planned to pass through Archaeological Survey of India (ASI) Ext station was elevated. In this alternative also, no new depot was proposed.

Alternative 3 - This alternative is the second alignment selected at the planning stage. This alignment is similar to Alternative-2 except for one major difference that a new depot was proposed at Mangol Puri Industrial Area by the side of Northern Railway Line for depot. The area requirement of the depot was 23 Ha.

Comparison of Alternatives

It is evident from the above that all the three alternatives have some advantage and disadvantage in terms of cumulative impact-environmental, social etc. On the assessment of the advantages and disadvantages of the three alternatives and certain limitation, it is considered that **Alternative 1** is the most preferred option. Since land acquisition and number of structures affected are also very less as compared to other options and also it will serve for more people. No archeological structures (within the prohibited zone) within the vicinity of alternative 1. Cost of project is also low, however more trees are getting impacted as compare to other 2 options which will be compensated under compensatory afforestation so that impact on localized ecological balance will be considered as negligible. The comprehensive comparison of three alternatives is summarized and presented in Table 3.4.

Table 3.4: Comprehensive Comparison of Three Alternatives

| Sl. No. | Issues | Alternative 1 | Alternative 2 | Alternative 3 |
|---------|--|--|--|--|
| 1. | Length and no. of stations | 28.92 km and 21 stations | 28.92 km and 28 stations | 28.92 km and 28 stations |
| 2. | Length of elevated section and no. of elevated stations | 21.18 km and 14 stations | 21.18 km and 18 stations | 21.18 km and 18 stations |
| 3. | Length of underground section and no. of underground stations | 7.74 km and 7 stations | 7.74 km and 7 stations | 7.74 km and 7 stations |
| 4. | No. of Depots | 0 | 0 | 1 |
| 5. | Safety | High Safety Standard | High Safety Standard | High Safety Standard |
| 6. | Permanent Land requirement | 10.16 Ha | 21.41 Ha | 38.03 ha |
| 7. | No. of trees to be felled | 3,829 | Approx. 1,584 | Approx. 1,584 + tree at the depot location |
| 8. | No. of archaeological structures within the 100m periphery (prohibitory zone) of the alignment | 0 | 2 | 2 |
| 9. | Construction duration | 36 – 42 months | 36 – 42 months | 36 – 48 months |
| 10. | Impact on the Environment | <ul style="list-style-type: none"> - Loss of trees (3829) - C&D waste management - No impact on Fauna | <ul style="list-style-type: none"> - Loss of trees (approx. 1584) - C&D waste management - No impact on Fauna | <ul style="list-style-type: none"> - Loss of trees (approx. 1584 + trees at depot area) - C&D waste management - No impact on Fauna |
| 11. | No. of structures affected | 23 | 169 | 169 |
| 12. | Issues of noise and vibration | Noise pollution in elevated corridor and vibration issue in underground corridor | Noise pollution in elevated corridor and vibration issue in underground corridor | Noise pollution in elevated corridor and vibration issue in underground corridor |
| 13. | Approx. cost | Rs. 9349 Cr | Rs. 9558 Cr | Approx. Rs. 10500 Cr |
| 14. | Conclusion | This is the most desirable plan. | This plan is inferior to ALT1. | This plan is inferior to ALT1 and ALT2. |

3.5. ENVIRONMENT AND SOCIAL CONSIDERATIONS

Limited analysis of alternatives was done due to the limited option for the metro route. However, the alignment of the above corridors are so selected that they will serve the maximum population, will entail less private land acquisition, least demolition of private and government structures, least tree cutting and will avoid impact on archaeological and historical structures. To achieve the above goals, the alignment suggested is mainly on the central verge of the road. In the highly densely populated area, the alignment is kept under the ground so as to lessen the social impacts that may have resulted from the acquisition of property. Similarly, to protect the archaeological/historical monuments, the proposed metro corridors near the monuments are underground except Shah Alam Tomb where alignment is elevated. The entire underground section will be constructed by tunnelling through State of Art Tunnel Boring Machine (TBM). The existing depots will be utilized for these priority corridors.

The details of phase IV priority corridors are given in Table 3.5.

Table 3.5: Details of Phase IV Part A (Priority) Corridors

| S.No. | Corridor | Under-ground | Elevated /at Grade | Total Length (km) | Stations (Nos) | | |
|--------------|-------------------------------|---------------|--------------------|-------------------|----------------|-----------|-----------|
| | | | | | Under-ground | Elevated | Total |
| 1.0 | Aerocity to Tughlakabad | 19.343 | 4.279 | 23.622 | 11 | 4 | 15 |
| 2.0 | Janakpuri West to R.K. Ashram | 7.740 | 21.180 | 28.920 | 7 | 14 | 21 |
| 3.0 | Mukundpur-Maujpur | 0.000 | 12.558 | 12.558 | 0 | 8 | 8 |
| Total | | 27.083 | 38.017 | 65.100 | 18 | 26 | 44 |

4. ENVIRONMENTAL BASELINE DATA

4.1 ENVIRONMENTAL SCOPING

The information presented in this chapter stems from various sources. The objective of Environmental Impact Assessment (EIA) is to ascertain the baseline environmental conditions and then assess the impacts as a result of the proposed project during various phases of the project cycle. Identification of environmental parameters, data collection and impact predictions form the core of Environmental Impact Assessment process. Data on land environment has been collected and compiled from various reports and field surveys. The data on water quality, ground water hydrology, vegetation and fauna, air and noise quality was collected during field studies. Efforts have been made to compile the available data from literature, books, maps, websites and reports. The methodology adopted for data collection is highlighted wherever necessary. Environmental Attributes and Frequency of Baseline Survey is presented in **Table 4.1**. A scoping matrix has been formulated to identify the attributes likely to be affected due to the proposed project and summarized in **Table 4.2**.

Table 4.1: Environmental Attributes and Frequency of Monitoring

| S. No | Attribute | Parameter | Frequency | Source |
|-----------------------------------|------------------------|---|-----------|---|
| Land Environment | | | | |
| 1 | Soil | Soil Characteristics | Once | Field Study/Literature review |
| 2 | Geology | Geological Status | --- | Literature review |
| 3 | Seismology | Seismic Hazard | --- | Literature review |
| Water Environment | | | | |
| 4 | Water Quality | Physical, Chemical and Biological parameters | Data | Field Study/Literature review (DPCB) |
| Air, Noise and Meteorology | | | | |
| 5 | Ambient Air Quality | PM _{2.5} , PM ₁₀ , NO _x , SO ₂ , CO, O ₃ , NH ₃ , Pb and HC | 24 hourly | Field Studies/literature review |
| 6 | Meteorology | Temperature, Relative humidity, Rainfall, wind direction and speed | Data | India Meteorological Department/literature review |
| 7 | Noise | Noise levels in dB (A) | 24 hourly | Field monitoring/ Literature review |
| Ecology | | | | |
| 8 | Trees | Number/species | Once | Filed Studies |
| Scio-Economic | | | | |
| 9 | Socio-economic aspects | Socio-economic characteristic | Once | Field Studies, Literature review. |

Table 4.2: Scoping Matrix

| No. | Impacts | Rating | Brief Description | Assumed mitigation measures | Survey for assessing impacts in this study |
|---|--|--------|---|---|--|
| Land Environment | | | | | |
| 1 | Topography and Geographical features | B | Plain terrain and falls in seismic zone IV | Consideration of seismic factor as per Seismic Zone IV for all the structural design | Secondary source data and topographical survey |
| 2 | Landscape/Aesthetics | B | Metro corridors passing through built up area however there are 7 Archeological monuments and one sanctuary nearby | To preserve the landscape/aesthetics monuments and sanctuary, metro corridor is proposed underground. | Secondary source data and off field study |
| 3 | Soil Erosion | B | Run off from unprotected excavated areas, and underground tunnel faces can result in excessive soil erosion | Careful planning, timing of cut and fill operations and revegetation | Soil condition will be assessed by taking soil sample and geotechnical study |
| 4 | Soil Contamination | D | Oil spills, paints, solvents may cause soil contamination | To provide for oil trays and drip pans and provision of separate storage | Soil testing |
| 5 | Ground Subsidence | C | There will be possibility of subsidence. | A detailed survey of condition of buildings/houses along proposed alignment will be conducted. During construction monitoring of Condition of buildings/houses will be conducted. In case of occurrence of crack at wall of buildings/houses, damaged wall will be repaired immediately | Building condition survey prior to construction, and during construction and operation |
| Water Environment and Sanitation | | | | | |
| 6 | Water Rights and Rights of Common due to Water Usage | D | No impact is anticipated as water requirement will be met from separate tube wells for the project | Appropriate permission from concerned authority will be obtained prior to ground water extraction | Water requirement from DPR |
| 7 | Water Pollution | C | Construction of bridge on Yamuna may create water pollution | To select proper construction method. | Water quality of the river will be surveyed by water sampling. |
| 8 | Sanitation | B | Sanitation condition may deteriorate due to inflow of large number of construction workers. | Proper sanitation facilities will be provided (e.g. portable toilets) and ensure the proper management of waste. | Current sanitation condition at the project site will be ascertained. |
| 9 | Groundwater | B | Impact on ground water is expected as requirement of water for construction and operation of depot will met though tube well. | Rainwater harvesting will be done | Ground water table data from CGWA. |

| | | | | | |
|---|---|------------|---|--|---|
| 10 | Hydrological Situation | D | No impact on hydrological situation is anticipated. | | |
| Air, Noise Environment and Meteorology | | | | | |
| 11 | Meteorology | D | No impact on meteorology in anticipated | | |
| 12 | Air Pollution | B | Emission from construction equipments and vehicles will increase air pollutants. | -To use proper construction vehicles with good condition to minimize emission. | Air quality monitoring in project area |
| 13 | Global Warming | D | No activity which will cause the global warming is anticipated. | | |
| 14 | Noise and Vibration | B | Construction noise will be generated. Noise and vibration from metro operation may impact Surrounding area. | To restrict construction at night. To install noise barriers if necessary | Noise quality monitoring in project area |
| Ecology | | | | | |
| 15 | Flora, Fauna and Biodiversity | B D | Trees will be cut which are falling along the alignment. No rare and endangered species are found. No impact on fauna is anticipated as the project is in urban area where there is no wildlife | Compensatory afforestation will be carried out. | Tree survey will be carried out during the study |
| Other | | | | | |
| 16 | Accidents | B | There are risks of accidents during construction. During operation accidents will be reduced | to secure the safely control. | |
| 17 | Waste | B | Construction surplus soil will be generated. | - To select proper site to dispose the soil. | - Quantity of surplus soil will be identified. |
| 18 | Hazards (Risk) Infectious diseases such as HIV/AIDS | B | The risk of infectious diseases may increase due to inflow of large Number of construction workers. | To consider health care programs. | Information about diseases will be collected through the interview survey. (Social baseline survey) |

Rating: A: Significant negative impact is expected.
C: Extent of impact is unknown

B: Some negative impact is expected.
D: No impact is expected

4.2 LAND ENVIRONMENT

The Project area is situated in Delhi, the Capital of India. The average elevation of Delhi plains is 200 m above the sea level (a-MSL). The ridge however has a higher elevation going upto 300 m above mean sea level and is about 15 to 60 m above the surrounding plains. Delhi is located between 28°24'15" and 25°53'00" North latitude and 76°50'24" and 77°20'30" East Longitude. Parameters involved in land environment are, physiography, geology, soil and seismicity. These are discussed in the following paragraphs.

4.2.1 Physiography

The physiography of Delhi is dominated by the river Yamuna, the Aravalli range and the plains in between formed by alluvium deposits of recent formation. The Delhi Ridge and its four sections, the northern, the central, the south central and the southern constitute the farthest extension of the Aravalli range, its spurs meeting the Yamuna at two points in the north and the east. The Noida or Shahdara area drains from east to west into the Yamuna River. Similarly Delhi and New Delhi areas also drain in Yamuna River through various drains such as Najafgarh drain. The average gradient is gentle of the order of 1 to 4 m/km. Delhi area is generally flat except for a gentle rise to form a central ridge from North – East to South – South – West. The Yamuna River is Delhi's source of drinking water.

4.2.2 Geology and Soils

The geology of Delhi is of mix type containing various soil deposits. It consists of quartz rock and extends from south part to west bank of the Yamuna River for about 35 km. The soil textures in Delhi are alluvial and quartz type. The Yamuna river flood carried different types of soils and hence at some places the soil is a mixture of various constituents. General stratigraphic sequences of the rock formation in Delhi are unconsolidated; inter bedded, sand lenses, silt, gravel, clay, kankar and quartz. The Yamuna is the only river flows through the city and it enters into Delhi at north-west side and leave at south-east end. The soils of the Delhi area are mostly light with subordinate amount of medium texture soils. The light texture soils are represented by sandy, loamy and sandy loam types; whereas medium texture soils are represented by loam silty loam.

In order to know the characteristic of soil of the project area, 13 soil samples were collected along the corridors. The samples were collected in the month of June 2020 and analyzed by NABL accredited laboratory. The location details are given in the **Table 4.3** and the results of soil samples are presented in **Table 4.4**. Test results shows that soil is little bit alkaline except at Khanpur. The soil is found sandy at all locations.

Figure 4.1: The Map Showing Geological Units of Delhi

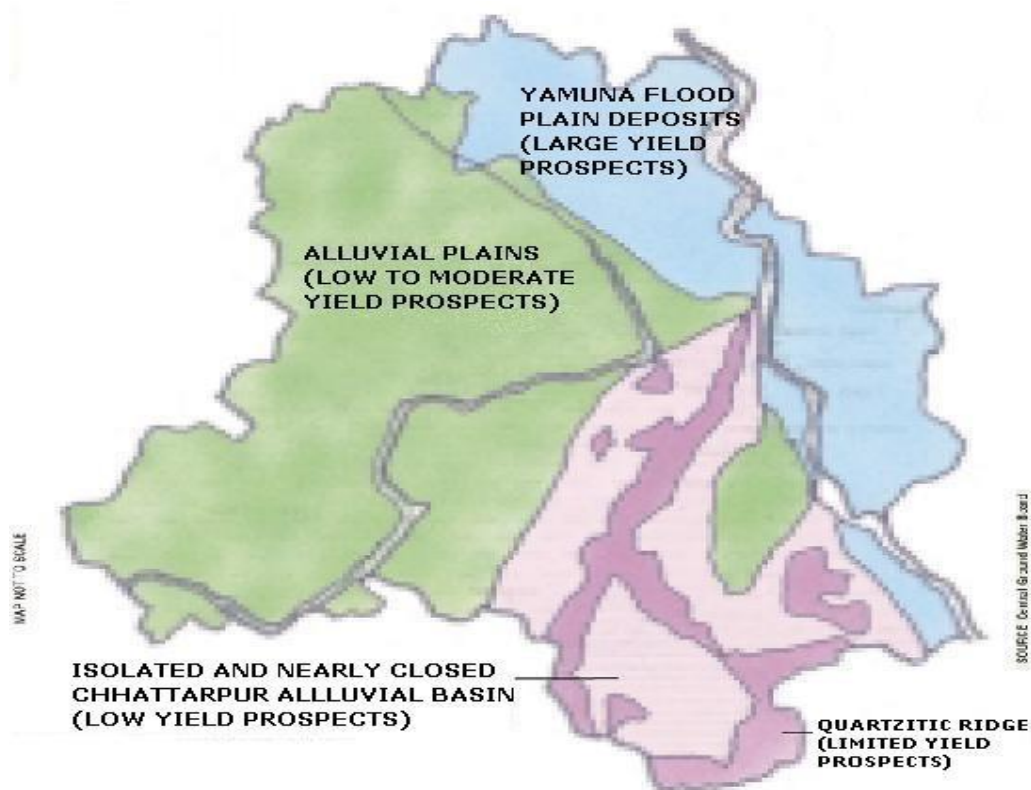


Table 4.3: Soil and Water Sampling Locations

| Sampling Location Number | Location Name |
|------------------------------------|--------------------------|
| R K Ashram - Janakpuri West | |
| 1 | Krishanpark |
| 2 | Peeragarhi |
| 3 | Prashantvihar |
| 4 | Nabi Karim |
| 5 | Pulbhangash |
| 6 | Derawal Nagar |
| Mukundpur - Maujpur | |
| 7 | Yamuna Viah Casting Yard |
| 8 | Jagatpur |
| Aerocity -Tughalakabad | |
| 9 | Tughalakabad |
| 10 | Khanpur |
| 11 | Aerocity |
| 12 | Saket |
| 13 | Mundka Casting Yard |

Figure 4.2: Soil Sample Location Map

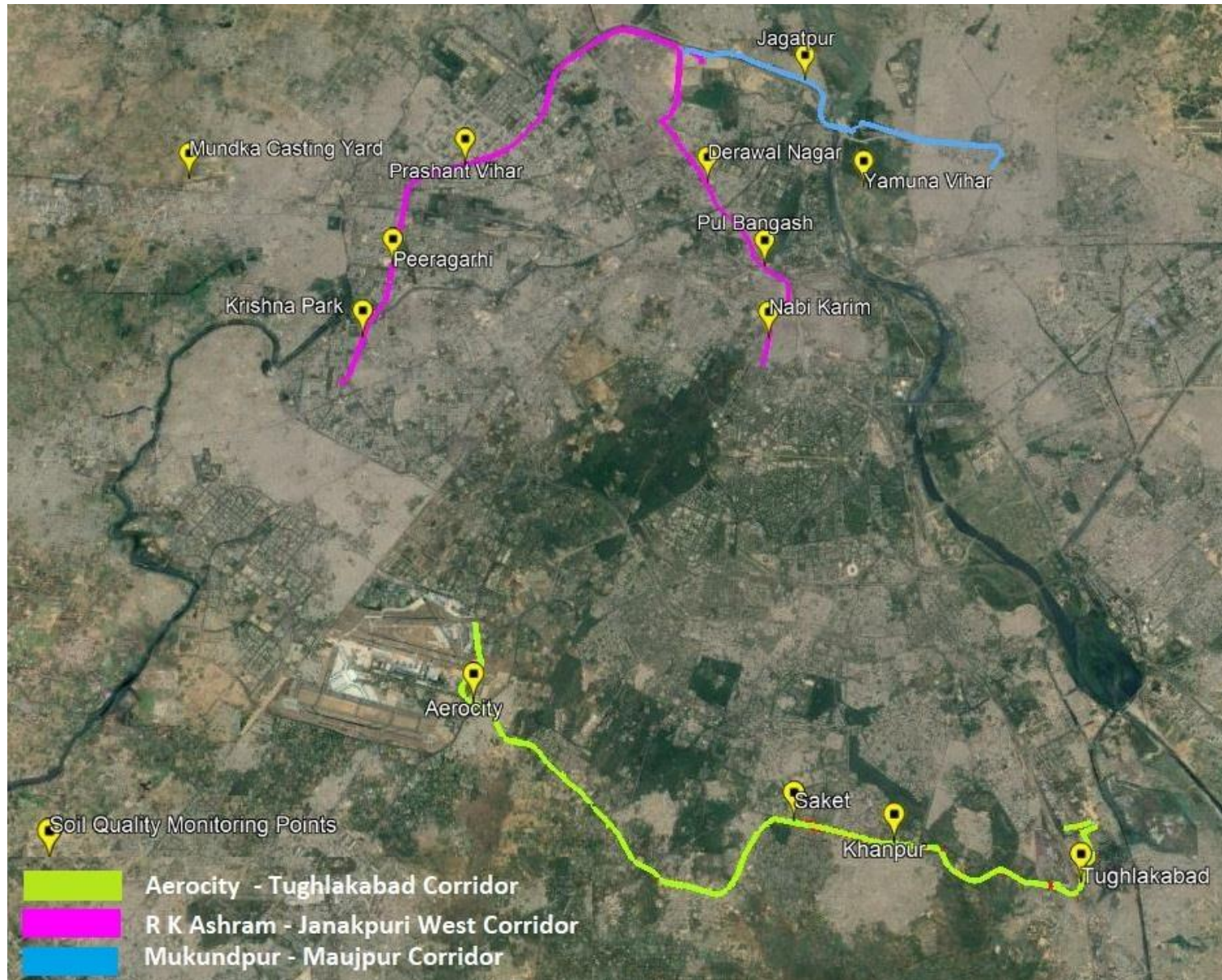


Table 4.4: Soil Test Results

| Sl. No. | PARAMETERS | R K Ashram - Janakpuri West | | | | | | Mukundpur - Maujpur | | Aerocity - Tughalakabad | | | | Casting yard Location |
|---------|---------------------------|-----------------------------|------|------|------|------|------|---------------------|------|-------------------------|------|------|------|-----------------------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| 1 | PH | 7.71 | 7.69 | 7.67 | 6.87 | 7.19 | 8.29 | 7.84 | 7.58 | 7.37 | 6.94 | 7.28 | 8.15 | 7.42 |
| 2 | Conductivity,µs/cm | 557 | 735 | 783 | 689 | 543 | 621 | 715 | 793 | 829 | 498 | 859 | 961 | 948 |
| 3 | Calcium as Ca,mg/kg | 798 | 825 | 894 | 934 | 879 | 963 | 1084 | 957 | 931 | 864 | 985 | 784 | 1024 |
| 4 | Sodium as Na,mg/kg | 163 | 212 | 239 | 181 | 167 | 235 | 261 | 278 | 197 | 185 | 205 | 239 | 306 |
| 5 | Potassium as K,mg/kg | 57 | 61 | 84 | 73 | 91 | 69 | 73 | 56 | 82 | 61 | 89 | 77 | 83 |
| 6 | Magnesium as Mg,Mg/kg | 267 | 245 | 239 | 287 | 263 | 274 | 291 | 261 | 303 | 247 | 279 | 312 | 237 |
| 7 | Organic Matter,% by mass | 0.67 | 0.89 | 1.07 | 0.92 | 0.93 | 1.07 | 0.59 | 0.94 | 0.88 | 0.76 | 1.02 | 0.66 | 1.08 |
| 8 | Nitrogen as N,mg/kg | 37.3 | 37.9 | 41.2 | 36.9 | 36.1 | 38.6 | 40.1 | 37.1 | 37.5 | 39.4 | 36.2 | 38.9 | 39.6 |
| 9 | Phosphorous Content,mg/kg | 7.1 | 7.7 | 7.3 | 8.1 | 8.4 | 7.6 | 8.2 | 7.4 | 7.2 | 8.5 | 8.9 | 7.8 | 7.1 |
| 10 | Texture | | | | | | | | | | | | | |
| | Sand,%by mass | 78 | 72 | 79 | 80 | 73 | 77 | 81 | 79 | 74 | 77 | 76 | 75 | 71 |
| | Clay,by mass | 12 | 17 | 13 | 15 | 15 | 13 | 5 | 10 | 17 | 12 | 15 | 19 | 17 |
| | Slit,by mass | 10 | 11 | 8 | 5 | 12 | 10 | 14 | 11 | 8 | 11 | 9 | 6 | 12 |

Note: 1 to 13 is location numbers, Ref: Table 3.2

4.2.3 Seismicity

The country has been classified into different zones indicating the intensity of damage or frequency of earthquake occurrences. These zoning maps indicate broadly the seismic coefficient that could generally be adopted for design of buildings in different parts of the country. These maps are based on subjective estimates of intensity from available information on earthquake occurrence, geology and tectonics of the country. Delhi is located in zone IV of seismic zoning map of India (**Figure 4.3**). The zone has fairly high seismicity with general occurrence of earthquakes of 5-6 magnitude, a few of magnitude 6-7 and occasionally of 7-8 magnitude. Delhi thus lies among the high-risk areas. Seismicity around Delhi appears to be associated with a major geological structure known as the Delhi-Haridwar Ridge. This ridge constitutes an important tectonic block between 28°-30° N and 76°-79° E with a NE-SW trend. It coincides with the extension of the Aravalli Mountain belt beneath the alluvial plains of the Ganga basin to the northeast of Delhi towards the Himalayan Mountain. The first recorded major earthquake in this region occurred on 15th July 1720 of intensity 9.0. Subsequent other earthquake events occurred in 1803, 1819, 19005, 1934, 1937, 1945, 1949, 1958, 1960, 1966, 1975, 1980, 1994, of intensity between 7.0 to 9.0.

4.3 WATER ENVIRONMENT

Water environment consists of water resources and its quality. Its study is important from the point of view to assess the sufficiency of water resources for the needs of the project in its various stages of the project cycle and also to assess the impact of the project on water environment. In the present project, ground water is proposed to be used during construction after taking approval from competent authority i.e. Central Ground Water Board. Anticipated impacts of the proposed project on water environment have also been addressed.

4.3.1. Water Resources

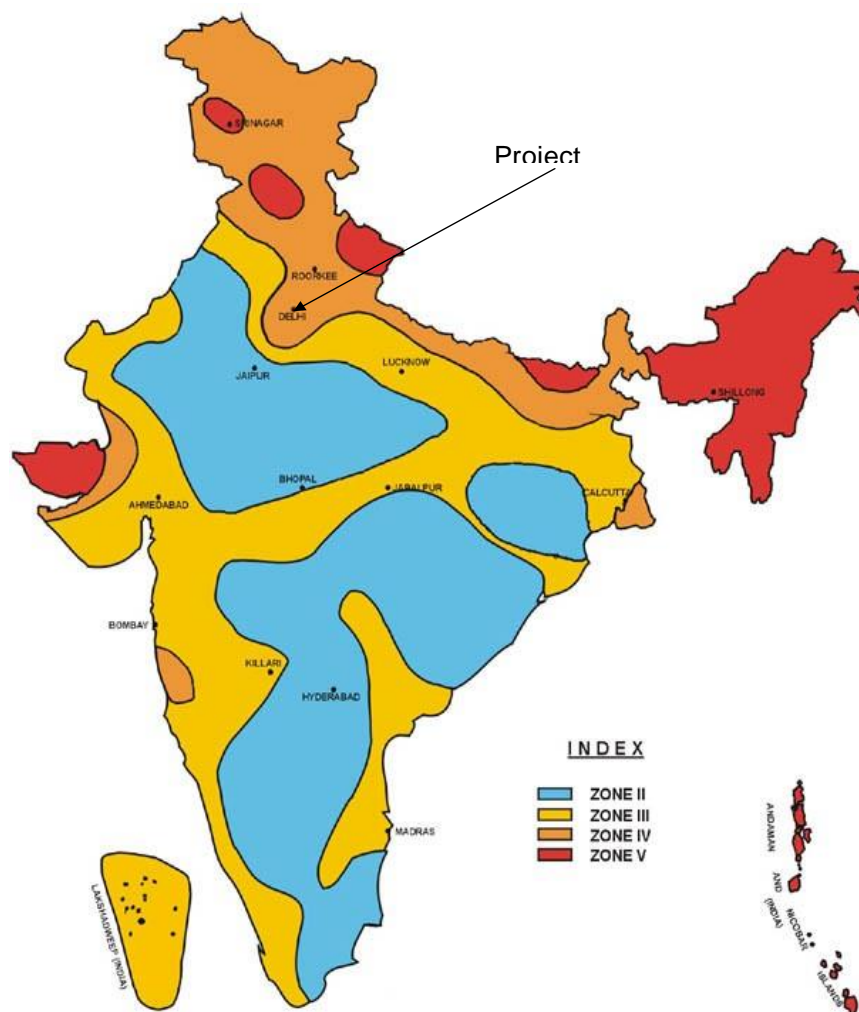
The water availability and its quality play a significant role in the project. Water supply to Delhi is from Yamuna River which flows through the project area. The Yamuna River originates from the Yamnatri glacier in the lower Himalayas at an elevation of about 6,387 metre above mean sea level. The river sluggishly meanders from Tajewala via Delhi to its confluence with the Ganga at Allahabad after flowing a distance of about 1,200 kms. Delhi's share of river Yamuna, as per inter-state agreements, is 4.6%. The water availability of river Yamuna at 90% dependability during different seasons in a year

is as follows:

- Monsoon : 10.0 Mm³/day
- Post monsoon : 1.2 Mm³/day
- Winter : 0.8 Mm³/day
- Summer : 0.1 Mm³/day

Delhi gets its water from the Ganga Canal, the western Yamuna canal, the Bhakra Canal and the river Yamuna. The ground water table in Delhi has been depleting in various areas across the city. It is said that water table is falling about 3m/year. Ground water levels have depleted by 2-6 m in Alipur and Kanhwala Blocks, 10m in Najafgarh block and about 20m in Mehrauli Block. The flow of river varies from season to season as reported above. During summer the flow is less, since most of the treated sewage, untreated flow from drains are directly discharged into the river at at-least 17 locations which make the river unsuitable for supporting any aquatic life specially the fish species. Plans by the Government, to clean up the river, under the Yamuna Action Plan, are underway.

Figure 4.3: Seismic Zoning Map Of India



Rainwater: Delhi has a monsoon climate with an average yearly rainfall of 611.8 mm. The utilized rainwater runoff is 193 Mm³ per year.

4.3.2. Ground Water

The ground water availability in the territory is controlled by the hydro geological situation characterized by occurrence of alluvial formation and quartzite hard rocks. The NCT Delhi can be divided into following distinct hydro geological units: Newer Alluvium - Yamuna flood plain deposits, Older Alluvium - Eastern and western sides of the ridge, Older Alluvium - Isolated and nearly closed Chattarpur alluvial basin and Quartzitic Formation - NNE-SSW trending Quartzitic Ridge. The formation wise details of ground water characteristics in NCT Delhi are given in **Table 4.5**.

Table 4.5: Ground Water Characteristics in Different Geological Formation

| S. No. | Nature of Formation | Depth of the well (mbgl) | Discharge (m ³ /hr) | Drawdown (m) | Transmissivity (m ³ /day) |
|--------|---------------------|--------------------------|--------------------------------|--------------|--------------------------------------|
| 1. | Newer Alluvium | 40-60 | 50-180 | 6.0-8.0 | 600-2000 |
| 2. | Older Alluvium | 30-60 | 20-60 | 6.0-24 | 130-403 |
| 3. | Quartzite | 50-150 | 02-10 | 6.0-30 | 05-135 |

Source: Groundwater Management in NCT Delhi, by Shashank Shekhar, Raja Ram Purohit & Y. B. Kaushik

The complex situations of ground water occurrence in different formations, presence of saline ground water at varying depth in the aquifers and growing urbanization influences availability of ground water in different parts of NCT of Delhi. Central Ground Water Board estimated the annual replenishable ground water resources in NCT Delhi as 29,710 hectare meter (ha-m) and the net ground water availability of NCT Delhi as 28,156 ha-m. The annual ground draft for NCT Delhi (as on 2004) is 47,945 ha-m of which 20,002 ha-m is for irrigation use, 21,506 ha-m is for domestic use, 2,137 ha-m by farmhouses and around 4,300 ha-m for industrial uses. A decline in water table of 4 m has been observed in Delhi for last few decades. District wise details of fall in ground water levels are given in **Table 4.6**. The main reasons for decline in ground water levels in NCT of Delhi include increasing ground water withdrawal for various purposes especially in areas where piped water supply is inadequate and rapid pace of urbanization resulting in reduced natural recharge to aquifers. The Depth to water level recorded in NCT Delhi ranges from 1.20 to 67.73 mbgl. The deeper water levels are mostly found in south and south west districts of NCT Delhi, while the shallower water levels are found in central, northern and eastern part of Delhi. The Yamuna flood plain in NCT Delhi has depth to water level in the range of 2-5 mbgl. Depth to ground water level is shown in **Figure 4.4**.

Table 4.6: Groundwater Fall In Delhi

| District | Total No. of observation wells monitored | No. of wells showing fall in ground water levels | Minimum fall (m) | Maximum fall (m) |
|------------|--|--|------------------|------------------|
| Central | 2 | 1 | 1.91 | 1.91 |
| East | 21 | 14 | 0.13 | 3.34 |
| New Delhi | 23 | 22 | 0.05 | 5.83 |
| North | 11 | 9 | 0.01 | 1.10 |
| North East | 7 | 5 | 0.07 | 0.91 |
| North West | 40 | 27 | 0.04 | 3.97 |
| South | 39 | 34 | 0.04 | 7.92 |
| South West | 46 | 39 | 0.05 | 9.25 |
| West | 12 | 9 | 0.16 | 2.36 |

Source: <http://pib.nic.in/newsite/erelease.aspx?relid=68305>

4.3.3. Water Quality

Water quality is the physical, chemical and biological characteristics of water. It is most frequently used with reference to a set of standards against which compliance can be assessed. The most common standards used to assess water quality relate to drinking water, safety of human contact and for health of ecosystems. An understanding of the various factors influencing water quality is thus very important as human health is largely dependent on the quality of water available for our use. The ground water samples have been collected at 13 locations along the corridors. The samples were collected in the month of June 2020, location details are given in **Table 4.3** and water quality have been analyzed in NABL accredited laboratory. The laboratory analysis results are given in **Table 4.7**. The water parameters are compared with the prescribed limits of various parameters as per IS 10500:2012. TDS is below permissible limit at all locations except at the Mundka casting yard. The fluorides is found high at all locations. Coliform found in all water samples except at four locations. Most of the parameters at all locations are within permissible limits.

Table 4.7: Water Quality at Project Site

| PARAMETERS | R K Ashram - Janakpuri West | | | | | | Mukundpur - Maujpur | | Aerocity -Tughalakabad | | | | Casting yard Location | LIMITS (IS 10500-2012) |
|----------------------------------|-----------------------------|-------------|-------------|-------------|-------------|-------------|---------------------|-------------|------------------------|-------------|-------------|-------------|-----------------------|------------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | |
| Colour, Hazen | Colour less | Colour less | Colour less | Colour less | Colour less | Colour less | Colour less | Colour less | Colour less | Colour less | Colour less | Colour less | Colourless | 5 (15) Max |
| Turbidity, NTU | 1.8 | 2.3 | 2.7 | 0.89 | 1.7 | 2.3 | 0.62 | 1.4 | 4.2 | 2.8 | 1.5 | 0.67 | 2.6 | 1 (5) Max |
| PH | 7.86 | 7.74 | 7.59 | 7.89 | 7.82 | 7.74 | 7.71 | 7.69 | 7.52 | 7.53 | 7.68 | 7.81 | 7.85 | 6.5-8.5 Max |
| Total Hardness as Caco3, Mg/l | 354 | 326 | 282 | 348 | 414 | 396 | 292 | 306 | 267 | 304 | 404 | 382 | 598 | 200 (600) Max |
| Chloride as Cl, Mg/l | 196 | 268 | 279 | 187 | 294 | 264 | 157 | 132 | 239 | 309 | 294 | 174 | 729 | 250 (1000) Max |
| Total Iron as Fe, Mg/l | 0.08 | 0.07 | 0.11 | 0.15 | 0.21 | 0.27 | 0.06 | 0.23 | 0.24 | 0.23 | 0.19 | 0.17 | 0.14 | 0.3 Max |
| Total Dissolved Solids, Mg/l | 1352 | 1478 | 1285 | 1634 | 1795 | 1538 | 967 | 1482 | 1067 | 1173 | 1751 | 1638 | 4128 | 500 (2000) Max |
| RFC, Mg/l | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | 0.2(1) Max |
| Total Suspended Solids,Mg/l | 12 | 19 | 21 | BDL | 18 | 21 | BDL | 11 | 24 | 14 | 10 | BDL | 16 | -- |
| Sulphates as So4, Mg/l | 136 | 124 | 89 | 96 | 209 | 214 | 154 | 115 | 132 | 128 | 164 | 173 | 362 | 200 (400) Max |
| Nitrates as No3, Mg/l | 21 | 23 | 29 | 41 | 53 | 38 | 42 | 19 | 27 | 32 | 39 | 56 | 61 | 45 Max |
| Fluorides as F, Mg/l | 3.28 | 2.74 | 3.26 | 2.87 | 2.45 | 2.74 | 3.14 | 3.12 | 3.19 | 2.17 | 1.89 | 3.68 | 2.94 | 1.0 (1.5) Max |
| Lead as Pb, Mg/l | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.01 Max |
| Copper as Cu,Mg/l | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.05 (1.5) Max |
| Manganese as Mn,Mg/l | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.1 (0.3) Max |
| Phenolic Compound as C6H5OH,Mg/l | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.001 (0.002) Max |
| Mercury as Hg,Mg/l | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.001 Max |
| Cadmium as Cd,Mg/l | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.01 Max |

| | | | | | | | | | | | | | | |
|---------------------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|---------------|
| Selenium as Se, Mg/l | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.01 Max |
| Arsenic as As, Mg/l | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.05 Max |
| Cyanide as Cn, Mg/l | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.05 Max |
| Zinc as Zn, Mg/l | 0.65 | 0.19 | 0.23 | BDL | 0.28 | 1.42 | 1.23 | 0.69 | BDL | 1.33 | 0.39 | 1.27 | 1.44 | 5 (15) Max |
| Nickel as Ni, Mg/l | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.02Max |
| Calcium as Ca, Mg/l | 81 | 78 | 67 | 85 | 105 | 91 | 71 | 83 | 69 | 79 | 91 | 89 | 126 | 75(200)Max |
| Magnesium as Mg, Mg/l | 37 | 32 | 28 | 33 | 37 | 41 | 28 | 24 | 23 | 26 | 43 | 39 | 69 | 30 (100)Max |
| Dissolved Oxyzen, Mg/l | 7.2 | 6.9 | 8.1 | 6.3 | 7.4 | 8 | 7.6 | 6.3 | 6.7 | 6.9 | 8.2 | 7.9 | 7.1 | -- |
| Chromium as Cr+6 ,Mg/l | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.05 Max |
| Total Alkalinity as Caco3, Mg/l | 217 | 207 | 185 | 231 | 287 | 239 | 203 | 244 | 212 | 231 | 248 | 219 | 393 | 200 (600) Max |
| Aluminum as Al, Mg/l | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.03(2) Max |
| Boron as B, Mg/l | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.5(1) Max |
| COD, mg/l | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | |
| Oil & Grease, Mg/l | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | -- |
| Ammonia as N, mg/l | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.5 Max |
| PAH | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.0001 Max |
| Pesticides | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | No relaxation |
| Bacteriological Analysis | | | | | | | | | | | | | | |
| a) Coliform, MPN/100MI | 856 | Nil | Nil | 697 | 1125 | 487 | 589 | 1548 | 663 | Nil | 389 | Nil | 1609 | 10 Max |
| b) E-Coli/MI | Negati ve | Negati ve | Neg ative | Negati ve | Negati ve | Negati ve | Negati ve | Negati ve | Negati ve | Negati ve | Negati ve | Negati ve | Negati ve | Negative |

Note: 1 to 13 are the location number, Ref: Table 3.2

Figure 4.4: Depth to Water Level Map, NCT Delhi (Pre-Monsoon, May 2009)

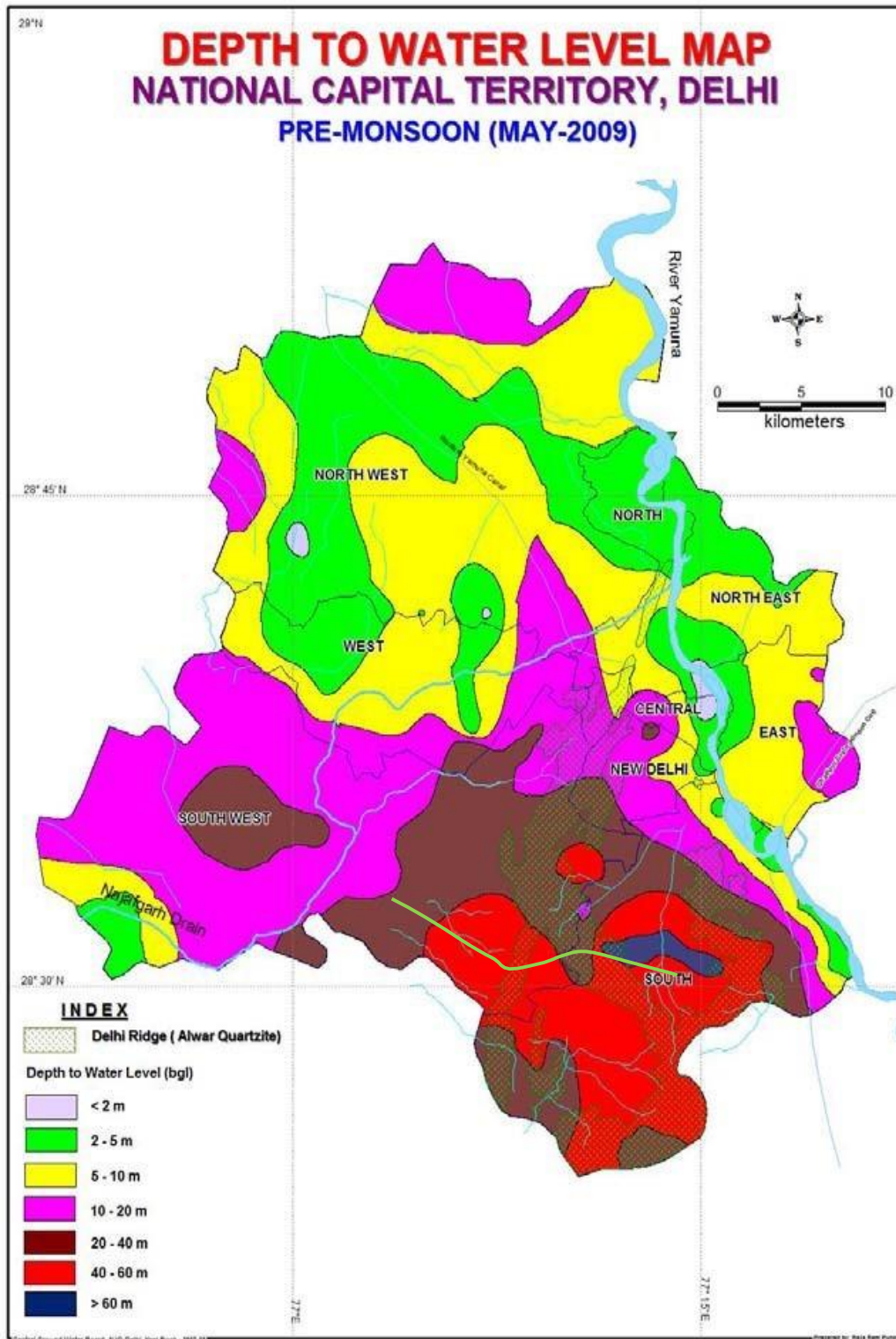
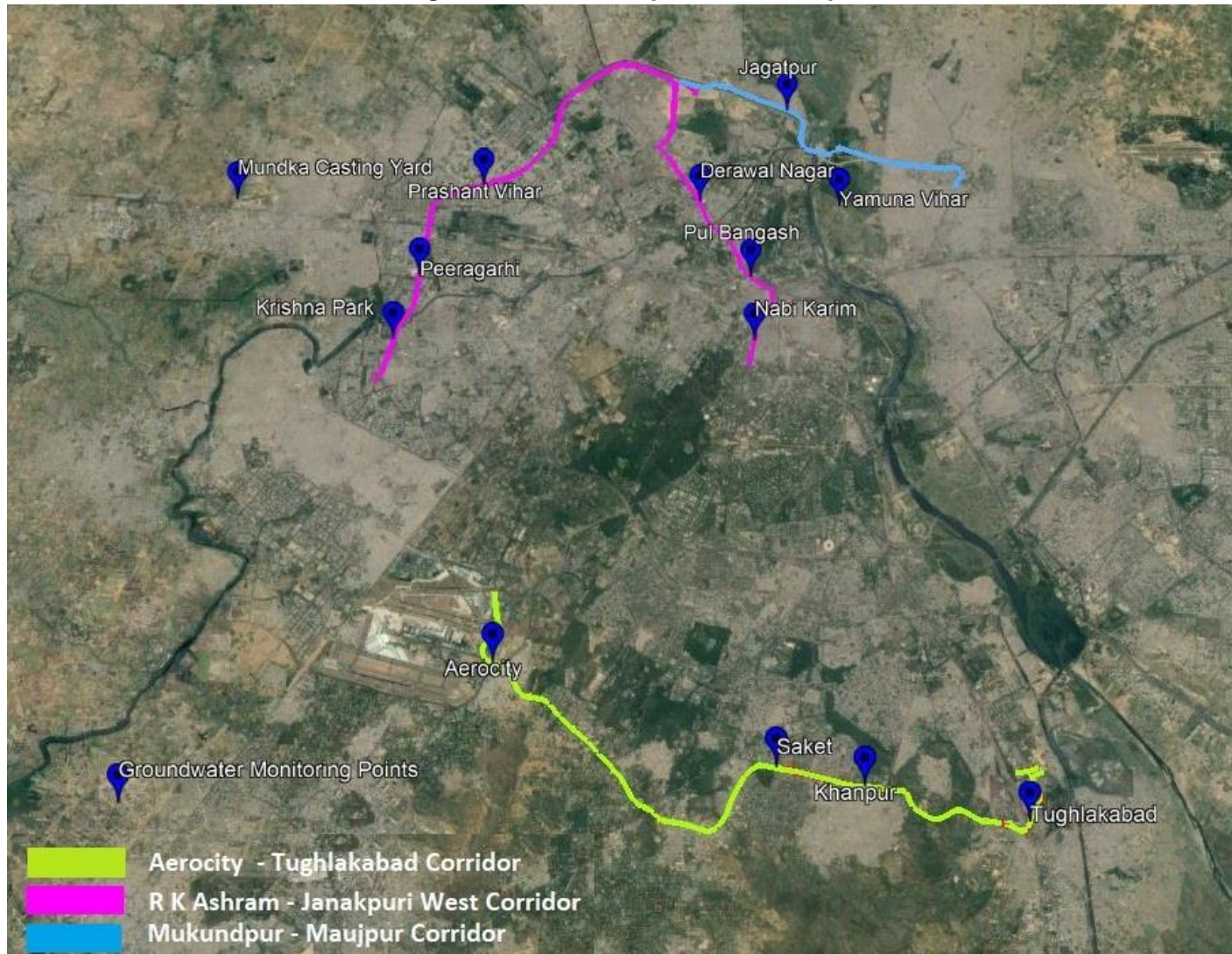


Figure 4.5: Water Sample Location Map



4.4 METEOROLOGY AND AIR ENVIRONMENT

Meteorology is an important parameter in an environmental impact assessment exercise. All air pollutants emitted by point and non-point sources are transported, dispersed or concentrated by meteorological and topographical conditions. The main parameters are: temperature, humidity, rainfall, winds and cloud cover. The meteorology and air environment of the area are discussed in subsequent sections.

4.4.1 Meteorology

Delhi has an extreme climate, which is very cold in winter and hot in summer. The climatic conditions in project area are characterized by a rainy season (July-October), winter (November-March) and Summer (April-June). Delhi has a monsoon climate with an average yearly rainfall of 611.8 mm of which 81% is received during rainy season. The relative humidity at Delhi varies almost throughout the year but seldom drops below 30%. Records of monthly rainfall, relative humidity of Delhi obtained from Indian Meteorological Department, for year 2012 are given in **Table 4.8 to Table 4.10**. Records of mean maximum and mean minimum temperatures for year 2012 are given in **Table 4.11** and **Table 4.12** respectively. Windrose diagrams for year 2012 are given in **Figure 4.6**. As seen from windrose diagrams for year 2012, predominant wind direction is westerlies.

Table 4.8: Monthly Rainfall (mm), 2012

| DATE | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|------|-----|-----|-----|-----|-----|-----|------|------|------|-----|-----|-----|
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15.6 | 0 | 0 | 0 | 0 |
| 2 | 0.6 | 0 | 0 | 0 | 0 | 0 | 0 | 8.9 | 0 | 0 | 0 | 0 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0.2 | 0 | 0.1 | 2.5 | 0 | 0 | 0 |
| 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.6 | 0 | 0 | 0 |
| 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.8 | 0 | 0 | 0 |
| 6 | 0.7 | 0 | 0 | 0 | 0 | 12 | 0 | 0.8 | 0 | 0 | 0 | 0 |
| 7 | 7.9 | 0 | 0 | 0 | 0 | 0.8 | 40.1 | 0.1 | 0 | 0 | 0 | 0 |
| 8 | 0 | 1.6 | 0 | 0 | 0 | 0 | 0.3 | 5 | 2.6 | 0 | 0 | 0 |
| 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10.7 | 0 | 0 | 0 | 0 |
| 10 | 0 | 0 | 0 | 0.4 | 0 | 0 | 5.3 | 0.2 | 0 | 0 | 0 | 0 |
| 11 | 0 | 0 | 0 | 5.6 | 0 | 0 | 6.4 | 0 | 0 | 0 | 0 | 0 |
| 12 | 0 | 0 | 0 | 0.4 | 0 | 0 | 0.2 | 17.8 | 0 | 0 | 0 | 0 |
| 13 | 0 | 0 | 6.2 | 0 | 1.4 | 0 | 4.1 | 0 | 9.3 | 0 | 0 | 2 |
| 14 | 0 | 0 | 0 | 0 | 0 | 0 | 15.6 | 15.1 | 0 | 0 | 0 | 0 |
| 15 | 0 | 0 | 0 | 6.6 | 0 | 0 | 0.1 | 3 | 10.8 | 0 | 0 | 0.1 |
| 16 | 4.2 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 24 | 0 | 0 | 0 |
| 17 | 0.5 | 0 | 0 | 0.7 | 1.7 | 0 | 0 | 0 | 0 | 0 | 0 | 0.2 |
| 18 | 0 | 0 | 0 | 0 | 0 | 2.1 | 0 | 0 | 2.2 | 0 | 0 | 0 |
| 19 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.3 | 0 | 0 | 0 | 0 |
| 21 | 0 | 0 | 0 | 0 | 0.1 | 0 | 0 | 54.5 | 0 | 0 | 0 | 0 |
| 22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 28.4 | 0 | 0 | 0 | 0 |
| 23 | 0 | 0 | 0 | 1.4 | 0 | 0 | 0 | 25.4 | 0 | 0 | 0 | 0 |
| 24 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 | 9.6 | 0 | 8.1 | 0 | 0 |
| 25 | 0 | 0 | 0 | 0.4 | 0 | 0 | 0 | 13.7 | 0 | 0 | 0 | 0 |
| 26 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 24.6 | 0 | 0 | 0 | 0 |

| | | | | | | | | | | | | |
|----|---|---|---|-----|---|-----|-----|------|---|---|-----|---|
| 27 | 0 | 0 | 0 | 2.8 | 0 | 0 | 0.1 | 26 | 0 | 0 | 0 | 0 |
| 28 | 0 | 0 | 0 | 0 | 0 | 0.4 | 12 | 43.1 | 0 | 0 | 0 | 0 |
| 29 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 59.5 | 0 | 0 | 0 | 0 |
| 30 | 0 | | 0 | 0 | 0 | 0 | 0 | 14.4 | 0 | 0 | 1.1 | 0 |
| 31 | 0 | | 0 | | 0 | | 9.5 | 0 | | 0 | | 0 |

Table 4.9: Relative Humidity at 8:30 Hrs (%), 2012

| DATE | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 1 | 88 | 79 | 88 | 60 | 40 | 31 | 33 | 95 | 81 | 67 | 92 | 83 |
| 2 | 95 | 69 | 78 | 49 | 49 | 41 | 66 | 78 | 84 | 66 | 88 | 76 |
| 3 | 97 | 75 | 67 | 50 | 35 | 45 | 59 | 63 | 86 | 75 | 75 | 82 |
| 4 | 97 | 90 | 75 | 53 | 45 | 42 | 64 | 79 | 83 | 62 | 78 | 82 |
| 5 | 97 | 88 | 63 | 54 | 36 | 39 | 64 | 84 | 78 | 65 | 86 | 69 |
| 6 | 98 | 93 | 85 | 44 | 49 | 45 | 69 | 74 | 76 | 62 | 77 | 66 |
| 7 | 95 | 78 | 71 | 58 | 51 | 46 | 97 | 83 | 81 | 64 | 85 | 60 |
| 8 | 86 | 65 | 68 | 49 | 43 | 45 | 74 | 83 | 93 | 61 | 85 | 52 |
| 9 | 94 | 60 | 76 | 54 | 42 | 44 | 77 | 83 | 82 | 63 | 79 | 85 |
| 10 | 94 | 64 | 67 | 59 | 34 | 31 | 74 | 89 | 77 | 72 | 86 | 88 |
| 11 | 85 | 69 | 78 | 68 | 45 | 42 | 92 | 80 | 84 | 75 | 90 | 89 |
| 12 | 88 | 76 | 69 | 61 | 52 | 44 | 83 | 82 | 81 | 62 | 92 | 92 |
| 13 | 76 | 70 | 75 | 54 | 49 | 42 | 77 | 79 | 85 | 84 | 96 | 95 |
| 14 | 69 | 89 | 78 | 61 | 38 | 29 | 75 | 89 | 85 | 64 | 77 | 87 |
| 15 | 90 | 42 | 61 | 81 | 43 | 40 | 72 | 85 | 89 | 56 | 86 | 80 |
| 16 | 82 | 68 | 67 | 55 | 34 | 43 | 65 | 80 | 80 | 68 | 84 | 93 |
| 17 | 97 | 67 | 71 | 67 | 45 | 41 | 65 | 82 | 39 | 71 | 90 | 84 |
| 18 | 100 | 81 | 81 | 61 | 40 | 74 | 55 | 77 | 81 | 75 | 72 | 75 |
| 19 | 97 | 50 | 72 | 54 | 39 | 58 | 50 | 72 | 89 | 71 | 86 | 66 |
| 20 | 100 | 65 | 75 | 49 | 38 | 36 | 55 | 79 | 86 | 83 | 72 | 64 |
| 21 | 89 | 88 | 46 | 50 | 34 | 41 | 76 | 100 | 83 | 82 | 70 | 73 |
| 22 | 76 | 91 | 39 | 43 | 43 | 44 | 69 | 86 | 81 | 81 | 67 | 84 |
| 23 | 86 | 78 | 43 | 46 | 33 | 41 | 70 | 97 | 77 | 75 | 76 | 97 |
| 24 | 77 | 68 | 47 | 45 | 24 | 42 | 75 | 93 | 66 | 81 | 86 | 100 |
| 25 | 73 | 55 | 62 | 53 | 21 | 42 | 77 | 92 | 63 | 77 | 90 | 97 |
| 26 | 72 | 54 | 62 | 56 | 28 | 42 | 85 | 92 | 62 | 84 | 70 | 89 |
| 27 | 87 | 56 | 63 | 64 | 34 | 44 | 73 | 94 | 78 | 75 | 58 | 87 |
| 28 | 88 | 66 | 62 | 46 | 26 | 47 | 81 | 90 | 76 | 80 | 66 | 91 |
| 29 | 81 | 80 | 55 | 44 | 23 | 37 | 80 | 98 | 76 | 77 | 88 | 90 |
| 30 | 76 | | 49 | 50 | 20 | 37 | 81 | 97 | 75 | 92 | 95 | 97 |
| 31 | 88 | | 58 | | 24 | | 95 | 97 | | 90 | | 94 |

Table 4.10: Relative Humidity at 17:30 (%), 2012

| DATE | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 1 | 86 | 34 | 35 | 32 | 25 | 22 | 22 | 83 | 64 | 49 | 68 | 54 |
| 2 | 82 | 28 | 30 | 32 | 20 | 32 | 37 | 64 | 75 | 43 | 74 | 57 |
| 3 | 58 | 34 | 33 | 36 | 18 | 44 | 65 | 55 | 63 | 44 | 68 | 50 |
| 4 | 71 | 51 | 45 | 23 | 26 | 26 | 56 | 68 | 72 | 30 | 70 | 53 |
| 5 | 78 | 39 | 38 | 15 | 21 | 56 | 46 | 62 | 60 | 25 | 66 | 49 |
| 6 | 85 | 43 | 42 | 36 | 32 | 32 | 53 | 61 | 60 | 28 | 78 | 37 |

| | | | | | | | | | | | | |
|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 7 | 85 | 67 | 34 | 34 | 21 | 35 | 75 | 75 | 68 | 36 | 49 | 47 |
| 8 | 76 | 28 | 56 | 21 | 22 | 30 | 60 | 94 | 69 | 32 | 48 | 56 |
| 9 | 50 | 37 | 27 | 19 | 18 | 23 | 64 | 79 | 65 | 33 | 54 | 54 |
| 10 | 48 | 28 | 32 | 68 | 28 | 23 | 59 | 68 | 61 | 40 | 47 | 58 |
| 11 | 50 | 36 | 21 | 54 | 41 | 22 | 64 | 86 | 70 | 41 | 64 | 83 |
| 12 | 50 | 39 | 36 | 31 | 53 | 26 | 88 | 62 | 77 | 42 | 60 | 68 |
| 13 | 49 | 51 | 43 | 43 | 27 | 20 | 71 | 95 | 71 | 38 | 62 | 59 |
| 14 | 52 | 42 | 34 | 60 | 27 | 15 | 60 | 76 | 81 | 38 | 59 | 65 |
| 15 | 59 | 36 | 30 | 35 | 16 | 19 | 51 | 68 | 75 | 42 | 67 | 66 |
| 16 | 82 | 35 | 36 | 24 | 13 | 23 | 44 | 65 | 71 | 44 | 60 | 72 |
| 17 | 79 | 45 | 30 | 33 | 23 | 20 | 40 | 59 | 77 | 96 | 61 | 50 |
| 18 | 67 | 27 | 40 | 36 | 17 | 57 | 40 | 53 | 79 | 40 | 59 | 39 |
| 19 | 64 | 35 | 44 | 28 | 16 | 27 | 33 | 72 | 65 | 46 | 52 | 39 |
| 20 | 73 | 38 | 38 | 30 | 22 | 19 | 66 | 94 | 65 | 51 | 38 | 48 |
| 21 | 52 | 41 | 26 | 28 | 14 | 21 | 57 | 88 | 53 | 45 | 55 | 49 |
| 22 | 62 | 38 | 29 | 31 | 18 | 27 | 54 | 92 | 45 | 44 | 52 | 55 |
| 23 | 51 | 44 | 27 | 22 | 11 | 27 | 68 | 77 | 47 | 82 | 54 | 82 |
| 24 | 50 | 39 | 24 | 30 | 10 | 28 | 52 | 95 | 44 | 53 | 57 | 69 |
| 25 | 54 | 28 | 20 | 26 | 19 | 34 | 63 | 92 | 54 | 42 | 48 | 77 |
| 26 | 59 | 38 | 29 | 41 | 25 | 27 | 67 | 89 | 45 | 51 | 50 | 76 |
| 27 | 58 | 29 | 28 | 29 | 15 | 38 | 87 | 83 | 51 | 52 | 51 | 76 |
| 28 | 55 | 40 | 32 | 17 | 15 | 23 | 62 | 97 | 41 | 57 | 50 | 65 |
| 29 | 38 | 34 | 21 | 21 | 12 | 28 | 76 | 81 | 49 | 56 | 59 | 61 |
| 30 | 31 | | 23 | 36 | 15 | 21 | 75 | 84 | 41 | 58 | 74 | 66 |
| 31 | 35 | | 33 | | 19 | | 86 | 63 | | 48 | | 76 |

Table 4.11: Maximum Temperature (°C), 2012

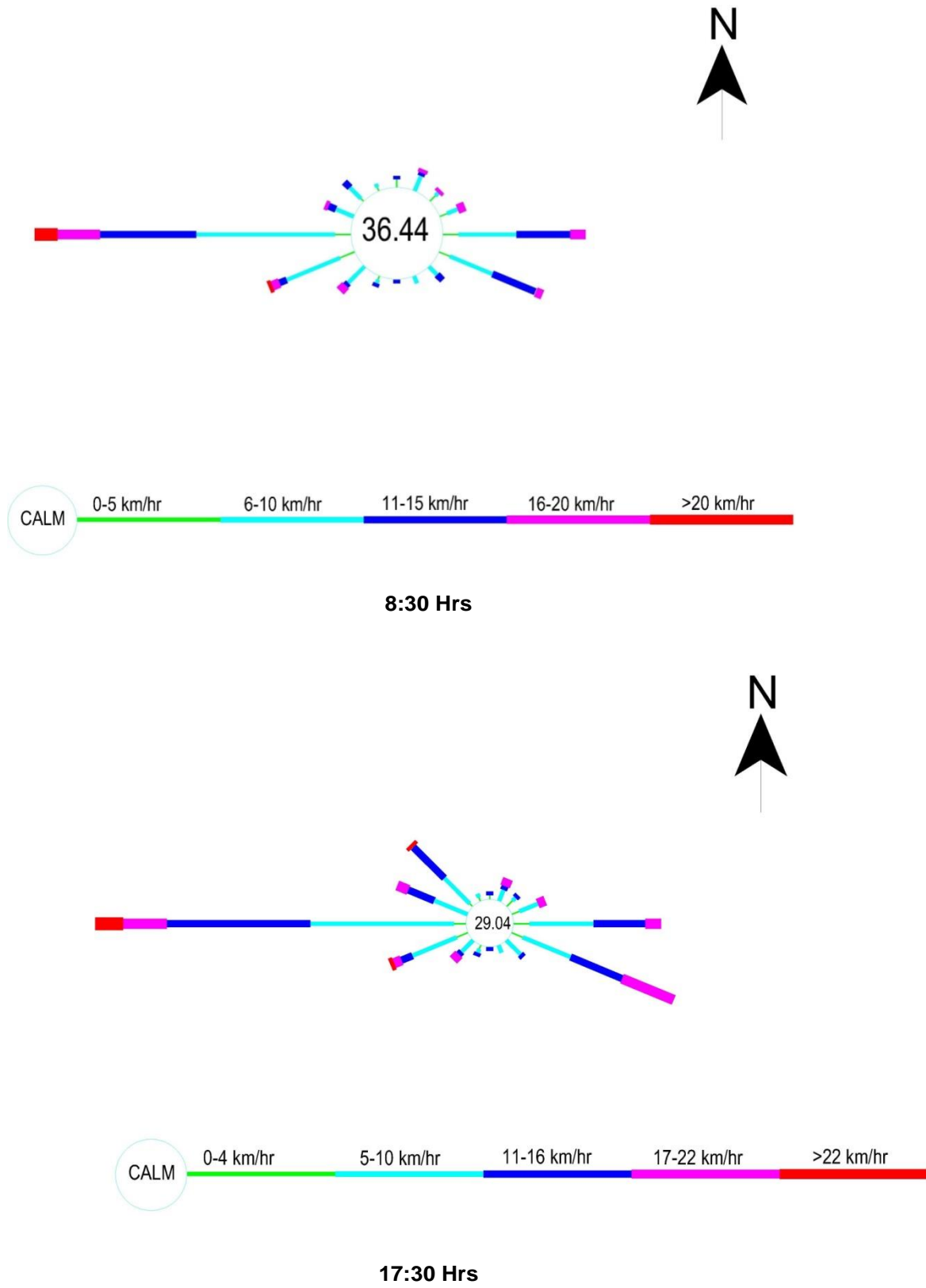
| DATE | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 1 | 23.3 | 21.6 | 26.7 | 36.5 | 36.9 | 45.4 | 42.4 | 27.9 | 34.5 | 35.1 | 28.7 | 21.6 |
| 2 | 19.5 | 22.1 | 29.4 | 37.6 | 36 | 44.4 | 43.5 | 29.4 | 35.3 | 34.6 | 28.8 | 23.1 |
| 3 | 19.7 | 22.8 | 29.5 | 38.3 | 37.7 | 44.2 | 41.8 | 36.9 | 34.9 | 34.6 | 27.2 | 24.5 |
| 4 | 20.6 | 23.6 | 29.2 | 38.7 | 37.6 | 42.4 | 40.7 | 36.6 | 34.4 | 35.4 | 27.8 | 23.8 |
| 5 | 21.8 | 24 | 32.7 | 37.6 | 38.7 | 41.9 | 41.2 | 34.3 | 32.6 | 36.3 | 26.5 | 24 |
| 6 | 19.3 | 23.8 | 33 | 37.4 | 39.6 | 40.8 | 41.1 | 35.5 | 34.9 | 36.1 | 28.9 | 24.7 |
| 7 | 16.9 | 22 | 29.1 | 37 | 39.6 | 38.7 | 38.4 | 34.6 | 33.8 | 35.9 | 26.9 | 26.1 |
| 8 | 17.7 | 20.5 | 29 | 37.5 | 39.8 | 38.2 | 30.3 | 32.9 | 32.6 | 34.1 | 29.3 | 25.9 |
| 9 | 18 | 19.3 | 27.7 | 36.6 | 40.6 | 39.3 | 33.9 | 34.6 | 33.6 | 33.6 | 28.1 | 26.8 |
| 10 | 17.6 | 19 | 25 | 38.5 | 40.8 | 40.6 | 33.9 | 31.7 | 35.5 | 33.7 | 30.3 | 28.1 |
| 11 | 17.9 | 20.6 | 26.2 | 37.8 | 42.6 | 41.8 | 36.2 | 34.1 | 36.9 | 33.7 | 30.9 | 27.7 |
| 12 | 18.5 | 21.8 | 27.6 | 30.3 | 39.2 | 41.4 | 33.9 | 35.1 | 35.1 | 33.1 | 30.7 | 18.7 |
| 13 | 18.7 | 26.1 | 30.2 | 35.5 | 40.3 | 42.3 | 32.8 | 35.2 | 34 | 34.7 | 30.3 | 23.8 |
| 14 | 19.8 | 24.8 | 27.2 | 29.7 | 37.6 | 43.2 | 36.2 | 33.2 | 35.8 | 35.3 | 26.6 | 25.6 |
| 15 | 22.6 | 23.6 | 25.8 | 29.6 | 34.8 | 42.7 | 33 | 32.6 | 32.6 | 35.5 | 27.5 | 22.8 |
| 16 | 25.6 | 21.7 | 27.8 | 31.3 | 39.8 | 43.5 | 37 | 33.7 | 34 | 34.7 | 26.8 | 24.7 |
| 17 | 20.3 | 21.2 | 31 | 35.6 | 42.2 | 43.2 | 37.8 | 33.1 | 32.4 | 31.8 | 26.8 | 23.5 |
| 18 | 14 | 22.3 | 34.6 | 34.1 | 38.2 | 43.6 | 38.4 | 35.6 | 31.5 | 32.2 | 26.7 | 22.8 |
| 19 | 15.5 | 23.7 | 35.6 | 33.6 | 41 | 37.2 | 40.3 | 35.7 | 31.3 | 32 | 28.4 | 24.9 |

| | | | | | | | | | | | | |
|----|------|------|------|------|------|------|------|------|------|------|------|------|
| 20 | 17.7 | 24.6 | 37 | 36.7 | 40.8 | 41.5 | 40.5 | 34.5 | 33.1 | 32.6 | 27.7 | 22.7 |
| 21 | 14.6 | 25.5 | 34.5 | 37.5 | 41.4 | 43.3 | 36.7 | 33.3 | 32.9 | 31 | 27.1 | 21.6 |
| 22 | 18.4 | 29.3 | 26.3 | 34.8 | 42.3 | 43 | 36.6 | 29.4 | 33.5 | 30.9 | 26.4 | 22.8 |
| 23 | 18 | 30.1 | 27.4 | 35.6 | 42.2 | 43 | 37.5 | 32.6 | 35.5 | 31.3 | 25.6 | 21.7 |
| 24 | 22.7 | 28 | 30.7 | 36 | 42.2 | 42.4 | 37.2 | 31.1 | 35.1 | 31.8 | 26.6 | 18.7 |
| 25 | 21.6 | 26.6 | 32.8 | 37.6 | 43.1 | 42.1 | 38.6 | 30.7 | 34.4 | 27.8 | 27 | 19.1 |
| 26 | 21.1 | 23.4 | 33.4 | 35.6 | 44 | 42.3 | 35 | 29 | 34.4 | 27.7 | 25.8 | 16.2 |
| 27 | 21.1 | 23.8 | 36.2 | 34.6 | 42.7 | 40.6 | 33.2 | 32.9 | 34.6 | 29.5 | 24.9 | 18.3 |
| 28 | 21 | 25 | 34.5 | 34.7 | 41.6 | 40.2 | 35.3 | 34.5 | 33.9 | 29.7 | 25.5 | 16.6 |
| 29 | 21.7 | 26.4 | 33.6 | 36.8 | 42.2 | 41.6 | 35.4 | 31.9 | 34.7 | 29.6 | 26 | 10.6 |
| 30 | 20.9 | | 32.8 | 37.1 | 43.5 | 42 | 31.8 | 31.2 | 34.8 | 28.8 | 28.4 | 21.4 |
| 31 | 22.2 | | 34.6 | | 45 | | 32 | 30.8 | | 29.3 | | 17 |

Table 4.12: Minimum Temperature (°C)

| DATE | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 1 | 11.3 | 6.7 | 10.6 | 21 | 21 | 34.3 | 31.4 | 26.6 | 26.8 | 21.3 | 15.3 | 10.1 |
| 2 | 11.6 | 8.4 | 12.2 | 22.3 | 20.5 | 33.2 | 32.3 | 26.3 | 28 | 22.5 | 15.9 | 7.8 |
| 3 | 7 | 9.8 | 12.4 | 24 | 21.4 | 29.7 | 32.6 | 28.8 | 25.6 | 24.4 | 15.3 | 6.8 |
| 4 | 8 | 10.1 | 14.5 | 21.9 | 21.6 | 29 | 29.2 | 27.5 | 26 | 20.9 | 15.6 | 6.5 |
| 5 | 11.2 | 11.7 | 17.5 | 22.2 | 24.4 | 29.5 | 29.5 | 27.5 | 26.4 | 20.8 | 15.2 | 9 |
| 6 | 12.4 | 10.6 | 18.6 | 22.4 | 25.4 | 26 | 29.1 | 28.6 | 26.5 | 19.7 | 13.8 | 7.5 |
| 7 | 12.5 | 7.6 | 13.1 | 22 | 24.6 | 26.9 | 23.2 | 27.1 | 26 | 20.4 | 14 | 10.2 |
| 8 | 11.9 | 8.5 | 12.7 | 22.1 | 27.2 | 27 | 26.4 | 27.2 | 24.8 | 19.6 | 14.3 | 9.3 |
| 9 | 8.4 | 4 | 11.8 | 23.1 | 28.4 | 29.1 | 28 | 26.1 | 26.2 | 19.7 | 12.8 | 9 |
| 10 | 4.5 | 6.4 | 9.7 | 22.3 | 27.4 | 29.5 | 28.4 | 26.6 | 27.4 | 19.5 | 13.9 | 9.4 |
| 11 | 4.6 | 6.6 | 9.6 | 21.1 | 26.6 | 30 | 27.2 | 27.8 | 27.8 | 19.7 | 14 | 11.5 |
| 12 | 5.3 | 9.2 | 11 | 19.6 | 25.2 | 28.6 | 28.2 | 25.4 | 27.3 | 19.3 | 14.1 | 7 |
| 13 | 5.5 | 11.2 | 14.8 | 23.3 | 22 | 30.4 | 27.4 | 26.8 | 27.2 | 19.7 | 13.4 | 12.5 |
| 14 | 6.7 | 11.7 | 13.1 | 21.3 | 26.4 | 31.8 | 25.7 | 25.9 | 27.3 | 19.5 | 13 | 14 |
| 15 | 9.5 | 11.3 | 14 | 19 | 26.4 | 31.5 | 28 | 26.7 | 24.8 | 20 | 12.8 | 12.8 |
| 16 | 10.5 | 7.1 | 14.2 | 18.3 | 25.6 | 32.4 | 27.5 | 25.5 | 24.8 | 19.3 | 12 | 14.1 |
| 17 | 9.3 | 6.6 | 15.3 | 19.7 | 27.3 | 32.7 | 29.5 | 26.5 | 26.5 | 19.3 | 10.9 | 11.2 |
| 18 | 5.6 | 8.7 | 17.3 | 22.6 | 27.5 | 28.2 | 29.2 | 28 | 24.8 | 19.2 | 10.8 | 10.5 |
| 19 | 4.8 | 9.6 | 19.4 | 21.7 | 29 | 28.4 | 32.2 | 29.8 | 24.8 | 17.5 | 12.3 | 11.3 |
| 20 | 4.5 | 11.4 | 19.4 | 24.8 | 25.4 | 29.7 | 32.2 | 27.4 | 24.6 | 17.8 | 10.8 | 9.5 |
| 21 | 5.4 | 11.1 | 13.5 | 23.6 | 27.7 | 33.6 | 28.6 | 24.8 | 23.9 | 18.2 | 9.6 | 7.6 |
| 22 | 6.6 | 13.5 | 15.1 | 23.4 | 27.2 | 32.4 | 28.5 | 25.2 | 22.6 | 16.7 | 9.6 | 6.2 |
| 23 | 5.6 | 13.5 | 14.9 | 19.7 | 26.3 | 31.4 | 29.8 | 25.3 | 22.7 | 17.4 | 8.6 | 5.9 |
| 24 | 7.5 | 11.6 | 17.7 | 21.5 | 27.3 | 33.3 | 29.3 | 25.5 | 23.2 | 16.4 | 9.5 | 7.7 |
| 25 | 9 | 10.5 | 17.3 | 21.4 | 27.8 | 31.2 | 27.9 | 25.5 | 23.4 | 14.9 | 10.3 | 7 |
| 26 | 9.3 | 9.7 | 18.2 | 22.6 | 32.5 | 33.3 | 27.7 | 25 | 23.6 | 13.9 | 10.5 | 7.8 |
| 27 | 7.6 | 10.3 | 19.2 | 19.8 | 34.2 | 31 | 28.7 | 26 | 23.3 | 14.2 | 9.4 | 9.2 |
| 28 | 5.1 | 12.5 | 17.8 | 21.3 | 26.2 | 30.4 | 27.8 | 25.3 | 22.8 | 13.9 | 8.5 | 6.3 |
| 29 | 5.3 | 11.9 | 19.2 | 20.7 | 26.8 | 31.6 | 27.9 | 23.6 | 22.4 | 14.6 | 9.3 | 9.8 |
| 30 | 7.3 | | 17.6 | 20.9 | 28.2 | 31.5 | 28 | 24.2 | 22.4 | 15.6 | 10.9 | 7.7 |
| 31 | 4.4 | | 18.6 | | 31.2 | | 25.4 | 24.6 | | 17.2 | | 5.3 |

Figure 4.6: Windrose Diagram



4.4.2 Air Quality

Delhi in terms of air pollution is ranked among the most polluted cities in the world. The ambient air quality monitoring is carried out regularly by Central Pollution Control Board and Delhi Pollution Control Committee. The annual average levels of suspended particulate matter increased to 450 $\mu\text{g}/\text{m}^3$ during 1996 and the annual average levels of CO also increased to 5587 $\mu\text{g}/\text{m}^3$ during that period as against the National Ambient Air Quality Standard of 200 $\mu\text{g}/\text{m}^3$ for SMP and 2000 $\mu\text{g}/\text{m}^3$ for CO for the residential areas notified by the Ministry of Environment, Govt. of India during that period. In fact, 1996 is considered the peak year in terms of air pollution load. The transport, industrial and the domestic sectors were the major contributors towards the rising ambient air pollution levels, in addition to the presence of natural dust due to meteorological conditions.⁸ In order to establish the baseline concentrations of air pollutants, air quality monitoring was carried out near to the corridors by setting up ambient air quality monitoring stations. The air monitoring has been carried out at 12 strategic locations along the corridors. The locations chosen near to habited area or near to sensitive receptors. Air Monitoring was carried out for the following parameters PM_{2.5}, PM₁₀, NOx, SO₂, CO, O₃, NH₃, Pb and Ozone. The ambient air monitoring were carried out at 13 locations in the month of June 2020 and analyzed in NABL accredited laboratory. The monitoring locations details are given in **Table 4.13** and results of the air quality monitoring are presented in **Table 4.14**. All the parameters except No₂, So₂ and CO are more than the permissible limits specified by CPCB.

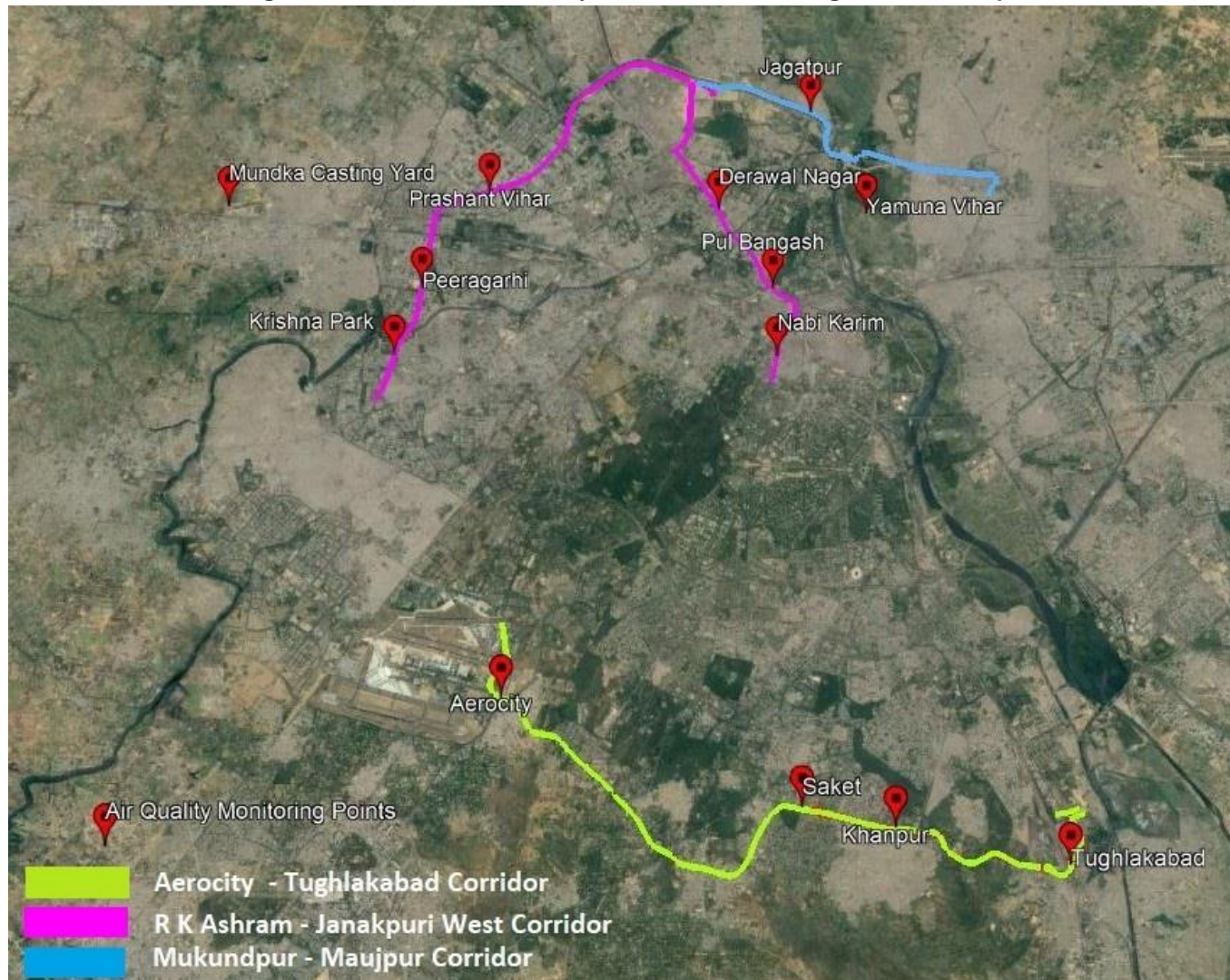
Table 4.13: Ambient Air and Noise Monitoring Locations

| Sampling Location Number | Location Name | Corridor |
|--------------------------|---------------------------|-----------------------------|
| 1 | Krishna park | R K Ashram – Janakpuri West |
| 2 | Peeragarhi | |
| 3 | Prashant vihar | |
| 4 | Nabi Karim | |
| 5 | Derawal nagar | |
| 6 | Pulbhangesh | |
| 7 | Yamuna vihar casting yard | Mukundpur – Maujpur |
| 8 | Jagatpur | Aerocity – Tughlakabad |
| 9 | Aerocity | |
| 10 | Saket | |
| 11 | Khanpur | |
| 12 | Tughlakabad | Casting yard |
| 13 | Mundka | |

Table 4.14: Ambient Air Quality along the Corridors

| Name Of Location | Corridor | PM10 (24Hr) | PM2.5 (24Hr) | SO ₂ (24Hr) | NO ₂ (24Hr) | CO (8HR) | Pb (24Hr) | Ozone (8hr) | Ammonia (24Hour) |
|---------------------------|--------------------------------|----------------|-----------------|---------------------------|---------------------------|-------------|--------------|----------------|---------------------|
| Krishna park | R K Ashram – Janakpuri West | 256 | 189 | 43.6 | 61.3 | 1.31 | BDL | 126 | 17.3 |
| Peeragarhi | | 278 | 169 | 41.5 | 68.2 | 1.39 | BDL | 144 | 20.9 |
| Prashant vihar | | 284 | 179 | 38.6 | 66.3 | 1.27 | BDL | 137 | 19.3 |
| Nabi Karim | | 305 | 234 | 45.2 | 54.3 | 1.66 | BDL | 146 | 23.1 |
| Derawal nagar | | 198 | 109 | 36.1 | 60.8 | 1.37 | BDL | 132 | 17.2 |
| Pulbhangesh | | 317 | 219 | 52.8 | 67.1 | 1.79 | BDL | 136 | 22.7 |
| Yamuna vihar casting yard | Mukundpur – Maujpur | 242 | 126 | 34.6 | 59.7 | 1.32 | BDL | 127 | 21.3 |
| Jagatpur | | 306 | 211 | 50.8 | 73.2 | 1.56 | BDL | 151 | 26.9 |
| Aerocity | Aerocity – Tughlakabad | 267 | 157 | 37.2 | 57.1 | 1.46 | BDL | 129 | 12.6 |
| Saket | | 273 | 149 | 29.1 | 49.8 | 1.28 | BDL | 134 | 19.5 |
| Khanpur | | 295 | 184 | 46.4 | 63.4 | 1.69 | BDL | 119 | 18.2 |
| Tughalakabad | | 318 | 207 | 51.3 | 76.1 | 1.84 | BDL | 127 | 21.6 |
| Mundka | Casting yard | 269 | 134 | 39.2 | 52.8 | 1.34 | BDL | 141 | 23.4 |

Figure 4.7: Ambient Air Quality and Noise Monitoring Location Map



Note: Air and Noise monitored at same locations

4.5 NOISE ENVIRONMENT

Noise is responsible for adverse impact on physical and mental health of the people. The other impacts are:

- ❖ Physiological effects,
- ❖ Hearing impairment,
- ❖ Communication interference, and
- ❖ Sleep disruption

The assessment of impacts of noise sources on surrounding community depends on:

- ❖ Characteristics of noise sources (instantaneous, intermittent or continuous in nature).
- ❖ Time of day at which noise occurs, for example high noise levels at night in residential areas are not acceptable because of sleep disturbance.
- ❖ Location of noise source, with respect to noise sensitive land use, which determines the loudness and period of exposure.

A noise level survey was conducted along the alignments with an objective to establish the baseline noise levels and assess the impacts of total noise expected due to the proposed metro. Noise level monitoring has been carried out at 13 locations along the corridors in the month of February 2020. The monitoring location map is shown in Figure 3.6. The noise levels so obtained are summarized in **Table 4.15**. It could be concluded that the day time and night time noise levels recorded at various places are higher than prescribed permissible levels of 55-dBA (day) and 45-dBA (night) respectively for residential areas.

Table 4.15: Noise Levels

| S. No. | Location | Results in dBA | | | | | | | | |
|--------|---------------------------|----------------|------|------|------|------|------|-------|--------|------|
| | | Leq | L10 | L50 | L90 | Lmax | Lmin | Lday | Lnight | Ldn |
| 1. | Krishna Park | 60.6 | 67.1 | 59.2 | 54.8 | 81.6 | 52.1 | 62.1 | 53.5 | 62.7 |
| 2. | Aerocity | 61.4 | 70.4 | 60.4 | 56.1 | 77.2 | 53.2 | 63.4 | 55.2 | 64.2 |
| 3. | Saket | 58.6 | 54.5 | 53.1 | 55.4 | 81.2 | 50.1 | 60.2 | 53.5 | 61.7 |
| 4. | Khanpur | 59.2 | 65.8 | 61.5 | 59.9 | 78.4 | 52.5 | 63.4 | 51.9 | 62.9 |
| 5. | Tughalakabad | 63.7 | 70.9 | 63.4 | 60.8 | 79.4 | 57.5 | 66.3 | 61.2 | 68.8 |
| 6. | Mundka Casting Yard | | 56.9 | 52.3 | 45.6 | 91.7 | 36.2 | 61.26 | 53.47 | |
| 7. | Peeragarhi | 59.8 | 56.3 | 59.4 | 61.4 | 77.4 | 54.6 | 62.4 | 51.3 | 56.9 |
| 8. | Prashant Vihar | 61.4 | 64.2 | 62.3 | 59.7 | 74.6 | 57.3 | 64.3 | 52.8 | 58.6 |
| 9. | Jagatpur | NA | 69.6 | 57.1 | 42.3 | 95.8 | 35.9 | 64.25 | 53.21 | NA |
| 10. | Yamuna Vihar Casting Yard | NA | 66.5 | 55.6 | 42.6 | 93.6 | 36.9 | 62.49 | 51.92 | NA |
| 11. | Derawal Nagar | 61.3 | 63.8 | 60.4 | 57.6 | 76.9 | 55.6 | 64.9 | 52.6 | 58.8 |
| 12. | Pulbangesh | NA | 68.4 | 48.5 | 38.2 | 87.1 | 36 | 59.4 | 51.96 | NA |
| 13. | Nabi Karim | NA | 68.9 | 52 | 44.6 | 92.1 | 34.7 | 62.18 | 51.76 | NA |

4.6 ECOLOGY

An ecological study of the project area is essential to understand the impact due to project development activities on flora and fauna of the area. The project site is located in city area and it is free of any wildlife fauna. On site construction activities about 10,438 trees will be felled. These are the final numbers of trees after survey. The predominant tree species are Pipal, Neem, Kikar, Eucalyptus, Ashok, Ficus and Bakaan, etc. An inventory of trees likely to be lost has been prepared and summarized in **Table 4.16**. There are 10393 trees on public land and 45 trees on

private land. Necessary permission will be required from the Deputy Conservatory of Forest, Department of Forest, Delhi to fell these trees on both public and private land.

Table 4.16: Inventory of Trees

| Sl. No. | Corridor | Number of Trees Affected | | |
|---------|------------------------------|--------------------------|-----------------|--------------|
| | | On Public land | On Private land | Total |
| 1. | R K Ashram to Janakpuri West | 4163 | 14 | 4177 |
| 2. | Aerocity – Tughlakabad | 4240 | 31 | 4271 |
| 3. | Maujpur – Mukundpur | 1990 | 0 | 1990 |
| | Total | 10393 | 45 | 10438 |

4.6.1 Forests

Forests/trees play an important role in maintaining the eco-system balance. The project layout was superimposed on land-use maps to assess the number of trees in the project area. Delhi state seems overwhelmingly green. However, the green cover is not uniformly distributed, as some areas have considerably more green patches than the others. The districts of New Delhi and South Delhi are much greener compared to other districts. As per the India State of Forest Report (SFR)-2009, the total Forest and Tree Cover of NCT of Delhi is 299.58 sq. km. (20.20%) as against 283sq. km. (19.09%) reported in SFR-2005. This is made up of 123 sq. kms. of tree cover and 176.58 sq. km of forest cover making a total of 299.58 sq. kms. Thus there is an increase of Green Cover of Delhi from 19.09% to 20.20% which works out to 1.11% of the geographic area. The district wise forest cover of Delhi is given in **Table 4.17**. Some of the portion of the tunnel and stations of Aerocity to Tughlakabad corridor having 10.27 Ha land is coming in the Ridge Area which falls under reserved forest. The permission is required to be taken from Ridge Management Board, Forest Department, Delhi under the Forest Conservation Act 1980.

Table 4.17: District Wise Forest Cover of Delhi

| District | Geographical Area | Forest Area in Sq km | Percentage of Forest Cover |
|------------------|-------------------|----------------------|----------------------------|
| Central Delhi | 25 | 5.05 | 20.20 |
| East Delhi | 64 | 6.05 | 4.67 |
| New Delhi | 35 | 16.31 | 46.60 |
| North Delhi | 59 | 4.81 | 8.15 |
| North East Delhi | 60 | 3.59 | 5.89 |
| North West Delhi | 440 | 16.41 | 3.73 |
| South Delhi | 250 | 78.64 | 31.46 |
| South West Delhi | 421 | 42.45 | 10.08 |
| West Delhi | 129 | 6.33 | 4.91 |
| Total | 1489.00 | 176.58 | 11.91 |

Source: http://delhi.gov.in/wps/wcm/connect/doi_forest/Forest/Home/Forests+of+Delhi/

4.6.2 Flora and Fauna

Over 80 years ago Delhi was the haunt of a large variety of animals. Foxes and hare were present. Blackbuck was common in the plains while the Chinkara was found on the Ridge and in the hilly range North-east of Delhi. Wolves roamed such inhabited places as the Cantonments

and were occasionally shot by the British Soldiers. Leopards too were not uncommon, especially in Tughlakabad. Bluebull or Nilgai was easily sighted. Peafowl, duck, snipe were plentiful, so were the black and gray partridge. There were deer, wild boar, blue bull, panther and a wide variety of bird life on huge trees. Hare were plentiful and so were hyenas, jackals and porcupines. Mahasir, Rohu and Betchwa were among the varieties of fish that were plentiful. Unpolluted river was infested with crocodiles.

But such wildlife in Delhi has vanished because of indiscriminate shooting after partition in 1947 and the ever-increasing human activities. The domestic animals in the project area consist of cows, bullock, sheep, goat, cat and dogs.

4.6.3 Ecological Sensitive Zone (ESZ)

Asola Bhatti Wildlife Sanctuary (ABWLS)

Introduction: The Asola-Bhatti Wildlife Sanctuary located on the South-Eastern part of south ridge is a manmadesanctuary. The Asola Sanctuary (Area : 4707 Acres)- was declared as a protectedarea in year 1986 and subsequently Bhatti Area (2107 Acres) too came in this category underthe Section 18 of Wildlife (Protection) Act, 1972 and collectively came to be known as aAsola-Bhatti Wildlife Sanctuary.

The Asola-Bhatti Wildlife Sanctuary lies at the far southern edge of the city of Delhi, at Asola near Tughlakabad in the Delhi National Capital Territory of India. It covers a vast area of over 6800 acres and contains many species of flora and fauna. It is located on Southern Ridge, the northern terminal of Aravalli Hill Range, one of the oldest mountain systems of the world. Biodiversity significance of Ridge lies in its merger with Indo-Gangetic plains.

Geographically: The sanctuary is located in the Southern Ridge and extends from 28°30'15.454"N 77°15'35.514"E to 28°24'42.147"N 77°13'2.181"E and 28°29'17.408"N 77°16'19.757"E to 28°29'11.876"N 77°12'18.407"E.

The sanctuary has the following boundaries:

- North - Sangam Vihar and Durga Vihar colonies bordering Mehrauli - Badarpur Road.
- South - Inter - state border with Haryana.
- East - Haryana interstate border and road from Tughlakabad Fort to Suraj Kund.
- West - Asola, Fatehpur Beri and some other villages of Delhi and Haryana State

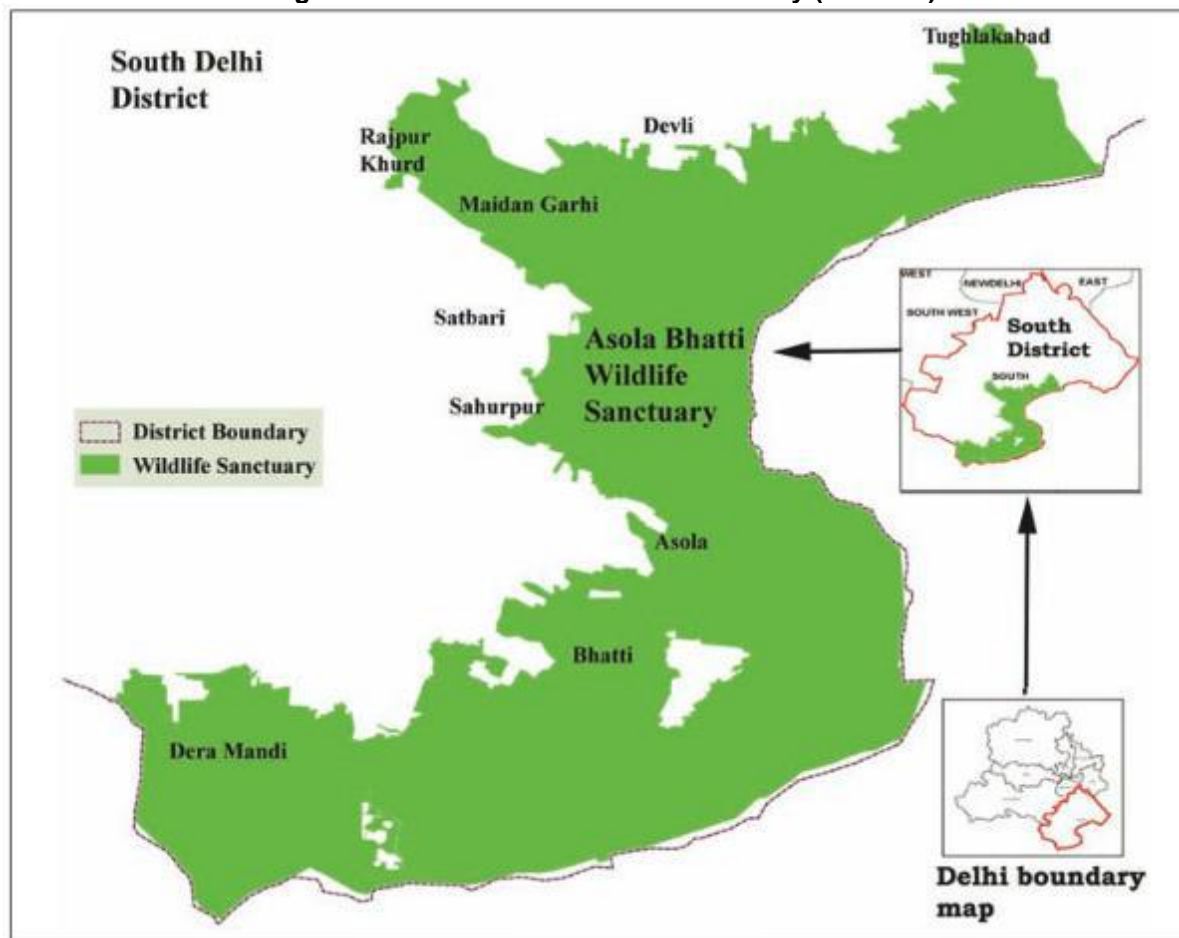
In order to preserve the sanctity of the area,2,679.29 acres of land was carved out from the community land of three villages namely Asola, Sahurpur and Maidan Garhi and notified as Asola Wildlife Sanctuary under the Wildlife (Protection) Act, 1972 vide notification No. F.3(116)/CWLW/84/897/to 906 dated 09.10.1986. After imposing a ban on the mining of Badarpur, and in the larger interest to protect the ecology of the area, 2,166.28 acres of village Bhatti was notified under section 18 of the Wildlife (Protection) Act, 1972 vide notification No. F.2(19)/DCF/90-91/1382-91 dated 15.04.1991as the Asola Bhatti Wildlife Sanctuary (4,845.57 acres).

The Asola-Bhatti Wildlife Sanctuarywas created to serve the purpose of:

- A potential green lung and carbon sink.
- Conservation, education and nature interpretation programme.
- A shelterbelt against advancing aridity.
- Conserving indigenous flora and fauna.
- A nature's foremost line of defence against soaring mercury for the Delhites and bypassers.

- A barrier to dust and desertification.
- As an effective buffer to absorb noise pollution

Figure 4.8: Asola Bhatti Wildlife Sanctuary (AB WLS)



Physiography: The part of the Asola-Bhatti Wildlife Sanctuary falls under tropical thorn forest zone; thenatural regeneration would, therefore, lead a xerophytic higher density forest over moist sites. However, the area of sanctuary is barren, dry and honey combed with pits and roads and grasses coming up diffused with xerophytic plants.

Climate: Typically, continental climate characterized by cold winter months and hot and dry summer months. Cool oceanic air is able to penetrate the area only during the months of July, August and September i.e. during monsoons. The South West monsoon has a major impact as most of the precipitation is received during this period and effects both vegetation and fauna of the area.

Flora: The sanctuary consists of a mixture of indigenous and exotic species of Flora and is known to harbor around 83 species of trees, around 30 species of shrubs, around 95 species of herbs, around 18 species of grasses and around 4 species of sedges; The native flora includes various species of *Acacia* such as *Acacia nilotica*, *Acacia leucophloea*, *Acacia catechu*, *Acacia senegal*, *Acacia modesta*, *Butea monosperma*, *Cassia fistula*, *Salvadorapersica* and in the small boulder hillocks a few scattered trees of *Anogeissus pendula* are also found; some other trees found in the area include *Dalbergia sissoo*, *Ficus Religiosa*, *Morusindica*, *Azadirachtaindica*, *Pongamiapinnata* etc. Complete list is given in **Annexure 4.1**. Different species of plants have been reported in Asola-Bhatti Wildlife Sanctuary, Delhi, which are also listed in Annexure 4.1.

Faunal Profile: The main faunal element includes Nilgai, Jungle Cat, Small Indian Civet, Ruddy

Mongoose and Small Indian Mongoose, Rufous Tailed hare, Porcupine, Spiny tailed lizard and about 200 species of resident and migratory birds. Hyaena, Leopard, Wolf and Chinkara, reported in the Gazetteer of Delhi, have not been sighted after 1940.

While various agencies are engaged in revitalizing the biological potentials and ecological functions of Asola-Bhatti Wildlife Sanctuary, it becomes obligatory to decipher the existing biodiversity of the area, its past potential and possible re-introduction or rehabilitation of the species lost earlier due to dismal degradation, erosion, mining and other human interference over the time. Kumar and Khanna (1997) published a faunal profile of ABWLS based on the work of Kalpavriksha (1991), Sawarkar and Hussain (1997) and Zoological Survey of India (1997). The comprehensive and updated faunal profile provided incorporated inventory of 246 species of fauna spreading over 3 species of Mollusca, one species of Thysanura, one of Odonata, nine of Orthoptera, four of Isoptera, 4 of Coleoptera, one Diptera, 4 Lepidoptera, 5 Hymenoptera, 3 Chilopoda amongst invertebrates, and 2 species of Amphibia, 3 species of Reptilia, 196 species of Aves and ten species of Mammalia amongst vertebrates, List of Fauna report in ABWLS are presented in Annexure-1

Threatened Fauna: The Table 4.18 lists the threatened species reported from AB WLS, as listed in the Red Data Book (ROB) of the Zoological Survey of India (ZSI) and International Union for Conservation of Nature and Natural Resources (IUCN) respectively, vis-a-vis their status as assigned in the Indian Wildlife (Protection) Act, 1972, their designation in the appendices of Convention on International Trade in Endangered species of Fauna and Flora (CITES).

Table 4.18: Threatened Species Reported from ABWLS

| Category | Species | Red Data Book ZSI, 1994 | W(P) Act 1972 | CITES | IUCN |
|-------------|--|----------------------------|------------------|----------|------------------|
| A. Mammalia | 1. <i>Macaca mulatta</i> | - | Sch. II | - | LC ¹ |
| | 2. <i>Canis aureus</i> | - | Sch. II (I) | - | LC ² |
| | 3. <i>Viverricula indica</i> | - | Sch. II (II) | App. III | LC ³ |
| | 4. <i>Herpestes edwardsi</i> ; | | Sch. IV | App. III | LC ⁴ |
| | 5. <i>Herpestes smithi</i> | - | Sch. IV | App. III | LC ⁵ |
| | 6. <i>Canis hyaena</i> | - | Sch. III | - | NT ⁶ |
| | 7. <i>Felis chaus</i> | - | Sch. II (II) | App. II | LC ⁷ |
| | 8. <i>Antelope cervicapra</i> < <i>Antelope cervicapra</i> ?> | Vu | Sch. I | App. III | LC ⁸ |
| | 9. <i>Manis crassicaudata</i> | Vu | Sch. I | App. II | EN ⁹ |
| B. Aves | 10. <i>Pavocristatus</i> | Vu | Sch. I | App. I | LC ¹⁰ |

Source: Some of the selected Fauna in ABWS, Zoological Survey of India, Fauna of Conservation Area No. 16 (2003)

LC- least concern, NT- Near Threatened, EN-endangered species

¹<https://www.iucnredlist.org/species/12554/17950825>

²<https://www.iucnredlist.org/species/118264161/163507876>

³<https://www.iucnredlist.org/species/41710/45220632>

⁴<https://www.iucnredlist.org/species/41611/45206787>

⁵<https://www.iucnredlist.org/species/41617/45208195>

⁶<https://www.iucnredlist.org/species/10274/45195080>

⁷<https://www.iucnredlist.org/species/8540/50651463>

⁸<https://www.iucnredlist.org/species/1681/50181949>

⁹<https://www.iucnredlist.org/species/12761/123583998>

¹⁰<https://www.iucnredlist.org/species/22679435/92814454>

Site Inspection: To understand the impact of the proposed corridor on the Asola Bhatti Wildlife Sanctuary, DMRC team (General Manager/Environment, Executive Director/Civil and their team) along with Dr D K Pandey from JICA Study Team inspected the proposed alignment with respect to the Asola Bhatti Wildlife Sanctuary ESZ on 20.07.2020. The team also had a discussion with the District Forest Officer (DFO) - Asola Bhatti Wildlife Sanctuary over video conference. DFO was new to his present posting and he was less conversant with Asola Wildlife issues. From the site inspection, it has become clear that the proposed alignment is quite far away from the core zone of wildlife sanctuary and poses no threat to its flora and fauna. Photographs taken during the site inspection are attached at **Annexure 4.2**.

4.7 ARCHEOLOGICAL MONUMENTS

There are seven numbers of archeological monuments along the priority corridors of Delhi Metro Phase IV as given in **Table 4.19**. Out of 7 monuments, proposed metro is underground at 6 locations. Metro is elevated at the location of Tomb of Shah Alam. The metro alignment is passing through regulated area of monuments as per AMSR Act 1958 and amended in 2010.

Table 4.19: Archaeological Structures along Priority Corridors

| S.No. | Monument | Type of Corridor Near Monument | Distance from Alignment (m) | ASI Protected |
|--|-------------------|--------------------------------|-----------------------------|---------------|
| Aerocity- Tuglakabad | | | | |
| 1. | Tughlakabad Fort | Underground | 212 | Yes |
| 2. | Ghiyasuddin Tomb | Underground | 168 | Yes |
| 3. | Nai-ka-kot | Underground | 179 | Yes |
| 4. | Adilabad Fort | Underground | 135 | Yes |
| Janakpuri West To Ram Krishna Ashram Marg | | | | |
| 5. | Tripolia Gate | Underground | 138 | Yes |
| 6. | Roshnara Bagh | Underground | 130 | Yes |
| Mukundpur - Maujpur | | | | |
| 7. | Tomb of Shah Alam | Elevated | 108 | Yes |

4.8 RIVERBED SCORING AND RIVER BANK PROTECTION

A study was carried out through M/s. CWPRS Pune to ascertain suitability Bridge site from hydraulic considerations, assess orientation of the bridge required for free and smooth flow conditions, assess the afflux on upstream and its effects on the structures upstream and downstream of existing bridges and assess the maximum expected scour based on the maximum intensities of flow assessed from the model studies.

CWPRS/Pune has carried out the hydraulic model studies under existing conditions and with proposed bridge over Yamuna. Summary of the study are mentioned below:

- Alignment of proposed Bridge found to be 'Hydraulically Satisfactory' in respect of river morphology.
- Proposed bridge will not induce any changes in the flow conditions to adversely affect Wazirabad Barrage upstream or Signature Bridge downstream
- Proposed bridge to cause an afflux of 9 cm, 13 cm and 15 cm at proposed bridge axis for the discharges of 7022 m³/s, 9910 m³/s and 12750 m³/s respectively.
- The afflux is found to get submerged under high velocity flow of Barrage and hence, found to be immeasurable (i.e. negligible) upstream of barrage for all discharges

- Maximum Water Level observed at proposed bridge is about 209.86 m for discharge of 12750 m³/s. Deck Level needs to be decided taking sufficient free board as per Indian Standard.
- With the maximum discharge intensity, the deepest scour level is expected to be about RL 178.86 m.
- Considering the grip length of about 1/3rd of the maximum scour depth below HFL, the founding level may be provided at RL 168.52 m subject to geotechnical conditions.

4.9 SOCIO-ECONOMICS

The socio-economic study is undertaken in separate volume on Social Impact Assessment Report. During the field survey, about 54 families having 250 numbers of families are identified along the corridors which are likely to be impacted due to construction and operation of the proposed 3 priority metro corridors of Delhi Metro Phase IV.

5. NEGATIVE ENVIRONMENTAL IMPACTS

5.1 GENERAL

The primary function of an environmental impact assessment study is to predict and quantify the magnitude of impacts, evaluate and assess the importance of the identified changes and formulate plans to monitor and mitigate the actual changes. Environmental impacts could be positive or negative, direct or indirect, local, regional or global, reversible or irreversible.

With rapid strides in economic development, particularly in urban development, the need for rationalizing and upgrading the transport system is imperative. In the process of development, there has been intensive use of natural resources. Very often the process of development has adversely affected the environment leading to ecological imbalances. The importance of conserving and enhancing the environmental assets has assumed urgency. Apart from land-use, conservation of water, flora and fauna, transportation planning is an important aspect of economic development.

The main aim of the project is to decongest the road traffic. The project is designed keeping in view population growth, future traffic demands and environmental protection aspects. Moreover any connection from/to Phase- I, Phase- II and Phase III Metro-Stations will help in direct interchange. This will not only reduce vehicles on road and vehicular pollution but also the pedestrians. The reduction of air pollution in Delhi is reported in Chapter 5.

The process began by identifying the development and operational activities resulting from the proposed project as contained in **Chapter-2. Chapter-3** was dedicated for providing information on the baseline environmental conditions for various parameters. This chapter discusses the potential impacts on environment. As far as possible, attempts have been made to quantitatively predict the impacts due to proposed project. For non-quantitative impacts, qualitative assessment has been made.

Negative impacts likely to result from the proposed development have been listed under the following headings:

- ❖ Impacts due to Project Location;
- ❖ Impacts due to Project Design;
- ❖ Impacts due to Construction; and
- ❖ Impacts due to Project Operation.

For each of these headings, potential impacts have been considered, while recommendations for mitigating measures have been stated in **Chapter-6**.

5.2 ENVIRONMENTAL IMPACTS

This section identifies and appraises the negative impacts on various aspects of the environment likely to result from the proposed development. It is pertinent to mention that the negative environmental impacts listed below are based on the assumption that no negative impact

mitigation measure or benefit enhancements are adopted.

- ❖ Land Environment
- ❖ Water Environment
- ❖ Air Environment
- ❖ Noise Environment
- ❖ Biological Environment
- ❖ Socio-Economic Environment

The impacts on the above environmental components have been further assessed during various phases of project cycle namely project location, project design, construction and operation.

5.2.1 Impacts due to Project Location

During this phase, those impacts, which are likely to take place due to the layout of the project, have been assessed. These impacts are:

- ❖ Project Affected People (PAPs)
- ❖ Change of Land use;
- ❖ Loss of trees/forest;
- ❖ Utility/Drainage Problems

A. Project Affected People (PAPs)

About 54 families consisting 250 persons will be affected due to the proposed metro project. Majority of families will be affected in Aero City to Tuglakabad corridor. Rehabilitation and Resettlement (R&R) of displaced families is an important issue addressed in Revised SIA Report. The main point to be addressed is the extent to which the “land for land” policy can be maintained for those who have their own land/house and suitable compensation to those who fall in the category of unauthorized occupants.

B. Change of Land Use

Under the present study, project layout maps were superimposed on land use maps to find out the change in land use. The project shall require the acquisition/transfer of 73.69 ha of land. Out of the total land, 73.2 ha is government land and 0.49 ha is private land. Out of the total government land, 17.39 ha is for permanent use and 55.81 ha is identified for temporary use. The land identified for temporary use shall be returned to the owning agencies, after the completion of the project construction. The entire private land is identified for temporary use. It is observed that out of the total land requirement, about 99.32 per cent of total land would be acquired from government agencies and only 0.68 per cent of the land requirements shall be fulfilled by the private landowners. The details of land requirement and acquisition are presented in **Table 5.1**.

Table 5.1: Land Requirement and Acquisition

| Corridor | Land Requirement (Ha) | | | | | |
|-----------------------------|-----------------------|----------------|---------------|---------------|----------------|----------------|
| | Government | | Private | | Total | |
| | P | T | P | T | P | T |
| Aerocity - Tughlakabad | 7.17 | 38.66 | 0.2407 | 0.4825 | 7.4107 | 39.1425 |
| Janakpuri West – R K Ashram | 11.01 | 26.12 | 0.08 | 0 | 11.09 | 26.12 |
| Mukundpur - Maujpur | 0.62 | 7.1773 | 0.0 | 0.0427 | 0.62 | 7.22 |
| Total | 18.8 | 71.9573 | 0.3207 | 0.5252 | 19.1207 | 72.4825 |

C. Flora and Fauna

There are approximately 10,438 trees along the 3 priority corridors. These trees are likely to be cut during construction. Trees are major assets in purifications of urban air, which by utilizing CO₂ from atmosphere, release oxygen into the air. However, with removal of these trees, the process for CO₂ conversion will get effected and the losses are reported below:

- | | | | |
|------|---|---|------------------|
| i) | Total number of Trees | : | 10,438 |
| ii) | Decrease in CO ₂ absorption due to loss of trees | : | 2,42,438 kg/year |
| iii) | Decrease in Oxygen production due to tree loss | : | 5,11,462 kg/year |

The above loss of oxygen production is equivalent to loss of oxygen requirement of about 1,782 people round the year. Trees help carbon sequestration acting a carbon sink. By removing the carbon and storing it as cellulose, trees release oxygen back into the air.

ESZ of Asola Bhati Wildlife Sanctuary: The proposed Tughlakabad-Aerocity corridor of Delhi MRTS Phase-IV was to initially pass through the prohibitory zone of the ASI protected monuments. The original alignment was then revised by rerouting the underground tunnel significantly away from the ASI monuments. As a result, now the proposed Tughlakabad-Aerocity corridor passes through the Eco-Sensitive Zone (ESZ) of the Asola Bhatti Wildlife Sanctuary at few places. However, the proposed alignment is underground and is quite far away from the core area of the wildlife sanctuary. The area, where the proposed alignment is within the ESZ, is a human settlement. The places where the alignment is within the ESZ is underground and therefore no direct or indirect impacts on the flora and fauna of the sanctuary are envisaged neither during construction nor operation of the proposed project. It is expected that during construction and operation phase project will not have any direct or indirect adverse impact on Flora and Fauna due to noise and vibration.

Clearance from the National Board for Wildlife (NBWL): The Ministry of Environment Forest and Climate Change vide its Gazette Notification No. S.O. 2996(E) dated 11th September 2017 notified an area with an extent upto one kilometer from the boundary of the Asola Bhatti Wildlife Sanctuary in the National Capital Territory of Delhi as the Asola Bhatti Wildlife Sanctuary Eco-Sensitive Zone. Copy of the notification is attached as **Annexure 5.1**. As per this notification infrastructure projects comes under the category of regulated activities and can be carried out with mitigation measures, as per applicable laws, rules and regulation and available guidelines. The notification does not mention about clearance from the Standing Committee of National Board for Wildlife.

As per the Office Memorandum of Ministry of Environment Forest and Climate Change dated 8th August 2019 (copy enclosed as **Annexure 5.2**), proposals involving developmental activity/projects located within the notified Eco-Sensitive Zones (ESZ) shall be regulated and governed by the concerned ESZ notification. However, for the developmental project/activity located within the notified ESZ and covered under the schedule of the EIA Notification 2006, prior clearance from Standing Committee of the National Board for Wildlife is mandatory. Since the metro projects are not covered under the schedule of EIA Notification 2006, the Tughlakabad – Aerocity corridor even though it is

passing through the ESZ of Asola Bhatti Wildlife Sanctuary, the project is not required to obtain clearance from the Standing Committee of the National Board for Wildlife.

However, it will be ensured that there will be no hunting, poaching, or unnecessary habitat destruction. The Forest Department will monitor the Flora and Fauna between the project boundary and the Asola Bhatti Wildlife Sanctuary boundary. In the case of any negative impact on account of the project, DMRC will consider the advice of the Forest Department in drafting a mitigation strategy for implementing measures to negate or minimize the negative impacts.

D. Utility/Drainage Problems

The proposed Metro corridors are planned to run through the urban area above the ground i.e. elevated in less densely populated and underground in populated and sensitive areas. The alignment will cross drains, large number of sub-surface, surface and utility services, viz. sewer, water mains, storm water drains, telephone cables, overhead electrical transmission lines, electric pipes, traffic signals etc. These utilities/ services are essential and have to be maintained in working order during different stages of construction by temporary/permanent diversions or by supporting in position. Since these affect construction and project implementation time schedule/costs for which necessary planning/ action needs to be initiated in advance.

5.2.2 Impacts due to Project Design

Considered impacts, due to project designs are:

- ❖ Stations Planning,
- ❖ Ventilation and lighting,
- ❖ Railway station refuse, and
- ❖ Seismological factors.

A. Stations Planning

The stations of Phase IV have been planned on the basis of the norms and criteria already adopted in existing corridors. The Elevated station is generally located on the road median. Total length of the station is 140m. All the stations are two-level stations. The concourse is planned along the whole length of the platform with staircases leading from either side of the road. The maximum width of the station at concourse is ~21m. Passenger facilities like ticketing, information, etc as well as operational areas are provided at the concourse level. In elevated stations, 4.5m wide side platforms have been proposed. These platform widths also have been checked for holding capacity of the platform for worst-case scenario. Since the station is in the middle of the road, minimum vertical clearance of 5.5-m has been provided under the concourse. Platforms are at a level of about 14.5-m from the road.

The typical underground station is a two-level station with platforms at the lower level and concourse on the upper level. Structure of the underground station is essentially a concrete box about 22-m wide, 14.6-m high and 240 to 260 m long with an intermediate slab. Sides of the box are made of 1.2 m thick RCC. A uniform platform width of 13m wide is proposed for the underground stations.

Provision has been made for escalators in the paid area i.e. from concourse to platforms. On each platform, one escalator has been proposed. In addition, two staircases with a combined

width of 6 m are provided on each platform connecting to the concourse. These stairs and escalator together provide an escape capacity adequate to evacuate maximum accumulated passengers in emergency from platforms to concourse in 5.5 minutes. Lifts have been provided one each on either platform, to provide access for elderly and disabled. Since the rise to road from the concourse is about 8m, it is proposed to provide escalators and lifts in addition to stairs for vertical movement of passengers from street to concourse on either side of the road.

Fire fighting provisions in Underground Metro Stations are in Accordance with the NFPA 130 Guidelines and for Elevated metro stations in accordance with the National Building Code of India 1983 (part IV, Fire protection) amendment no. 3 under Fire protection Annexure II.

B. Ventilation and Lighting

The platform and concourse areas will be air-conditioned using supply 'Air Handling Units' located in Environmental Control System (ECS) plant rooms throughout the station. Each Platform and Concourse will be served by at least two air handling units (AHU's) with the distribution systems combined along to ensure coverage of all

areas in the event of single equipment failure. Based on the initial estimation about 4 units of 30 m³/s each would be needed for the full system capacity.

Ancillary spaces such as Staff Room, Equipment Room, will be mechanically ventilated or air conditioned in accordance with the desired air change rates and temperatures/humidity. All ancillary areas that require 24-hour air conditioning will be provided with Fan Coil Units (FCUs) main Chilled Water plant for running during the revenue hours and with Air Cooled Chillers or standby AC units or VRV system for running during the non-revenue hours. Return air will be circulated through washable air filters

The platforms, concourse, staircase and escalator areas both for underground and elevated stations will have adequate and uniform fluorescent lighting to provide pleasant and cheerful environment. It is proposed to adopt the norms prevailing in Delhi Metro Phase I, II and for illumination as reported in **Table 5.2**.

Table 5.2: Illumination at Different Locations

| LOCATION/PREMISES | ILLUMINATION (LUX) |
|---|--------------------|
| Entrance to stations from the road | 250 |
| Booking/Concourse | 200 |
| Platforms | 150 |
| Passenger staircase and escalator areas | 250 |
| Toilets | 100 |
| Offices | 200 |
| Tunnels | 100 |
| Sub-ways | 250 |
| Emergency lighting of stations, platforms, passages, escalators & public utilities. | 50 |

C. Railway Station Refuse

The collection and removal of refuse from railway stations in a sanitary manner is of great importance for effective vector control, nuisance abatement, aesthetic improvement and fire protection. The refuse from railway station includes;

- ❖ Garbage,
- ❖ Rubbish, and
- ❖ Floor Sweepings.

As per the available data from Delhi Metro Phase I and II, about 28 cum of solid waste will be generated from underground stations and 38.25 cum from elevated/at-grade stations from all 3 priority corridors of Phase IV metro stations. Thus a total of 66.25 cum of solid waste per day is estimated to be generated from all metro stations. The maintenance of adequate sanitary facilities for temporarily storing refuse on the premises is considered a responsibility of the DMRC project authorities. The storage containers for this purpose need to be designed. However it is suggested that the capacity of these containers should not exceed 50 litres and these should be equipped with side handles to facilitate handling. To avoid odour and the accumulation of fly-supporting materials, garbage containers should be washed at frequent intervals.

D. Risk Due to Earthquake

The project area lies in Zone IV of Bureau of Indian Standards (BIS) Seismic Zoning Map. Earthquakes of 3 to 9 magnitude on Richter scale have occurred in the past in the zone. Provision of Bureau of Indian Standards codes like IS: 1893:1984, IS: 1893 (Part 1) 2002, IS : 1893 (Part 4) 2005, IS : 4326:1993 etc. shall be incorporated suitably while designing the structures. It is understood that such measures have already been taken in construction of earlier phases.

5.2.3 Impact due to Project Construction

Although environmental hazards related to construction works are mostly of temporary nature, it does not mean that these should not be considered. Appropriate measures should be included in the work plan and budgeted for. The most likely negative impacts related to the construction works are: -

- ❖ Soil erosion, pollution and health risk at construction site,
- ❖ Traffic diversion and risk of existing building,
- ❖ Excavated soil disposal problems,
- ❖ Dust Generation
- ❖ Increased water demand
- ❖ Impact due to Supply of Construction Material
- ❖ Impact due to Construction near Archaeological Structures
- ❖ Noise Pollution
- ❖ Impact due to Vibration
- ❖ Impact due to depot

A. Soil Erosion, Pollution and Health Risk at Construction Site

Run off from unprotected excavated areas, can result in excessive soil erosion, especially when the erodability of soil is high. River bed scoring and river bank erosion may be takes places if proper care is not taken. Mitigation measures include careful planning, timing of cut and fill operations and re-vegetation. In general, construction works are stopped during monsoon season.

Problems could arise from dumping of construction spoils (Concrete, bricks) waste materials (from contractor camps) etc. causing surface and ground water pollution. However, it is proposed to have mix concrete directly from batching plant for use at site. Batching plants will be located away from the site and from human settlement. The other construction material such as steel, bricks, etc. will be housed in a fenced stored yard. The balance material from these yards will be removed for use/disposal.

Ventilation, dust generation, naxious gasses and Air Cooling in underground work may be health hazard for the workers. Health risks include disease hazards due to lack of sanitation facilities (water supply and human waste disposal) and insect vector disease hazards of local workers and disease hazards to the local population. Mitigation measures should include proper water supply, sanitation, drainage, health care and human waste disposal facilities. In addition to these, efforts need to be made to avoid water spills, adopt disease control measures and employment of local labour. Problems could arise due to difference in customs of workers from outside and local residents. These risks could be reduced by providing adequate facilities in worker's camps, raising awareness amongst workers and by employment of preferably local labour.

B. Traffic Diversions and Risk to Existing Buildings

During construction period, complete/partial traffic diversions on road will be required, as most of the construction activities are on the road but most of the roads are double lane. Hence, wherever possible, rather than completely blocking the roads it will be advisable to make these roads as one way to allow for operation of traffic together with construction activities. Moreover, on both sides of the roads, a clear passage of 8 m shall be maintained for smooth operation of traffic, emergency and local movements. Advance traffic updates/information on communication systems will be an advantage to users of affected roads. The elevated rail corridor does not pose any serious risk to existing buildings.

C. Problems of Excavated Soil Disposal and Construction & Demolition Waste

The metro route is both elevated and underground. The construction activity involves cut and cover, tunnel (bored and rock), foundation, fill and embankment. Owing to paucity of space in busy cites and for safety reasons, elaborate measures need to be adopted for collection, storage, transfer and disposal of soil. All these activities will generate about 3.4 Mm³ of soil. Out of this, about 1.02 Mm³ is likely to be reutilized in backfilling. The balance 2.38 Mm³ shall be disposed off in environmental friendly manner. Disposal of excess soil should be permitted in low lying areas owned by DDA. The excess soil disposal site will be those identified by DDA and communicated to DMRC. During the project construction activities about 1,10,415 MT of the construction and demolition waste will be generated. About 10% to 20% of which will be utilized for backfilling and rest will be recycled. DMRC have a C&D waste recycling plant of 150 TPD at Ranikheda, Mundka. So that remaining C&D waste will be recycled in this plant.

D. Pollution Due to Disposal of Earth

Transportation of earth and establishment of the material will involve use of heavy machinery like compactors, rollers, water tankers, and dumpers. This activity is machinery intensive resulting in dust generation. However, this activity will be only short-term. Protective measures shall be undertaken during construction phase. It is estimated that, about 3.4 Mm³ of earth will be transported in trucks for backfilling and final disposal. It is assumed that the earth will be hauled over a period of 1825 days. The truck movement required to transport the soil/earth will be about 187 truck trips per day for the entire length of construction period. On an average a truck is anticipated to move about 30 km per trip. Hence total distance travelled would be 5610 km per day. The total dust emission/pollution would be 7 kg/day, 1.27 kg/day of particulate matter, 28.42 kg/day of CO, 1.27 kg/day of HC, 59.03 kg/day of NO_x and 3668.70 kg/day of CO₂.

E. Increased Water Demand

The water demand will increase during construction phase. Sufficient water for construction purpose is to be made available by digging tube well within the vicinity of the project site during the construction phase. Hence proper care shall be taken while deciding the location of these activities or drawing water from public facilities. Water requirement for construction of Metro will be met through the tube-wells bored specially for the purpose of metro construction after taking approval from competent authority i.e. Central Ground Water Board. Hence, there will be no negative impact on the residents living in the vicinity of tube wells whose water demand is, in any case, met by municipal water.

F. Impact due to Construction of Bridges on Yamuna River

Ground water contamination can take place only if chemical substances get leached by precipitation of water and percolate to the ground water table. This is not the case with the present project, as the activity does not use any harmful ingredients, which could leach down to water table. Therefore, no impact on ground water quality is anticipated from the project during the construction phase. Proposed project will not alter the existing water quality of River Yamuna. One major bridge of 560m long is planned on the alignment on river Yamuna for Mukundpur-Maujpur section. The bridge will be designed at a later stage. However, the studies have been conducted by the Central Water and Power Research Station (CWPRS), Pune in April 2019 to ensure complete safety. In their studies CWPRS concluded that the alignment of proposed MRTS Bridge across river Yamuna between Wazirabad barrage and Signature Bridge is found to be hydraulically satisfactory in respect of river morphology. The construction of proposed MRTS Bridge will not cause any major change in the river regime in the reach under consideration.

The bridge may be with well foundation, substructure with mass concrete and superstructure with PSC girder. Because of such construction, no major impact on flow of water, surface and ground water quality is anticipated. Foundation of piers shall be on wells. Activities of well foundation and sinking shall be taken at intervals, so that the obstruction to the flow of water is limited. Care shall be taken that construction activities are not carried out during the monsoon period. Contamination of surface water bodies may result due to spilling of construction materials, however, the quantity of such spills will be negligible.

G. Impact due to Supply of Construction Material

Metro construction is a material intensive activity. Different quantity of construction material will be required for construction of metro corridor. A summary of approximate construction material required for the corridors is given in **Table 5.3**.

Quarry operations are independently regulated activities and outside the purview of the project proponent. It is nonetheless, appropriate to give consideration to the environmental implications

in selection of quarry sources since poorly run operations create dust problems, contribute noise pollution, ignore safety of their employees, or cause the loss of natural resources.

About 10-15% of the construction material such as waste material from contractor camps is left behind by the contractor as construction waste/spoils. Dumping of construction waste/spoil in a haphazard manner may cause surface and ground water pollution near the construction sites.

Table 5.3: Construction Material Requirement

| Material | Unit | Total Qty |
|----------------------------|------|-----------|
| Underground station | | |
| Cement | MT | 351571 |
| Fly Ash | MT | 127379 |
| Sand | MT | 772086 |
| Aggregate 20mm | MT | 751533 |
| Aggregate 10mm | MT | 559488 |
| Reinforcement | MT | 202833 |
| Stone Work | sqm | 294500 |
| MS Structure | kg | 744000 |
| Stainless Steel | kg | 1067950 |
| Paint | Ltr | 186000 |
| Tiles Work | sqm | 52700 |
| Tunnel | | |
| Cement | MT | 75736 |
| Fly Ash | MT | 12252 |
| Sand | MT | 135974 |
| Aggregate 20mm | MT | 98890 |
| Aggregate 10mm | MT | 120878 |
| Silica | MT | 21587 |
| Reinforcement | MT | 21587 |
| Elevated Station | | |
| Concrete | cum | 377544 |

| | | |
|----------------|-----|---------|
| Steel | MT | 51238 |
| Viaduct | | |
| Concrete | cum | 1124529 |
| Steel | MT | 159358 |
| HT stand | MT | 8096 |

Source: DPR, March 2019

H. Loss of Historical and Cultural Monuments

No historical/cultural monuments will be lost as a result of the proposed development. However some of the historical and cultural monuments are passing through regulated zone are described below. The details are given in **Table 5.4**, out of 7 ASI monuments the permission from ASI has been obtained for 5 and for 2 monuments (at Sr. No 5 & 6) is under process.

Aerocity- Tuglakabad Corridor:

(a) Tughlakabad Fort

Alignment from km 15.550 to km 17.520 passes through Tughlakabad area along Mehrauli Badarpur Road. Alignment in this area also is underground and construction is proposed by TBM.

(b) Ghiyasuddin Tomb

Ghiyas ud-Din Tughluq was the founder of Tughluq dynasty of the Delhi Sultanate in India. The tomb was constructed in 1325 and is built of red sandstone and white marble, materials commonly used in Islamic structures at that time.

(c) Nai-ka-kot

There's yet another fortress in the distance, tinier and even more ruined, also said to have been built by Muhammad bin Tughlaq. Not much more than a wall remains there, but its name is intriguing: Nai ka Kot (Barber's fort). Historians haven't been able to find out much about this place.

(d) Adilabad Fort

The fort of Adilabad was built in ad 1327–28, soon after the death of Ghiyasuddin Tughlaq, by his son Muhammad bin Tughlaq, allegedly as a symbol of his own might and power. Adilabad, a fort of modest size, built on the hills to the south of Tughlaqabad was provided with protective massive ramparts on its boundary around the city of Jahanpanah. The fort was much smaller than its predecessor fort, Tughlaqabad fort, but of similar design.

Janakpuri West to Ram Krishna Ashram Marg Corridor:

(a) Tripolia Gate

The Tripolia Gates an archaeological monument are two historical gateways of similar form located at GT Karnal Road, Delhi. These are triple passage gateways situated 250 meters apart in the area between Rana Pratap Bagh and Gur Mandi in North Delhi. These structures were made by Nazir Mahaldar Khan, superintendent of women's quarter in the palace of Mughal emperor Muhammed Shah during the period 1728-29 as entrances towards a market from both ends. Out of these two gates, northern gate is restored and the southern gate is still under restoration.

(b) Roshnara Bagh

Roshanara Garden is a Mughal era garden built by Roshanara Begum, the second daughter of the Mughal emperor Shah Jahan. It is situated in Shakti Nagar near Kamla Nagar Clock Tower and North Campus of University of Delhi. Today the garden holds a white marble pavilion built in memory of the princess Roshanara, who died in 1671 and was buried there.

Mukundpur – Maujpur Corridor: This corridor is passing near Shah Alams Tomb at Wazirabad, which was built by Ferozshah Tughlaq during his reign.

Table 5.4: Details of Archaeological Structures

| S.No. | Monument | Type of Corridor Near Monument | Distance from Alignment (m) | ASI Protected |
|--|-------------------|--------------------------------|-----------------------------|---------------|
| Aerocity- Tuglakabad | | | | |
| 1. | Tughlakabad Fort | Underground | 212 | Yes |
| 2. | Ghiyasuddin Tomb | Underground | 168 | Yes |
| 3. | Nai-ka-kot | Underground | 179 | Yes |
| 4. | Adilabad Fort | Underground | 135 | Yes |
| Janakpuri West To Ram Krishna Ashram Marg | | | | |
| 5. | Tripolia Gate | Underground | 138 | Yes |
| 6. | Roshnara Bagh | Underground | 130 | Yes |
| Mukundpur - Maujpur | | | | |
| 7. | Tomb of Shah Alam | Elevated | 108 | Yes |

The proposed metro corridors near these monuments are underground except Shah Alam Tomb where alignment is elevated. The tunnel will be constructed by State of Art Technology i.e. Tunnel Boring Machine (TBM) which gives negligible vibration and does not affect the surrounding structures. Station will be constructed by Cut and Cover method which is widely accepted and the safest technique being adopted by metro in India and abroad.

Technical impact assessment study of projected ground deformation and Tunnel Boring Machine (TBM) operations on the monuments was conducted through Omikron Kappa-Indus Consultants JV which was then re-evaluated by IIT Delhi.

According to the report, considering the worst-case scenarios for the revised alignment, it was observed that the spread of settlement is not more than 40 m either side of the alignment, with a moderate TBM face pressure of 1.2 bar. Since the distance of all the monuments from the proposed alignment is more than 40m, therefore there will be no impact on the monuments.

I. Noise Pollution

Construction noise in the community may not pose a health risk or damage to peoples hearing, but it can adversely affect people's quality of life. To some degree, construction noise can be a contributing factor to the degradation of someone's health in that it can cause people to be irritated and stressed and can interrupt their ability to sleep - all of which may lead to higher blood pressure, anxiety, and feelings of animosity toward the people or agencies responsible for producing the noise. Construction noise may disturb people at home, in office buildings or retail businesses, in public institutional buildings, at locations of religious services depending upon

their vicinity to construction site. Construction noise is unwelcome during nighttime in residential areas during sleep; it can be equally unwelcome during the daytime in commercial areas if it interferes with peoples' ability to conduct business. The major sources of noise pollution during construction are movement of vehicles for transportation of construction material to the construction site and the noise generating activity at the construction site itself. The Metro construction is equipment intensive. Hence, 10m high barricading will be installed around the construction site, construction yard wherever required. A noise prediction is carried out for Lmax and Leq for different combinations of construction equipments working simultaneously at a site with the help of construction noise model. Various input required in the model are 1) type of landuse , ii) baseline noise levels, iii) distance to receptor and iv) type of noise generating equipment. The Result of the noise prediction is presented in **Table 5.5** and shown graphically in **Figure 5.1** through **Figure 5.3**.

Table 5.5: Noise Level Prediction during Construction

| Distance (m) | Concrete Batch Plant + Concrete Mixer Truck | | Auger Drill Rig +Dump Truck + Generator + Slurry Plant | | Dump Truck + Excavator + Pneumatic Tools | |
|--------------|---|------|--|------|--|------|
| | Lmax | Leq | Lmax | Leq | Lmax | Leq |
| 5 | 92.7 | 87.5 | 94 | 92.5 | 94.9 | 93.3 |
| 10 | 86.7 | 81.5 | 88 | 86.5 | 85.8 | 85.3 |
| 15 | 83.1 | 77.9 | 84.5 | 83 | 82.3 | 81.8 |
| 20 | 80.6 | 75.4 | 82 | 80.5 | 79.8 | 79.3 |
| 25 | 78.7 | 73.5 | 80.1 | 78.6 | 77.9 | 77.4 |
| 30 | 77.1 | 71.9 | 78.5 | 77 | 76.3 | 75.8 |
| 35 | 75.8 | 70.6 | 77.1 | 75.6 | 75 | 74.5 |
| 40 | 74.6 | 69.4 | 76 | 74.5 | 73.8 | 73.3 |
| 45 | 73.6 | 68.4 | 75 | 73.4 | 72.8 | 72.3 |
| 50 | 72.7 | 67.5 | 74 | 72.5 | 71.9 | 71.4 |
| 55 | 71.9 | 66.7 | 73.2 | 71.7 | 71 | 70.5 |
| 60 | 71.1 | 65.9 | 72.5 | 71 | 70.3 | 69.8 |
| 65 | 70.4 | 65.2 | 71.8 | 70.3 | 69.6 | 69.1 |
| 70 | 69.8 | 64.6 | 71.1 | 69.6 | 68.9 | 68.4 |
| 75 | 69.2 | 64 | 70.5 | 69 | 68.3 | 67.8 |
| 80 | 68.6 | 63.4 | 70 | 68.5 | 67.8 | 67.3 |
| 85 | 68.1 | 62.9 | 69.4 | 67.9 | 67.3 | 66.8 |
| 90 | 67.6 | 62.4 | 68.9 | 67.4 | 66.8 | 66.3 |
| 95 | 67.1 | 61.9 | 68.5 | 67 | 66.3 | 65.8 |
| 100 | 66.7 | 61.5 | 68 | 66.5 | 65.8 | 65.3 |

Figure 5.1: Noise Levels db(A)Due To Concrete Batch Plant + Concrete Mixer Truck

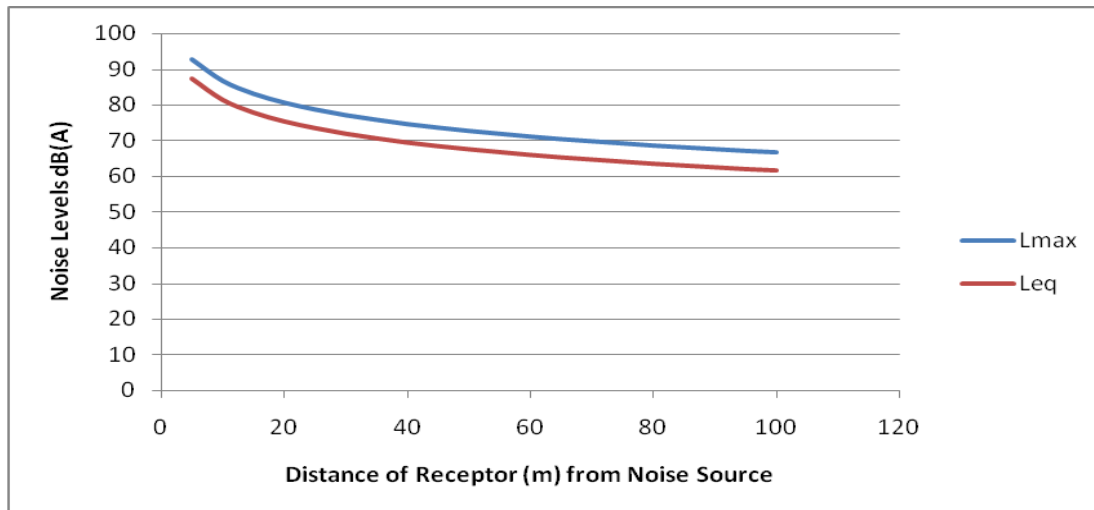


Figure 5.2: Noise Levels Db(A)Due To Auger Drill Rig + Dump Truck + Generator + Slurry Plant

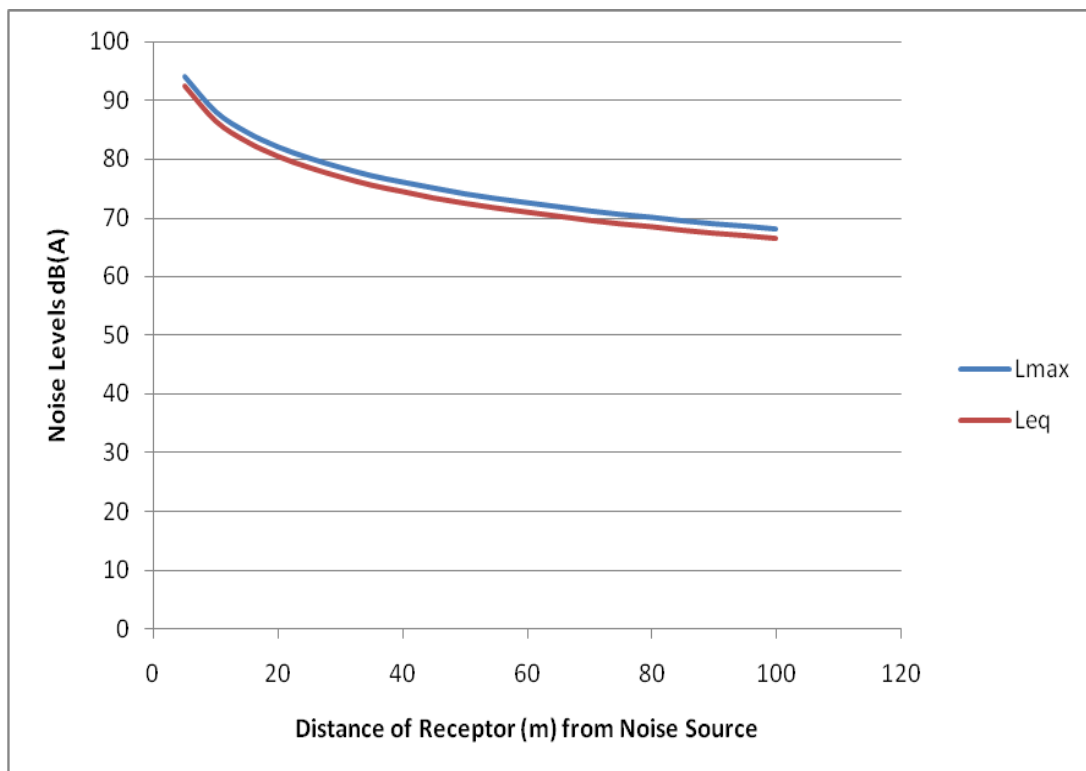
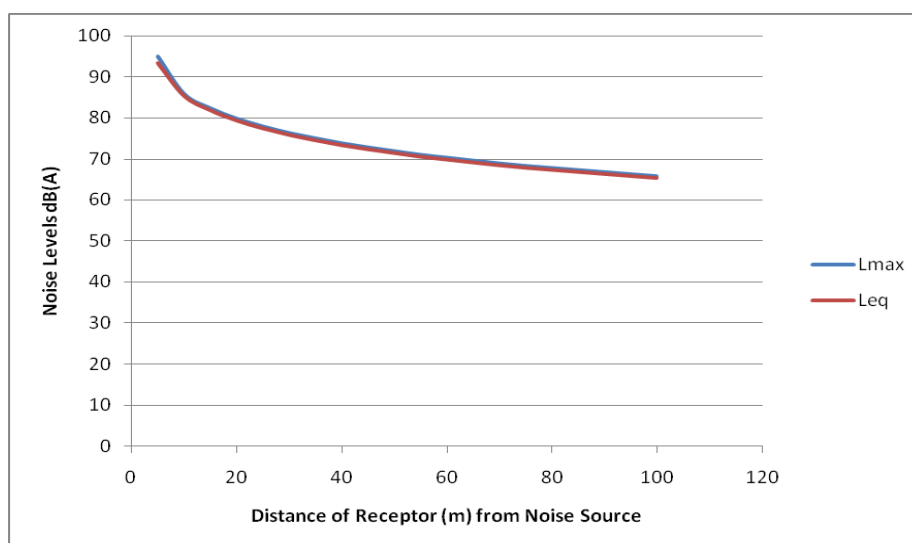


Figure 5.3: Noise Levels Db(A) Due To Dump Truck + Excavator + Pneumatic Tools

It is observed from the above table when Dump Truck, Excavator and Pneumatic Tool is working simultaneously at site, person working near the equipment will be exposed to maximum noise levels (leq 93.3 dB(A) and Lmax 94.9) at 5m. Hence as per OSHA guidelines (Table 5.6) if employees is subjected to sound exceeding 95 dB for more than 4 hours a day feasible administrative or engineering controls shall be utilized. If such controls fail to reduce sound levels within the 95dB(A) personal protective equipment shall be provided and used to reduce sound levels.

Table 5.6: Permissible Noise Exposures

| Duration per day, hours | Sound level dB(A slow) response |
|-------------------------|----------------------------------|
| 8 | 90 |
| 6 | 92 |
| 4 | 95 |
| 3 | 97 |
| 2 | 100 |
| 1 ½ | 102 |
| 1 | 105 |
| ½ | 110 |
| ¼ or less | 115 |

The residential structures and sensitive receptors are given at **Annexure 5.3**

, distance of which varies along the alignment. Noise level attenuates as the distance increases from the centre line of alignment. The noise level is projected for various combination instruments in use and is compared of their impacts with national and international standard as given at **Annexure 1.5**.

J. Impact Due to Subsidence

In a cut and cover method a trench is excavated with necessary ground support. The construction will be in situ concrete, precast concrete and corrugated steel. Use of permanent Diaphragm wall

helps to maintain retention of the surrounding soil and ground water. The D-wall method is useful where ground water is high. The D-walls for underground station construction would be 80 to 100 cm thick and will function as a permanent side wall of the station. It is rigid type of support system and therefore ensures the maximum safety against settlement to the adjacent structures.

State of the art technology like Earth Pressure Balance Tunnel Boring Machine (TBM) will be adopted during construction to minimize probability of subsidence. Earth Pressure Balance Machine (EPBM) is the correct technical solution when the project is located in an urban environment and ground surface subsidence cannot be tolerated. The so called Earth Pressure Balance Shields (EPB) turns the excavated material into a soil paste that is used as pliable, plastic support medium. This makes it possible to balance the pressure conditions at the tunnel face, avoids uncontrolled inflow of soil into the machine and creates the conditions for rapid tunneling with minimum settlement. The spoil is admitted into the tunnel boring machine (TBM) via a screw conveyor (cochlea) arrangement which allows the pressure at the face of the TBM to remain balanced without the use of slurry. A rotating cutting wheel equipped with tools is pressed onto the tunnel face and excavates the material. The soil enters the excavation chamber through openings, where it mixes with the soil paste already there. Mixing arms on the cutting wheel and bulkhead mix the paste until it has the required texture. The bulkhead transfers the pressure of the thrust cylinders to the pliable soil paste. When the pressure of the soil paste in the excavation chamber equals the pressure of the surrounding soil and groundwater, the necessary balance has been achieved.

Any areas with risks of land subsidence will be carefully avoided based on soil investigation tests. No notable ground subsidence has occurred in the past. The detailed survey of condition of buildings/houses along proposed alignment will be conducted. During construction monitoring of condition of buildings/houses will be conducted. In case of occurrence of crack at wall of buildings/houses, damaged wall will be repaired immediately.

The other support walls which can be used depending on the site conditions are as follows:

Sheet Piles: 'Z'/'U' sheet piles can be used as temporary support wall. This can be advantageous where it is possible to re-use the sheet pile again and again and therefore, economy can be achieved. However the main concern remains, driving of sheet piles causes vibrations/noise to the adjacent buildings. This may sometimes lead to damage to the building and most of the time causes inconvenience to the occupants of the building. Situation becomes more critical if sensitive buildings are adjacent to the alignment like hospitals, schools, laboratories, etc. Silent pile driving equipments however are now available and can be used where such problems are anticipated.

Retaining Casing Piles: This is suitable for situation where the cut and cover is to be done in partly soil and partly rock. The top soil retaining structure can be done with the help of Casing pile which is then grouted with cement slurry. This is considered suitable in case of shallow level, non-uniform, uneven nature of rock head surface which render the construction of sheet piles/diaphragm wall impracticable. These are suitable up to 7-meter depth. The common diameter used for such casing pile is 2.00-2.50 m dia.

Soldier Piles and Lagging: Steel piles (H Section or I section) are driven into the ground at suitable interval (normally 1-1.5 m) centre-to-centre depending on the section and depth of excavation. The gap between two piles is covered with suitable lagging of timber planks/shot-creting /steel sheets/GI sheets during the process of excavation.

Secant Piles: are cast-in-situ bored piles constructed contiguously to each other so that it forms a rigid continuous wall. This is considered an alternative to diaphragm wall where due to soil conditions it is not advisable to construct diaphragm wall from the consideration of settlement during the trenching operation. 800 to 1000 mm dia piles are commonly used. Two alternate soft piles are driven and cast in such a way that the new pile partly cuts into earlier constructed piles. This new pile is constructed with suitable reinforcement. With this, alternate soft and hard pile is constructed. This has got all the advantages of diaphragm wall. However, this wall cannot be used as part of permanent structure and permanent structure has to be constructed in- side of this temporary wall.

K. Impact on Groundwater Flow

Due to underground tunnel construction there might be impact on groundwater flow. However as a precautionary measure, detailed hydrological investigation will be undertaken prior to the construction of tunnel to locate the ground water aquifer falling in the alignment of metro tunnel and to safeguard the ground water flow wherever feasible. Extraction of ground water is necessary to build underground stations. This water should be used for simultaneous recharge. De-watering is going to impact ground water. A comprehensive impact study will be taken before starting de-watering. As a precautionary measure DMRC will take conservation norms.

The hydro geological study should cover

- Appraisal of hydro geological situation in and around the proposed underground Metro corridors. through field investigations, analysis of primary and secondary data.
- Decipher aquifer disposition to estimate ground water resources availability and its quality at various depth in different aquifers.
- Assess the ground water availability and its development prospects vis-à- vis water demand of the proposed project.
- Suggest suitable site for ground water monitoring wells.
- The behavior of the ground water regime with the expected stresses like withdrawal of ground water due to coming up of new infrastructure through ground water modeling.

L. Vibration Impact

Vibration is an Oscillatory motion. It can be described in terms of displacement, velocity or acceleration. Since motion is oscillatory, there is not net movement of the vibration element and the average of any of the motion descriptors is zero. During the vibration the oscillatory wave propagate from the source through the ground to adjacent buildings. The rumbling sound caused by the vibration of room surface is called ground-borne noise. Typical frequency range for environmental ground vibrations is 1 – 200 Hz.

Peak particle Velocity (PPV) is the maximum Instantaneous positive or negative peak of the vibration signal and Root mean square (rms) amplitude is the square root of the average of the squared amplitude of the signal. The average is typically over a one second period.

Vibration velocity level in decibel is calculated as under $L_v = 20 \times \log_{10}(v/v_{ref})$

Where

L_v is the velocity level in decibels, " v " is the rms velocity amplitude, and " v_{ref} " is the reference velocity amplitude which is 1×10^{-6} inch/sec (2.54×10^{-8} m/s) in the USA and 1×10^{-8} m/sec or 5×10^{-8} m/sec in the rest of the world.

Various types of construction equipment have been measured under wide variety of construction activities with an average source levels reported in terms of velocity levels as shown in Table 5.7. The data provide a reasonable estimate for a wide range of soil conditions.

Table 5.7: Vibration Source Levels for Construction Equipments

| Equipment | | PPV at 25 ft (inch/sec) | Approx L_v^* at 25 ft (Vdb) |
|--------------------------------|-------------|-------------------------|-------------------------------|
| Pile Driver (Impact) | Upper Range | 1.518 | 112 |
| | typical | 0.644 | 104 |
| Pile Driver (sonic) | Upper Range | 0.734 | 105 |
| | typical | 0.17 | 93 |
| Clam shovel drop (slurry wall) | | 0.202 | 94 |
| Hydromill (slurry wall) | in soil | 0.008 | 66 |
| | in rock | 0.017 | 73 |
| Large Bulldozer | | 0.089 | 87 |
| Caisson drilling | | 0.089 | 87 |
| Loaded Trucks | | 0.076 | 86 |
| Jackhammer | | 0.035 | 79 |
| Small Bulldozer | | 0.003 | 58 |

*RMS velocity in decibels (VdB) re 1 μ inch/second

Estimated vibration level (L_v) a distance D for consideration of annoyance or interference with vibration sensitive activities can be calculated by following equation: $L_v(D) = L_v(25 \text{ ft}) - 20 \log(D/25)$. Results are given in Table 5.8.

Table 5.8: Vibration Levels at Different Distances (Construction)

| Equipment | | Distance | | | | |
|--------------------------------|-------------|----------|--------|-------|-------|-------|
| | | 10m | 20m | 30m | 40m | 50m |
| Pile Driver (Impact) | Upper Range | 109.23 | 103.26 | 99.68 | 97.18 | 95.25 |
| | typical | 101.78 | 95.81 | 92.24 | 89.74 | 87.80 |
| Pile Driver (sonic) | Upper Range | 102.91 | 96.95 | 93.37 | 90.87 | 88.93 |
| | typical | 90.21 | 84.24 | 80.67 | 78.17 | 76.23 |
| Clam shovel drop (slurry wall) | | 91.71 | 85.74 | 82.16 | 79.67 | 77.73 |
| Hydromill (slurry wall) | in soil | 63.66 | 57.69 | 54.12 | 51.62 | 49.68 |
| | in rock | 70.21 | 64.24 | 60.67 | 58.17 | 56.23 |
| Large Bulldozer | | 84.59 | 78.62 | 75.05 | 72.55 | 70.61 |
| Caisson drilling | | 84.59 | 78.62 | 75.05 | 72.55 | 70.61 |
| Loaded Trucks | | 83.22 | 77.25 | 73.67 | 71.18 | 69.24 |
| Jackhammer | | 76.48 | 70.51 | 66.94 | 64.44 | 62.50 |
| Small Bulldozer | | 55.14 | 49.18 | 45.60 | 43.10 | 41.16 |

The threshold of human response to vibration is around 65 VdB and the background vibration velocity level in residential areas is usually 50VdB or lower. For a person in their residence, the lower threshold for annoyance is 72 VdB (FTA 2006). As per the guidelines of Research and Development Organisation (RDSO), 2015, GBV impact level shall be 72 VdB for residences and buildings where people normally sleep. The vibration affects human health by causing fatigue, increased pulse & respiration rates, dizziness & loss of balance, anger and irritation.

The US department of Transportation has studied the effects of construction vibration and they are presented in Table 5.9.

Table 5.9: EFFECTS OF CONSTRUCTION VIBRATION

| Peak Particle velocity (in/sec) | Effect on Humans | Effect on buildings |
|---------------------------------|--|--|
| <0.005 | Imperceptible | No effect on buildings |
| 0.005 to 0.015 | Barely perceptible | No effect on buildings |
| 0.02 to 0.05 | Level at which continuous vibration begins to annoy in buildings | No effect on buildings |
| 0.1 to 0.5 | Vibration considered unacceptable for people exposed to continuous or long-term vibration | Minimal potential for damage to weak or sensitive structures |
| 0.5 to 1.0 | Vibrations considered bothersome by most people, however tolerable if short term in length | Threshold at which there is a risk of architectural damage to buildings with plastered ceilings and walls. Some risk to ancient monuments and ruins. |
| 1.0 to 2.0 | Vibrations considered unpleasant by most people | U.S. Bureau of mines data indicates that vibration in this range will not harm most buildings. Most construction vibration limits are in this range |
| >3.0 | Vibration is unpleasant | Potential for architectural damage and possible minor structural damage. |

The underground tunneling of Delhi Metro Phase IV project will be carried out by Tunnel Boring Machine (TBM). TBM is the worldwide accepted machine having less impact of vibration. Continuous effect of vibration on the buildings can cause damage to the buildings. Building subjected to the vibration effect with more than 50 mm/s would receive structural damage. Historic buildings are more susceptible to vibration effect due to type of building material and design. Old structures generally lose structure strength over the period.

Table 5.10 lists various activities of construction phase and their probable impacts on various components of environment. The impacts further have been classified as long-term impacts and short-term impacts. Most of these impacts are envisaged to be short term impacts, confined to the construction period only. Mitigation measures for significant impacts are discussed in Chapter 7 at the respective sections.

Table 5.10 : Identification of Construction Activities and Probable Impacts

| Construction Activities | Environmental Attributes | Potential Impacts |
|---|--------------------------|--|
| A) Long Term Impacts | | |
| Land | Land use | <input type="checkbox"/> Permanent land use change and ancillary development in the vicinity of the proposed stations |
| Tunnel | Geology & Hydrology | <input type="checkbox"/> Void shall be created due to construction of tunnel <input type="checkbox"/> Excavated soil/debris from the tunnel will need to be disposed <input type="checkbox"/> The ground water flow shall be affected |
| B) Short Term Impacts | | |
| Site clearing and Leveling (cutting, stripping, earth excavation, compaction) | Air | <input type="checkbox"/> Fugitive Dust (PM10 and PM2.5) Emissions causing health concerns to local community and workers <input type="checkbox"/> Air Emissions from construction equipment & machinery and backup power generation, causing health concerns to local community and workers |
| | Water | <input type="checkbox"/> Run-off from vegetation stripped area and erosion <input type="checkbox"/> Domestic effluent discharge from the labour camp and construction camp <input type="checkbox"/> There may be change in the natural drainage pattern |
| | Groundwater | <input type="checkbox"/> Seepage of wastewater from the project site into the groundwater table |
| | Ecology | <input type="checkbox"/> Loss of vegetation cover (trees) |
| | Noise & Vibration | <input type="checkbox"/> Increase in noise levels due to running of heavy construction equipment <input type="checkbox"/> Frequent vibration impact due to demolition (existing pavement, road surfaces, etc.), underground tunneling and compaction work for viaduct <input type="checkbox"/> Noise propagation due to plying of heavy construction vehicles at the sites |
| Transportation and Storage of Construction Material/ Equipment | Air | <input type="checkbox"/> Gaseous emissions from construction vehicles particularly on unpaved access roads <input type="checkbox"/> Fugitive Dust Emissions due to Traffic Movement <input type="checkbox"/> Fugitive emissions arising out of construction materials (cement, paints and varnishes) |
| | Water | <input type="checkbox"/> Spillage of construction material and flow into streams particularly during the monsoon months <input type="checkbox"/> Run-off from Storage areas of Construction Material |
| | Soil | <input type="checkbox"/> Deposition of spilled construction material on soil |
| | Traffic | <input type="checkbox"/> Increased traffic volume and density <input type="checkbox"/> Congestion on roads |
| Civil Construction Activities | Air | <input type="checkbox"/> Gaseous Emissions from Construction Machinery <input type="checkbox"/> Fugitive Dust (PM10 and PM2.5) Emissions due to Movement of Traffic <input type="checkbox"/> Fugitive dust (PM10 and PM2.5) emission from the batching, mixing and concreting plant |
| | Water | <input type="checkbox"/> Run-off from Construction Areas during curing and also from the storage area of the construction materials |
| | Groundwater | <input type="checkbox"/> Seepage of wastewater from the project site into the groundwater table |

| | | |
|--|-----------|---|
| | Noise | <input type="checkbox"/> High noise emitting from the construction equipment <input type="checkbox"/> Noise generated from the running of heavy vehicles deployed in the construction activities |
| | Vibration | <input type="checkbox"/> Vibration in the nearby area due to piling <input type="checkbox"/> Running of heavy construction equipment |
| Mechanical and Electrical Works | Air | <input type="checkbox"/> Air emissions from running of construction machineries due to fuel |
| | Water | <input type="checkbox"/> Run-off from erection areas containing spent oils, Paints |
| | Vibration | <input type="checkbox"/> Induced vibration may be experienced due to erection activities <input type="checkbox"/> Running of heavy mechanical and electrical equipment |
| Influx of Labour & Construction of Temporary Houses/Camps | Water | <input type="checkbox"/> Sanitary effluents from labour colonies/camps |
| Transportation and Disposal of Construction & Demolition Waste | Air | <input type="checkbox"/> Noise and Air Emissions from Transport Vehicles <input type="checkbox"/> Fugitive Dust Emissions due to Movement of Traffic on the unpaved access roads <input type="checkbox"/> Spillage and fugitive emissions during handling of C&D waste <input type="checkbox"/> Fugitive emission from the pile of C&D waste |
| | Water | <input type="checkbox"/> Spillage/ spread of debris material and flow into streams <input type="checkbox"/> Run-off from Disposal Areas |
| | Soil | <input type="checkbox"/> Spillage/ spread/ deposition of debris |

M. Impact due to depot

In priority corridors of Delhi MRTS Phase – IV, Construction of New Depot is not planned. Existing depot at Mukundpur will be strengthened by augmenting facilities to serve the extension of Line – 7 (Maujpur – Mukundpur) and Line – 8 (Janakpuri West – R.K. Ashram) corridors. The existing depot of Line – 6 at Sarita Vihar will be used for Tughlakabad – Aerocity Corridor. The expansion works will be carried out within the existing depot boundary. Therefore no land acquisition and related impacts are envisaged. Also no major excavation and civil construction works are also proposed hence, no environmental impacts envisaged.

5.2.4 Impacts due to Project Operation

Along with many positive impacts, (Refer **Chapter 6**) the project may cause the following negative impacts during operation of the project due to the increase in the number of passengers and trains at the stations:

- ❖ Noise pollution,
- ❖ Water supply and sanitation at Stations,
- ❖ Pedestrainisation and traffic congestion issues

A. Noise Pollution

During the operation phase the main source of noise will be from running of metro trains. Noise radiated from train operations and track structures generally constitute the major noise sources.

Airborne noise is radiated from at-grade and elevated structures, while ground-borne noise and vibration are of primary concern in underground operations. Basic Sources of wayside airborne noise are:

- i) *Wheel / Rail Noise* : Due to wheel /rail roughness
- ii) *Propulsion Equipment: Traction motors, cooling fans for TM, reduction gears etc.*
- iii) *Auxiliary Equipment: Compressors, motor generators, brakes, ventilation systems, other car mounted equipment*
- iv) *Elevated Structure Noise*

- At low speed(<15 km/h) auxiliary equipment may predominate
- At speeds up to approx. 50 km/h, W/R noise predominates
- At speeds greater than 50 km/h, the propulsion equipment noise predominates
- For light weight steel elevated structures, the structure noise can predominate at all speeds above 15 km/h

US data shows that the noise levels inside the rail transit cars range from about 65 to 105 dB(A) during normal operation. Wide range of noise levels depends on following factors:

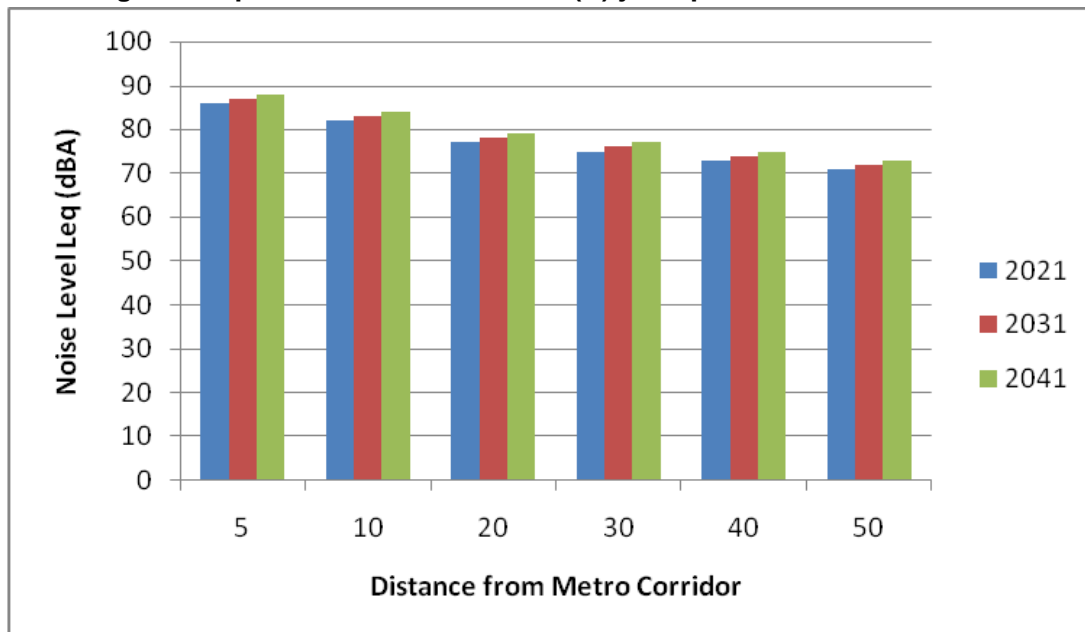
- i) **Train speed (V):** Car interior noise levels vary from $15 \log_{10} V$ to $40 \log_{10} V$.
- ii) **Type of Way structure:** Noise levels lowest on AG ballast and tie-welded track and highest for operations on light-weight structures and in tunnels with concrete track bed and no acoustic treatment.
- iii) **Sound Insulations of car body:** Single leaf or Sandwich construction.
- iv) **Type & Design of Mechanical Equipment:** Propulsion system & Auxiliary Equipment (A/c system, compressors and motor generator sets).
- v) **Wheel and Rail conditions:** Rail corrugations and wheel flats can increase the noise levels by 10-15 dB(A)

Noise prediction has been done for the three corridors for different horizon years using Noise model and is presented in **Table 5.10**. The various inputs required for this model are: landuse type, type of source, source speed, number of trains per hour, cars per train, distance of source to receiver, number of trains during day time and night time, type of track (jointed or embedded), presence of barrier. Peak hour train operation is taken for prediction, considering the welded track, aerial structure. The maximum speed of the train is taken as 80km/hr and assumed that no barrier is present. If a corridor has two or more sections, section which has maximum number of train operation is taken for noise prediction. Graphical representation is shown in **Figure 5.4** through **5.9**. It is observed from the results that metro noise level will be in range of 80-85 dB(A) at 10 m distance, 74-81 dB(A) at distance of 20m and 72-78 dB(A) at 30m. Metro corridor is underground in congested residential areas where noise levels will come down due to reduction of vehicles. There are certain sensitive receptors like Hospitals, schools and colleges near to elevated section. Noise barrier will be required at these sensitive receptors. Due to reduction of vehicular traffic, the road traffic noise is expected to come down. A list of sensitive receptors is given at **Annexure 5.2**.

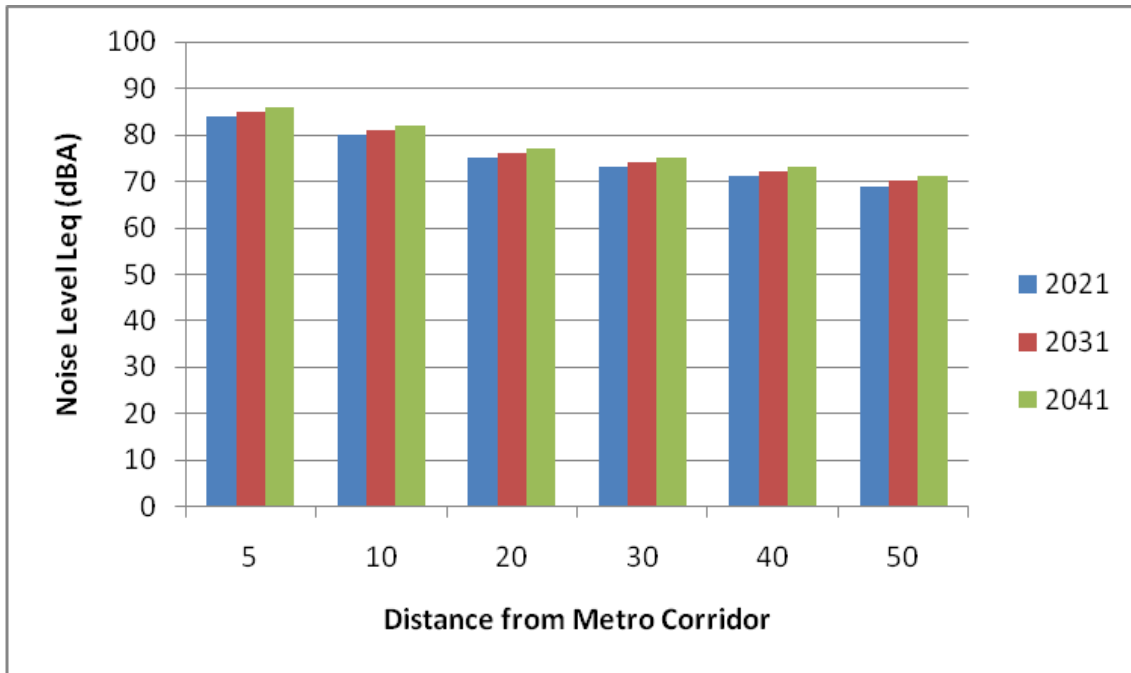
Table 5.11: Noise Levels at Different Distances dB (A)

| Horizon Year | Noise level, Leq dB(A) | Distance from Metro Corridor (m) | | | | | |
|--------------|------------------------------|----------------------------------|----|----|----|----|----|
| | | 5 | 10 | 20 | 30 | 40 | 50 |
| 2021 | Janakpuri West - R.K. Ashram | 86 | 82 | 77 | 75 | 73 | 71 |
| | Aerocity – Tuglakabad | 84 | 80 | 75 | 73 | 71 | 69 |
| | Mukundpur-Maujpur | 86 | 82 | 77 | 75 | 73 | 71 |
| 2031 | Janakpuri West - R.K. Ashram | 87 | 83 | 78 | 76 | 74 | 72 |
| | Aerocity - Tuglakabad | 85 | 81 | 76 | 74 | 72 | 70 |
| | Mukundpur-Maujpur | 87 | 83 | 78 | 76 | 74 | 72 |
| 2041 | Janakpuri West - R.K. Ashram | 88 | 84 | 79 | 77 | 75 | 73 |
| | Aerocity - Tuglakabad | 86 | 82 | 77 | 75 | 73 | 71 |
| | Mukundpur-Maujpur | 88 | 84 | 79 | 77 | 75 | 73 |

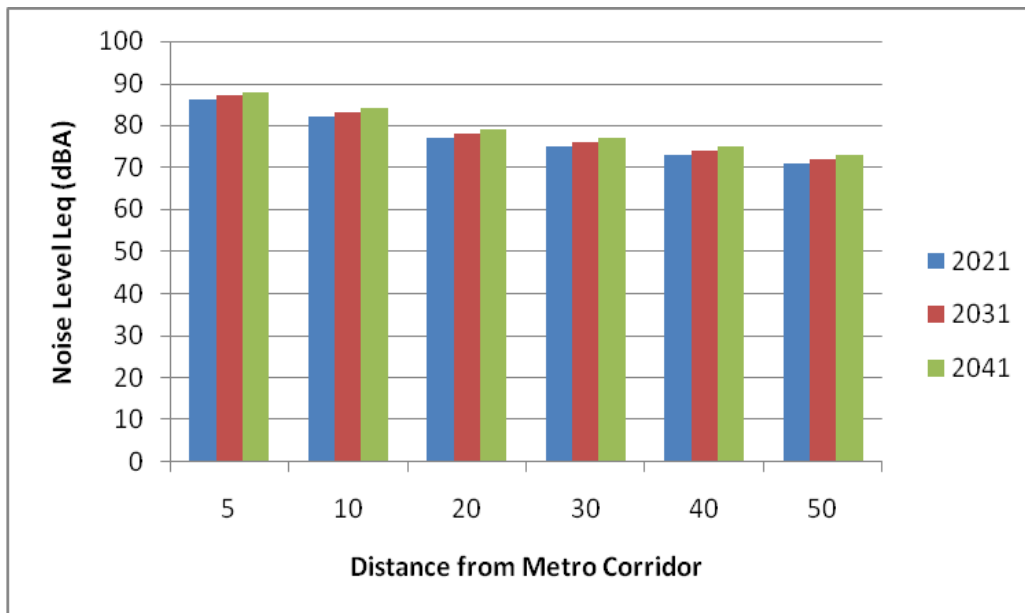
Figure 5.4: predicted noise levels dB(A) janakpuri west – R.K. Ashram



**Figure 5.5: predicted noise levels dB (A)
Aero city – Tuglakabad**



**Figure 5.6: predicted noise levels dB (A)
Mukundpur-Maujpur**



B. Water Supply and Sanitation

Public Health facilities such as water supply, sanitation and wash rooms are very much needed at the stations. The water demands will be on station for drinking, toilet, cleaning and also for other purpose like AC, chiller and other purposes. Water Demand is calculated and presented in

Table 5.11. Water should be treated before use upto WHO drinking water standards. The water requirement for the stations will be met through the public water supply system after taking necessary approvals.

Table 5.12: Water Requirement

| S.No. | Particular | Water Demand (KLD) |
|-------|------------------------|--------------------|
| 1 | In Underground station | 1615 |
| 2 | In Elevated stations | 432 |
| | Total | 2047 |

C. Pedestrian Issues

There is an expectation that MRTS will increase the pedestrianisation in CBD. As has been demonstrated in several countries, notably in Western Europe and North America, pedestrianisation of certain localities is a desirable change in CBDs of the city. While initial reactions of the residents or commercial establishments are sometimes unfavorable to the concept, in no case has dissatisfaction been expressed, or a reversal of Pedestrianisation instituted, once an area has been so developed. The benefits are seen to outweigh any disadvantages of increased movements for access etc. The main aim of MRTS system is to decongest the road traffic in Central Business Districts. The connections will further reduce the pedestrian number, which are available now on the roads.

As seen from Delhi Metro, once the metro services commence, it results in passenger rush at stations in turn, results in congestion around station vicinities. Essentially, the decongestion scheme should involve setting up of taxi and auto rickshaw stands, a halting space for public buses and other such facilities. These should be planned up within the vicinity of each station such that passengers get off the bus or park their two-wheeler within walking distance from the station and at the same time the locality does not see congestion due to such parking. Also, bus stops outside the stations should be moved about 50 metres away from the stations. No parking space has to be earmarked for vehicles outside any station. If anyone parks them, they should be towed away.

D. Visual Impacts

The introduction of MRTS implies a change in streets through which it will operate. An architecturally well designed elevated section can be pleasing to the eyes of beholders. Recent MRTS projects have attempted to incorporate this objective in their designs. Since a low profile would cause the least intrusion, the basic elevated section has been optimized at this stage itself.

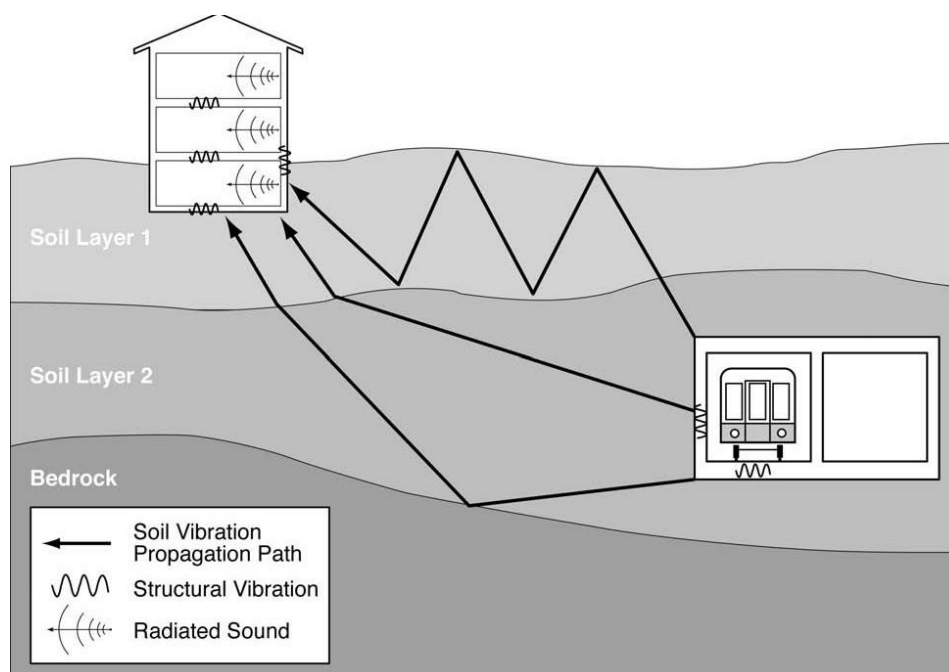
E. Vibration Impact

During metro operation there will be vibration impact. It is presumed that underground metro operation may cause Ground Borne Vibration (GBV) on building above the tunnel. The propagation of ground borne vibration is illustrated in the Figure 5.7.

The sources of the vibration and noise induced by the metro trains are mainly the rolling stock, track and the interaction between them. The vibration of the transit structure excites the adjacent ground, creating vibration waves that propagate through the various soil and rock strata to the foundations of nearby buildings. The vibration propagates from the foundation throughout the

remainder of the building structure. The intensity of vibration depends on operational and vehicle parameters, track system, geology and condition of receiving building.

Figure 5.7: Propagation of Ground Borne Vibration (GBV)



Source: Federal Transit Administration – Transit Noise and Vibration Impact Assessment

Primarily effect of ground borne vibration will be rattling of window panes and rumble noise which cause annoyance to the occupants. However, it is not expected to cause any structural damage to the building as such. Based on Delhi Metro's previous experience, the intensity of vibration varies from 65 VdB to 90 VdB. As per International guidelines, humans start perceiving vibration from 65 VdB and it becomes an annoyance from 72 VdB. As per the guidelines of Research and Development Organisation (RDSO), 2015, GBV impact level shall be 72 VdB for residences and buildings where people normally sleep. If proper precaution is not taken to address this issue, it could cause severe discomfort to the occupants as well affect the working of sensitive equipments.

25 meters on either side from central of the tunnel is considered as shadow zone of ground borne vibration. If any building especially residential building falls within this zone precautionary measures need to be taken to mitigate the effect of ground borne vibration. In the case of sensitive building such as archeological buildings it is safe to keep a minimum horizontal distance of 60 meters from the tunnel. At certain stretches the alignment passes beneath residential areas where it is recommended to take mitigation measures as mentioned in the EMP.

Table 5.13 lists various activities of operation and maintenance phase and their probable impacts on various components of environment. Most of these impacts are long term impacts. However, the significance of most of these impacts is envisaged to be moderate.

Table 5.13: Identification of Operation Activities and Potential Impacts

| Operation and Maintenance Activities | Sector | Potential Impacts |
|---|-------------------|---|
| Running of metro rail | Water | <input type="checkbox"/> Discharge of untreated sanitary effluents from the station into local sewers <input type="checkbox"/> Increased water demand |
| | Noise & Vibration | <input type="checkbox"/> Generation of high level noise along the proposed metro rail alignment <input type="checkbox"/> Generation of vibration due to running metro rail <input type="checkbox"/> Potential damage to old structures located close to alignment |
| | Climate Change | <input type="checkbox"/> Green House Gas (GHG) emission from the air conditioning system in the rolling stock and also from the station |
| Domestic Use of Water at Stations and Maintenance Depot | Water | <input type="checkbox"/> Generation of sewage and effluent |

5.3 IMPACTS DUE TO DEPOT

In priority corridors of Delhi MRTS Phase-IV, Construction of New Depot is not planned. Existing depot at Mukundpur will be strengthened by augmenting facilities to serve the extension of Line – 7 (Maujpur – Mukundpur) and Line – 8 (Janakpuri West – R.K. Ashram) corridors. The existing depot of Line – 6 at Sarita Vihar will be used for Tughlakabad – Aerocity Corridor. The provision of additional civil works has been made in Non – JICA financed civil works contracts. Other minor works as required will be met out of physical contingencies. The likely impacts due to strengthened by augmenting facilities at these existing depots are;

Water Supply

The water will be required for train washing purpose and for other requirement (Departments and Contractors office). A three day cycle is assumed for outside Cleaning (wet washing on automatic washing plant). Estimated water demand for car washing in year 2041 is 1498 KLD at Mukundpur Depot and 108 KLD for Sarita Vihar Depot. This water will be sourced from the existing bore wells at each Depot. Hence, there will be no negative impact on the residents living in the vicinity of tube wells whose water demand is, in any case, met by municipal water.

Effluent Generation

The estimate effluent that will be generated from the washing of trains at the depots are about 1348 KLD at Mukundpur Depot and 97 KLD for Sarita Vihar Depot. The wastewater will be treated and will be recycled to use at depot horticulture purpose. Based on past experience in similar projects the wastewater characteristics could be as reported in **Table 5.14**.

Table 5.14: Effluent Characteristics

| S. NO. | PARAMETER | UNIT | EFFLUENT |
|--------|------------------|------|----------|
| 1. | pH | --- | 6-8.5 |
| 2. | BOD | mg/l | 150 |
| 3. | Suspended Solids | mg/l | 500 |
| 4. | COD | mg/l | 300 |
| 5. | Oil and Grease | mg/l | 500 |
| 6. | Detergents | mg/l | 100 |

Oil Pollution

Oil spillage during change of lubricants, cleaning and repair processes, in the maintenance Depot cum workshop for maintenance of rolling stock, is very common. The spilled oil should be trapped in oil and grease trap. The collected oil would be disposed off to authorised collectors, so as to avoid any underground/ surface water contamination.

Noise Pollution

The main source of noise from depot is the operation of workshop. The roughness of the contact surfaces of rail and wheel and train speed are the factors, which influence the magnitude of rail - wheel noise. The vibration of concrete structures also radiates noise. Due to less activity, no impact on the ambient noise is anticipated.

Solid Waste

It is estimated that about 0.18 Ton per month of solid waste will be generated from each of the Depot sites which will be taken by the cleaning contractor weekly and disposed to the MCD waste disposal sheds. Sludge will be generated from ETP, oil and grease will be produced from car maintenance and iron turning of the PWL for the wheel profiling will be generated from each of the metro Depot.

5.4 EPILOGUE

Based on above negative impacts, a checklist of impacts has been prepared along with positive impacts in **Chapter-6**. The net resultant impacts without management plans are also summarised. The management plans to mitigate the negative impacts are reported in **Chapter-7**.

6. POSITIVE ENVIRONMENTAL IMPACTS

Based on project particulars (**Chapter - 2**) and existing environmental conditions (**Chapter - 4**), potential impacts that are likely to result from the proposed DMRC Phase IV Part A development have been identified and wherever possible these have been quantified. This chapter deals with the positive impacts of the project. The introduction of DMRC Phase IV Part A will also yield benefits from non-tangible parameters such as saving due to equivalent reduction in road construction and maintenance, vehicle operating costs, less atmospheric air pollution and socio-economic benefits of travel time, better accessibility, better comfort and quality of life. However, all benefits cannot be evaluated in financial terms due to non-availability of universally accepted norms. The parameters such as economic growth, improvement in quality of life, reduction in public health problems due to reduction in pollution, etc have not been quantified.

Various positive impacts have been listed under the following headings:

- ❖ Employment Opportunities,
- ❖ Benefits to Economy
- ❖ Quick Service and Safety
- ❖ Reduction in Fuel consumption
- ❖ Less Air pollution
- ❖ Carbon Credits.

6.1 EMPLOYMENT OPPORTUNITIES

The civil works of the project is likely to be completed in a period of 5 years. During this period manpower will be needed for various project activities. The civil works of the project is likely to be completed in a period of 5 years. During this period manpower will be needed for various project activities. There are nine construction packages for the three priority corridors on DMRC Phase IV. Total employment generation per month during construction is 4050. This includes the local labors also. In post-construction phase, about 2170 people will be employed for operation and maintenance of the system. Thus, the project would provide substantial direct employment equal to the above number. In addition to these, more people would be indirectly employed for allied activities.

6.2 BENEFITS TO ECONOMY

In the present context, the project will streamline and facilitate movement of public from different parts of Delhi and NCR. This link will yield tangible and non tangible saving due to equivalent reduction in road traffic and certain socio-economic benefits. Introduction of this metro will result in the reduction in number of buses, usage of private vehicles. This in turn will result in significant social benefits due to reduction in fuel consumption, vehicle operating cost and travel time of passengers. With the development of the 3 corridors of Delhi Metro phase IV Part A project, it is likely that more people will be involved in trade, commerce and allied services. During public consultations participants expressed the view that Metro system will result in reduction in traffic congestion and travel time, improved connectivity, economy and infrastructure. Summary of EIA related outputs of public consultations is placed at **Annexure 6.1**. Minutes of consultations are placed at **Annexure 6.2**.

6.3 QUICK SERVICE AND SAFETY

With the implementation six corridors of Delhi Metro Phase IV, travel time of passengers travelling by other modes of vehicles in the absence of Metro will get reduced. Also, implementation of the metro will provide improved safety and lower number of accidents, injuries and accidental deaths. The reduced vehicles on road in turn will reduce accidents and increase safety of persons as per table below based on accident data of Delhi year 2011. During public consultations participants expressed the view that Metro system will result in reduction in personal safety of ladies and accidents.

Table 6.1: Road Safety Due To Phase IV

| Particular | 2021 | 2031 | 2041 |
|---------------------------------|------|------|------|
| Total Accidents saved | 220 | 288 | 358 |
| Number of fatal accidents saved | 61 | 79 | 99 |
| Number of persons killed saved | 62 | 82 | 102 |
| Number of person injured saved | 218 | 286 | 356 |

Source: DPR, March 2019

6.4 LESS FUEL CONSUMPTION

On implementation of the project, consumption of petrol, diesel and CNG will get reduced. The estimated numbers of vehicles trips that will be reduced due to construction 3 corridors of Delhi Metro Phase IV Part A are given in **Table 6.2**. Based on number of vehicle trips reduction, reduction in fuel consumption is reported in **Table 6.3**. It is estimated that about 3.486 million litres of diesel, 10.912 million litres of petrol and 14.846 million kg of CNG gas will be saved in year 2021. These reductions will increase to 5.683 million litres of diesel, 17.790 million litres of petrol and 24.203 million kg of CNG gas in year 2041. Net saving on fuel expenditure at current price level is given in **Table 6.4**. It is estimated savings will be of Rs 1258.921 million in year 2021, Rs 1647.490 million in year 2031 and Rs 2052.486 million in year 2041.

Table 6.2: Reduction in Vehicle Trips

| Mode | 2021 | 2031 | 2041 |
|--------------|---------------|---------------|---------------|
| Bus | 14260 | 18661 | 23248 |
| Car | 59156 | 77415 | 96446 |
| 2W | 135565 | 177409 | 221021 |
| Auto | 10846 | 14192 | 17681 |
| Total | 219827 | 287677 | 358396 |

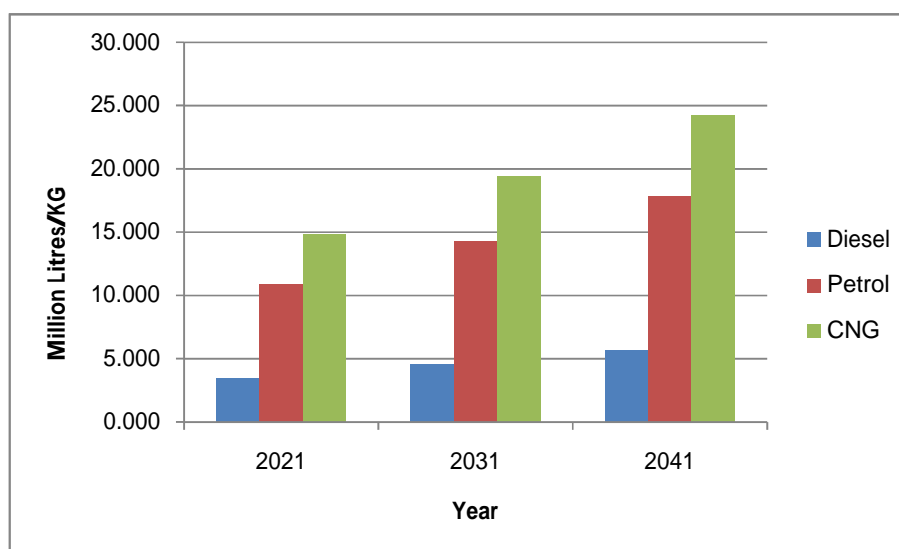
Table 6.3: Reduction in Fuel Consumption

| Year | Diesel (Million liters) | Petrol (Million liters) | CNG (Million Kg) |
|------|-------------------------------|-------------------------------|------------------------|
| 2021 | 3.486 | 10.912 | 14.846 |
| 2031 | 4.561 | 14.280 | 19.428 |
| 2041 | 5.683 | 17.790 | 24.203 |

Source: DPR, March 2019

Table 6.4: Net Saving On Fuel Expenditure (Rs Million)

| Fuel | 2021 | 2031 | 2041 |
|--------|----------|----------|----------|
| Diesel | 193.379 | 253.067 | 315.278 |
| Petrol | 798.314 | 1044.722 | 1301.545 |
| CNG | 267.228 | 349.701 | 435.662 |
| Total | 1258.921 | 1647.490 | 2052.486 |

Figure 6.1: Reduction in Fuel Consumption

6.5 LESS AIR POLLUTION

The major vehicular pollutants that define the ambient air quality are: Particulate matter, Nitrogen oxides, Carbon monoxide, Hydro Carbons and Carbon dioxide. In addition to the above pollution, un-burnt products like aldehydes, formaldehydes, acrolein, acetaldehyde and smoke are by products of vehicular emissions. The reduction of air pollutants with the present corridors are presented in **Table 6.5**. During public consultations participants expressed the view that Metro system will result in reduction in pollution.

Table 6.5: Pollution Reduction (Tons/Year)

| Pollutant | Year | | |
|-----------------------------------|-------|--------|--------|
| | 2021 | 2031 | 2041 |
| Carbon Monoxide (CO) | 795 | 1040 | 1296 |
| Hydro-Carbons (HC) | 406 | 531 | 662 |
| Nitrogen Oxide (Nox) | 553 | 723 | 901 |
| Particulate Matter (PM) | 18 | 24 | 30 |
| Carbon Dioxide (CO ₂) | 85667 | 112107 | 139665 |

Source: DPR, March 2019

Figure 6.2: Net Saving On Fuel Expenditure (Rs Million)

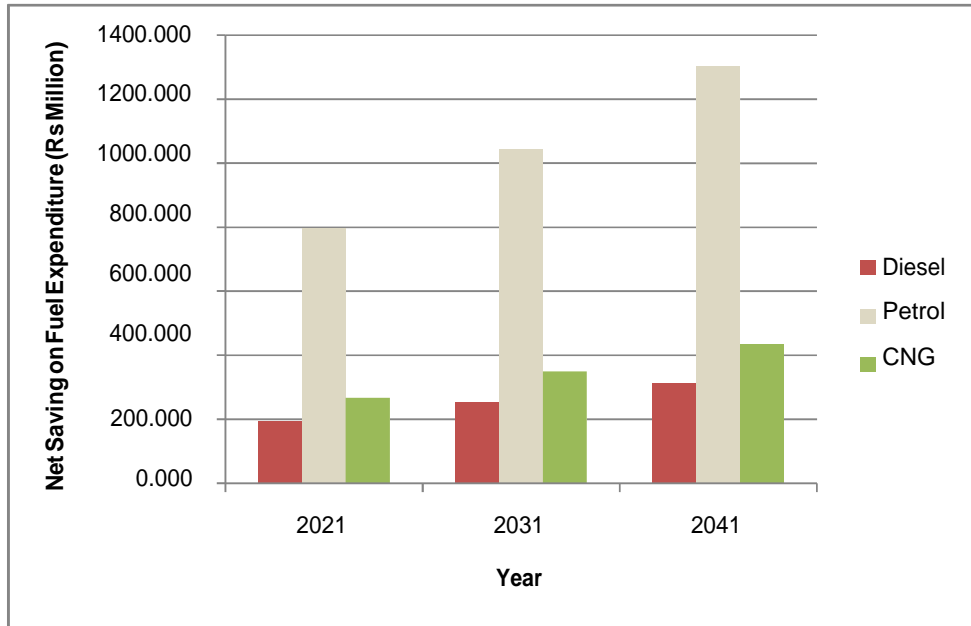


Figure 6.3: Pollution Reduction (Tons/Year)

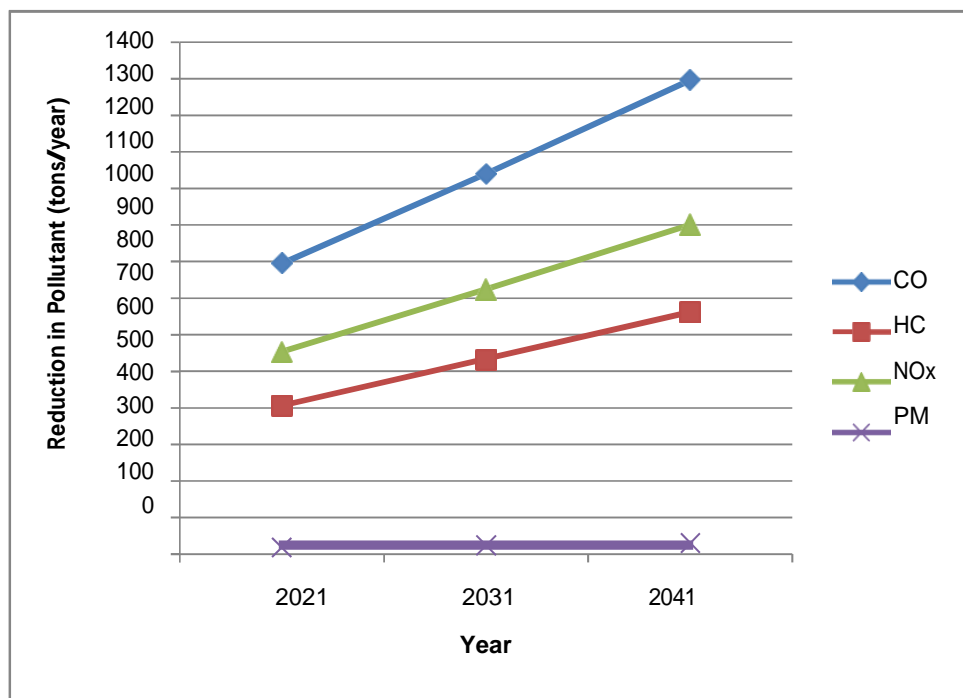
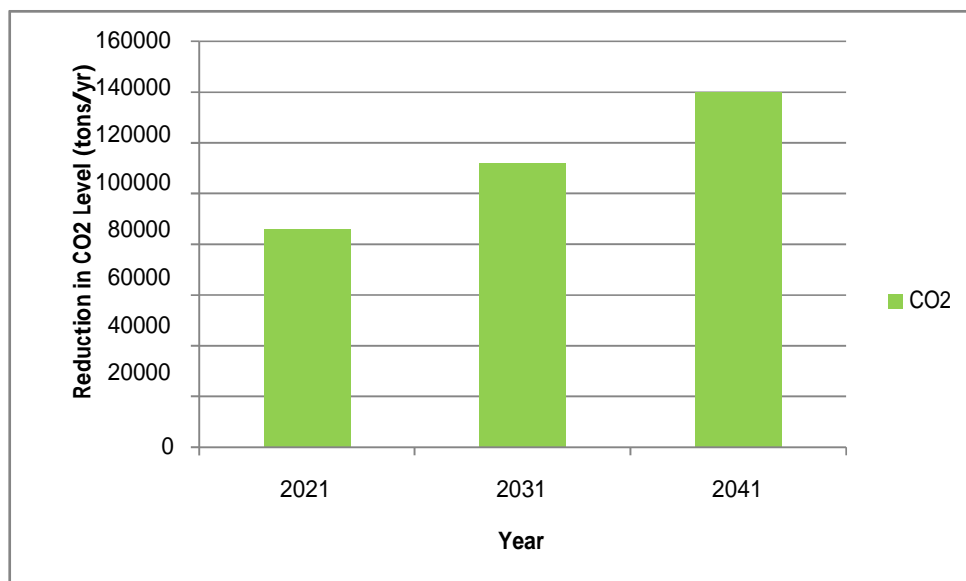


Figure 6.4: Reduction In Carbon Dioxide Levels (Tons/Year)

6.6 CARBON CREDITS

As nations have progressed we have been emitting carbon, or gases which result in warming of the globe. Some decades ago a debate started on how to reduce the emission of harmful gases that contributes to the greenhouse effect that causes global warming. So, countries came together and signed an agreement named the Kyoto Protocol. The Protocol was initially adopted on 11 December 1997 in Kyoto, Japan, and entered into force on 16 February 2005.

Under the Protocol, 37 countries commit themselves to a reduction of four greenhouse gases (GHG) (carbon dioxide, methane, nitrous oxide, sulphur hexafluoride) and two groups of gases (hydrofluorocarbons and perfluorocarbons) produced by them, and all member countries gave general commitments. At negotiations, 37 countries (including the US) collectively agreed to reduce their greenhouse gas emissions by 5.2% on average for the period 2008-2012. This reduction is relative to their annual emissions in a base year, usually 1990. Since the US has not ratified the treaty, the collective emissions reduction of 37 Kyoto countries falls from 5.2% to 4.2% below base year.

Developed countries, mostly European, had said that they will bring down the level in the period from 2008 to 2012. In 2008, these developed countries have decided on different norms to bring down the level of emission fixed for their companies and factories.

A company has two ways to reduce emissions. One, it can reduce the GHG (greenhouse gases) by adopting new technology or improving upon the existing technology to attain the new norms for emission of gases. Or it can tie up with developing nations and help them set up new technology that is eco-friendly, thereby helping developing country or its companies 'earn' credits.

India, have the advantage because it is a developing country. Any company, factories or farm owner in India can get linked to United Nations Framework Convention on Climate Change and know the 'standard' level of carbon emission allowed for its outfit or activity. The extent to which one is emitting less carbon (as per standard fixed by UNFCCC) one get credited in a developing country. This is called carbon credit. These credits are bought over by the companies of developed countries - mostly Europeans - The United States has not signed the Kyoto Protocol. Carbon credits are measured in units of certified emission reductions (CERs). Each CER is

equivalent to one ton of carbon dioxide reduction.

The traditional mode of transport including buses, taxis, private cars, rickshaws, motorcycles and bikes. The traditional mode (being run on high intensive carbon fuel) emit huge amount of GHG into the atmosphere. Metro complements other modes of transport and replaces partially, the trips made by conventional or traditional means of transit. Due to modal shift (road to metro) results into reduction of traffic on road in terms of daily vehicle trips and corresponding reduction in daily fuel consumption as given in Table 5.2 and Table 5.3.

The emission reductions are additional as the above project activity is expected to result in a reduction in anthropogenic emissions by sources of greenhouse gases (GHG) that are additional to any that would occur in the absence of the proposed project activity. Reduction of CO₂ emissions (tCO₂eq) due to modal shift are 27462 in 2021, 108940 in 2031 and 138172 in 2041.

6.7 CHECKLIST OF IMPACTS

The impact evaluation determines whether a project development alternative is in compliance with existing standards and regulations. It uses acceptable procedures and attempts to develop a numeric value for total environmental impact. A transformation of the review of multiple environmental objectives into a single value or a ranking of projects is the final step in impact assessment. The methods for carrying out impact assessment can be grouped into the following categories:

- ❖ Ad – hoc method
- ❖ Checklist
- ❖ Matrix
- ❖ Network
- ❖ Overlays
- ❖ Environmental Index and
- ❖ Cost Benefit analysis.

Each of the methods is subjective in nature and none of these is applicable in every case. Of the 7 methods listed above, checklist has been used and presented.

Checklist is a list of environmental parameters or impact indicators which encourages the environmentalist to consider and identify the potential impacts. The checklist identifying anticipated environmental impacts is shown in **Table 6.6**.

Table 6.6: Checklist of Impacts

| S. No. | Parameter | Negative Impact | No Impact | Positive Impact |
|-----------|---|-----------------|-----------|-----------------|
| A. | Impacts due to Project Location | | | |
| i. | Displacement of People | * | | |
| ii. | Change of Land use and Ecology | * | | |
| iii. | Loss of Cultural and Religious Structures | | * | |
| iv. | Drainage & Utilities Problems | * | | |
| B. | Impact due to Project Design | | | |

| | | | | |
|-----------|---|---|---|---|
| i. | Platforms - Inlets and Outlets | | * | |
| ii. | Ventilation and Lighting | | * | |
| iii. | Railway Station Refuse | * | | |
| iv. | Risk due to Earthquakes | | * | |
| C. | Impact due to Project Construction | | | |
| i. | Soil Erosion, Pollution and Health risk | * | | |
| ii. | Traffic Diversions and Risk to Existing Buildings | * | | |
| iii. | Problems of Soil Disposal and Seepage Risk | * | | |
| D. | Impact due to Project Operation | | | |
| i. | Oil Pollution | * | | |
| ii. | Noise | * | | |
| iii. | Water Demands | * | | |
| iv. | Pedestrian Issues | | | * |
| v. | Visual Impacts | | | * |
| vi. | Employment Opportunities | | | * |
| vii. | Enhancement of Economy | | | * |
| viii. | Mobility | | | * |
| ix. | Safety | | | * |
| x. | Traffic Congestion Reduction | | | * |
| xi. | Less fuel Consumption | | | * |
| xii. | Less Air Pollution | | | * |
| xiii. | Carbon dioxide Reduction | | | * |
| xiv. | Reduction in Buses | | | * |
| xv. | Reduction in Infrastructure | | | * |

7. ENVIRONMENTAL MANAGEMENT PLAN

The Delhi Mass Rapid Transit System (MRTS) Phase IV priority corridors will provide employment opportunity, quick mobility service and safety, traffic congestion reduction, less fuel consumption and air pollution on one hand and problems of muck disposal, traffic diversion, utility dislocation etc. on the other hand.

Protection, preservation and conservation of environment have always been a primary consideration in Indian ethos, culture and traditions. Management of Environment by provision of necessary safeguards in planning of the project itself can lead to reduction of adverse impacts due to a project. This chapter, therefore, spells out the set of measures to be taken during project construction and operation to mitigate or bring down the adverse environmental impacts to acceptable levels based on the proposed Environmental Management Plan (EMP).

The most reliable way to ensure that the plan will be integrated into the overall project planning and implementation is to establish the plan as a component of the project. This will ensure that it receives funding and supervision along with the other investment components. For optimal integration of EMP into the project, there should be investment links for:

- ❖ Funding,
- ❖ Management and training, and
- ❖ Monitoring.

The purpose of the first link is to ensure that proposed actions are adequately financed. The second link helps in embedding training, technical assistance, staffing and other institutional strengthening items in the mitigation measures to implement the overall management plan. The third link provides a critical path for implementation and enables sponsors and the funding agency to evaluate the success of mitigation measures as part of project supervision, and as a means to improve future projects. This chapter has been divided into three sections:

- ❖ Mitigation measures,
- ❖ Disaster management, and
- ❖ Emergency measures.

For every issue discussed for above measures, the implementing agency as well as staffing, equipment, phasing and budgeting have been presented as far as possible. All required funds will be channeled through the project authority. The Environmental Management Plans have been prepared and discussed in subsequent sections.

7.1 MITIGATION MEASURES

The main aim of mitigation measures is to protect and enhance the existing environment of the project. This section includes measures for:

- ❖ Flora and Fauna

- ❖ Construction Material Management
- ❖ Labour Camp
- ❖ Welfare and safety of labour during construction
- ❖ Energy Management
- ❖ Hazardous Waste Management
- ❖ Housekeeping
- ❖ Utility Plan
- ❖ Archaeological and Historical Preservation
- ❖ Air Pollution Control Measures
- ❖ Noise Control Measures
- ❖ Vibration Control Measures
- ❖ Traffic Diversion/Management
- ❖ Soil Erosion Control
- ❖ Muck Disposal
- ❖ Construction and Demolition waste
- ❖ Draining of Water from Tunnel
- ❖ Underground Tunneling Work
- ❖ Water Supply, Sanitation and Solid Waste management
- ❖ Rain water harvesting
- ❖ Management Plans for Depot, and
- ❖ Training and Extension

7.1.1 Flora and Fauna

a) Compensatory Plantation

Due to the proposed project, 10,438 trees are likely to be lost. Out of the 10,438 trees, 626 trees are coming under the reserve forest area. As per the prevailing practice of the Forest Department, Delhi, 10 tree saplings are to be planted for every tree felled. Hence 1,04,380 trees need to be planted. Trees will be planted, maintained, and monitored by the Delhi Development Authority (DDA) on behalf of DMRC on their land. Plantation will be carried out by DDA with native plant species. Cost of the compensatory plantation will be about Rs 5949.66 Lakh considering Rs 57,000/- per tree. In addition to this, the same amount of Rs 5949.66 Lakh will be given to the Forest Department, Delhi as a security deposit, which will be refunded to DMRC after 7 years based on successful survival of the plantation. Therefore, the total cost of the compensatory plantation is **Rs 11,899.32 Lakh**.

b) Compensatory Afforestation

Permission for use of 10.27 ha reserve forest land will be obtained under the Forest Conservation Act, 1980. An equivalent area will be made available to the forest department for carrying out compensatory afforestation. DMRC will arrange the land through DDA. Normally wasteland/ proposed green area land as per DDA's planning is made available for the purpose free of cost. The cost of compensatory afforestation will be calculated at the rate of 1100 tree per hectare at the unit rate of Rs. 5700/- the cost of raising per plant. Therefore, 11,297 trees will be planted by the forest department in the 10.27 ha of land. The cost of afforestation @ Rs. 5700/- per tree will be Rs 643.93 Lakhs. Furthermore, as per the FCA, the Net Present Value (NPV) of Forest Land lost due to non-forest activities, is also required to be worked out and compensated accordingly. This has been worked out as Rs 57.82 Lakhs. Hence, the total cost for the compensatory afforestation is estimated at **Rs 701.75 Lakh**.

c) Sensitive Species within the Asola Bhatti WLS ESZ

The proposed Tughlakabad-Aerocity corridor passes through the Eco-Sensitive Zone (ESZ) of the Asola Bhatti Wildlife Sanctuary at few places. However, the proposed alignment is underground and is quite far away from the core area of the wildlife sanctuary. The area, where the proposed alignment is within the ESZ, is surrounded by human settlements and utility infrastructures. The places where the alignment is within the ESZ is underground and therefore no direct or indirect impacts on the flora and fauna of the sanctuary are envisaged, neither during construction nor operation of the proposed project. It is expected that during the construction and the operation the project will not have any direct or indirect adverse impact on Flora and Fauna due to noise and vibration.

However, necessary countermeasures during construction will be taken wherever required. It will be ensured that there will be no hunting, poaching, or unnecessary habitat destruction. The Forest Department will monitor the Flora and Fauna between the project boundary and the Asola Bhatti Wildlife Sanctuary boundary. In the case of any negative impact on account of the project, DMRC will consider the advice of the Forest Department in drafting a mitigation strategy for implementing measures to negate or minimize the negative impacts.

7.1.2 Construction Material Management

The major construction material to be used for construction of Metro Corridor will be coarse aggregates, cement, coarse sand, reinforcement steel, structural steel, water supply, drainage and sanitary fittings etc. The material will be loaded and unloaded by engaging labour at both the locations by the contractor.

The duties of the contractor will include monitoring all aspects of construction activities, commencing with the storing, loading of construction materials and equipment in order to maintain the quality. During the construction period, the construction material storage site is to be regularly inspected for the presence of uncontrolled construction waste. Close liaison with the officer of the DMRC and the head of the construction crew will be required to address any environmental issues and to set up procedures for mitigating impacts. The scheduling of material procurement and transport shall be linked with construction schedule of the project. The Contractor shall be responsible for management of such construction material during entire construction period of the project. Sufficient quantity of materials should be available before starting the each activity. The contractor should test all the materials in the Government labs or Government approved labs in order to ensure the quality of materials before construction. This is also the responsibility of the contractor, which would be clearly mentioned in the contractor's agreement.

7.1.3 Labour Camp

The Contractor during the progress of work will provide, erect and maintain necessary (temporary) living accommodation and ancillary facilities for labour to standards and scales approved by the DMRC. All temporary accommodation must be constructed and maintained in such a fashion that uncontaminated water is available for drinking, cooking and washing. Safe drinking water should be provided to the dwellers of the construction camps. Adequate washing and bathing places shall be provided, and kept in clean and drained condition. Construction camps are to the responsibility of the concerned contractors and these shall not be allowed in the construction areas but sited away. Adequate health care is to be provided for the work force.

Sanitation Facilities: Construction camps shall provide sanitary latrines and urinals. Sewerage

drains should be provided for the flow of used water outside the camp. Drains and ditches should be treated with bleaching powder on a regular basis. The sewage system for the camp must be properly designed, built and operated so that no health hazard occurs and no pollution to the air, ground or adjacent watercourses takes place. Waste water from site is not discharged into sewer without approval. Compliance with the relevant legislation must be strictly adhered to. Garbage bins must be provided in the camp and regularly emptied and the garbage disposed off in a hygienic manner.

Shelter at Workplace: At every workplace, shelter shall be provided free of cost, separately for use of men and women labors. The height of shelter shall not be less than 3m from floor level to lowest part of the roof. Sheds shall be kept clean and the space provided shall be on the basis of at least 0.5m² per head.

Canteen Facilities: A cooked food canteen on a moderate scale shall be provided for the benefit of workers wherever it is considered necessary. The contractor shall conform generally to sanitary requirements of local medical, health and municipal authorities and at all times adopt such precautions as may be necessary to prevent soil pollution of the site.

First aid facilities: At every workplace, a readily available first-aid unit including an adequate supply of sterilized dressing materials and appliances will be provided. Suitable transport will be provided to facilitate taking injured and ill persons to the nearest hospital.

Day Crèche Facilities: At every construction site, provision of a day crèche shall be worked out so as to enable women to leave behind their children. At construction sites where 20 or more women are ordinarily employed, there shall be provided at least a hut for use of children under the age of 6 years belonging to such women. Huts shall not be constructed to a standard lower than that of thatched roof, mud walls and floor with wooden planks spread over mud floor and covered with matting. Huts shall be provided with suitable and sufficient openings for light and ventilation. There shall be adequate provision of sweepers to keep the places clean. There shall be two maidservants (or aayas) in the satisfaction of local medical, health, municipal or cantonment authorities. Where the number of women workers is more than 25 but less than 50, the contractor shall provide with at least one hut and one maidservant to look after the children of women workers. Size of crèches shall vary according to the number of women workers employed.

Security: Security guards shall be deployed at construction sites as well as labour camps. In connection with their behaviour, they shall be subject to conditions of their employment and criminal liability. To ensure that security guard involved in the project will not violate safety of other individuals or local residents there will be an agreement of project contractor with security agency w.r.t rules and regulations, the guards will be confined within site only, no arms will be provided to them and a formal training will be provided to them.

7.1.4 Welfare and safety of labour during construction

Construction works shall be executed as laid down in the Safety Health and Environment (SHE) Manual prepared by DMRC.

The SHE manual

- i) Describes the SHE interfaces between Employer and the Contractor.
- ii) Details the processes by which the contractor shall manage SHE issues while carrying out the work under the contract

iii) Describes by reference, the practices and procedures

The construction works shall be undertaken in accordance with all applicable legislation and Indian statutory requirements and guidelines - OHSAS 18001-1999: Occupational Health and Safety Management System and ISO 14001-2004: Environmental Management Systems.

The key elements of the SHE manual are as follows:

1. The unit responsible for co-ordinating and monitoring the Contractor's SHE performance;
2. Procedures for identifying and estimating hazards, and the measures for addressing the same; A list of SHE hazards anticipated
3. SHE training courses and emergency drills
4. SHE inspections to identify any variation in construction activities and operations, machineries, plant and equipment and processes against the SHE Plan and its supplementary procedures and programs: Planned General Inspection, Routine Inspection, Specific Inspection and Other Inspection
5. Safety Audit
6. SHE Audit to assess potential risk, liabilities and the degree of compliance of construction Safety, Health & Environmental plan and its supplementary procedures and programs against applicable and current SHE legalisation regulations and requirements of the employer.
7. Electrical Safety Audit External SHE Audit
8. SHE Communication to communicate the Safety, Occupational health and Environment management measures through posters campaigns / billboards / banners / glow signs being displayed around the work site
9. SHE Reporting –reports, minutes, inspection reports, audit reports
10. Accident reporting and investigation
 - i) Reports of all accidents (fatal / injury) and dangerous occurrences to the Employer
 - ii) Reporting to Govt. organisations
11. Investigations of Accidents and Dangerous Occurrences, Near misses and minor accidents
12. Prepare an Emergency Response Plan for all work sites including injury, sickness, evacuation, fire, chemical spillage, severe weather and rescue.
13. The Contractor will be required to conduct awareness programs and other measures to prevent infectious diseases spreading.

Workplace safety and occupational health shall be ensured with special focus on following areas:

- a) Housekeeping
- b) Working at Height and Falling objects and Danger areas
- c) Lifting Appliances
- d) Launching Operation
- e) Construction machinery, tools equipment - Safe worthiness
- f) employ qualified electrical personnel on site and requirements of electrical equipment, distribution etc
- g) Lighting
- h) Exposure of worker to use of exhaust or harmful gases in confined locations
- i) Fire prevention, protection and fighting system
- j) Corrosive substances
- k) Demolition

- l) Excavation and Tunnelling
- m) Traffic Management
- n) Personal Protective Equipments (PPEs)
- o) Reporting which will contain results of monitoring and inspection programs
- p) Process of response to Inquiries, complaints and requests for information from private and government entities
- q) Physical fitness of workmen
- r) Medical Facilities on site : Occupational Health Centre, Ambulance van and room HIV/ AIDS prevention and control
- s) Exposure to Noise – prevention measures
- t) Ventilation and illumination
- u) Welfare measures for workers: latrine, canteen, drinking water, living accommodation, creches
- v) Environmental issues during metro construction stage generally involve equity, safety and public health issues.

The construction agencies require complying with laws of the land, which include inter alia, the following:

- **Bonded Labour System (abolition) Act, 1976 (amended once in 1985):** An Act to provide for the abolition of bonded labour system with a view to preventing the economic and physical exploitation of the weaker sections of the people and for matters connected therewith or incidental thereto.
- **Building and other construction worker's (Regulation of Employment and conditions of service) Act, 1996:** The Act provides for regulating the employment and conditions of service of building and other construction workers and also provides for their safety, health and welfare measures and other matters connected therewith or incidental thereto.
- **Building and other Construction Worker's Welfare Cess Act, 1996:** The Act provides for levy and collection of cess on the cost of construction incurred by employers with a view to augmenting the resources of the Building and Other Constructions Workers Welfare Board. The Act provides for regulating the employment and conditions of service of building and other construction workers and also provides for their safety, health and welfare measures and other matters connected therewith or incidental thereto.
- **Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996:** The Rules provide for mandatory preparation of On-Site Emergency Plans by the industry and Off-Site Plans by the district collector and the constitution of four tier crisis groups at the centre, district, and local levels for the management of chemical disaster.
- **Child Labour (Prohibition and Regulation) Act 1986:** The Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of child labour is prohibited in Building and Construction Industry.
- **Children Pledging of Labour Act, 1933:** Pledging of Labour of children prohibited and penalty for parents/guardians pledging child labour prescribed
- **Contact Labour (Regulation and Abolition) Act, 1970 (amended once in 1986):** The Act provides for certain welfare measures to be provided by the contractor to contract labour.
- **Employee's Provident Fund and Miscellaneous Provisions Act, 1952 (amended 14 times 1953, 1956, 1957, 1958, 1960, 1962, 1963, 1965, 1971, 1973, 1976, 1988, 1996, 1998):** It is an important piece of Labour Welfare legislation enacted by the Parliament to provide social security benefits to the workers . At present , the Act and the Schemes framed there under provides for three types of benefits -Contributory Provident Fund , Pensionary benefits to the employees/ family members and the insurance cover to the members of the Provident Fund.
- **Employees PF and Miscellaneous Provision Act 1952:** The Act provides for monthly

contributions by the employer plus worker.

- **Employees State Insurance Act, 1948 (amended 6 times in 1951, 1966, 1970, 1975, 1984, 1989):** This act envisage an integrated need based social insurance scheme that would protect the interest of workers in contingencies such as sickness, maternity, temporary or permanent physical disablement, death due to employment injury resulting in loss of wages or earning capacity. The Act also guarantees reasonably good medical care to workers and their immediate dependants.
- **Employers Liability Act, 1938 (amended 3 times, in 1951 twice and 1970):** An Act to declare that certain defenses shall not be raised in suits for damages in respect of injuries sustained by workmen whereas it is expedient to declare that certain defenses shall not be raised in suits for damages in respect of injuries sustained by workmen.
- **Equal Remuneration Act, 1976 (Amended once in 1987):** The Act provides for payment of equal wages for work of equal nature to Male and Female workers and not for making discrimination against Female employees.
- **Fatal accidents Act, 1855:** The objective of this act is to provide compensation to families for loss occasioned by the death of a person caused by actionable wrong.
- **Industrial Disputes Act, 1947:** The Act lays down the machinery and procedure for resolution of industrial disputes, in what situations a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing down the establishment.
- **Industrial Employment (Standing Orders) Act; 1946:** The Act provides for laying down rules governing the conditions of employment.
- **Inter-State Migrant Workmen's (Regulation of Employment and Conditions of Service) Act, 1979:** The inter-state migrant workers, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, travelling expenses from home to the establishment and back, etc.
- **Maternity Benefit (Amendment Bill) Bill 2006:** The Act provides for leave and some other benefits to women employees in case of confinement or miscarriage, etc.
- **Minimum Wages Act, 1948 (amended 8 times in 1950, 1951, 1954, 1957, 1961, 1970, and 1986):** The employer is supposed to pay not less than the Minimum Wages fixed by appropriate Government.
- **Motor Transport Worker's Act, 1961:** To provide for the welfare of motor transport workers and to regulate the conditions of their work.
- **Payment of Bonus Act, 1965 (amended 3 times in 1976, 1980, 1995):** The Act provides for payments of annual bonus subject to a minimum of 83.3% of wages and maximum of 20% of wages.
- **Payment of Gratuity Act, 1972 amended 5 times in 1984 twice, 1987, 1994, 1999):** Gratuity is payable to an employee under the Act on satisfaction of certain conditions on separation if an employee has completed 5 years.
- **Payment of Wages Act 1936 (amended 12 times in 1937 twice, 1940, 1951, 1957, 1960, 1964, 1971, 1974, 1976, 1977, 1982):** It lays down as to by what date the wages are to be paid, when it will be paid and what deductions can be made from the wages of the workers.
- **Personal Injuries (Compensation Insurance) Act, 1970:** An Act to impose on employers a liability to pay compensation to workmen sustaining personal injuries and to provide for the insurance of employers against such liability.
- **The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 and the Cess Act of 1996:** All the establishments who carry on any building or other construction work and employs 10 or more workers are covered under this Act; the employer of the establishment is required to provide safety measures at the building or construction work and other welfare measures, such as canteens, first-aid facilities, ambulance, housing accommodation for Workers near the workplace, etc.

- **The Factories Act, 1948:** The Act lays down the procedure for approval of plans before setting up a factory, health and safety provisions, welfare provisions, working hours and rendering information-regarding accidents or dangerous occurrences to designated authorities.
- **Trade Unions Act, 1926:** The Act lays down the procedure for registration of trade unions of workers and employers. The trade unions registered under the Act have been given certain immunities from civil and criminal liabilities.
- **Workmen's Compensation Act 1923 (amended 4times in 1933,1959, 1962, 1995) :** This Act provides for compensation in case of injury by accident arising out of and during the course of employment.

7.1.5 Energy Management

The contractor shall use and maintain equipment so as to conserve energy and shall be able to produce demonstrable evidence of the same upon the request of officer of the Project Implementation Unit.

Measures to conserve energy include but not limited to the following:

- ❖ Optimizing the use of tools, plants and equipment to perform tasks with correct power.
- ❖ Optimizing cable size and joint can control voltage drops
- ❖ Use of energy efficient motors (90% efficiency or more) and pumps (at least 80% efficiency),
- ❖ Replacing inefficient lamps with the most efficient lamp for the purpose, taking into account size, shape, colour and output of the lamp.
- ❖ Replacing standard choke ballasts with high frequency electronic ballasts.
- ❖ Luminaries - retrofitting standard luminaries with high-efficiency specular reflectors or replacing standard luminaries with high-efficiency luminaries
- ❖ Adequate and uniform illumination level at construction sites suitable for the task,
- ❖ Use of energy efficient air conditioner.
- ❖ The engines shall be capable of delivering specified prime power rating of variable loads for PF of 0.8 lag with 10% overload available in excess of specified output for one hour in every 12 hours.
- ❖ Engine of DG set shall complies with CPCB norms
- ❖ Planning in advance and selecting location to receive and store material such that these are at the least distance from the place of use. Such an approach will result in less energy being consumed since optimum energy will be expended for transport of material.
- ❖ Maintenance schedule - setting up a maintenance schedule to clean and replace lamps on a regular basis.
- ❖ Promoting employees awareness on energy conservation
- ❖ Training staff on methods of energy conservation and to be vigilant to such opportunities
- ❖ The contractor shall design site offices for maximum daylight and minimum heat gain. The rooms shall be well insulated to enhance the efficiency of air conditioners and the use of solar films on windows may be used where feasible.

7.1.6 Hazardous Waste Management

Classification of waste as hazardous shall be in accordance with the Hazardous and Other Wastes (Management, Handling & Trans-boundary movement) Rules 2016. The contractor shall identify the nature and quantity of hazardous waste generated as a result of his activities and shall file an Application for obtaining authorization in "Form I" with Delhi Pollution Control Committee along with a map showing the location of storage area. Hazardous waste would mainly arise from the maintenance of equipment which may include used engine oils, hydraulic fluids, waste fuel, spent mineral oil/cleaning fluids from mechanical machinery, scrap batteries or spent acid/alkali, spent solvents etc. Outside the storage area, the contractor shall place a 'display board', which will display quantity and nature of hazardous waste on date. Hazardous Waste needs to be stored in a secure place. It shall be the responsibility of the contractor to ensure that hazardous wastes are stored, based on the composition in a manner suitable for handling storage and transport. The labeling and packaging is required to be easily visible and be able to withstand physical conditions and climatic factors. The storage of hazardous waste should not exceed 90 days and the contractor shall maintain a record of sale, transfer, storage of such waste and make these records available for inspection. The contractor shall approach only Authorized Recyclers for disposal of Hazardous Waste, under intimation to the DMRC. Used lubricants should be collected and stored in individual containers which are fully labeled in English and Hindi and stored in a designated secure place. These wastes should be sent to authorized re-cyclers, and the empty drums collected by appropriated companies for reuse or refill. The environmentally hazardous waste shall be stored in an impermeable surface with containment bounding to retain leaks, spills and ruptures. Heavy metal test will be done during the excavation for the underground station. In case of metal contamination it will be handled & disposed off in environmental friendly manner as per Hazardous Waste Management Rule 2016.

7.1.7 Environmental Sanitation

Environmental sanitation also referred to as Housekeeping, is the act of keeping the working environment cleared of all unnecessary waste, thereby providing a first-line of defense against accidents and injuries. Contractor shall understand and accept that improper environmental sanitation is the primary hazard in any construction site and ensure that a high degree of environmental sanitation is always maintained. Environmental sanitation is the responsibility of all site personnel, and line management commitment shall be demonstrated by the continued efforts of supervising staff towards this activity.

General environmental sanitation shall be carried out by the contractor and ensured at all times at Work Site, Batching Plant, Stores, Offices and toilets/urinals.

Towards this the Contractor shall constitute a special group of environmental sanitation personnel. This group shall ensure daily cleaning at work sites and surrounding areas and maintain a register as per the approved format by the DMRC.

Team of environmental sanitation squad shall carry out:

- ❖ Full height fence, barriers, barricades etc. shall be erected around the site in order to prevent the surrounding area from excavated soil, rubbish etc, which may cause inconvenience to and endanger the public. The barricade especially those exposed to public shall be aesthetically maintained by regular cleaning and painting as directed by the Employer. These shall be maintained in one line and level.
- ❖ The structure dimension of the barricade, material and composition, its colour scheme,

logo and other details.

- ❖ All stairways, passageways and gangways shall be maintained without any blockages or obstructions. All emergency exits passageways, exits fire doors, break-glass alarm points, fire-fighting equipment, first aid stations, and other emergency stations shall be kept clean, unobstructed and in good working order.
- ❖ All surplus earth and debris shall be removed/disposed off from the working areas to officially designated dumpsites. Trucks carrying sand, earth and any pulverized materials etc. shall be covered while moving in order to avoid dust or odour impact.
- ❖ No parking of trucks/trolleys, cranes and trailers etc. shall be allowed on roads, which may obstruct the traffic movement.
- ❖ Roads shall be kept clear and materials like: pipes, steel, sand boulders, concrete, chips and brick etc. This material shall not be allowed on the roads to obstruct free movement of road traffic.
- ❖ Water logging or bentonite spillage on roads shall not be allowed.
- ❖ Proper and safe stacking of material are of paramount importance at yards, stores and such locations where material would be unloaded for future use. The storage area shall be well laid out with easy access and material stored / stacked in an orderly and safe manner.
- ❖ Flammable chemicals/compressed gas cylinders shall be safely stored.
- ❖ Unused/surplus cables, steel items and steel scrap lying scattered at different places within the working areas shall be removed to identify locations.
- ❖ All wooden scrap, empty wooden cable drums and other combustible packing materials, shall be removed from work place to identified locations.
- ❖ Empty cement bags and other packaging material shall be properly stacked and removed.
- ❖ The Contractor shall ensure that all his sub-contractors maintain the site reasonably clean through provisions related to environmental sanitation (house-keeping).
- ❖ Water for construction will be arranged by contractor. Permission has to be taken from the concerned local govt. in case of ground water extraction. Waste water from site is not discharged into sewer without approval

7.1.8 Utility Plan

The proposed Metro alignment run along major arterial roads of the city, which serve Institutional, Commercial and Residential areas. Large number of sub-surface, surface and overhead utility services, viz. sewers, water mains, storm water drains, telephone cables, electrical transmission lines, electric poles, traffic signals etc. already exist along the proposed alignment. These utility services are essential and have to be maintained in working order during different stages of construction by temporary/permanent diversions or by supporting in position. As such, these may affect construction and project implementation time schedule/costs, for which necessary planning/action needs to be initiated in advance. The Organizations / Departments responsible for concerned utility services are reported in Table 7.1.

Prior to the actual execution of work at site, detailed investigation of all utilities and location will be undertaken well in advance by making trench pit to avoid damage to any utility. While planning for diversion of underground utility services e.g. sewer lines, water pipe lines, cables etc., during construction of Metro, the following guidelines could be adopted:

- Utility services shall be kept operational during the entire construction period and after completion of project. All proposals should therefore, ensure their uninterrupted functioning.

The elevated viaduct does not pose any serious difficulty in negotiating the underground utility services, especially those running across the alignment. In such situation, the spanning arrangement of the viaduct may be suitably adjusted to ensure that no foundation need be constructed at the location, where utility is crossing the proposed Metro alignment. In case of utility services running along the alignment either below or at very close distance, the layout of piles in the foundations shall be suitably modified such that the utility service is either encased within the foundation piles or remains clear of them. In priority corridors of Delhi MRTS Phase – IV, Construction of New Depot is not planned. Existing depot at Mukundpur and Sarita Vihar will be strengthened by augmenting facilities. The expansion works are within the exiting depot boundary hence, there will not be any utility shifting.

Table 7.1: Organizations Responsible for Utilities and Services

| S. No. | Organization/ Department | Utility/Services |
|--------|---|---|
| 1. | Delhi Jal Board | Sewerage and drainage lines. Water mains and their service lines, including hydrants and fountains etc, water treatment plants, pumping stations etc. in non NDMC area |
| 2. | New Delhi Municipal Committee | Roads, surface water drains, nallahs, sewer lines, street lights, high mast lights etc. in NDMC area etc. |
| 3. | Central Public Works Department | Roads, surface water drains, nallahs etc. |
| 4. | NHAI | Roads, surface water drains, nallahs etc. |
| 5. | NDPL and BSES | Power cables and their appurtenances, pole mounted transformers, power cables of 33 & 11KV's |
| 6. | Mahanagar Telephone Nigam Ltd. (MTNL) | Telecommunication cables, junction boxes, telephone posts, O.H. lines etc. |
| 7. | Office of Commissioner of Police, Delhi | Traffic signal posts, junction boxes and cable connection etc. |
| 8. | Reliance Mobile India Limited, Idea, Airtel and Tata Tele service India Limited | Telecommunication cables, junction boxes etc. |
| 9. | Indraparastha Gas Limited | Gas Pipelines |

7.1.9 Archaeological and Historical Preservation

Monuments located near the proposed alignment are listed in para 4.5.8. Prior to the initiation of construction, DMRC intends to review a resources protection plan for historic structures where it appears they may be affected by the project. This plan will be develop by the contractor in consultation with the Archaeological Survey of India (ASI) and other parties. This plan will identify the sensitive resources as well as specify the construction monitoring requirement. These requirements may include ground vibration monitoring and recording any component subjected

to impact.

The tunnel for the metro network is being constructed by using the state of the art technology i.e. Tunnel Boring Machine (TBM) which gives negligible vibration. The stations are being constructed by cut and cover method which is widely accepted and the safest technique being adopted by metros in India and abroad. The above technology has been adopted successfully by DMRC in the past while carrying out works in the regulated/prohibited areas (ASI protected monuments) as well as close to public and private buildings.

Where the alignment, runs within the prohibited/regulated zone of the monuments, DMRC have to apply for No Objection Certificate (NOC) from Director of Archaeology, Archaeological Survey of India as per provision of National Monuments and Archeological Sites and Remains (Amendment & Validation Act 2010). In this regard DMRC has been obtained the NOC for 5 ASI monuments and for the rest of the 2 monuments is under process.

7.1.10 Air Pollution Control Measures

During the construction period, the impact on air quality will be mainly due to increase in Particulate Matter (PM) along haul roads and emission from vehicles and construction machinery. Mitigation measures which shall be adopted to reduce the air pollution are presented below:

- The Contractor shall take all necessary precautions to minimize fugitive dust emissions from operations involving excavation, grading, and clearing of land and disposal of waste. He shall not allow emissions of fugitive dust from any transport, handling, construction or storage activity to remain visible in atmosphere beyond the property line of emission source for any prolonged period of time without notification to the Employer.
- Contractor's transport vehicles and other equipment shall conform to emission standards fixed by Statutory Agencies of Government of India or the State Government from time to time. The Contractor shall carry out periodical checks and undertake remedial measures including replacement, if required, so as to operate within permissible norms.
- The Contractor shall cover loads of dust generating materials like debris and soil being transported from construction sites. All trucks carrying loose material should be covered and loaded with sufficient free - board to avoid spills through the tailboard or sideboards.
- The temporary dumping areas shall be maintained by the Contractor at all times until the excavate is re-utilised for backfilling or as directed by Employer. Dust control activities shall continue even during any work stoppage.
- The Contractor shall place material in a manner that will minimize dust production. Material shall be minimized each day and wetted, to minimize dust production. During dry weather, dust control methods must be used daily especially on windy, dry days to prevent any dust from blowing across the site perimeter.
- The Contractor shall water down construction sites as required to suppress dust, during handling of excavation soil or debris or during demolition. The Contractor will make water sprinklers, water supply and water delivering equipment available at any time that it is required for dust control use. Dust screens will be used, as feasible when additional dust control measures are needed

specially where the work is near sensitive receptors.

- The Contractor shall provide a wash pit or a wheel washing and/or vehicle cleaning facility at the exits from work sites such as construction depots and batching plants. At such facility, high-pressure water jets will be directed at the wheels of vehicles to remove all spoil and dirt.
- The Contractor shall design and implement blasting techniques so as to minimize dust, noise, and vibration generation and prevention fly rock.

7.1.11 Noise Control Measures

There will be an increase in noise level in the ambient air due to construction and operation of the Metro corridors. However, noise levels in the core city are expected to go down during operation. The increase in noise levels is marginal; hence local population will not be adversely affected. However the exposure of workers to high noise levels especially, near the engine, vent shaft etc. need to be minimized. This could be achieved by:

- ❖ Job rotation,
- ❖ Automation,
- ❖ Construction of permanent and temporary noise barriers,
- ❖ Use of electric instead of diesel powered equipment,
- ❖ Use of hydraulic tools instead of pneumatic tools,
- ❖ Acoustic enclosures should be provided for individual noise generating construction equipment like DG sets,
- ❖ Scheduling truck loading, unloading and hauling operation,
- ❖ Scheduling work to avoid simultaneous activities that generates high noise levels,
- ❖ Anti drumming floor and noise absorption material,
- ❖ Low speed compressor, blower and air conditioner,
- ❖ Mounting of under frame equipments on anti-vibration pad,
- ❖ Smooth and gradual control of door,
- ❖ Provision of GRP baffle on the via-duct for elimination of noise transmission,
- ❖ Provision of sound absorbing material in the supply duct and return grill of air conditioner,
- ❖ Sealing design to reduce the aspiration of noise through the gap in the sliding doors and piping holes, and
- ❖ Sound proof compartments control rooms etc.

Before start of work at site DMRC should: 1) implement a low-noise procurement policy (purchase and hire) for machinery and work equipment; 2) set desired noise-control requirements in the tender specifications (meeting national legislation as a minimum); 3) plan the work process to minimise worker exposure to noise; 4) implement a noise-control programme (for example, by planning, training, induction, site layout, maintenance activities).

Control: There will be three steps to the protection of workers from noise, using technical and organisation measures:

- ❖ Control the noise at source
- ❖ Collective measures, including work organisation;
- ❖ Personal hearing protection.

Control of noise at source: Such control measures will include:

- ❖ Using a machine with lower noise emissions;
- ❖ Avoidance of metal on metal impacts;
- ❖ Damping to reduce noise or isolating vibrating parts;
- ❖ Fitting silencers;
- ❖ Carrying out preventive maintenance: as parts become worn, noise levels can change.

Collective control measures: Actions should be taken to reduce the exposure to noise of all those who may be exposed, in addition to the steps above. On sites with more than one contractor, liaison between employers is essential. Collective measures will include:

- ❖ Isolating noisy procedures and restricting access to noisy areas;
- ❖ Interrupting the path of airborne noise through the use of noise enclosures and barriers;
- ❖ Using absorptive materials to reduce reflected sound;
- ❖ Controlling ground-borne noise and vibration by using floating slab measures;
- ❖ Organising work so that the time spent in noisy areas is limited;
- ❖ Planning to have noisy work done when as few workers will be exposed as possible;
- ❖ Implementing work schedules that control exposure to noise.

Personal hearing protection: Personal hearing protection should be used as a last resort.

- ❖ The personal hearing protection must be worn and its use enforced;
- ❖ It should be suitable for the job, type and level of noise, and compatible with other protective equipment;
- ❖ Workers should have a choice of suitable hearing protection, so that they can find the most comfortable;
- ❖ Training should be given on how to use, store, and maintain the hearing protection

The workers employed in high noise level area could be employed in low noise level areas and vice-versa from time to time. Automation of equipment and machineries, wherever possible, should be done to avoid continuous exposure of workers to noise. At work places, where automation of machineries is not possible or feasible, the workers exposed to noise should be provided with protective devices. Special acoustic enclosures should be provided for individual noise generating equipments, wherever possible.

Workers in those sections where periodic adjustment of equipment/machinery is necessary, should be provided with sound proof control rooms so that exposure to higher noise level is reduced. During construction, there may be high noise levels due to pile driving, use of compressors and drilling machinery. Effective measures should be taken during the construction phase to reduce the noise from various sources. The noise from air compressor can be reduced by fitting exhaust and intake mufflers.

The pile driving operation can produce noise levels up to 100 dB (A) at a distance of 25-m from site. Safety precaution as stipulated in IS: 5121 (1969) 'Safety Code for Piling and other Deep Foundation' need to be adopted.

Noise level from loading and unloading of construction materials can be reduced by usage of various types of cranes and placing materials on sand or sandy bag beds.

The ballast-less track supported on two layers of rubber pads can reduce track noise and ground vibrations. In addition, providing skirting of coach shell covering the wheel will screen any noise coming from the rail wheel interaction as of propagating beyond the viaduct. Ambient noise levels at all locations are more than the noise standards.

It is proposed that during the operation phase, for the receptors which are being affected by metro operations (specially the sensitive receptors) noise barrier may be provided of height varying from 1m to 3m. It is proposed to install absorptive barrier Perforated Aluminium sheet or Perforated aluminium sheet with glass wool or mineral wool inside with a NRC value of 0.80, sturdy and weather resistant. A noise mapping study for the elevated section should be carried out to find out effect of metro operation on ambient noise level with and without adopting noise barriers. Noise barrier will be provided along the viaduct at all the sensitive receptors. The estimated cost of noise barrier is **Rs 2435.52 Lakh**.

7.1.12 Vibration Control Measures

The large forces between the wheel and the rail are the primary cause of vibration. These forces fluctuate in response to wheel and rail roughness over a wide range of frequencies. The main frequency band of train excitation is between 10Hz and 150Hz with a maximum range at approximately 30 to 50 Hz. In a building, the higher range of this frequency is noticeable as a rumbling noise that radiates from walls and floors commonly referred as ground borne noise. The building floors usually respond (resonance) with lower range of frequencies referred as ground borne vibration.

Vibration can be reduced by minimizing surface irregularities of wheel and rail, improving track geometry, providing elastic fastenings, and separation of rail seat assembly from the concrete plinth with insertion of resilient and shock absorbing pad.

While designing the track structure for Mass Rapid Transit System all the above points have to be taken into consideration in the following ways:

- ❖ To prevent development of surface irregularities on the rail, a fairly heavy rail section of 60 kg/m, 90 UTS rail, supported at every 60 cms has been proposed. Further rail grinding at regular intervals by rail grinding machine and also lubrication of rail by vehicle mounted lubricator have been contemplated.
- ❖ Rails will be continuously welded and also will be laid to fine tolerances so that any noise/vibration on account of track geometry could be reduced.
- ❖ The vibration generated from rail-wheel interaction will be greatly absorbed by the elastic fastening system proposed to be used.
- ❖ The lower vibration can be achieved by providing of bolster less type bogies having secondary air spring.
- ❖ In addition, locations where the alignment is close to sensitive/heritage structures, the contractor shall prepare a monitoring scheme prior to construction at such locations. This scheme shall include:
 - ❖ Monitoring requirements for vibrations at regular intervals throughout the construction period.
 - ❖ Pre-construction structural integrity inspections of historic and sensitive structures in project activity.
 - ❖ Information dissemination about the construction method, probable effects, quality control measures and precautions to be used.

Mass-spring system (MSS) should be used to reduce vibrations generated due to train movements and to protect the buildings at the surface. Mass Spring Systems (MSS) on the tracks prevent any kind of vibration from reaching the structures above these tunnels. MSS is the solution that helps in mitigating vibrations generated by the passing trains at the source itself.

MSS elastically separates the track slabs in the tunnels or on the viaducts from the supporting structure. The material used for isolation is a microcellular Polyurethane Elastomer (e.g. - Sylomer from Getzner- Austria). Use of MSS helps in minimizing the transmission of vibrations (structure-borne noise) to the surrounding establishments in the vicinity of tracks. In addition MSS also effectively reduces the development of audible secondary airborne noise, which is caused by the vibration of buildings and other infrastructure component The mass- spring system, which uses soft steel coil springs in the concrete track slabs, helps in reducing vibrations and noise due to movements of train. MSS with a floating permanent way as shown in figures below:



The spread of settlement is not more than 40 m either side of the alignment, with a moderate TBM face pressure of 1.2 bar. Since the distance of all the monuments from the proposed alignment is more than 40m, therefore there will be no impact on the monuments.

7.1.13 Traffic Diversion/ Management

During such construction, traffic is most likely to be affected. Hence Traffic Diversion Plans are required in order to look for options and remedial measures so as to mitigate any traffic congestion situations arising out due to acquisition of road space during Metro construction. Any reduction of road space during Metro construction will result in constrained traffic flow. In order to retain satisfactory levels of traffic flow during the construction period; traffic management and engineering measures need to be taken. They can be road widening exercises, traffic segregation, one-way movements, traffic diversions on influence area roads, acquisition of service lanes, etc.

Various construction technologies are in place to ensure that traffic impedance is done at the minimum. They are:

-
- 'Cut-and-Cover' method is proposed for construction of the underground stations. This means that the stretch between two points will have to be blocked during construction. However, temporary decking may be provided by blocking the road carriageway partially to permit traffic movement along the same stretch. Construction of switch- over-ramp also requires some road space.
- For elevated section wherever it is passing along the road, the requirement would be mainly along the central verge.
- As regards to the alignment cutting across a major traffic corridor, 'Continuous Cantilevered Construction Technology' would be applied to prevent traffic hold-ups or diversions of any kind.
- Wherever the stations are isolated, areas available around it should be utilized for road diversion

purposes such as lay-byes and service roads.

Only temporary diversion plans will be required during construction of the Metro corridor. At the onset, all encroachments from road ROW will have to be removed. These encroachments vary from 'on-street' parking to informal activities. During the construction of works on underground section, it is proposed that temporary decking may be provided by blocking the road carriageway partially to permit 'through' as well as right-turning traffic movements. Total blockage of traffic along the underground section is not recommended.

Keeping in view the future traffic growth and reduction of carriageway due to Metro construction, implementation of traffic management/diversion plans shall become inevitable for ensuring smooth traffic movement and traffic diversion plans shall be formulated.

Traffic Management Guidelines: The basic objective of the following guidelines is to lay down procedures to be adopted by contractor to ensure the safe and efficient movement of traffic and also to ensure the safety of workmen at construction sites.

All construction workers should be provided with high visibility jackets with reflective tapes at most of viaduct/tunneling and station works or either above or under right-of-way. The conspicuity of workmen at all times shall be increased so as to protect from speeding vehicular traffic.

- ❖ Warn the road user clearly and sufficiently in advance.
- ❖ Provide safe and clearly marked lanes for guiding road users.
- ❖ Provide safe and clearly marked buffer and work zones
- ❖ Provide adequate measures that control driver behavior through construction zones.
- ❖ The primary traffic control devices used in work zones shall include signs, delineators, barricades, cones, pylons, pavement markings and flashing lights.
- ❖ The contractor should hire a transportation consultant that carryout the traffic survey and suggest alternative routes for smooth flow of traffic.

7.1.14 Soil Erosion Control

Prior to the start of the relevant construction, the Contractor shall submit to the DMRC for approval, his schedules for carrying out temporary and permanent erosion/sedimentation control works as are applicable for the items of clearing and grubbing, roadway and drainage excavation, embankment/sub-grade construction and other structures across water courses, pavement courses and shoulders. He shall also submit for approval his proposed method of erosion/sedimentation control on service road and his plan for disposal of waste materials. Work shall not be started until the erosion/sedimentation control schedules and methods of operations for the applicable construction have been approved by the DMRC.

The surface area of erodible earth material exposed by clearing and grubbing, excavation shall be limited to the extent practicable. The Contractor may be directed to provide immediate control measures to prevent soil erosion and sedimentation that will adversely affect construction

operations, damage adjacent properties, or cause contamination of nearby streams or other watercourses. Such work may involve the construction of temporary berms, dykes, sediment basins, slope drains and use of temporary mulches, fabrics, mats, seeding, or other control devices or methods as necessary to control erosion and sedimentation.

The Contractor shall be required to incorporate all permanent erosion and sedimentation control features into the project at the earliest practicable time as outlined in his accepted schedule to minimize the need for temporary erosion and sedimentation control measures.

Temporary erosion/sedimentation and pollution control measures will be used to control the phenomenon of erosion, sedimentation and pollution that may develop during normal construction practices, but may neither be foreseen during design stage nor associated with permanent control features on the Project. Under no conditions shall a large surface area of credible earth material be exposed at one time by clearing and grubbing or excavation without prior approval of the DMRC.

The DMRC may limit the area of excavation, borrow and embankment operations in progress, commensurate with the Contractor's capability and progress in keeping the finish grading, mulching, seeding and other such permanent erosion, sedimentation and pollution control measures, in accordance with the accepted schedule.

Temporary erosion is sometimes caused due to the Contractor's negligence, carelessness or failure to install permanent controls. Sedimentation and pollution control measures then become necessary as a part of the work as scheduled or ordered by the DMRC, and these shall be carried out at the Contractor's own expense. Temporary erosion, sedimentation and pollution control work required, which is attributed to the Contractor's negligence, carelessness or failure to install permanent controls, will be performed as ordered by the DMRC. Maintaining proper vegetation cover and erosion protection at the river bank. Constant surveillance will be done as part of routine maintenance. Need to assess orientation of the bridge required for free and smooth flow conditions, assess the afflux on upstream and its effects on the structures upstream and downstream of existing bridges and assess the maximum expected scour based on the maximum intensities of flow assessed from the model studies.

7.1.15 Muck Disposal

Owing to paucity of space in the busy cities and for safety reasons, elaborate measures need to be adopted for collection, transfer, storage and disposal of excavated muck. Muck shall be collected in containers from the construction sites, transported and consolidated at dumping ground and then transferred to disposal sites. Dumping areas are essential to store the excavated earth temporarily for back filling at later date and final disposal.

Disposal of excess soil will be permitted in low lying areas owned by land owning agencies. The excess excavated soil will be reused at another site in consultation with DDA/other authority/agency. The excess soil disposal site will be those identified by land owning agency and communicated to DMRC. The transfer and disposal of surplus soil may create air pollution and leached water problem. To mitigate these problems following mitigation measure are proposed to be adopted:

- ❖ The disposal sites will be cleaned and then treated so that leached water does not contaminate the ground water.

- ❖ Material will be stabilized each day by watering or other accepted dust suppression techniques.
- ❖ The height from which soil will be dropped shall be minimum practical height to limit the dust generation.
- ❖ The stockpiling of earth in the designated locations with suitable slopes.
- ❖ During dry weather, dust control methods such as water sprinkling will be used daily especially on windy, dry day to prevent any dust from blowing.
- ❖ Sufficient equipment, water and personnel shall be available on dumping sites at all times to minimise dust suppression.
- ❖ Dust control activities shall continue even during work stoppages.
- ❖ The muck shall be filled in the dumping site in layers and compacted mechanically. Dumping sites on sloping ground shall be protected adequately against any possible slide/slope failure through engineering measures.
- ❖ It is desirable to first clean the disposal area site for vegetation biomass exists over it. The faces and top should be treated/vegetated to avoid erosion. Once the filling is complete, the entire muck disposal area shall be provided with a layer of good earth on the top, dressed neatly, and covered with vegetation.
- ❖ Before excavation, the Contractor will be required to test the soil quality including heavy metals and the results will be compared with US EPA standards. If the soil is contaminated, the polluter will be responsible for treatment and disposal.

7.1.16 Construction and Demolition Waste

The construction and demolition waste can be managed by the following ways;

- ❖ Construction & Demolition (C&D) waste shall be stored at a designated area.
- ❖ The contractor shall be responsible for collection, segregation and storage of construction and demolition waste, as directed or notified by the concerned local authority in consonance with the Construction & Demolition Waste Management Rules, 2016.
- ❖ The contractor shall ensure that other waste does not get mixed with this waste and is stored and disposed separately.
- ❖ The contractor shall dispose C&D waste only at authorized processing facilities and ensure that there is no littering or deposition of construction and demolition waste so as to prevent obstruction to the traffic or the public or drains.
- ❖ The requirement of concrete/RCC/PCC waste disposal, generated from the entire contract shall be either when 15 Tonnes of C&D waste has been generated or such C&D waste has been stored for 15 days (irrespective of quantity), of the two whichever is earlier.
- ❖ A minimum of 10% of C&D recycled products shall be used for external development and road works for finishing contracts. Before accepting recycled products, the same shall be tested as per required specifications. The recycled materials products shall be used in non structural members like kerb stone, paver tiles in foot path, earth filling, use of bricks in non-load bearing partition walls, boundary walls, toe walls, recycled aggregates in lean concrete/PCC etc.

7.1.17 Draining of Water from Tunnel

Problems of water flow associated with tunneling are bound to take place where water table is low. In cut and cover type construction continuous pumping is an economical alternative.

The well point system is recommended for dewatering as the volume of water to be pumped out is not large. The deep well system is adopted where the water table has to be lowered over a large depth in a small area. The deep wells can be installed either inside or outside the

diaphragm walls or inside the cut.

A suitable piezometer is installed to monitor the water table constantly and to see how much lowering has been effectively done. The dewatering should not be stopped unless it is ensured from design calculations that the load of the constructed box component has reached a stage where it will be able to counter act the hydrostatic pressure from below.

The dewatering can be achieved by:

- ❖ Leading the ground water to a sump by drains and pump out the water from the sump.
- ❖ To prevent loss of fines, inverted filter may have to be used.
- ❖ Dewatering as suggested above may not be effective in preventing sand flows. Lowering of the ground water by properly designed single or double stage well points will be effective in such cases.
- ❖ The construction of diaphragm walls of concrete along the side of channels, before the commencement of excavation will be required. The concrete walls are taken down to rest on bed rock or impervious strata or, in their absence, deep enough below the bottom of excavation, to serve as an effective cut off for the inflow of ground water into the proposed excavation. The trenches are made in lengths of 2.5 to 5m and kept continuously filled with a thiotropic material like Bentonite slurry, which has the effect of stabilising the trench and preventing any subsidence. As the excavation proceeds, concrete wall can be strutted mutually or anchored with surrounding rocks or soil with long tie rods.
- ❖ During operation phase, seepage water have to be drained along the side of walls (retaining). Proper drainage system need to be incorporated in design and implemented during construction phase.
- ❖ The pumped water from sump wells will be put into storm water drain to avoid any load to waste water treatment plants. These storm water drains finally join natural existing streams/nallahs.

7.1.18 Underground Tunneling Work

Excavation tunnel tubes will made be as per the tunneling Method Statements. All working areas in a free air tunnel are provided with ventilation system as approved by the Director General and the fresh air supplied in such tunnel is not less than 6 m³/min for each worker employed in tunnel as per Rule 153 of BOCWR. Any flammable or explosive substance, including dusts, vapours or gases, shall be protected as to prevent, so far as is reasonably practicable, danger arising from such exposure.

7.1.19 Water Supply, Sanitation, and Solid Waste Management

The public health facilities, such as water supply, sanitation and toilets are much needed at the stations. Water should be treated before use up to WHO drinking water standards. The collection and safe disposal of human wastes are among the most important problems of environmental health. The water carried sewerage solves the excreta disposal problems. The sewerage disposal systems should be adopted for sewage disposal. Drinking water and raw water requirement for underground and elevated stations shall be provided from municipal source. Wastewater from station will either be treated by onsite STP or discharged to the existing

sewage network after taking permission from the municipal corporation. The waste generated from stations is primarily solid waste comprising paper and plastic from eatables consumed by commuters. The waste shall be collected in bins marked for two types- bio-degradable and others. To avoid odour and the accumulation of fly-supporting materials, garbage containers shall be washed at frequent intervals. This shall be collected and transported to local municipal bins for onward disposal to disposal site by municipality.

During construction wastewater (e.g. wash water) from the concrete batching plant and Casting yard will be collected into a sedimentation tank (2 chamber), and the treated water will be reused on site (e.g. water sprinkling), No discharge will be allowed outside of the premises.

During construction there will be excessive usage of ground water. During operation, as mitigation measures rainwater harvesting will be carried out at stations. To avoid excess usage of water during construction following measures will be taken to reduce water consumption.

1. Recycle of water consumed in wheel washing.
2. Recharge of discarded water from RO plant should be explored where ever practically feasible.
3. Water from dewatering will also be used for ground water re-charge.

7.1.20 Construction of Bridge on River Yamuna

Following measures will be taken to avoid impacts on the environment

- ❖ No polluting vehicles, construction machineries and plants allowed
- ❖ Use of ready mix concrete for concreting
- ❖ Disposal of construction and demolition waste at recycling plant at Burari and using recycled material such as paver blocks in the project.
- ❖ Using of non polluting polymer in the pile foundation
- ❖ No use of hazardous materials which can contaminate water/soil
- ❖ No harm to aquatic flora and fauna
- ❖ Vehicles carrying construction materials and debris shall also be covered
- ❖ Construction material stored on the site shall be fully covered to avoid dispersal of dust in the air
- ❖ Environmental quality monitoring at site
- ❖ Prevention of river bed scoring and protection of river bank erosion

7.1.21 Rain water harvesting

Seven out of the nine revenue districts of Delhi are considered critical in regard to ground water resources. Taking into account the depleting ground water resources in Delhi, Central Ground Water Authority had declared whole of South and South West districts of NCT Delhi as “Notified Areas” in August, 2000 and imposed prohibition and restriction in these districts on the construction and installation of any new structure for extraction of ground water resources to avoid further depletion and deterioration in water quality in the said districts. Central Ground Water Authority through its public notices issued between 3/2001 and 8/2004 has directed Group Housing Societies/ Institutions/ Schools/Hotels /industrial establishments/Farm Houses in South and South–West Districts and group housing societies located outside notified areas of NCT Delhi (where ground water levels are more than 8 meters below the ground surface) to adopt Roof top Rain water Harvesting systems in their premises. Ministry of Urban Development & Poverty Alleviation (Delhi Division), Govt. of India by its notification dated 28.7.2001 had made

modification / additions in the building Bye laws 1983 as under:

- i) Water harvesting through storing of water runoff including rain water in all new building on plots of 100 sq. meters and above will be mandatory. The plans submitted to the local bodies shall indicate the system of storm water drainage along with points of collection of the water in surface reservoirs or in recharge wells.
- ii) All buildings having a minimum discharge of 10,000 liters and above per day shall incorporate waste water-re-cycling system. The recycled water should be used for horticultural purposes.

To conserve and augment the storage of groundwater, it has been proposed to construct roof top rainwater harvesting structure of suitable capacity at the elevated stations and in the elevated alignment. Each pillar can have inbuilt downpipes to collect the rainwater from the viaduct and into the underground tanks on the median. A recharge tank shall be constructed at suitable distance. The water collected will percolate down to the subsoil through numerous layers of sand, gravel and boulders. Total elevated length of the corridors is about 31 km. Annual rainfall of Delhi is 611.8mm per year. Considering a runoff coefficient of 0.85 the annual rainwater harvesting potential of elevated stations and elevated section is estimated as 1,65,605 cum.

7.1.22 Management Plan for Depot

The management plan for depot site includes:

- Water Supply,
- Oil Pollution Control,
- Hazardous waste management,
- Effluent Pollution Control,
- Rain water harvesting and
- Solid waste management

Water Demand: Water will be required for operation and functioning of depot which could be collected from existing tube wells. If required more tube wells will be bored after approval from the concerned authority.

Oil Pollution Control: The oil tends to form scum in sedimentation chambers, clog fine screens, interfere with filtration and reduce the efficiency of treatment plants. Hence oil and grease removal tank will be utilized from the existing facility of depot. Such tanks usually employ compressed air to coagulate the oil and grease and cause it to rise promptly to the surface. Compressed air may be applied through porous plates located in bottom of the tank.

Hazardous waste Management: Hazardous wastes that will be generated from Depot and train operation will mainly include sludge from ETP, waste oil from machinery and cotton soaked with grease. All of these wastes will be disposed through authorized recyclers. As per Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016, the occupiers of facilities may store the hazardous and other wastes for a period not exceeding ninety days and shall maintain a record of sale, transfer, storage, recycling, recovery, pre- processing, co-processing and utilisation of such wastes and make these records available for inspection.

Effluent Pollution Control: The effluent that will be generated from depot will be treated in the existing ETP up to the level so that it could be used for horticulture purpose in the campus. The existing ETP will easily cater the increased quantity of the effluent, another ETP may be

constructed in future if needed. The effluent will have oil, grease and, detergent as main pollutants. This has to be treated as per requirement of Delhi Pollution Control Committee. The treated effluents from the maintenance depot will be used for horticulture purposes inside the depot, and no discharge will be allowed outside of the premises.

Rain water harvesting: To conserve and augment the storage of groundwater, it has been proposed to construct roof top rainwater harvesting structure of suitable capacity in the depots. Most of the area in depot will be open to sky and very less area is covered. The cost for the rainwater harvesting is included in the civil cost.

Solid Waste Disposal: The solid waste generated from the Depot will be taken by the cleaning contractor weekly and disposed to the municipal waste disposal sites in accordance with relevant National and State laws and regulations. Cost is not included in EMP.

7.2 TRAINING

The training for engineers and managers will be imparted by DMRC on regular basis to implement the environmental protection clauses of the tender document and to implement the best environmental practices during the construction phase. The course content can be drawn from past experiences of Delhi Metro. These training programs will be imparted through regular training workshops in which presentations will be made on a variety of issues pertaining to environmental management so as to sensitise the participants and raise their awareness on environmental issues in general and conditions of contract on environment, in particular. These programmes could be extended for the local population for their active participation in the project implementation. Apart from training, such programme should include guidelines for safety, methods of disaster prevention, action required in case of emergency, fire protection, environmental risk analysis etc. The cost involved for such programme is presented in **Table 7.2**.

Table 7.2: Cost for Training Programme

| S. No | Item | Cost (Rs) |
|--------------|--|------------------|
| 1 | Curriculum Development and course preparation 1 months Rs.50000/month | 50,000 |
| 2 | 5 Extension Officer (1 year) Rs.35,000/ month | 21,00,000 |
| 3 | Instructor 10 sessions of 10 days each | 3,00,000 |
| 4 | Demonstration/Presentation Aids | 50,000 |
| 5 | Material etc | 50,000 |
| Total | | 25,50,000 |

7.3 DISASTER MANAGEMENT

Disaster is an unexpected event due to sudden failure of the system, external threats, internal disturbances, earthquakes, fire and accidents. The first step is to identify the causes which develop/ pose unexpected danger to the structural integrity of Metro tunnel or overhead rail. The potential causes are excessive load, cracks, failure and malfunctioning of sensing instruments, accident, etc. These need to be looked into with care.

Preventive Action

Once the likelihood of a disaster is suspected, action has to be initiated to prevent a failure. Engineers responsible for preventive action should identify sources of repair equipments, materials, labour and expertise for use during emergency.

Reporting Procedures

The level at which a situation will be termed a disaster shall be specified. This shall include the stage at which the surveillance requirements should be increased both in frequency and details. The Engineer-in-Chief should notify the officer for the following information:

- Exit points for the public,
- Safety areas in the tunnel/overhead rail, and
- Nearest medical facilities.

Communication System

An efficient communication system is absolutely essential for the success of any disaster management plan. This has to be worked out in consultation with local authorities. More often, the entire communication system gets disrupted when a disaster occurs. The damage areas need to be clearly identified and provided with temporary and full proof communication system.

Emergency Action Committee

To ensure coordinates action, an Emergency Action Committee should be constituted. The civic administrator may be the Chairman of this Committee. The committee may comprise of:

- Station Master concerned,
- Police Officer of the area,
- Delhi Transport Corporation Representative,
- Home Guard representative,
- Fire Brigade representative,
- Health Department representative,
- Department of Information and Publicity, and
- Non-Governmental Organization of the area.

Emergency Action Committee will prepare the evacuation plan and procedures for implementation based on local needs and facilities available. The plan should include:

- Demarcation of the areas to be evacuated with priorities,
- Safe route to be used, adequacy of transport for evacuation, and traffic control,
- Safe area and shelters,
- Security of property left behind in the evacuated areas,
- Functions and responsibilities of various members of evacuation teams, and
- Setting up of joint control room.

All personnel involved in the Emergency Action Plan should be thoroughly familiar with all the

elements of the plan and their responsibilities. They should be trained through drills for the Emergency Action Plan. The staff at the site should be trained for problem detection, evaluation and emergency remedial measures. Individual responsibility to handle the segments in emergency plan must be allotted.

Success of an emergency plan depends on public participation, their response to warning notifications and timely action. Public has to be educated on the hazards and key role in disaster mitigation by helping in the planned evacuation and rescue operations.

It is essential to communicate by whom and how a declared emergency will be terminated. There should be proper notification to the public on de-alert signals regarding termination of the emergency. The notification should be clear so that the evacuees know precisely what to do when re-entering or approaching the affected areas.

7.4 EMERGENCY MEASURES

The emergency measures are adopted to avoid any failure in the system such as lights, fire, means of escape, ventilation shafts etc. The aim of Emergency Action Plan is to identify areas, population and structures likely to be affected due to a catastrophic event or accident. The action plan should also include preventive action, notification, warning procedures and co-ordination among various relief authorities. These are discussed in following sections.

Emergency Lighting

The emergency lights operated on battery power should be provided at each station. The battery system should supply power to at least 25% of the lights at the station, platforms, tunnels/viaducts for a period of 2 hours. The underground station should have transformer at each end of the platform. Both the transformers need to be kept energized and should feed independently alternate rows of lights so that in case of failure of one transformer, there will not be complete darkness. The tunnels need to be provided with fluorescent incandescent lamps at a spacing of 20 m.

Fire Protection

The building materials should be of appropriate fire resistance standard. For underground structures the fire resistance period should be at least 4 hours, and 2 hours for surface or over head structures. Wood shall not be used for any purpose, excluding artificial wood products, which are flame resistant. The materials which have zero surface burning characteristics need to be used. The electrical systems shall be provided with automatic circuit breakers activated by the rise of current as well as activated by over current. The design of a station will include provision for the following:

- Fire prevention measures,
- Fire control measures,
- Fire detection systems,
- Means of escape,
- Access for fireman, and
- Means of fire fighting.

Accumulations of refuse of any inflammable material like paper, plastic cartons constitute a major fire hazards and should not be permitted. Smoking should be strictly prohibited at all locations of MRTS.

All aspects of fire prevention and control will be dealt in close collaboration with the city fire fighting authority. Smoke control will be achieved by the following means:

- Downstand bulkheads of a minimum depth of 600 mm to provide smoke containment. These will be provided around openings for escalators, lifts and stairs in underground stations,
- In underground stations the ventilation system will be designed to extract smoke in the event of fire, and
- In enclosed public areas of above ground stations (e.g. a concourse located below a platform) arrangement for smoke extraction will be provided.

A minimum of 30 minutes supply of water is to be assured in the case of fire. The pumps/overhead tanks shall have the capacity to discharge the water at the rate of 1100 litres per minute at a head of 21 m at nozzle mouth.

The storage capacity in an underground or overhead tank may be divided into two parts i.e. dead storage and running storage. Fire fighting pumps shall be provided with a diesel pump as a standby arrangement, in case of power failure.

Fire of electrical origin, water cannot be used until the electric system has been made dead and earthed. For electrical fires, non-aqueous agents like ABC Power Chloro Bromo Methane or CO₂ gas are utilized for fire fighting. Fire extinguishers with these agents shall be liberally provided at static installations and on the rolling stock.

Generally there are often more casualties from smoke inhalation than from burning. Smoke need to be transported away from the site of the fire. In order to achieve this, both fresh air has to be introduced into the underground section and exhaust gases should be sucked out from other section.

Openings, including ducts and passages, between MRTS property and any adjoining structures which allow free access into the MRTS property will be protected by fire doors, fire shutters, fire dampers etc. as appropriate. Fire detection and alarm systems will be provided as per the prevailing state of are technology.

A. Fire Prevention and Safety Measures

Fire prevention measures will be designed and implemented to minimize the risk of outbreak of fire by appropriate choice, location and installation of various materials and equipment. In stations planning, potential sources of fire can be reduced by:

i. Fire Prevention

- Use of non-combustible or smoke retardant materials where possible,
- Rolling stock is provided with fire retarding materials, low smoke zero halogen type electric

cable is also provide,

- Provision of layout which permits ease of maintenance for equipment and cleaning of the station premises,
- Provision of special storage spaces for combustible materials such as paint and oil,
- Prohibition of smoking in fire prone areas,
- Provision of cigarette and litter bins, and
- Good housekeeping.

ii. Safety

Following provisions will be required from fire safety point of view:

- Automatic sprinkler/detection system to be provided if floor area exceeds 750 sq.m
- One wet riser-cum-down comer per 1000 sqm floor area with static underground storage tank, overhead tanks and pumps of suitable capacity with hydrants, first-aid reel, etc.
- Portable fire non-aqueous extinguishers of Carbon di Oxide, chemical dry powder etc. at suitable places.
- Automatic smokes venting facilities.
- Two separate means of exit shall be provided, if more than 10 persons are working and the area exceeds 1400 sq.m
- Fire resisting doors shall be provided at appropriate places along the escape routes to prevent spread of fire and smoke.
- The travel distance for fire escape shall not exceed 20 m where escape is available in more than one direction; the distance could be upto 40 m.

B. Fire Alarm and Detection System

A complete fire detection system with equipment complying with the requirements of Delhi Fire Services shall be provided through out each station and ancillary buildings including entrance passageways, subways and adits etc. to give visual and audible indication of alarm conditions actuated by the operation of break glass contact or fire sensors e.g. detector heads, linear heat detecting cables etc. The system shall be operated from 24 V DC Power sources.

Manually operated call points shall be provided at every hydrant and nose reel points, station head wall, tail wall and other locations. Alarm bells shall be installed in each plant room complex at both platform and concourse level and shall be clearly audible at all points in the room/area.

Beam detector or heat detector shall be installed at roof level, ceiling and floor cavity, whilst linear detecting cables shall be installed in under platform cable ducts and cable shafts.

Smoke probe units shall be installed in rooms/compartments. When an alarm point is operated, the fire pump shall start to operate automatically. A station fire control and indicating panel shall be provided an installed in the station controllers room, for the control, indication and monitoring of the whole detection and fire fighting systems. While designing the fire fighting system, the zone of Delhi Fire Services shall be taken into account for linking with the same.

C. Fire Control Measures

Control of the spread of fire and smoke will be achieved by partition of fire risk areas, planning for

smoke extraction, and arrangement for smoke containment. Partition is aimed at limiting the extent of a fire. The openings must be capable of being sealed in the event of fire. With the exception of station public areas, a fire compartment will not exceed 1500 m². Partition of the public areas in stations is not practicable for operational reasons. The fire resistance period of this separated area should be about 3 hours.

D. Access for Fireman

A secondary access to the station, not used by passengers for evacuation, shall be available to fireman should the need arise. The entry point shall be easily accessible from the road. Access shall be available to all levels of the station. The minimum width of the stairs is 1.0 m and maximum height should not exceed 60 cm.

Ventilation Shafts

The Environmental Control system for underground stations requires ventilation openings between various plants, plant rooms and the atmosphere. The tunnel vent shafts of approximately 20 sq. m. area will be constructed at each end of the stations. There shall be supply shaft and exhaust shafts of similar dimensions at the stations. Three mid shaft in Aerocity to Tughlakabad corridor may be required at three locations in between Mashoodpur to Kishangarh , Kishangarh to Mehrauli and Tigri to Anandmayee Marg and three mid shaft in Inderlok to Indraprastha corridor may be required at three locations in between Ajmal Khan park to Nabi Karam , Nabi Karam to New Delhi and Delhi Gate to Delhi Sachivalaya.

Emergency Door

The rolling stock is provided with emergency doors at both ends of the cab to ensure directed evacuation of passengers in case of any emergency including fire in the train.

7.5 SUMMARY OF ENVIRONMENTAL MANAGEMENT PLAN (EMP)

The environmental impacts stemming out of the proposed project can be mitigated with simple set of measures, dealing with careful planning and designing of the metro alignment and structures. Adequate provision of environmental clauses in work contracts and efficient contract management will eliminate or reduce significantly all possible problems. A common problem encountered during implementation of environmental management plans of such projects is lack of environmental awareness among engineers and managers concerned with day to day construction activities, which can be solved through regular environmental training programs. A set of preliminary EMP is presented in **Table 7.3**, which defines actions to be undertaken during the design stage, pre-construction, construction and operation stage of the project. The effectiveness of environmental considerations will, however, depend on appropriate inclusion of these in the work contracts.

The major concern during the construction stage is that the contractors, due to lack of enforcement, would not practice good environmental sanitation (housekeeping), may intend to get unauthorized use of the easily available natural resources and other available infrastructure like roads and water resources. This would result in degradation of ambient air quality, water resources and land environment around the construction sites and workers camp. Improper management of earthwork and bridge construction activities would disrupt the natural drainage and increase soil erosion. Improper management may result in spillage of explosives into the hands of unsocial elements. Finally the implementation of the mitigation actions requires that the project implementation unit would record an end-of-construction mitigation checklist, before

releasing the final payment of any work contract.

In addition to that DMRC, should prepare and established Environmental and Health Policy and Procedures as per Phase III and that should become an integral part of contract document.

Operational phase mitigation would involve good environmental sanitation (housekeeping) practice at metro establishments including effective solid waste collection and disposal, wastewater disposal, upbringing of plantations and green area. Protection of earth slopes in landslide prone area would be a very important task. During the operation period, the metro operating unit will be required to confirm receipt of the construction period mitigation report through the PIU and prepare a follow on timetable of actions.

Table 7.3: Environmental Management Action Plan (EMAP)

| Environmental Impact | Mitigation Measures Taken or To Be Taken | Time Frame | Implementing Organization | Responsible Organization |
|--|--|---|---------------------------|-----------------------------|
| DESIGN PHASE | | | | |
| Metro Alignment | The proposed corridor alignment was selected to minimize the land disturbance to avoid archaeological sites, temples and other environmentally sensitive areas in least. | During Design | DPR and design consultant | PIU |
| Cultural Heritage | Avoided by adjustment of alignment. | During Design | DPR and design consultant | PIU |
| Flood | Bridges shall be well designed | During Design | DPR and design consultant | PIU |
| Loss of Water Bodies | Utmost care taken to avoid alignment crossing water bodies | During Design | DPR and design consultant | PIU |
| Inadequate design provision for safety against seismologic al hazard | Make sure that design provides for safety of structures against worst combination of forces in the probability of an earthquake likely to occur in seismic zone-III. | DPR and detailed design stage | DPR and design consultant | PIU |
| PRE –CONSTRUCTION STAGE | | | | |
| Water requirement | The requirement of water shall be for construction purpose etc., shall be planned and shall be arranged in order to avoid digging of Tube wells. | Pre construction stage | Contractor | PIU/EMP implementing agency |
| Disposal of final treated effluent from treatment plat | Options for final disposal shall be studied and the suitable disposal route shall be decided carefully to minimize the impact of receiving bodies. As far as possible zero discharge rules may be adopted. | During design stage / and pre construction of treatment plant | Contractor | PIU/EMP implementing agency |
| CONSTRUCTION PHASE | | | | |
| Environmental Management and Monitoring | This will include institutional requirements, training, environmental management and monitoring | During and after construction | Contractor | PIU/EMP implementing agency |
| Dust | Water should be sprayed during construction phase and site clearing, wherever it is required to avoid dust. Vehicles delivering materials should be covered to reduce spills and dust blowing | During construction | Contractor | PIU/EMP implementing agency |

| | | | | |
|--|--|---|------------|-----------------------------|
| | off the load. | | | |
| Air Pollution | Vehicles and machinery are to be regularly maintained so that emissions conform to National and State AAQ Standards. Regulations covering emissions standards for ambient air quality are at Annexure 1.4 . Construction equipment vehicle emission norms are given in Annexure 7.1 . | Beginning with and continuing throughout construction | Contractor | PIU/EMP implementing agency |
| Equipment Selection maintenance and operation | Construction plants and equipment will meet recognized international standards for emissions and will be maintained and operated in a manner that ensures relevant air, noise, and discharge regulations are met. | During construction | Contractor | PIU/EMP implementing agency |
| Noise | Noise standard will be strictly enforced at construction sites and during site clearing. Workers in vicinity of strong noise will wear earplugs and their working time should be limited as a safety measure. At construction sites within 150m of sensitive receptors construction will be stopped from 22:00 to 06:00. Temporary noise barriers shall be installed for silence zones including schools and hospitals. | Beginning and through construction | Contractor | PIU/EMP implementing agency |
| Vibration | The vibration level limits at worksites adjacent to the alignment shall conform to the permitted values of peak velocity as given in the relevant tender document. As regards to the heritage structures, it is submitted that the spread of settlement due to vibration is modelled to be not more than 40 m on either side of the alignment, with a moderate TBM face pressure of 1.2 bar. Since the distance of all the monuments from the proposed alignment is more than 40m, therefore there will be no impact on such monuments. | Beginning and through construction | Contractor | PIU/EMP implementing agency |
| Disposal of debris from dismantling structures | The contractor shall be responsible for collection, segregation and storage of construction and demolition waste, as directed or notified by the concerned local authority in consonance with the Construction & Demolition Waste Management Rules, 2016. | Beginning and through construction | Contractor | PIU/EMP implementing agency |
| Under Ground Tunnelling Work | | | | |
| Excavation of Tunnel Tubes | As per the tunneling Method Statements | Beginning and through construction | Contractor | PIU/EMP implementing agency |

| | | | | |
|--|--|---|------------|-----------------------------|
| Ventilation and Air Cooling Undergroud Work | All working areas in a free air tunnel are provided with ventilation system as approved by the Director General and the fresh air supplied in such tunnel is not less than 6 m ³ /min for each worker employed in tunnel as per Rule 153 of BOCWR. | Beginning and through construction | Contractor | PIU/EMP implementing agency |
| Control of Dust, Noxious Gasses in Undergroud Work | Any flammable or explosive substance, including dusts, vapours or gases, shall be protected as to prevent, so far as is reasonably practicable, danger arising from such exposure. | Beginning and through construction | Contractor | PIU/EMP implementing agency |
| Energy Management | The contractor shall use and maintain equipment so as to conserve energy and shall be able to produce demonstrable evidence of the same upon DMRC request. | Through construction | Contractor | PIU/EMP implementing agency |
| WATER | | | | |
| Contamination from Wastes | All justifiable measures will be taken to prevent the wastewater produced in construction from entering directly into rivers and irrigation system | Throughout construction period | Contractor | PIU/EMP implementing agency |
| Wastage of water | Measures shall be taken to avoid misuse of water. Construction agency shall be instructed accordingly to follow strict procedures while using the water for construction and drinking | Beginning with and continuing throughout construction | Contractor | PIU/EMP implementing agency |
| Construction water use and wastewater generation from construction yard and labour camps | Water for construction will be arranged by contractor. Permission has to be taken from the concerned local govt. in case of ground water extraction. Waste water from site is not discharged into sewer without approval. Provision of Bio-toilet has been made extensively throughout the contract. | Beginning with and continuing throughout construction | Contractor | PIU/EMP implementing agency |
| Ground Water management | The contractor shall obtain necessary permission for extracting ground water from relevant government agency. Rainwater harvesting pit has been developed in casting yard and depot to augment groundwater recharge. This will ensure groundwater is not depleted. | Beginning with and continuing throughout construction | Contractor | PIU/EMP implementing agency |
| Sewerage disposal during construction at Service Centres | A minimum distance of any sewage or toilet facility from water sources should be 200 meters | Throughout construction period | Contractor | PIU/EMP implementing agency |

| | | | | |
|---|---|--|-------------------|-----------------------------|
| Sanitation and Waste Disposal in Construction Camps | Sufficient measures will be taken in the construction camps, i.e. provision of garbage tank and sanitation facilities. Waste in septic tanks will be cleared periodically. Drinking water will meet Indian National Standards. Garbage will be collected in a tank and disposed of daily. Special attention shall be paid to the sanitary condition of camps. Camps will be located at a minimum distance of 200 m from water sources. | Before and during building of construction camps | Contractor | PIU/EMP implementing agency |
| SOIL | | | | |
| Quarrying | Quarrying will be carried out at approved and licensed quarries only. | During construction | Contractor | PIU/EMP implementing agency |
| Contamination due to heavy metals | Heavy metal test will be done during the excavation for the underground station. In case of metal contamination it will be handled & disposed off in environmental friendly manner as per Hazardous Waste Management Rule 2016. | During construction | Contractor | PIU/EMP implementing agency |
| River Bed Scoring and River Bank Erosion | The proposed bridge over river Yamuna is only 400 m downstream of existing barrage. This barrage is maintained and monitored by the Irrigation and Flood Control Department of Govt. of Delhi. The piers and spans arrangement of the proposed DMRC bridge is aligned with the piers of the barrage. Therefore, there will be no hindrance to the river flow. Hence, the proposed bridge will not cause any riverbed scouring. The proposed alignment is completely on the viaduct and there will be no abutment of the bridge. Moreover, DMRC will not be constructing any structures at the riverbank. Therefore, there will be no erosion of riverbank due to the proposed bridge. Moreover, the Irrigation and Flood Control Department which maintains the barrage conducts regular monitoring of riverbed scouring and riverbank erosion. | Before and during the construction | Contractor | PIU/EMP implementing agency |
| FLORA AND FAUNA | | | | |
| Loss of trees and Avenue Plantation | Areas of tree plantation cleared will be replaced according to Compensatory afforestation Policy under the Forest Conservation Act. Trees will be planted against every tree cut as per norms. | After completion of construction activities | Forest Department | Forest Department |
| Sensitive Species within the ESZ | The proposed alignment is underground and through habitat area, so no impact is envisaged. - No hunting, poaching, or unnecessary habitat destruction is to be ensured. | Before and during construction | Contractor, PIU | PIU/EMP implementing agency |

| | | | | |
|--|---|---|------------|--------------------------------|
| | - The Forest Department will monitor the Flora and Fauna between the project boundary and the Asola Bhatti Wildlife Sanctuary boundary. In the case of any negative impact on account of the project, DMRC will consider the advice of the Forest Department in drafting a mitigation strategy for implementing measures to negate or minimize the negative impacts. | | | |
| SOCIAL | | | | |
| Loss of Access | Temporary access should be built at the interchange and other roads. | During construction | Contractor | PIU/ Traffic department |
| Traffic jams and congestion | If there are traffic jams during construction, measures should be taken to relieve the congestion with the co-ordination of transportation and traffic police department | During construction | Contractor | PIU/ Traffic department |
| Safety with vehicles, people and livestock and signage | Safety education and fines. Allow for adequate traffic flow around construction areas Provide adequate signage, barriers and flag persons for safety precautions. Communicate to the public through radio, TV & newspaper announcements regarding the scope and timeframe of projects, as well as certain construction activities causing disruptions or access restrictions | During construction | Contractor | PIU/ Traffic department |
| Increase in disease Water-borne Insect-borne Communicable diseases | Make certain that there is good drainage at all construction areas, to avoid creation of stagnant water bodies. Provide adequate sanitation and waste disposal at construction camps. Provide adequate health care for workers and locate camps away from vulnerable groups | During construction At start-up Throughout construction | Contractor | PIU/EMP implementing agency |
| Location of camps depots and storage areas | Location of camps depots and storage areas shall be as per the contract specifications. | Throughout construction | Contractor | PIU/EMP implementing agency |
| Establishment and Operation of the Labour Camps | The Contractor during the progress of work will provide, erect and maintain necessary (temporary) living accommodation and ancillary facilities for labour to standards and scales approved by the DMRC. | Throughout construction | Contractor | PIU/EMP implementing agency |
| Labour Health and Welfare- HIV/AIDS | Provide adequate health care for workers and locate camps away from vulnerable groups | Throughout construction | Contractor | PIU/EMP implementing agency |
| Emergency Preparedness and Response Management | The emergency measures are adopted to avoid any failure in the system such as lights, fire, means of escape, ventilation shafts etc. | Throughout construction | Contractor | PIU/EMP implementing agency |
| OPERATION PHASE | | | | |
| Noise and Vibration | Noise barriers shall be installed on viaduct at sensitive locations. The public shall be | After completion of construction | PIU/EMP | PIU/EMP |

| | | | | |
|---|--|--|-----------------------------|-----------------------------|
| | educated about the regulations of noise and vibration pollution and its implications. | | implementing agency | implementing agency |
| WATER | | | | |
| Oil pollution | Suitable treatment shall be taken for treatment oil before discharging the wastewater specially in depot areas. | During operation of the treatment plant | PIU/EMP implementing agency | PIU/EMP implementing agency |
| Maintenance of Storm Water Drainage System | The urban drainage systems will be periodically checked and cleared so as to ensure adequate storm water flow. | Beginning and end of monsoon | PIU/EMP implementing agency | PIU/EMP implementing agency |
| Disposal of final treated effluent from treatment plant | Options for final disposal shall be studied and the suitable disposal route shall be decided carefully to minimize the impact of receiving bodies. As far as possible zero discharge rules may be adopted. | During operation of the treatment plant | PIU/EMP implementing agency | PIU/EMP implementing agency |
| Sensitive Species within the ESZ | The Forest Department will monitor the Flora and Fauna between the project boundary and the Asola Bhatti Wildlife Sanctuary boundary. In the case of any negative impact on account of the project, DMRC will consider the advice of the Forest Department in drafting a mitigation strategy for implementing measures to negate or minimize the negative impacts. | During operation | Forest Department | Forest Department/PIU |
| SOCIAL | | | | |
| Safety and noise disturbance s | New buildings should be prohibited within 50 m of the edge of carriageway. No new schools and hospitals should be allowed within 200 m of carriageway. | Throughout and after project development period. | Planning Department /PIU | PIU/EMP implementing agency |

8. ENVIRONMENTAL MONITORING PLAN

8.1 PRE-CONSTRUCTION PHASE

The environmental monitoring programme is a vital process of any Environmental Management Plan (EMP) of development project for review of indicators and for taking immediate preventive action. This helps in signalling the potential problems resulting from the proposed project activities and will allow for prompt implementation of corrective measures. Environmental monitoring should be an integral part of works towards better environmental management of air, noise, vibration, water quality etc both during construction and in operation phases of the project. Generation of dust and noise are two main issues during any large construction activity. Degradation of water quality is another. The parameters monitored in pre- construction, construction and operation phase are based on the need to evaluate the deviation of environmental conditions from baseline environmental conditions due to construction and operation of the Metro. The environmental monitoring will be required during both construction and operational phases. The following parameters are proposed to be monitored:

- ❖ Water Quality, Air Quality,
- ❖ Noise and Vibration,
- ❖ Environmental Sanitation and Waste Disposal,
- ❖ Ecological Monitoring and Afforestation,
- ❖ Workers Health and Safety, and
- ❖ River bed scoring and River bank erosion.

Environmental monitoring during pre-construction phase is important to know the baseline data and to predict the adverse impacts during construction and operations phases. Pre- construction phase monitoring has been done for the proposed project for air, noise, water, soil quality and ecology. The results so obtained are documented in **Chapter 4**.

8.2 CONSTRUCTION PHASE

During construction stage environmental monitoring will be carried out for air quality, noise levels, vibrations, water quality and ecology. At this stage it is not possible to visualize the exact number of locations where environmental monitoring must be carried out. However keeping a broad view of the sensitive receptors and also the past experience an estimate of locations has been made and are summarized in **Table 8.1**. These numbers could be modified based on need when the construction actually commences.

8.2.1 Water Quality

Since water contamination leads to various water related diseases, the project authorities shall establish a procedure for water quality surveillance and ensure safe water for the consumers. The water quality parameters are to be monitored during the entire period of project construction to ensure that water is safe for drinking purpose. Monitoring should be carried out by NABL certified private or Government agency. Water quality should be analyzed following the procedures given in the standard methods. Parameters for monitoring will be as per BIS: 10500. The monitoring points could be ground and surface water. The purpose of monitoring quality of water is to ensure that output water meets standards for drinking and construction during

construction phase.

8.2.2 Air Quality

Air quality is regularly monitored by Delhi Pollution Control committee at number of places in Delhi. In addition to these, air quality should be monitored at the locations of baseline monitoring. The parameter recommended is Particulate Matter (PM_{2.5} and PM₁₀), SO₂, NO_x. The contractor will be responsible for carrying out air monitoring during the entire construction phase under the supervision of DMRC.

8.2.3 Noise and Vibration

The noise and vibration will be monitored at construction sites for entire phase of construction by the site contractor and under the supervision of DMRC.

8.2.4 Ecological Monitoring

Compensatory Plantation & Compensatory Afforestation: For 60Ha compensatory plantation adjacent to the CWG Village, the Department of Forest, Govt. of Delhi will monitor the status of the ecology of the saplings planted in lieu of the trees felled so as to ensure and maintain the ecological environment and to monitor the survival rate of saplings planted. For 10.27Ha compensatory afforestation designated as per the FCA1980, also the Department of Forest, Govt. of Delhi will monitor the status of the saplings or rehabilitation activities as per the FCA1980. Hence, the cost of ecological monitoring have not been considered.

Sensitive Species within the ESZ: The Department of Forest, Govt. of Delhi, as the competent authority of the Asola Bhatti WLS as well as its ESZ, will monitor the status of the sensitive species between the Asola Bhatti WLS and its ESZ close to project alignments.

8.2.5 Soil Quality

Soils quality monitoring is to be carried out at underground stations to ascertain the presence of soil polluting chemicals due to construction activities. The parameters required to be monitored are: pH, Sodium, Potassium, Chloride, Nitrogen, Phosphorous, Organic Matter, Heavy Metals (Mercury, Cadmium, Arsenic, Cyanide, lead, chromium), Oil and Grease. The monitoring is to be carried out by contractor through NABL accredited private or government agency.

8.2.6 Workers health and safety

Monitoring of health risk issues that might arise throughout the project life time will be done. Epidemiological studies at construction sites will be performed to monitor the potential spread of diseases. Regular inspection and medical checkups shall be carried out to workers health and safety monitoring. Any reoccurring incidents such as irritations, rashes, respiratory problems etc shall be recorded and appropriate mitigation measures shall be taken. Contractor will be the responsible person to take care health and safety of workers during the entire period of the construction and project proponent is responsible to review/audit the health and safety measures/plans. The monitoring Schedule for Water Air, noise, vibration, and water are presented in **Table 8.1**. The estimated cost for monitoring during construction is 117 Lakh.

8.2.7 River Bed Scoring and River Bank Erosion

Riverbed scouring and riverbank erosion will be monitored by the Irrigation and Flood Control Department, Govt. of Delhi, which is the nodal agency also maintaining the Wazirabad Barrage. This barrage is 400m upstream of the proposed bridge.

Table 8.1: Construction Stage Monitoring Schedule

| ITEMS | DESCRIPTION |
|---|--|
| Air | |
| Parameters to be monitored | PM _{2.5} , PM ₁₀ , SO ₂ , NO _x |
| Locations and frequency | 2x24 Hour, twice in a month at 15 locations for 5 years. |
| Standard | National Ambient air quality standards, 18 th November 2009 |
| Responsible organisation | Contractor through NABL accredited lab |
| Noise | |
| Parameters to be monitored | Leq, L ₉₀ , L ₅₀ , L ₁₀ , L _{max} , L _{min} (for both day and night). |
| Locations and frequency | 24 hours once a week at 15 locations for 5 years. |
| Standard | The Noise Pollution (Regulation and Control) Rules, 2000 |
| Responsible organisation | Contractor through NABL accredited lab |
| Vibration | |
| Parameters to be monitored | ppV |
| Locations and frequency | 24 hours once a week at 8 locations for 5 years. |
| Standard | ISO 8041:1990 (Day time and night time) |
| Responsible organisation | Contractor |
| Water | |
| Parameters to be monitored | pH, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Dissolved Solids, Chlorides, Nitrates, Sulphates, Iron, Calcium, Total Nitrogen, Lead, Total Phosphates, oils and grease. |
| Locations and frequency | Once in a six months at 10 locations for 5 years. |
| Standard | CPCB (BIS 10500:2012) |
| Responsible organisation | Contractor through NABL accredited lab |
| Soil Quality | |
| Parameters to be monitored | pH, Sodium, Potassium, Chloride, Nitrogen, Phosphorous, Organic Matter, Heavy Metals (Mercury, Cadmium, Arsenic, Cyanide, lead, chromium), Oil and Grease |
| Locations and frequency | Once in a six months at 10 locations (bridge and viaduct pier locations-100m and 200m downstream of the active bridge pier construction) for 5 years. |
| Responsible organization | Contractor through NABL accredited lab |
| Ecology (Compensatory Plantation & Afforestation) | |
| Parameters to be monitored | Number of saplings, number of survival trees |
| Locations and frequency | Plantation site adjacent to CWG Village (60Ha) and Designated afforestation site by Gov. of NCT (10.27Ha) |
| Responsible organization | Forest Department, Delhi |
| Ecology (Endangered Species in ESZ of Asola Bhatti Wildlife Sanctuary) | |
| Parameters to be monitored | Monitoring for poaching, hunting and unnecessary habit destruction of forest products, flora and fauna |
| Locations and frequency | Once in six months between the project boundary and Asola Bhatti Wildlife Sanctuary boundary by the Forest Department |
| Responsible organization | Forest Department, Delhi |
| River bed scoring and river bank erosion | |
| Locations and frequency | By Irrigation and Flood Control Department, Govt. of Delhi. |
| Waste | |
| Waste stream to be monitored | Excavated Muck/Soil, C&D waste, Hazardous waste, Bio-medical waste |
| Location and frequency | From all construction sites once in a month |

| | |
|----------------------------|--|
| Responsible organization | Contractor |
| Groundwater Use | |
| Parameter | Water extraction and consumption in kilo litres |
| Location and frequency | Daily from all water extraction and consumption points |
| Responsible organization | Contractor |
| Traffic Jam | |
| Location and frequency | At major traffic points on daily basis |
| Responsible organization | Contractor |
| Transmitted Disease | |
| Location and frequency | Once in six months at construction camps |
| Responsible organization | Contractor |
| Accident | |
| Parameter | All accident and incident |
| Location and frequency | Daily at all construction sites |
| Responsible organization | Contractor |

8.2 OPERATION PHASE

Even though the environmental hazards during the operation phase of the project are minimal, the environmental monitoring will be carried out for air, noise, vibration, water and ecology during operation phase of the project. The parameters monitored during operation will be Particulate Matter (PM_{2.5} and PM₁₀), SO₂, NO_x for air. Drinking water quality parameters will be monitored as per BIS 10500 to ensure that output water meets standards for drinking. Input and output water of treatment plants will be monitored to check the performance of the treatment plants so that water can be used for horticulture. The monitoring schedule is presented in **Table 8.2**. The estimated cost for monitoring during operation is 40.59 Lakh. The monitoring program shall be conducted by an external agency certified by NABL under the supervision of Delhi Metro. Project Operator i.e. DMRC will be responsible for successful environmental monitoring of the proposed project during operation phase.

Table 8.2: Operation Stage Monitoring Schedule

| ITEMS | DESCRIPTION |
|----------------------------|--|
| Air | |
| Parameters to be monitored | PM _{2.5} , PM ₁₀ , SO ₂ , NO _x |
| Locations and frequency | 2x24 Hour, once in a month at 8 locations for 3 years. |
| Standard | National Ambient air quality standards, 18 th November 2009 |
| Responsible organisation | DMRC |
| Noise | |
| Parameters to be monitored | Leq, L90, L50, L10, Lmax, Lmin (for both day and night). |
| Locations and frequency | 24 hours four time a year for 1 st year and that than once a year at 8 locations for 3 years. |
| Standard | The Noise Pollution (Regulation and Control) Rules, 2000 |
| Responsible organisation | DMRC |
| Vibration | |
| Parameters to be monitored | ppV |
| Locations and frequency | At the boundary of ASI Monuments, 24 hours four time a year for 1 st year and that than once a year at 8 locations for 3 years. |
| Standard | ISO 8041:1990 (Day time and night time) |
| Responsible organisation | DMRC |
| Water | |

| | |
|---|--|
| Parameters to be monitored | pH, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Dissolved Solids, Chlorides, Nitrates, Sulphates, Iron, Calcium, Total Nitrogen, Lead, Total Phosphates, oils and grease. |
| Locations and frequency | Once a year at 5 for 3 years. |
| Standard | CPCB (BIS 10500:2012) |
| Responsible organisation | DMRC |
| Ecology | |
| Parameters to be monitored | Flora and Fauna |
| Locations and frequency | Once in six months for 3 years between the project boundary and Asola Bhatti Wildlife Sanctuary boundary by the Forest Department. |
| Responsible organization | Forest Department, Delhi |
| River bed scoring and river bank erosion | |
| Locations and frequency | By Irrigation and Flood Control Department, Govt. of Delhi. |

The results of Air quality, water quality, wastewater, vibration will be submitted to management quarterly during construction phase and semi annually during operation phase. Frequency and number of locations of monitoring shall be reviewed upon feedback during operation. The reporting formats of these results are presented at **Annexure 8.1**.

8.3 STRENGTHING OF ENVIRONMENTAL DIVISION

Delhi Metro has an Environment Division. This division needs to be strengthening at the initial stage of the Phase IV project itself due to increase in metro network. The division should be strengthening with an Environmental Officer and an Environment Engineer. The task of the division would be to supervise and coordinate studies, environmental monitoring and implementation of environmental mitigation measures, and it should report directly to Chief Engineer of the project authority. Organizational setups for Environmental Monitoring during construction and operation phase are shown in **Figure 8.1** and **Figure 8.2**. Progress of the division should be reviewed by an Environmental Advisor once in a year. The environmental Advisor should be an experienced expert familiar with environmental management in similar projects. Costs for the first 5 years (including 10% annual increase has been) given **Table 8.3**.

Table 8.3: Environmental Division Costs

| S No | ITEM | COST (Rs) |
|------|--|--------------------|
| A | Capital Cost | |
| | Office Furnishings (Computer, furniture etc) Lump Sum | 5,00,000 |
| B | Recurring Cost | |
| | Man Power Cost (For 12 months) | |
| | Environmental Officer @ Rs. 1,25,000/month | 15,00,000 |
| | Environmental Engineer/Assistant @80000/month | 9,60,000 |
| | Environmental Advisor once in a year @ Rs. 3,00,000/year | 3,00,000 |
| | Office Maintenance and consumables @ Rs. 25,000/month | 3,00,000 |
| C | Sub Total (A+B) | 35,60,000 |
| | Miscellaneous and unforeseen expenses, LS (10 % of C) | 3,56,000 |
| | Total cost for establishment of cell for 1 Year | 39,16,000 |
| | Total cost for 5 years with 10% annual increase | 2,39,07,572 |

Figure 8.1: Organizational Setup during Construction Phase

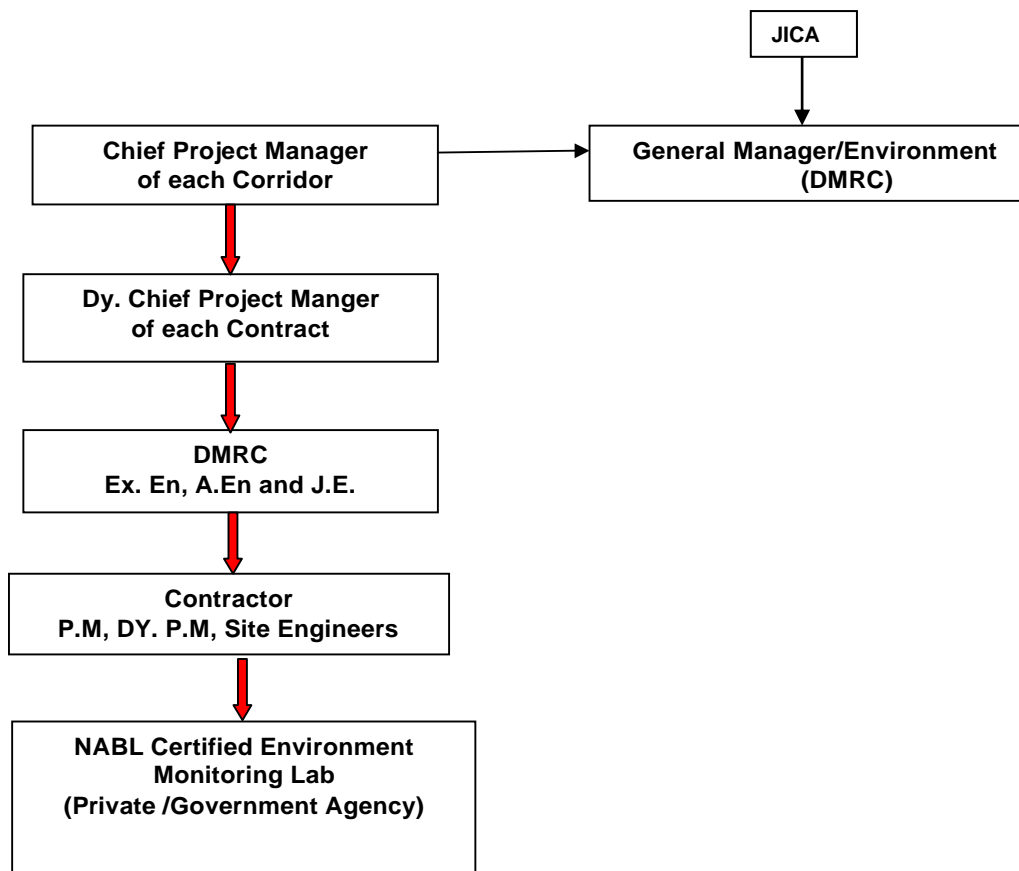
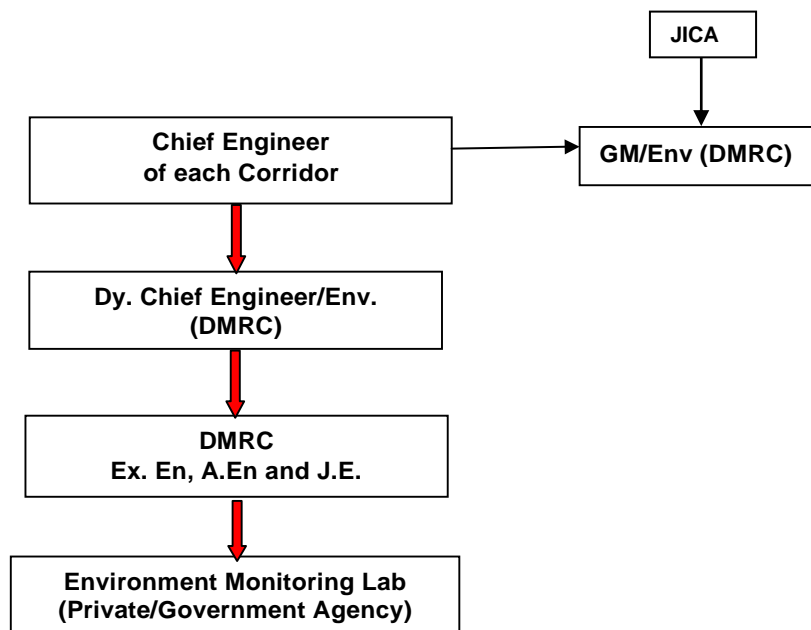


Figure 8.2: Organizational Setup during Operation Phase



9. INFORMATION DISCLOSURE AND PUBLIC CONSULTATIONS

In compliance with JICA's Guidelines on Environmental and Social Considerations, April 2010 (JICA E&S GL), the project proponents are required to publicly disclose information about the environmental and social considerations of the projects and seek the opinion/suggestions of the stakeholders through Public Consultation. The proposed Project is being implemented by the Delhi Metro Rail Corporation Ltd. (DMRC). As a JICA loan proponent, Delhi Metro Rail Corporation Ltd. (DMRC) has been committed to the stakeholder engagement as per the JICA E&S GL.

As per the JICA E&S GL categorization, the proposed project, Phase IV priority corridors, is category "A" due to the projects in sensitive sectors-railway¹¹. Definition of the Category A project is given in the following box.

Category A: Proposed projects are classified as Category A if they are likely to have significant adverse impacts on the environment and society. Projects with complicated or unprecedented impacts that are difficult to assess, or projects with a wide range of impacts or irreversible impacts, are also classified as Category A. These impacts may affect an area broader than the sites or facilities subject to physical construction. Category A, in principle, includes projects in sensitive sectors, projects that have characteristics that are liable to cause adverse environmental impacts, and projects located in or near sensitive areas. An illustrative list of sensitive sectors, characteristics, and areas is provided in Appendix 3 of JICA Guidelines.

Source: JICA Guidelines for Environmental and Social Considerations, April 2010

9.1 ENVIRONMENTAL INFORMATION DISCLOSURE

The information disclosure and public consultation are important tools for disseminating information of the project, its environmental and social impacts and consulting all relevant stakeholders of the host country as per Sections 2.2 and 2.4 of JICA's Guidelines.

DMRC's information disclosure strategy includes wide dissemination of project-related information, in print and electronic media regarding significant project details. Such dissemination is carried out both during construction and operation by DMRC's Public Relations Department and is aided by interviews and public discussions in which very senior DMRC management participate. The public is thus kept well informed and all significant issues concerning the public are incorporated in DMRC's web site for the techno-savvy. Furthermore, the project EIA report is also accessible to the public. Copies of the report are available not only in the DMRC office but in other government offices. The report will also be web hosted by DMRC from where it can be downloaded.

As per information disclosure strategy, the details on the Environmental Impact Assessment Report were presented to the people living near the corridors through Environmental Public Consultation. The stakeholders were communicated about the venue, time and date in advance. These were fixed in consultation with the Resident Welfare Associations (RWA) and Shopkeepers Association (SA) of the area along the corridors.

In the subsequent sections, the outcomes of the public consultations organized have been discussed and presented.

¹¹ Appendix 3. Illustrative List of Sensitive Sectors, Characteristics, and Areas, JICA Guidelines for Environmental and Social Considerations, 2010

9.2 COORDINATION AND HOLDING OF PUBLIC CONSULTATIONS

Detailed and extensive consultations had been carried out during the environmental baseline and socio- economic survey stages as well as the draft report stage from 2013 to 2020 along the communities of Impacts with project affected persons such as traders, women, squatters, kiosks and other inhabitants within the COI (corridor of Impact). The objective of such consultations was to inform affected persons about the project, its features (such as nature of physical constructions, alignment etc.), expected impacts, policies that govern project-related land acquisitions and R&R benefits such as compensation, income restoration, employment generation, information flow, grievance redress etc. This report incorporates all issues raised during public consultations and recommends institutional strengthening measures in response to issues raised. The following methods were adopted for conducting public consultation:

- Informal individual/group consultation by the field surveyors that informed the PAPs about the project, purpose of survey and clarifications on their queries.
- In-depth individual interviews/discussion with key representatives RWAs, Trade Associations etc.;
- Public Consultation with the affected families' representatives RWAs, Trade Associations etc.

9.3 METHODOLOGY ADOPTED FOR PUBLIC CONSULTATIONS

The methodology adopted for conducting public consultations included the following:

- **Information to PAPs:** The PAPs were informed before and about the purpose of the meeting.
- **Identification of Suitable Venue:** These venues were chosen in a way so that they can be easily approached by the PAPs/PAFs.
- **Formal Invitation to participants for the meeting:** A formal invitation was sent to all concerned about the public consultation 15 days in advance (**Annexure 9.1**). Further, follow up was done telephonically.

Conscious efforts were made to ensure higher representation of women, amongst the project affected persons. Between 20-80 persons turned up for each meeting. The procedure followed to ensure that participants represented the socio-economic strata of the project affected population.

During the public consultation, the public was informed about the project description, environmental baseline data, negative and positive environmental impacts, proposed mitigation measures and management plans. The public was also informed about the project benefits. The mode of information disclosure was PowerPoint Presentation in English and the mode of presentation was in Hindi (vernacular language). The environmental public consultations meeting on an average lasted 1 hour. Proceedings of the public consultations were recorded on paper.

9.4 PUBLIC CONSULTATIONS

The Public consultations had been carried out in three stages during the initial planning stage in 2013 and design and final design stages between 2019 and 2020. The details of public consultation in stages are presented below:

Initial Design Stage between August and October 2013:

During the initial planning stages of environmental survey process, multiple Focus Group Discussions (FGDs) were held with project affected people, resident welfare associations, trade associations etc along the potentially impacted area along the Phase IV corridors summarized in the Table 9.1. During focus group discussion, the potential impacts due to the project during the construction and operation phases were explained. Issues related to air pollution, noise pollution, tree cutting, water supply, dust

pollution, waste generations, traffic congestions, employment generation, safety, etc. were discussed. Also, the proposed methodologies for the survey were explained. Participants raised concerns and opinions and DMRC and its technical consultants responded those concerns and opinions. There were approximately 10-12 participants in each FGD. The key participants included both individuals and groups namely (i) head of households; (ii) household members; (iii) small business entrepreneurs (SBEs); (iv) local people. Summary of FGD locations and dates are given in **Table 9.1**.

Table 9.1: Details of Focus Discussion Held

| Sl. No. | Location | Date | No. of Participants |
|---------|-----------------------------|------------|--|
| 1. | Azadpur | 14.08.2013 | Approx. 10 to 12 per FGD (approx. 1 to 2 women) |
| 2. | Peeragarhi | 23.08.2013 | |
| 3. | Khanpur | | |
| 4. | Rangpuri village Mahipalpur | | |
| 5. | Jagatpur Village | 02.09.2013 | |
| 6. | LNJP Hospital | | |
| 7. | Sheikh Sarai | 10.09.2013 | |
| 8. | Andrews Ganj | | |
| 9. | Bawana Industrial Area | 07.10.2013 | |
| 10. | Anajmandi Narela | | |

Final Design Stage in September 2019:

During the final planning stage of the EIA 2020 and SIA 2020, joint Focus Group Discussions (FGDs) for EIA and SIA were held with project affected people, resident welfare associations, trade associations etc. for each location on dates mentioned in the Table 9.2. During FGDs, the potential impacts due to the project during the construction and operation phases explained. Issues related to air pollution, noise pollution, tree cutting, water supply, dust pollution, waste generations, traffic congestions, employment generation, safety, etc. were discussed. The issues raised by participants were addressed. There were approximately 8-10 numbers of participants in each consultation. The key participants included both individuals and groups namely (i) head of households; (ii) household members; (iii) small business entrepreneurs (SBEs); (iv) local people. The details of such meetings are tabulated in Table 9.2.

Table 9.2: Details of Focus Discussion Held

| Sl. No. | Location | Date | No. of Participants |
|---------|----------------------|-------------------------|---|
| 1. | Pul Bangash Area | 04.09.2019 – 05.09.2019 | Approx. 8 to 10 per FGD (approx. 1 to 2 women) |
| 2. | R K Ashram Area | | |
| 3. | Sadar Bazar Area | 06.09.2019 – 07.09.2019 | |
| 4. | Ghanta Ghar Area | | |
| 5. | Khanpur Market Area | 12.09.2019 – 14.09.2019 | |
| 6. | Anandmayee Marg Area | | |

Draft Final EIA & SIA Stage in February 2020:

In addition to above, during the draft final stage of the SIA2020 and EIA2020, six public consultations for EIA and SIA were conducted during February 2020. The outcomes of these public consultations had been recorded and analyzed for incorporation in both EIA and SIA Report in June 2020. Suitable recommendations have been made in project planning, design and operation based on the relevant outcomes of the consultation process. The venue, date and number of participants of such public consultations are presented in **Table 9.3**.

Table 9.3: Details of Public Consultations Held

| Sl. No. | Location | Date | No. of Participants* |
|---------|-----------------|------------|----------------------|
| 1. | Pul Bangash | 01.02.2020 | 20(0) |
| 2. | R K Ashram | 01.02.2020 | 80(5) |
| 3. | Sadar Bazar | 01.02.2020 | 25(0) |
| 4. | Ghanta Ghar | 02.02.2020 | 30(3) |
| 5. | Khanpur Market | 09.02.2020 | 50(10) |
| 6. | Anandmayee Marg | 10.02.2020 | 20(6) |

* No. in parenthesis denote female participants present in the meeting

During the public consultation, the public was informed about the project description, environmental baseline data, negative and positive environmental impacts, proposed mitigation measures and management plans. The public was also informed about the project benefits. The mode of information disclosure was PowerPoint Presentation in English and the mode of presentation was in Hindi (vernacular language).

9.5 KEY FINDINGS OF CONSULTATIONS

The key findings of the public consultations are presented in Table 9.4. Minutes of consultations are placed at **Annexure 9.2**.

Table 9.4: Key Findings of Initial Planning Stage FGDs in 2013

| Place & Date | Issues Discussed | Important views, questions & Suggestions | DMRC reply |
|--------------------------|--|--|---|
| Azadpur 14.08.2013 | <ul style="list-style-type: none"> - Environmental issues - General issues | <ul style="list-style-type: none"> - DMRC should take measures to control traffic during construction period - DMRC should take measures to control air pollution during construction - Extension of corridor till Sindhu Border - Tree cutting to be avoided - | <ul style="list-style-type: none"> - Traffic control measures will be implemented before the start of construction - Measures will be taken to control air pollution during construction. Once metro becomes operational, air pollution will reduce drastically. - Corridor extension is not part of Phase-IV - Tree cutting will be minimized to the extent possible |
| Peeragarhi 23.08.2013 | <ul style="list-style-type: none"> - Environmental issues - General issues | <ul style="list-style-type: none"> - Issue of traffic jam - Need to connect both Punjabi Bagh stations - Improvement in metro route | <ul style="list-style-type: none"> - Traffic control measures will be implemented before the start of construction - Connection of Line-5 and Line-7 Punjabi Bagh stations will be considered - New metro corridors will be considered in the subsequent phases |
| Khanpur 23.08.2013 | <ul style="list-style-type: none"> - Environmental issues - General issues | <ul style="list-style-type: none"> - DMRC should take measures to control air pollution during construction - Metro will result in time saving - Metro will reduce pollution - Journey by bus takes more time and creates | <ul style="list-style-type: none"> - Measures will be taken to control air pollution during construction. - DMRC confirmed that metro will result in pollution reduction, time saving etc. - Once metro becomes operational traffic jams will reduce - Metro will result in |

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|---|--|---|--|
| | | <ul style="list-style-type: none"> traffic jams - Development of local places | <ul style="list-style-type: none"> development of areas around metro stations and will bring in more economic activities. |
| Rangpuri Village Mahipalpur 23.08.2013 | <ul style="list-style-type: none"> - Environmental issues - General issues | <ul style="list-style-type: none"> - Metro will ease current transportation problems - Adequate compensation should be given where land will be taken for metro purpose - Mahipalpur to Chatterpur heavy traffic particularly during peak hours and metro will help to reduce traffic up to a great extent - Due to metro pollution will reduce however, during construction of metro there will be pollution | <ul style="list-style-type: none"> - DMRC confirmed that once metro will reduce traffic, pollution and save time. - Compensation will be provided as per government policies. - Once metro becomes operational it will reduce traffic - Measures will be taken to control air pollution during construction. |
| Jagatpur Village 02.09.2013 | <ul style="list-style-type: none"> - Environmental issues - General issues | <ul style="list-style-type: none"> - If metro comes, other infrastructure will also build up - Metro construction should be environment friendly - Waste from the construction site should not be dumped in the area | <ul style="list-style-type: none"> - Area development is an indirect benefit of metro system - DMRC follows green building norms for metro construction - Waste from construction will be disposed off as per norms |
| LNJP Hospital 02.09.2013 | <ul style="list-style-type: none"> - Environmental issues - General issues | <ul style="list-style-type: none"> - The proposed station should have inter connection with the under construction Delhi Gate station - DMRC should take measures to manage traffic during construction - Metro construction should not cause air and noise pollution - Road crossing facility to be provided during construction | <ul style="list-style-type: none"> - Interconnection will be provided between both stations - Measures will be taken to minimize traffic issues during construction - Measures will be taken to mitigate air and noise pollution during construction - Traffic marshals will be provided at key intersection to streamline traffic and help pedestrians crossroads |
| Sheikh Sarai 10.09.2013 | <ul style="list-style-type: none"> - Environmental issues - General issues | <ul style="list-style-type: none"> - Due to metro pollution will reduce however, during construction of metro there will be pollution - Waste from the construction site should not be dumped in the area - Private land acquisition should be avoided | <ul style="list-style-type: none"> - Measures will be taken to control air pollution during construction. - Waste from construction will be disposed off as per norms - Completely eliminating private land acquisition is practically not feasible. However, all efforts will be taken to minimize private land requirement |
| Andrews Ganj 10.09.2013 | <ul style="list-style-type: none"> - Environmental issues - General issues | <ul style="list-style-type: none"> - Metro will make travelling easier - Due to metro pollution | <ul style="list-style-type: none"> - Measures will be taken to control air pollution during construction. |

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| | | <p>will reduce however, during construction of metro there will be pollution</p> <ul style="list-style-type: none"> - From Noida and Andrewganj metro corridor is required - As compared to other modes of transport metro will save time | <ul style="list-style-type: none"> - New corridors will be considered in the subsequent phases - Metro will make travelling easier |
| Bawana Industrial Area 07.10.2013 | <ul style="list-style-type: none"> - Environmental issues - General issues | <ul style="list-style-type: none"> - Metro will reduce traffic related accidents - Due to improvement in transportation local economy will boost - Due to industrial area many people come here, and it will be helpful for their smooth transportation - Present transportation system is inadequate | <ul style="list-style-type: none"> - DMRC confirmed that these are the indirect benefits of metro system - Metro will improve the transportation system |
| Anajmandi Narela 07.10.2013 | <ul style="list-style-type: none"> - Environmental issues - General issues | <ul style="list-style-type: none"> - Present transportation system is inadequate - Due to metro, the existing market will be developed - Due to Bhawana Railway crossing, traffic jam is frequent. Metro will help to avoid traffic jam. | <ul style="list-style-type: none"> - DMRC confirmed that these are the indirect benefits of metro system |

The key findings of the public consultations during the draft final EIA and SIA stage are presented in Table 9.5. Minutes of consultations are placed at **Annexure 9.3**.

Table 9.5: Key Findings of Consultations

| Place & Date | Issues Discussed | Important views, questions & Suggestions | DMRC reply |
|---------------------------|-------------------------|---|--|
| Pul Bangash 01.02.2020 | On Environmental issues | <ul style="list-style-type: none"> - DMRC should take measures to control air pollution during construction - Noise pollution should be controlled during construction - Felling of trees should be minimized - Safety of structures during tunneling should be ensured - Waste from the construction site should not pollute the area | <ul style="list-style-type: none"> - Measures such as up to 10m high barricading, wheel washing, mist spraying and host of other measures will be taken during construction to minimize dust pollution - Proper care will be taken so that noise pollution does not cross the permissible limits during construction. This includes measures such as provision of noise barriers around construction site - Felling of trees will be minimized to the extent possible. Ten saplings will be planted against every tree cut as per norms. - Proper safety measures will be taken during construction to avoid any mishappening. As a part of this extensive monitoring will be carried out during tunneling - Waste from construction site will be disposed of only at authorized disposal facilities. For recycling C&D |

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| | | | waste, DMRC has setup its own recycling plant |
| | On alignment, station design and R&R | <ul style="list-style-type: none"> - Private land acquisition should be avoided - Entry/Exit structure should be accommodated in the MCD dispensary | <ul style="list-style-type: none"> - Completely eliminating private land acquisition is practically not feasible. However, all efforts will be taken to minimize private land requirement - Due to site constraints /land constraints, accommodating entry/exit structure in MCD dispensary is not feasible |
| | On other issues | <ul style="list-style-type: none"> - Pedestrian problem should be taken care of and construction should not affect day to day operation of their shops nearby. Walkways should be built for pedestrian movement - Traffic congestion around metro station should be controlled. - Underground parking area to be constructed - Construction should be completed fast - Metro should not damage the aesthetic view of the surrounding area | <ul style="list-style-type: none"> - During construction, a route plan will be developed in consultation with a traffic/transportation expert. Proper barricading of works will be carried out for pedestrian safety. Access to the shops will not be obstructed and care will be taken so that construction does not affect day to day working of nearby shops. - Provision of providing parking space depends on land availability. Where there is availability of land parking will be provided - All efforts will be made to minimize the period of construction - Stations will be designed aesthetically keeping in view of the surrounding area. |
| R K Ashram 01.02.2020 | On Environmental issues | <ul style="list-style-type: none"> - Construction should be environment and public friendly - Construction should be fast tracked near market area to minimize air and noise pollution - Malba (C&D Waste) from construction should not be dumped in the nearby locality - Safety of structures during tunneling should be ensured - Compensatory plantation should be carried out - Sanitation facilities should be provided to workers at construction site | <ul style="list-style-type: none"> - Phase-IV of Delhi Metro is planned and designed as per green building norms. Phase-IV construction will be environment and public friendly. - All efforts will be taken to move the project on fast track project near residential and commercial areas. - Waste will be disposed at designated places only - Proper safety measures will be taken during construction to avoid any mishappening. As part of this extensive monitoring will be carried out during tunneling - Ten saplings will be planted against every tree cut as per norms. - Proper sanitation facilities will be provided with the construction site. |
| | On alignment, station design and R&R | <ul style="list-style-type: none"> - Station location should be shifted 300m backwards to avoid any disturbance | <ul style="list-style-type: none"> - Due to site constraint, it is not feasible |
| | On other issues | <ul style="list-style-type: none"> - Distance between the existing station and the new station should be minimized - DMRC should start its own E-Rickshaw service - All necessary precaution may be taken during construction to avoid any mishappening. - Efforts should be made that people should face less difficulties as far as possible - Area around metro station should be kept neat and clean | <ul style="list-style-type: none"> - This will be taken into consideration during station design subject to availability of land - Possibility for providing Metro E-Rickshaw facility will be looked into - Safety is paramount for DMRC and all measures will be taken to avoid any mishap - Efforts will be made that people will face least difficulties during construction - All efforts will be taken to keep area around metro station neat & clean |
| Sadar Bazar 01.02.2020 | On Environmental issues | <ul style="list-style-type: none"> - Safety of structures during tunneling should be ensured - Dust and noise pollution should be mitigated during construction | <ul style="list-style-type: none"> - Proper safety measures will be taken during construction to avoid any mishappening. As part of this extensive monitoring will be carried out during tunneling |

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| | | <ul style="list-style-type: none"> - Construction should not affect sealing of tube-wells - What is the source of water for construction - Tree felling should be minimized, and compensatory plantation should be carried out. - Special precautions must be taken to protect animals during construction - | <ul style="list-style-type: none"> - Measures such as up to 10m high barricading, wheel washing, mist spraying and host of other measures will be taken during construction to minimize dust pollution - Proper care will be taken so that noise pollution does not cross the permissible limits during construction this includes measures such as provision of noise barriers around construction site - If tube-wells are coming on the alignment these tube-wells have to be sealed. However, alternate arrangements will be provided by DMRC - Water requirement for construction will be met either by extracting groundwater or sourcing water from outside. - Only those trees which are falling on the alignment will be cut. Ten saplings will be planted against every tree cut as per norms. - No impact on fauna is anticipated as the project is in urban area where there is no wildlife. Snakes rescued from construction site will be handed over to Wildlife NGOs. |
| | On alignment, station design and R&R | <ul style="list-style-type: none"> - The station should be constructed on the road - Shops for shop – All shop keepers should be rehabilitated by constructing market complex in the nearby area | <ul style="list-style-type: none"> - Due to site constraint, it is not feasible - Compensation/ rehabilitation will be as per Entitlement matrix |
| | On other issues | <ul style="list-style-type: none"> - Construction should not affect day to day working of the market - Pedestrian problem should be taken care of - Road should not be blocked during construction - Construction should be fast tracked - UG parking to be provided | <ul style="list-style-type: none"> - Access to the shops will not be obstructed and care will be taken so that construction does not affect day to day working of nearby shops. Proper barricading of work sites will be carried out for pedestrian safety. - As far as possible, road blockage will be avoided - All efforts will be made to minimize the period of construction - Provision of providing parking space depends on land availability. Where there is availability of land parking will be provided |
| Ghanta Ghar 02.02.2020 | On Environmental issues | <ul style="list-style-type: none"> - Will the construction cause damage to Tripoliagate - Air and Noise pollution should be mitigated during construction - Will DMRC construct rainwater harvesting structures at metro stations - Safety during tunneling to be ensured - The excavation period needs to be fast tracked near residential colonies to minimize air and noise pollution - Construction should be environment and public | <ul style="list-style-type: none"> - Tripolia Gate is approx. 138m from the alignment. There will not be any impact on the structure due to metro construction. Moreover, before any construction work at this area; permission from ASI will be obtained. Moreover, all precautions will be taken to avoid any mishap. - Measures such as up to 10m high barricading, wheel washing, mist spraying and host of other measures will be taken during to minimize dust pollution - Proper care will be taken so that noise pollution does not cross the permissible limits during construction this includes measures such as |

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| | | <p>friendly</p> <ul style="list-style-type: none"> - The project should not cause global warming - Tree felling should be minimized, and compensatory plantation should be carried out. | <p>provision of noise barriers around construction site</p> <ul style="list-style-type: none"> - Excavation near residential and commercial areas will be fast tracked to minimize disturbances - Phase-IV of Delhi Metro is planned and designed as per green building norms. Phase-IV construction will be environment and public friendly. - DMRC will provide Rainwater harvesting system at stations - No activity which will cause the global warming is anticipated. - Only those trees which are falling on the alignment will be cut. Ten saplings will be planted against every tree cut as per norms. - Feeling of trees will be minimized to the extent possible. Ten saplings will be planted against every tree cut as per norms. |
| | <p>On other issues</p> | <ul style="list-style-type: none"> - Metro fares should be reduced - Traffic congestion around station to be managed better - Metro feeder bus facility should be available between residence and the metro stations - More rail cars to be increased during the peak hours - Efforts should be made that people should face less difficulties as far as possible | <ul style="list-style-type: none"> - Metro fares are decided by a committee and DMRC has no role in fare fixation - Multi Model Integration (MMI) will be implemented to avoid congestion around operational metro station - Possibility for providing Metro feeder bus facility will be looked into. - People were informed that at the design stage itself, the basic unit of 6-car train is proposed for all the new upcoming corridors. The number of exclusive bogies for ladies, which is presently one, could be increased depending on the prevailing demand. - All efforts will be made to minimize the period of excavation during construction and all precautions will be taken to avoid air and noise pollution. |
| <p>Khanpur Market 09.02.2020</p> | <p>On Environmental issues</p> | <ul style="list-style-type: none"> - Construction should be environment and public friendly - Construction should be fast tracked near market area to minimize air and noise pollution - Noise barrier should be provided near residential areas during construction and operation - Precautions to be taken to prevent damage to archeological structures around Tughlakabad Fort area - Waste dumping around construction site to be avoided - Tree felling should be minimized, and compensatory plantation should be carried out. | <ul style="list-style-type: none"> - Phase-IV of Delhi Metro is planned and designed as per green building norms. Phase-IV construction will be environment and public friendly. - Excavation near residential and commercial areas will be fast tracked to minimize disturbances - Proper care will be taken so that noise pollution does not cross the permissible limits during construction this includes measures such as provision of noise barriers around construction site. Requirement of noise barrier will be studied. - Tughlakabad Fort is approx. 212m away from the alignment. There will not be any impact on the structure due to metro construction. Moreover, all precautions will be taken to avoid any mishap. - Waste from construction site will be disposed at authorized facility. - Feeling of trees will be minimized to the extent possible. Ten saplings will be planted against every tree cut as per norms. |

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|-------------------------------|--------------------------------------|---|--|
| | On alignment, station design and R&R | <ul style="list-style-type: none"> - All shop keepers should be rehabilitated in the nearby area before demolition | <ul style="list-style-type: none"> - Shopkeepers will be rehabilitated within 500m distance. |
| | On other issues | <ul style="list-style-type: none"> - Construction should not affect day to day working of the market - Pedestrian problem should be taken care of - Road should not be blocked during construction - Metro fares should be reduced to make it more accessible to all sections of society - E-Rickshaw services to be provided at stations | <ul style="list-style-type: none"> - Access to the shops will not be obstructed and care will be taken so that construction does not affect day to day working of nearby shops. - Proper barricading of works will be carried out for pedestrian safety. - Blockage of road will be avoided as far as possible. - Metro fares are decided by a committee and DMRC has no role in fare fixation - Possibility for providing Metro E-Rickshaw facility will be looked into. |
| Anandmayee Marg 10.02.2020 | On Environmental issues | <ul style="list-style-type: none"> - Dust and noise from construction should be mitigated - Malba (C&D Waste) from construction should not be dumped in the locality - Waste from the construction site should not pollute the area nearby - Rainwater harvesting needs to be carried out - Felling of trees should be minimized - Special precautions must be taken to protect animals during construction - | <ul style="list-style-type: none"> - Measures such as up to 10m high barricading, wheel washing, mist spraying and host of other measures will be taken during construction to minimize dust pollution - Proper care will be taken so that noise pollution does not cross the permissible limits during construction this includes measures such as provision of noise barriers around construction site - For recycling C&D waste, DMRC has set-up its recycling plant at Ranikhera, Mundka. C&D waste from DMRC construction will be recycled at this plant. - Felling of trees will be minimized to the extent possible. Ten saplings will be planted against every tree cut as per norms. - No impact on fauna is anticipated as the project is in urban area where there is no wildlife. Snakes rescued from construction site will be handed over to Wildlife NGOs. |
| | On alignment, station design and R&R | <ul style="list-style-type: none"> - Jhuggies coming in the work area should be rehabilitated in the nearby area before demolition - FOT to be built during construction | <ul style="list-style-type: none"> - Jhuggies will be rehabilitated within the nearby area. - Possibility of providing FOT will be looked into. |
| | On other issues | <ul style="list-style-type: none"> - Change from one station to another should be 'old age people friendly' - Metro feeder bus facility should be available between residence and the metro stations - Pedestrian problem should be taken care of and construction should not affect day to day operation of their shops nearby - More rail cars to be increased during the peak hours. Special ladies bogies should be increased. - Metro should not damage the aesthetic view of the surrounding area. | <ul style="list-style-type: none"> - The Station design shall take into consideration the features which will make the station to old and disabled people friendly. - Possibility for providing Metro feeder bus facility will be looked into. - Access to the shops will not be obstructed and care will be taken so that construction does not affect day to day working of nearby shops. - People were informed that at the design stage itself, the basic unit of 6-car train is proposed for all the new upcoming corridors. The number of exclusive bogies for ladies, which is presently one, could be increased depending on the prevailing demand. - Stations will be designed aesthetically keeping in view of the surrounding area. |

10. COST ESTIMATES

10.1 SUMMARY OF COSTS

Estimated cost of measures for environmental management and monitoring are presented in **Table 10.1**.

Table 10.1: Environmental Management and Monitoring Costs

| S. No. | Item | Quantity | Unit | Unit Cost (Rs) | Cost (Rs. Lakh) |
|--------|---|-----------------|----------|----------------|-----------------|
| 1 | Compensatory Plantation | 104380 | Nos | 5700 | 5949.66 |
| 2 | Security Deposit to Forest Department for Plantation | 104380 | Nos | 5700 | 5949.66 |
| 3 | For the use of Forest Land | | | | |
| | Afforestation cost | 11297 | Nos | 5700 | 643.93 |
| | NPV | 10.27 | Ha | 5.63 | 57.82 |
| 4 | Noise barriers on viaduct during operation | 17200 | Sq meter | 14160 | 2435.52 |
| 5 | Environmental Monitoring during Construction and Operation phase | | | | |
| | Water @ 3 times in a year for 5 year during construction and 3 year during operation | 195 | Nos | 7000 | 13.65 |
| | Soils @ 3 times in a year for 5 year during construction | 150 | Nos | 5000 | 7.50 |
| | Air and Noise @ 3 times in a year for 5 year during construction and 3 year during operation | 594 | Nos | 6000 | 35.64 |
| | Vibration @ 6 times in a year for 5 year during construction and 4 times in a year for 3 years during operation | 396 | Nos | 30000 | 100.80 |
| 6 | Strengthening of Environment Division | Refer Table 8.3 | | | 239.07 |
| 7 | Training | Refer Table 7.2 | | | 25.50 |
| | Total | | | | 15458.75 |

Annexure 1.1

DRINKING WATER QUALITY STANDARDS (IS 10500:2012)

| S. No. | Characteristic | Requirement (Acceptable Limit) | Permissible limit in the absence of alternate source | Remarks |
|----------------------------------|--|--------------------------------|--|---|
| Essential Characteristics | | | | |
| 1 | Colour, Hazen units, Max | 5 | 15 | Extended to 15 only, if toxic substances are not suspected in absence of alternate source |
| 2 | Odour | Agreeable | Agreeable | Test cold and when heated Test at several dilutions |
| 3 | pH Value | 6.5 to 8.5 | No relaxation | - |
| 4 | Taste | Agreeable | Agreeable | Test to be conducted only after safety has been established |
| 5 | Turbidity NTU, max | 1 | 5 | - |
| 6 | Total dissolved solids, mg/l, Max | 500 | 2000 | - |
| 7 | Aluminium (as Al), mg/l Max | 0.03 | 0.2 | - |
| 8 | Ammonia (as total ammonia-N), mg/l Max | 0.5 | No relaxation | - |
| 9 | Anionic detergents (as MBAS), mg/l, Max | 0.2 | 1.0 | - |
| 10 | Barium (as Ba), mg/l, max | 0.7 | No relaxation | - |
| 11 | Boron (as B), mg/l Max | 0.5 | 1.0 | - |
| 12 | Calcium (as Ca) mg/l, Max | 75 | 200 | - |
| 13 | Chloramines (as Cl ₂), mg/l, Max | 4.0 | No relaxation | - |
| 14 | Chloride (as Cl) mg/l, Max | 250 | 1000 | - |
| 15 | Copper (as Cu) mg/l, Max | 0.05 | 1.5 | - |
| 16 | Fluoride (as F) mg/l, Max | 1.0 | 1.5 | - |
| 17 | Free residual Chlorine, mg/l, Min | 0.2 | 1 | To be applicable only when water is chlorinated. Tested at consumer end. When protection against viral infection is required, it should be minimum 0.5 mg/l |
| 18 | Iron (as Fe) mg/l, max | 0.3 | No relaxation | Total concentration of manganese (as Mn) and iron (as Fe) shall not exceed 0.3mg/l |
| 19 | Magnesium (as Mg) mg/l, Max | 30 | 100 | - |
| 20 | Manganese (as Mn) mg/l, Max | 0.1 | 0.3 | - |
| 21 | Mineral oil, mg/l Max | 0.5 | No relaxation | - |
| 22 | Nitrate (as NO ₃) mg/l, Max | 45 | No relaxation | - |
| 23 | Phenolic compounds (as C ₆ H ₅ OH) mg/l, Max | 0.001 | 0.002 | - |

| S.No. | Characteristic | Requirement (Acceptable Limit) | Permissible limit in the absence of alternate source | Remarks |
|-------|--|--------------------------------|--|---|
| 24 | Selenium (as Se), mg/l, Max | 0.01 | No relaxation | - |
| 25 | Silver (as Ag), mg/l, Max | 0.1 | No relaxation | - |
| 26 | Sulphate (as SO ₄) mg/l, Max | 200 | 400 | May be extended to 400 provided that Magnesium does not exceed 30 |
| 27 | Sulphide (as H ₂ S) mg/l, max | 0.05 | No relaxation | - |
| 28 | Total alkalinity as calcium carbonate, mg/l Max | 200 | 600 | - |
| 29 | Total Hardness (as CaCO ₃) mg/l, Max | 200 | 600 | - |
| 30 | Zinc (as zn), mg/l, Max | 5 | 15 | - |
| 31 | Cadmium (as Cd), mg/l, Max | 0.003 | No relaxation | - |
| 32 | Cyanide (as CN), mg/l, Max | 0.05 | No relaxation | - |
| 33 | Lead (as Pb), mg/l, Max | 0.01 | No relaxation | - |
| 34 | Mercury (as Hg) mg/l, Max | 0.001 | No relaxation | - |
| 35 | Molybdenum (as Mo) mg/l, max | 0.07 | No relaxation | - |
| 36 | Nickle (as Ni), mg/l, max | 0.02 | No relaxation | - |
| 37 | Polychlorinated biphenyls, mg/l, max | 0.0005 | No relaxation | - |
| 38 | Polynuclear aromatic hydrocarbons (as PAH) mg/l, Max | 0.0001 | No relaxation | - |
| 39 | Total Arsenic (as As), mg/l, Max | 0.01 | 0.05 | - |
| 40 | Total Chromium (as Cr) mg/l, Max | 0.05 | No relaxation | - |
| 41 | Trihalomethanes Bromoform, mg/l, max | 0.1 | No relaxation | - |
| | Dibromochloromethane, mg/l, max | 0.1 | No relaxation | - |
| | Bromodichloromethane, mg/l, max | 0.06 | No relaxation | - |
| | Chloroform, mg/l, max | 0.2 | No relaxation | - |
| 42 | Radioactive materials | | | |
| | Alpha emitters Bq/l max | 0.1 | No relaxation | - |
| | Beta emitters pci/l, Max | 1.0 | No relaxation | - |

Annexure 1.2

EFFLUENT DISCHARGE STANDARDS (INLAND SURFACE WATER)

| S.No. | Parameter | Unit | Standards |
|-------|--|------|--|
| 1 | Colour & Odor | -- | All efforts should be made to remove colour and unpleasant odor as far as practicable. |
| 2 | Suspended Solids Max. | mg/l | 100 |
| 3 | Particle size of Suspended Solids | -- | Shall pass 850 micron IS Sieve |
| 4 | pH value | -- | 5.5 to 9.0 |
| 5 | Temperature, Max. | °C | Shall not exceed 5°C above the receiving water temperature |
| 6 | Oil and grease, Max. | mg/l | 10 |
| 7 | Total residual Chlorine, Max. | mg/l | 1.0 |
| 8 | Ammonical Nitrogen (as N), Max. | mg/l | 50 |
| 9 | Total Kjeldah Nitrogen (as N), Max. | mg/l | 100 |
| 10 | Free Ammonia (as NH ₃), Max. | mg/l | 5 |
| 11 | Biochemical Oxygen Demand (5 days at 20°C), Max. | mg/l | 30 |
| 12 | Chemical Oxygen Demand Max. | mg/l | 250 |
| 13 | Arsenic (as As), Max. | mg/l | 0.2 |
| 14 | Mercury (as Hg), Max. | mg/l | 0.01 |
| 15 | Lead (as Pb), Max. | mg/l | 0.1 |
| 16 | Cadmium (as Cd), Max. | mg/l | 2.0 |
| 17 | Hexavalent Chromium (as Cr ⁺⁶), Max. | mg/l | 0.1 |
| 18 | Total Chromium (as Cr) Max. | mg/l | 2.0 |
| 19 | Copper (as Cu), Max. | mg/l | 3.0 |
| 20 | Zinc (as Zn), Max. | mg/l | 5.0 |
| 21 | Selenium (as Se), Max. | mg/l | 0.05 |
| 22 | Nickel (as Ni), Max. | mg/l | 3.0 |
| 23 | Cyanide (as CN), Max. | mg/l | 0.2 |
| 24 | Fluorides (as F), Max. | mg/l | 2.0 |
| 25 | Dissolved phosphates (as P), Max. | mg/l | 5.0 |
| 26 | Sulphides (as S), Max. | mg/l | 2.0 |

| S.No. | Parameter | Unit | Standards |
|-------|---|------|---|
| 27 | Phenolic compounds (as C ₆ H ₅ OH), Max. | mg/l | 1.0 |
| 28 | Radioactive Materials □ Emitters, □ curie/ml, Max. □ Emitters, □ curie/ml, Max. | mg/l | 10 ⁻⁷ 10 ⁻⁶ |
| 29 | Bio-assay test | mg/l | 90% survival of fish after 96 hours in 100% effluent |
| 30 | Manganese (as Mn) | mg/l | 2.0 |
| 31 | Iron (as Fe) | mg/l | 3.0 |
| 32 | Vanadium (as V) | mg/l | 0.2 |
| 33 | Nitrate Nitrogen | mg/l | 10.0 |

Annexure 1.3

TOLERANCE LIMITS FOR INLAND SURFACE WATER QUALITY

| Characteristic | Designated Use Class of Inland Waters | | | | |
|--|---------------------------------------|------------|------------|------------|------------|
| | A | B | C | D | E |
| pH value | 6.5 to 8.5 | 6.5 to 8.5 | 6.5 to 8.5 | 6.5 to 8.5 | 6.0 to 8.5 |
| Dissolved Oxygen, mg/l, Min. | 6 | 5 | 4 | 4 | - |
| Biochemical Oxygen Demand (5 days at 20°C), mg/l | 2 | 3 | 3 | - | - |
| Total coliform organisms, MPN/100 ml. Max. | 50 | 500 | 5000 | - | - |
| Colour Hazen units | 10 | 300 | 300 | - | - |
| Chlorides (as Cl), mg/l Max. | 250 | - | 600 | - | 600 |
| Sodium Adsorption ratio Max. | - | - | - | - | 26 |
| Boron (as B), mg/l. Max. | - | - | - | - | 2 |
| Sulphates (as SO ₄), mg/l | 400 | - | 400 | - | 1000 |
| Nitrates (as NO ₃), mg/l Max. | 20 | - | 50 | - | - |
| Free Ammonia (as NH ₃), mg/l | - | - | - | 1.2 | - |
| Conductivity at 25° C microhm / cm Max. | - | - | - | 1000 | 2250 |
| Arsenic (as As), mg/l. Max. | 0.05 | 0.2 | 0.2 | - | - |
| Iron (as Fe), mg/l | 0.3 | - | 50 | - | - |
| Fluorides (as F), mg/l | 1.5 | 1.5 | 1.5 | - | - |
| Lead (as Pb), mg/l. Max. | 0.1 | - | 0.1 | - | - |
| Copper (as Cu), mg/l | 1.5 | - | 1.5 | - | - |
| Zinc (as Zn) mg/l/ Max. | 1.5 | - | 1.5 | - | - |
| Manganese (as Mn), mg/l | 0.5 | - | - | - | - |
| Total Dissolved Solids, mg/l | 500 | - | 1500 | - | 2100 |
| Total Hardness (CaCO ₃), mg/l | 300 | - | - | - | - |
| Magnesium (as Mg), mg/l | 100 | - | - | - | - |
| Chlorides (as Cl), mg/l | 250 | 600 | - | - | 600 |
| Cyanides (as CN), mg/l | 0.05 | 0.05 | 0.05 | - | - |

A: Drinking Water Source without conventional treatment but after disinfections; B: Outdoor bathing organized; C: drinking water source with conventional treatment followed by disinfections; D: propagation of wildlife and fisheries;

E: irrigation, industrial cooling, controlled waste disposal. Source: Central Pollution Control Board

NATIONAL AMBIENT AIR QUALITY STANDARDS

| Pollutant | Time Weighted Average | | Industrial, Residential, Rural & Other Area | Ecologically Sensitive Area (notified by Central Government) |
|---|-------------------------|-----|---|--|
| Sulphur Dioxide (SO ₂), µm ³ | Annual Hours** | 24 | 50 80 | 20 80 |
| Nitrogen Dioxide as NO ₂ , µm ³ | Annual Hours** | 24 | 40 80 | 30 80 |
| Particulate Matter (size less than 10µm) or PM ₁₀ µm ³ | Annual Hours** | 24 | 60 100 | 60 100 |
| Particulate Matter (size less than 2.5µm) or PM _{2.5} µm ³ | Annual Hours** | 24* | 40 60 | 40 60 |
| Ozone (O ₃) µm ³ | 8 hours** 24 Hours** | | 100 180 | 100 180 |
| Lead (Pb) µm ³ | Annual Hours** | 24* | 0.50 1.0 | 0.50 1.0 |
| Carbon Monoxide (CO) mg/m ³ | 8 Hours** 1 Hour** | | 02 04 | 02 04 |
| Ammonia (NH ₃) µm ³ | Annual Hours** | 24* | 100 400 | 100 400 |
| Benzene (C ₆ H ₆) µm ³ | Annual * | | 05 | 05 |
| Benzo (a) pyrene (BaP) particulate phase only nm ³ | Annual * | | 01 | 01 |
| Arsenic (AS) µnm ³ | Annual * | | 06 | 06 |
| Nickle (Ni) nm ³ | Annual * | | 20 | 20 |

Source: Central Pollution Control Board Notification dated 18th November 2009

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

** 24 hourly or 08 hourly or 01 hourly monitored values, as applicable, shall be complied with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days of monitoring.

NATIONAL AMBIENT NOISE STANDARDS

| Category of Zones | Leq in dB (A) | |
|-------------------|---------------|------------|
| | Day Time | Night Time |
| Industrial | 75 | 70 |
| Commercial | 65 | 55 |
| Residential | 55 | 45 |
| Silence Zone | 50 | 40 |

Source: Central Pollution Control Board

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

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

8 Silence zone is an area comprising not less than 100 metres around hospitals, educational institutions, courts, religious places or any other area which is declared as such by the competent authority

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

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

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

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

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

Recommended Criteria for Ground-borne Vibration & Ground-Borne Noise for General Assessment

| Land use category | Ground-borne Vibration Impact Levels (VdB ref=25.4μ mm/s) | Ground-borne Noise Impact Levels (dB ref 20 μ Pa) |
|--|---|---|
| Category 1: Buildings where vibration would interfere with interior operations | 65 VdB | N/A* |
| Category 2: Residences and buildings where people normally sleep | 72 VdB | 35 dBA |
| Category 3: Institutional land uses with primarily day time use | 75 VdB | 40 dBA |

Note : RDSO Standard, Ministry of Railways, Govt of India

Screening Distances (meters) for Vibration Assessment

| Type of Project | Critical Distance for Land Use Categories* Distance from Property Line | | |
|--------------------------------|---|--------|--------|
| | Cat. 1 | Cat. 2 | Cat. 3 |
| Conventional Commuter Railroad | 183 | 61 | 37 |
| Rail Rapid Transit | 183 | 61 | 37 |
| Light Rail Transit | 138 | 50 | 30 |
| Intermediate Capacity Transit | 61 | 30 | 15 |

Note : RDSO Standard, Ministry of Railways, Govt of India

Guideline Vibration Damage Potential Threshold Criteria

| Human /Structural Response | VdB | | Maximum PPV in in/sec | |
|--|-------------------|--|-----------------------|--|
| | Transient sources | Continuous/Frequent Intermittent Sources | Transient sources | Continuous/Frequent Intermittent Sources |
| Extremely fragile historic buildings, ruins, ancient monuments | 90 | 86.02 | 0.12 | 0.08 |
| fragile buildings | 94 | 88 | 0.2 | 0.1 |
| historic and some old buildings | 102 | 96 | 0.5 | 0.25 |
| Older residential structures | 102 | 98 | 0.5 | 0.3 |
| New residential structures | 108 | 102 | 1.0 | 0.5 |
| Modern industrial/commercial buildings | 114 | 102 | 2.0 | 0.5 |

Source :Transportation and Construction Vibration Guidance Manual, Caltrans, September 2013

Note : Transient sources create a single isolated vibration event, such as blasting or drop balls.

Continuous/frequent intermittent sources include impact pile drivers, pogo stick compactors, crack and seat equipment, vibratory pile drivers, and vibratory compact equipment

Annexure 4.1

List of Fauna and Flora reported in ABWLS (list provided by the ABWLS office on 21.07.2020)

Mammals:

| S. No | English/ local name | Scientific name | Family |
|-------|----------------------------|-----------------------------------|------------------|
| 1 | Common Leopard | <i>Panthera pardus</i> | Felidea |
| 2 | Jungle Cat | <i>Felischaus</i> | Felidae |
| 3 | Black Buck | <i>Antilope cervicapra</i> | Bovidae |
| 4 | Spotted Deer | <i>Axis axis</i> | Cervidae |
| 5 | Sambar | <i>Cervus unicolor</i> | Cervidae |
| 6 | Blue Bull/ Nilgai | <i>Boselaphustragocamelus</i> | Bovidae |
| 7 | Striped Hyena | <i>Hyaena hyaena</i> | Hyaenidea |
| 8 | Jackal | <i>Canisaurenus</i> | Canidae |
| 9 | Small Indian Civet | <i>Viverricula indica</i> | Viverridae |
| 10 | Common Palm Civet | <i>Paradoxurus hermaphroditus</i> | Viverridae |
| 11 | Small Indian Mongoose | <i>Herpestesja vanicus</i> | Herpestidae |
| 12 | Grey Mongoose | <i>Herpestesed wardsii</i> | Herpestidae |
| 13 | Ruddy Mongoose | <i>Herpestes smithii</i> | Herpestidae |
| 14 | Indian Hare | <i>Lepusni gricollis</i> | Leporidae |
| 15 | Indian Porcupine | <i>Hystrix indica</i> | Hystriidae |
| 16 | Rhesus Macaque | <i>Macaca mulatta</i> | Cercopithecidae |
| 17 | Hanuman langur | <i>Samnopithecus entellus</i> | Cercopithecidae |
| 18 | Five-striped palm Squirrel | <i>Funambulus pennantii</i> | Sciuridae |
| 19 | Large Bandicoot-Rat | <i>Bandicota indica</i> | Muridae |
| 20 | Lesser Bandicoot-Rat | <i>Bandicota bengalensis</i> | Muridae |
| 21 | Indian Bush Rat | <i>Golunda ellioti</i> | Muridae |
| 22 | House Rat | <i>Rattus rattus</i> | Muridae |
| 23 | Indian Gerbille | <i>Tatera indica</i> | Muridae |
| 24 | Little Indian Field Mouse | <i>Musbooduga</i> | Muridae |
| 25 | House Shrew | <i>Suncusmurinus</i> | Soricidae |
| 26 | Indian Flying Fox | <i>Pteropus giganteus</i> | Pteropodidae |
| 27 | Common Pipistrelle | <i>Pipistrellus pipistrellus</i> | Vespertilionidae |

Birds Checklist of Asola Bhatti Wildlife Sanctuary

| S.NO | Common Name | Scientific Name | Status |
|------|---------------------------|------------------------------------|--------|
| | Phasianidae | | |
| 1 | Indian Peafowl | <i>Pavo cristatus</i> | R |
| 2 | Gray Francolin | <i>Francolinus pondicerianus</i> | R |
| 3 | Black Francolin | <i>Francolinus francolinus</i> | R |
| | Anatidae | | |
| 4 | Bar-headed Goose | <i>Anser indicus</i> | M |
| 5 | Comb Duck | <i>Sarkidiornis sylvicola</i> | R |
| 6 | Gadwall | <i>Mareca strepera</i> | M |
| 7 | Eurasian Wigeon | <i>Mareca penelope</i> | M |
| 8 | Mallard | <i>Anas platyrhynchos</i> | M |
| 9 | Indian Spot-billed Duck | <i>Anas poecilorhyncha</i> | R |
| 10 | Northern shoveler | <i>Spatula clypeata</i> | M |
| 11 | Northern Pintail | <i>Anas acuta</i> | M |
| 12 | Eurasian teal | <i>Anas crecca</i> | M |
| 13 | Red-crested Pochard | <i>Netta rufina</i> | M |
| 14 | Common Pochard | <i>Aythya ferina</i> | M |
| 15 | Ferruginous Duck | <i>Aythya nyroca</i> | M |
| 16 | Tufted duck | <i>Aythya fuligula</i> | M |
| | Podicipedidae | | |
| 17 | Little Grebe | <i>Tachybaptus ruficollis</i> | R |
| | Ciconiidae | | |
| 18 | Painted Stork | <i>Mycteria leucocephala</i> | RM |
| 19 | Black Stork | <i>Ciconia nigra</i> | M |
| | Threskiornithidae | | |
| 20 | Black-headed Ibis | <i>Threskiornis melanocephalus</i> | M |
| 21 | Red-naped Ibis | <i>Pseudibis papillosa</i> | R |
| | Ardeidae | | |
| 22 | Black-crowned Night-Heron | <i>Nycticorax nycticorax</i> | R |
| 23 | Indian Pond-Heron | <i>Ardeola grayii</i> | R |
| 24 | Gray Heron | <i>Ardea cinerea</i> | RM |
| 25 | Purple Heron | <i>Ardea purpurea</i> | R |
| 26 | Cattle Egret | <i>Bubulcus ibis</i> | R |
| 27 | Great Egret | <i>Ardea alba</i> | R |
| 28 | Intermediate Egret | <i>Ardea intermedia</i> | R |
| 29 | Little Egret | <i>Egretta garzetta</i> | R |
| | Anhingidae | | |
| 30 | Oriental Darter | <i>Anhinga melanogaster</i> | R |
| | Phalacrocoracidae | | |
| 31 | Little Cormorant | <i>Microcarbo niger</i> | R |
| 32 | Indian Cormorant | <i>Phalacrocorax fuscicollis</i> | M |
| 33 | Great cormorant | <i>Phalacrocorax carbo</i> | P |
| | Falconidae | | |
| 34 | Eurasian Kestrel | <i>Falco tinnunculus</i> | R |
| 35 | Eurasian Hobby | <i>Falco subbuteo</i> | M |
| 36 | Perigrine Falcon | <i>Falco peregrinus</i> | M |
| | Accipitridae | | |
| 37 | Black-shouldered kite | <i>Elanus axillaris</i> | R |
| 38 | Black Kite | <i>Milvus migrans</i> | R |
| 39 | Black-eared kite | <i>(migrans)lineatus</i> | M |
| 40 | Grey-headed fish eagle | <i>Haliaeetus ichthyaetus</i> | M |
| 41 | Oriental Honey-buzzard | <i>Pernis ptilorhynchus</i> | R |
| 42 | Egyptian Vulture | <i>Neophron percnopterus</i> | R |

| | | | |
|----|-----------------------------|---|----|
| 43 | Egyptian vulture | <i>neophron percnopterus percnopterus</i> | R |
| 44 | white-rumped vulture | <i>Gyps bengalensis</i> | R |
| 45 | Eurasian griffon vulture | <i>Gyps fulvus</i> | M |
| 46 | Red-headed Vulture | <i>Sarcogyps calvus</i> | R |
| 47 | Short-toed Snake-Eagle | <i>Circaetus gallicus</i> | R |
| 48 | Crested serpent eagle | <i>Spilornis cheela</i> | R |
| 49 | Pallid Harrier | <i>Circus macrdurus</i> | M |
| 50 | Shikra | <i>Accipiter badius</i> | R |
| 51 | Eurasian Sparrowhawk | <i>Accipiter nisus</i> | RM |
| 52 | White-eyed Buzzard | <i>Butastur teesa</i> | R |
| 53 | Long-legged Buzzard | <i>Buteo refictus</i> | M |
| 54 | Indian spotted eagle | <i>Clanga hastata</i> | M |
| 55 | Greater spotted eagle | <i>Clanga clanga</i> | RM |
| 56 | Tawny eagle | <i>Aquila rapax</i> | R |
| 57 | Bonelli's eagle | <i>Aquila fasciata</i> | RM |
| 58 | Booted Eagle | <i>Hieraaetus pennatus</i> | M |
| 59 | Steppe Eagle | <i>Aquila nipalensis</i> | M |
| 60 | Imperial Eagle | <i>Aquila heliaca</i> | M |
| 61 | Himalayan buzzard | <i>Buteo refectus</i> | M |
| | Rallidae | | |
| 62 | White-breasted waterhen | <i>Amaurornis phoenicurus</i> | R |
| 63 | common moorhen | <i>Gallinula chloropus</i> | R |
| 64 | Eurasian coot | <i>Fulica atra</i> | RM |
| | Gruidae | | |
| 65 | Demoiselle Crane | <i>Grus virgo</i> | M |
| | Turnicidae | | |
| 66 | Barred Buttonquail | <i>Turnix suscitator</i> | R |
| | Burhinidae | | |
| 67 | Indian thick-knee | <i>Burhinus indicus</i> | R |
| | Recurvirostridae | | |
| 68 | Black-winged stilt | <i>Himantopus himantopus</i> | R |
| 69 | Pied Avocet | <i>Recurvirostra avosetta</i> | M |
| | Charadriidae | | |
| 70 | yellow-wattled lapwing | <i>Vanellus malabaricus</i> | R |
| 71 | Red-wattled Lapwing | <i>Vanellus indicus</i> | R |
| | Scolopacidae | | |
| 72 | Ruff | <i>Calidris pugnax</i> | M |
| 73 | Green Sandpiper | <i>Tringa ochropus</i> | M |
| 74 | Wood Sandpiper | <i>Tringa glareola</i> | M |
| 75 | Spotted redshank | <i>Tringa erythropus</i> | M |
| 76 | Common Redshank | <i>Tringa totanus</i> | M |
| 77 | Marsh sandpiper | <i>Tringa stagnatilis</i> | M |
| 78 | Common greenshank | <i>Tringa nebularia</i> | M |
| 79 | Common Sandpiper | <i>Actitis hypoleucos</i> | M |
| 80 | Temminck's Stint | <i>Calidris temminckii</i> | M |
| | Laridae | | |
| 81 | River Tern | <i>Sterna aurantia</i> | M |
| | Pteroclididae | | |
| 82 | Chestnut-bellied sandgrouse | <i>Pterocles exustus</i> | R |
| 83 | Painted Sandgrouse | <i>Pterocles indicus</i> | R |
| | Columbidae | | |
| 84 | Rock Pigeon | <i>Columba livia</i> | R |
| 85 | Yellow-footed green pigeon | <i>Treron phoenicoptera</i> | R |
| 86 | Oriental Turtle-Dove | <i>Streptopelia orientalis</i> | RM |

| | | | |
|-----|----------------------------|-----------------------------------|----|
| 87 | Eurasian Collared-Dove | <i>Streptopelia decaocto</i> | R |
| 88 | Red Collared-Dove | <i>Streptopelia tranquebarica</i> | R |
| 89 | Spotted Dove | <i>Spilopelia chinensis</i> | R |
| 90 | Laughing Dove | <i>Spilopelia senegalensis</i> | R |
| | Psittacidae | | |
| 91 | Alexandrine Parakeet | <i>Psittacula eupatria</i> | R |
| 92 | Rose-ringed Parakeet | <i>Psittacula krameri</i> | R |
| 93 | Plum-headed Parakeet | <i>Psittacula cyanocephala</i> | R |
| | Cuculidae | | |
| 94 | Jacobin cuckoo | <i>Clamator jacobinus</i> | RM |
| 95 | Common Hawk-Cuckoo | <i>Hierococyx varius</i> | RM |
| 96 | Common cuckoo | <i>Cuculus canorus</i> | M |
| 97 | Grey-bellied cuckoo | <i>Cacomantis passerinus</i> | SM |
| 98 | Asian Koel | <i>Eudynamys scolopaceus</i> | R |
| 99 | Sirkeer Malkoha | <i>Taccocua leschenaultii</i> | R |
| 100 | Greater Coucal | <i>Centropus sinensis</i> | R |
| | Tytonidae | | |
| 101 | Barn Owl | <i>Tyto alba</i> | R |
| | Strigidae | | |
| 102 | Indian Scops-Owl | <i>Otus bakkamoena</i> | R |
| 103 | Pallid Scops-Owl | <i>Otus brucei</i> | M |
| 104 | Oriental Scops Owl | <i>Otus sunia</i> | M |
| 105 | Spotted Owlet | <i>Athene brama</i> | R |
| 106 | Indian eagle-owl | <i>Bubo bengalensis</i> | R |
| 107 | Brown hawk-owl | <i>Ninox scutulata</i> | M |
| | Caprimulgidae | | |
| 108 | savanna nightjar | <i>Caprimulgus affinis</i> | R |
| | Apodidae | | |
| 109 | Little Swift | <i>Apus affinis</i> | R |
| | Upupidae | | |
| 110 | Eurasian Hoopoe | <i>Upupa epops</i> | RM |
| | Coraciidae | | |
| 111 | Indian Roller | <i>Coracias benghalensis</i> | R |
| 112 | European Roller | <i>Coracias garrulus</i> | PM |
| | Alcedinidae | | |
| 113 | White-throated Kingfisher | <i>Halcyon smyrnensis</i> | R |
| 114 | Pied Kingfisher | <i>Ceryle rudis</i> | R |
| | Meropidae | | |
| 115 | Green Bee-eater | <i>Merops orientalis</i> | R |
| 116 | Blue-cheeked Bee-eater | <i>Merops persicus</i> | RM |
| 117 | Blue-tailed Bee-eater | <i>Merops philippinus</i> | PM |
| | Bucerotidae | | |
| 118 | Indian Gray Hornbill | <i>Ocyrceros birostris</i> | R |
| | Megalaimidae | | |
| 119 | Brown-headed Barbet | <i>Psilopogon zeylanicus</i> | R |
| 120 | Coppersmith Barbet | <i>Psilopogon haemacephalus</i> | R |
| | Picidae | | |
| 121 | Yellow-crowned woodpecker | <i>Leiopicus mahrattensis</i> | R |
| 122 | Streak-throated woodpecker | <i>Picus xanthopygaeus</i> | R |
| 123 | Black-rumped flameback | <i>Dinopium benghalense</i> | R |
| 124 | Eurasian Wryneck | <i>Jynx torquilla</i> | R |
| | Pittidae | | |
| 125 | Indian Pitta | <i>Pitta brachyura</i> | SM |
| | Vangidae | | |
| 126 | Common Woodshrike | <i>Tephrodornis pondicerianus</i> | R |

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|-----|----------------------------|-----------------------------------|----|--|
| | Campephagidae | | | |
| 127 | Large Cuckooshrike | <i>Coracina macei</i> | R | |
| 128 | White-bellied Minivet | <i>Pericrocotus erythropygius</i> | R | |
| 129 | Small minivet | <i>Pericrocotus cinnamomeus</i> | | |
| 130 | Long-tailed Minivet | <i>Pericrocotus ethologus</i> | RM | |
| | Aegithinidae | | | |
| 131 | Marshall's Iora | <i>Aegithina nigrolutea</i> | R | |
| | Laniidae | | | |
| 132 | Isabelline shrike | <i>Lanius isabellinus</i> | M | |
| 133 | Bay-backed Shrike | <i>Lanius vittatus</i> | R | |
| 134 | Long-tailed Shrike | <i>Lanius schach</i> | R | |
| 135 | Southern grey shrike | <i>Lanius meridionalis</i> | M | |
| | Dicruridae | | | |
| 136 | Black Drongo | <i>Dicrurus macrocercus</i> | R | |
| 137 | Ashy Drongo | <i>Dicrurus leucophaeus</i> | RM | |
| 138 | White-bellied drongo | <i>Dicrurus caerulescens</i> | R | |
| | Oriolidae | | | |
| 139 | Indian Golden Oriole | <i>Oriolus kundoo</i> | R | |
| | Rhipiduridae | | | |
| 140 | White-browed Fantail | <i>Rhipidura aureola</i> | R | |
| | Monarchidae | | | |
| 141 | Indian Paradise-Flycatcher | <i>Terpsiphone paradisi</i> | R | |
| | Corvidae | | | |
| 142 | Rufous Treepie | <i>Dendrocitta vagabunda</i> | R | |
| 143 | House Crow | <i>Corvus splendens</i> | R | |
| 144 | large-billed crow | <i>Corvus macrorhynchos</i> | R | |
| | Paridae | | | |
| 145 | Cinereous Tit | <i>Parus cinereus</i> | M | |
| | Hirundinidae | | | |
| 146 | Gray-throated Martin | <i>Riparia chinensis</i> | R | |
| 147 | Dusky Crag-Martin | <i>Ptyonoprogne concolor</i> | R | |
| 148 | Streak-throated Swallow | <i>Petrochelidon fluvicola</i> | R | |
| 149 | Wire-tailed Swallow | <i>Hirundo smithii</i> | R | |
| 150 | Barn Swallow | <i>Hirundo rustica</i> | R | |
| 151 | Red-rumped Swallow | <i>Cecropis daurica</i> | R | |
| | Alaudidae | | | |
| 152 | Bengal Bushlark | <i>Mirafra assamica</i> | M | |
| 153 | Indian Bushlark | <i>Mirafra erythroptera</i> | R | |
| 154 | Ashy-crowned Sparrow-Lark | <i>Eremopterix griseus</i> | R | |
| 155 | Crested Lark | <i>Galerida cristata</i> | R | |
| 156 | Oriental Skylark | <i>Alauda gulgula</i> | RM | |
| | Pycnonotidae | | | |
| 157 | Red-whiskered Bulbul | <i>Pycnonotus jocosus</i> | R | |
| 158 | White-eared Bulbul | <i>Pycnonotus leucotis</i> | R | |
| 159 | Red-vented Bulbul | <i>Pycnonotus cafer</i> | R | |
| | Cisticolidae | | | |
| 160 | Gray-breasted Prinia | <i>Prinia hodgsonii</i> | R | |
| 161 | Graceful prinia | <i>Prinia gracilis</i> | R | |
| 162 | Jungle Prinia | <i>Prinia sylvatica</i> | R | |
| 163 | Yellow-bellied Prinia | <i>Prinia flaviventris</i> | R | |
| 164 | Ashy Prinia | <i>Prinia socialis</i> | R | |
| 165 | Plain Prinia | <i>Prinia inornata</i> | R | |
| 166 | Rufous-fronted Prinia | <i>Prinia buchanani</i> | R | |
| 167 | Zitting Cisticola | <i>Cisticola juncidis</i> | R | |
| 168 | Common Tailorbird | <i>Orthotomus sutorius</i> | R | |

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|-----|-------------------------------|----------------------------------|----|--|
| | Acrocephalidae | | | |
| 169 | Clamorous Reed Warbler | <i>Acrocephalus stentoreus</i> | RM | |
| 170 | Paddyfield Warbler | <i>Acrocephalus agricola</i> | M | |
| 171 | Blyth's Reed Warbler | <i>Acrocephalus dumetorum</i> | RM | |
| 172 | Booted Warbler | <i>Iduna caligata</i> | RM | |
| 173 | Sykes's Warbler | <i>Iduna rama</i> | M | |
| | Phylloscopidae | | | |
| 174 | Common Chiffchaff | <i>Phylloscopus collybita</i> | M | |
| 175 | Sulphur-bellied Warbler | <i>Phylloscopus griseolus</i> | RM | |
| 176 | Hume's Warbler | <i>Phylloscopus humei</i> | PM | |
| 177 | Greenish Warbler | <i>Phylloscopus trochiloides</i> | M | |
| | Sylviidae | | | |
| 178 | Lesser Whitethroat | <i>Sylvia curruca</i> | RM | |
| 179 | Orphean warbler | <i>Sylvia hortensis</i> | M | |
| 180 | Yellow-eyed Babbler | <i>Chrysomma sinense</i> | R | |
| | Leiothrichidae | | | |
| 181 | Common Babbler | <i>Turdoides caudata</i> | R | |
| 182 | Striated Babbler | <i>Turdoides earlei</i> | R | |
| 183 | Large Gray Babbler | <i>Turdoides malcolmi</i> | R | |
| 184 | Jungle Babbler | <i>Turdoides striata</i> | R | |
| | Zosteropidae | | | |
| 185 | Oriental White-eye | <i>Zosterops palpebrosus</i> | R | |
| | Sturnidae | | | |
| 186 | Bank Myna | <i>Acridotheres ginginianus</i> | R | |
| 187 | Common Myna | <i>Acridotheres tristis</i> | R | |
| 188 | Asian Pied Starling | <i>Gracupica contra</i> | R | |
| 189 | Brahminy Starling | <i>Sturnia pagodarum</i> | R | |
| 190 | Rosy Starling | <i>Pastor roseus</i> | PM | |
| 191 | Common Starling | <i>Sturnus vulgaris</i> | M | |
| | Turdidae | | | |
| 192 | Orange-headed Thrush | <i>Geokichla citrina</i> | R | |
| 193 | Black-throated Thrush | <i>Turdus atrogularis</i> | M | |
| 194 | Gray-winged Blackbird | <i>Turdus boulboul</i> | M | |
| 195 | Tickell's thrush | <i>Turdus unicolor</i> | RM | |
| | Muscicapidae | | | |
| 196 | Blue Rock-Thrush | <i>Monticola solitarius</i> | M | |
| 197 | Bluethroat | <i>Luscinia svecica</i> | M | |
| 198 | Oriental Magpie-Robin | <i>Copsychus saularis</i> | R | |
| 199 | Indian Robin | <i>Copsychus fulicatus</i> | R | |
| 200 | Black Redstart | <i>Phoenicurus ochruros</i> | M | |
| 201 | Common Stonechat | <i>Saxicola torquatus</i> | RM | |
| 202 | Pied Bushchat | <i>Saxicola caprata</i> | R | |
| 203 | Indian Chat | <i>Oenanthe fusca</i> | R | |
| 204 | Desert Wheatear | <i>Oenanthe deserti</i> | M | |
| 205 | Asian Brown Flycatcher | <i>Muscicapa dauurica</i> | SV | |
| 206 | Red-breasted flycatcher | <i>Ficedula parva</i> | M | |
| 207 | Taiga flycatcher | <i>Ficedula albicilla</i> | M | |
| 208 | Ultramarine Flycatcher | <i>Ficedula superciliaris</i> | R | |
| 209 | blue-throated blue flycatcher | <i>Cyornis rubeculoides</i> | M | |
| 210 | Verditer Flycatcher | <i>Eumyias thalassinus</i> | R | |
| | Stenostiridae | | | |
| 211 | Gray-headed Canary-Flycatcher | <i>Culicicapa ceylonensis</i> | M | |
| | Nectariniidae | | | |
| 212 | Purple Sunbird | <i>Cinnyris asiaticus</i> | R | |
| | Passeridae | | | |

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|-----|------------------------------|----------------------------------|----|
| 213 | House Sparrow | <i>Passer domesticus</i> | R |
| 214 | Spanish sparrow | <i>Passer hispaniolensis</i> | PM |
| 215 | Chestnut-shouldered Petronia | <i>Gymnoris xanthocollis</i> | R |
| 216 | Sind Sparrow | <i>Passer pyrrhonotus</i> | R |
| | Ploceidae | | |
| 217 | Black-breasted Weaver | <i>Ploceus benghalensis</i> | R |
| 218 | Streaked weaver | <i>Ploceus manyar</i> | R |
| 219 | Baya Weaver | <i>Ploceus philippinus</i> | R |
| | Estrildidae | | |
| 220 | Indian Silverbill | <i>Euodice malabarica</i> | R |
| 221 | Red Avadavat | <i>Amandava amandava</i> | R |
| 222 | Scaly-breasted Munia | <i>Lonchura punctulata</i> | R |
| 223 | tricoloured munia | <i>Lonchura malacca</i> | RM |
| | Motacillidae | | |
| 224 | Western Yellow Wagtail | <i>Motacilla flava</i> | RM |
| 225 | Citrine Wagtail | <i>Motacilla citreola</i> | RM |
| 226 | White Wagtail | <i>Motacilla alba</i> | RM |
| 227 | White-browed Wagtail | <i>Motacilla maderaspatensis</i> | R |
| 228 | Paddyfield pipit | <i>Anthus rufulus</i> | R |
| 229 | Tawny pipit | <i>Anthus campestris</i> | M |
| 230 | Long-billed pipit | <i>Anthus similis</i> | R |
| 231 | Tree Pipit | <i>Anthus trivialis</i> | RM |
| 232 | Olive-backed Pipit | <i>Anthus hodgsoni</i> | RM |
| | Fringillidae | | |
| 233 | Common Rosefinch | <i>Carpodacus erythrinus</i> | RM |
| | Emberizidae | | |
| 234 | Crested Bunting | <i>Melophus lathamii</i> | R |
| 235 | White-capped bunting | <i>Emberiza stewarti</i> | RM |
| 236 | Red-Headed Bunting | <i>Emberiza bruniceps</i> | PM |

Reptile and Amphibians

| Reptiles in Asola | | | |
|-------------------|---------------------------------|----------------------------|-------------|
| No | Species | Common Name | Family |
| 1 | <i>SitanaPonticeriana</i> | Fan throated Lizard | Agamidae |
| 2 | <i>CalotesVersicolor</i> | Indian Garden Lizard | Agamidae |
| 3 | <i>XenochropisPisicator</i> | CheckerdKeelback | Colubridae |
| 4 | <i>OligodonTaeniolatus</i> | Russel's Kukri Snake | Colubridae |
| 5 | <i>NajaNaja</i> | Spactacled Cobra | Elapidae |
| 6 | <i>Hamidactylusbrookii cf.</i> | Brook's gecko | Gekkonidae |
| 7 | <i>Hamidactylusflaviviridis</i> | Yellow bellied house gecko | Gekkonidae |
| 8 | <i>Cyrtopodionaravallensis</i> | Aravalli Hill gecko | Gekkonidae |
| 9 | <i>Ophisopsjardonii</i> | Jardon'ssnake -Eye | Lacertidae |
| 10 | <i>LygosomaPunctata</i> | Common Dotted Garden Skink | Scincidae |
| 11 | <i>Eutropismacularia</i> | Bronze skink | Scincidae |
| 12 | <i>RamphotyphlopsBraminus</i> | Brahminy Blind snake | Typhlopidea |
| 13 | <i>VaranusBangalansis</i> | Bangal monitor lizard | Varanidae |

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|----|---------------------------------|--------------------|----------------|
| 14 | <i>Oophiosopsjerdonii</i> | Snake eyed lizard | Lacertidae |
| 15 | <i>VaranusFlavescens</i> | Yellow Monitor | Varanidae |
| 16 | <i>BungarusCaeruleus</i> | Common Krait | Elapidae |
| 17 | <i>Eublepharismacularius</i> | Leopard gacko | Eublepharidae |
| 18 | <i>Eryxconicus</i> | Common Sand boa | Boidae |
| 19 | <i>Ptyas Mucosa</i> | Indian rat snake | Colubridae |
| 20 | <i>Ahaetullanasuta</i> | Common Vine snake | Colubridae |
| 21 | <i>SpalerosophisDidema</i> | Royal Snake | Colubridae |
| 22 | <i>EryxJohnii</i> | Red sand Boa | Boidae |
| 23 | <i>Lycodonaulicus</i> | Common Wolf Snake | Colubridae |
| 24 | <i>Echiscarinatus</i> | Saw-scaled viper | Viperidae |
| 25 | <i>Python molurusmolurus</i> | Indian rock python | Pythonidae |
| 26 | <i>Boigatrigonata</i> | Common cat snake | Colubridae |
| 27 | <i>Ophisopsmicrolepis</i> | Lacertid lizard | |
| | Amphibians | | |
| 28 | <i>Bufoautomaticus</i> | Marbled toad | Bufoinae |
| 29 | <i>Hoplobatrachustigerinus</i> | Indian bull frog | Dicroglossidae |
| 30 | <i>Euphylyctiscynoaphylctis</i> | Skittering frog | Dicroglossidae |
| 31 | <i>Euphylyctishexadactylus</i> | Green pond frog | Dicroglossidae |
| 32 | <i>Bufo melanostictus</i> | Common toad | Bufoinae |

Invertebrate**Lepidoptera**

| S. No. | Name | Scientific Name | Wing Span | Field mark |
|--------|-----------------------------------|----------------------------------|-----------|------------|
| | Hesperiidae(Skippers) | | | |
| 1 | Brown Awl | <i>Badamia exclamationis</i> | 50-55 mm | |
| 2 | Common -Banded Awl | <i>Hasora cromus</i> | 45-50 mm | |
| 3 | Common Awl | <i>Hasora badra</i> | 50-55 mm | |
| 4 | Indian Palm Bob | <i>Suastus gremius</i> | 32-45 mm | |
| 5 | Common Redeye | <i>Matapa druna</i> | 48-54 mm | |
| 6 | Rice Swift | <i>Borbo cinnara</i> | 30-36 mm | |
| 7 | Indian Skipper | <i>Spialia galba</i> | 20-27 mm | |
| 8 | Small Banded Swift | <i>Pelopidas mathias</i> | 32-38 mm | |
| 9 | Common Grass Dart | <i>Taractrocera danna</i> | 22-28 mm | |
| 10 | Dark palm Dart | <i>Telicota aneilla bambusae</i> | 33-36 mm | |
| 11 | Pale Palm Dart | <i>Telicota colon</i> | 32-36 mm | |
| 12 | Conjoined Swift | <i>Pelopidas conjuncta</i> | 45-52 mm | |
| | Papilionidae (Swallowtail) | | | |
| 13 | Common Jay | <i>Graphium doson</i> | 70-80 mm | |

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|----|---------------------------------------|---------------------------------|-----------|--|
| 14 | Crimson Rose | <i>Pachliopta hector</i> | 90-110 mm | |
| 15 | Common Rose | <i>Pachliopta aristolochiae</i> | 80-110 mm | |
| 16 | Common Mime | <i>Papilio clytia</i> | 90-100 mm | |
| 17 | Common Mormon | <i>Papilio polytes</i> | 90-100 mm | |
| 18 | Lime Butterfly | <i>Papilio demoleus</i> | 80-100 mm | |
| | Pieridae (White & Yellows) | | | |
| 19 | One Spot Grass Yellow | <i>Eurema andersoni</i> | 38-45 mm | |
| 20 | Three Spot Grass Yellow | <i>Eurema blanda</i> | 38-48 mm | |
| 21 | Small Grass Yellow | <i>Eurema brigitta</i> | 30-40 mm | |
| 22 | Common Grass Yellow | <i>Eurema hecabe</i> | 50-50 mm | |
| 23 | Spotless Grass Yellow | <i>Eurema laeta</i> | 30-45 mm | |
| 24 | Common Emigrant | <i>Catopsilia pomona</i> | 55-80 mm | |
| 25 | Mottled Emigrant | <i>Catopsilia pyranthe</i> | 55-80 mm | |
| 26 | Dark Clouded Yellow | <i>Colias fieldii</i> | 40-65 mm | |
| 27 | Small Salman Arab | <i>Colotis amata</i> | 35-50 mm | |
| 28 | Small Orange Tip | <i>Colotis etrida</i> | 25-45 mm | |
| 29 | Large Salman Arab | <i>Colotis fausta fausta</i> | 40-50 mm | |
| 30 | White Orange Tip | <i>Ixias marianne</i> | 50-55 mm | |
| 31 | Yellow Orange Tip | <i>Ixias pyrene</i> | 50-70 mm | |
| 32 | Striped Albatross | <i>Appias libythea</i> | 50-65 mm | |
| 33 | Common Albatross | <i>Appias albina</i> | 50-60 mm | |
| 34 | Small Cabbage White | <i>Pieris rapae</i> | 45-55 mm | |
| 35 | Large cabbage white | <i>Pieris brassicae</i> | 65-75 mm | |
| 36 | Common Gull | <i>Cepora nerissa</i> | 40-65 mm | |
| 37 | Common Jezebel | <i>Delias eucharis</i> | 72-88 mm | |
| 38 | Pioneer | <i>Belenois aurota</i> | 40-55 mm | |
| 39 | Psyche | <i>Leptosia nina</i> | 35-50 mm | |
| | Lycaenidae (Blues) | | | |
| 40 | Common Silverline | <i>Spindasis vulcanus</i> | 26-34 mm | |
| 41 | Forget-me-Not | <i>Catochrysops strabo</i> | 25-35 mm | |
| 42 | Pea Blue | <i>Lampides boeticus</i> | 25-35 mm | |
| 43 | Zebra Blue | <i>Leptotes plinius</i> | 22-30 mm | |
| 44 | Common Pierrot | <i>Castalius rosimon</i> | 24-34 mm | |
| 45 | Rounded Pierrot | <i>Tarucus nara</i> | 21-24 mm | |
| 46 | Spotted Pierrot | <i>Tarucus callinara</i> | 24-26 mm | |
| 47 | Dark Grass Blue | <i>Zizeeria karsandra</i> | 22-28 mm | |
| 48 | Pale Grass Blue | <i>Pseudozizeeria maha</i> | 26-30 mm | |
| 49 | Tinny Grass Blue | <i>Zizula hylax</i> | 16-24 mm | |
| 50 | Bright Babul Blue | <i>Azonus ubaldus</i> | 20-25 mm | |
| 51 | African Babul Blue | <i>Azonus jesous</i> | 21-26 mm | |
| 52 | Red Pierrot | <i>Talicauda nyseus</i> | 30-36 mm | |
| 53 | Dull Babul Blue | <i>Azonus uranus</i> | 20-25 mm | |
| 54 | Gram Blue | <i>Euchrysops cnejus</i> | 25-30 mm | |
| 55 | Plain Cupid | <i>Chilades pandava</i> | 25-35 mm | |

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|----|-----------------------------------|-----------------------------|-----------|--|
| 56 | Lime Blue | <i>Chilades lajus</i> | 26-30 mm | |
| 57 | Small Cupid | <i>Chilades parrhassius</i> | 20-25 mm | |
| 58 | Grass Jewel | <i>Freyeria trochylus</i> | 12-18 mm | |
| 59 | Guava Blue | <i>Virachola isocrates</i> | 34-50 mm | |
| 60 | Indian Red Flash | <i>Rapala jarbas</i> | 30-36 mm | |
| | Nymphalidae (Brush Footed) | | | |
| 61 | Blue Tiger | <i>Tirumala limniace</i> | 75-85 mm | |
| 62 | Striped Tiger | <i>Danaus genutia</i> | 75-95 mm | |
| 63 | Plain Tiger | <i>Danaus chrysippus</i> | 70-80 mm | |
| 64 | Common Crow | <i>Euploea core</i> | 95-100 mm | |
| 65 | Common Evening Brown | <i>Melanitis leda</i> | 80-90 mm | |
| 66 | Dark Evening Brown | <i>Melanitis phedima</i> | 60-70 mm | |
| 67 | Common Three Ring | <i>Ypthima asterope</i> | 32-37 mm | |
| 68 | Tawny Coster | <i>Acraea violae</i> | 95-105 mm | |
| 69 | Common Leopard | <i>Phalanta phalantha</i> | 50-60 mm | |
| 70 | Common Baron | <i>Euthalia aconthea</i> | 55-8- mm | |
| 71 | Common Castor | <i>Ariadne merione</i> | 45-60 mm | |
| 72 | Painted Lady | <i>vanesa cardul</i> | 55-65 mm | |
| 73 | Blue Pansy | <i>Junonia orithiya</i> | 45-60 mm | |
| 74 | Yellow Pansy | <i>Junonia hierta</i> | 45-60 mm | |
| 75 | Chocolate pansy | <i>Junonia iphita</i> | 55-80 mm | |
| 76 | Peacock Pansy | <i>Junonia almana</i> | 60-65 mm | |
| 77 | Lemon Pansy | <i>Junonia lemonias</i> | 60-65 mm | |
| 78 | Great Eggfly | <i>Hypolimnas bolina</i> | 70-110 mm | |
| 79 | Danaid Eggfly | <i>Hypolimnas misippus</i> | 70-85 mm | |

List of floral species in Asola Bhatti Wildlife Sanctuary

1. **Acanthaceae**

Andrographis paniculata
Blepharis maderasaptensis
Elytaria acaulis
Rostellularia crinita
Ruellia prostrata

2. **Amaranthaceae**

Achyranthes aspera
Aerva lanata
Chenopodium album

3. **Apocynaceae**

Alstonia scholaris
Carissa carandas
Cascabela thevetia
Catharanthus roseus

4. **Arecaceae**

Caryota urens

5. **Asparagaceae**

Asparagaus racemosus

6. **Asteraceae**

Ageratum haustonianum
Parthenium hysterophorus
Senecio vulgaris

- Sonchus oleraceus*
Tridax procumbens
Vernonia cinerea
7. **Balanitaceae**
Balanites aegyptiaca
8. **Bignoniaceae**
Tecomella undulata
9. **Capparaceae**
Capparis decidua
10. **Caryophyllaceae**
Stellaria media
11. **Cleomaceae**
Cleome viscosa
12. **Convolvulaceae**
Evolvulus alsinoides
Evolvulus sericeous
13. **Commeliniaceae**
Commelina benghalensis
14. **Cucurbitaceae**
Coccinia grandis
Cucumis maderspatanus
Diplocyclos palmatus
15. **Ebenaceae**
Diospyros montana
16. **Euphorbiaceae**
Euphorbia hirta
Jatropha gossypifolia
17. **Fabaceae**
Abrus precatorius
Acacia ferruginea
Acacia leucophloea
Acacia senegal
Alysicarpus monilifer
Bauhinia purpurea
Butea monosperma
Cassia fistula
Desmodium gangeticum
Indigofera cordifolia
Indigofera linifolia
Indigofera linnaei
Leucaena leucocephala
Pithecellobium dulce
Pongamia pinnata
Prosopis juliflora
Senna occidentalis
Tephrosia purpurea
Tephrosia villosa
18. **Lamiaceae**
Leucas cephalotes
Ocimum gratissimum
Ocimum sanctum
19. **Malvaceae**
Abutilon indicum
Malvastrum cormandelianum
Pavonia zeylanica
Sida acuta
Sida cordifolia
Urena sinuata

20. Moraceae

Ficus benjamina
Morus alba

21. Nyctaginaceae

Boerhavia diffusa
Bougainvillea glabra

22. Oxalidaceae

Oxalis corniculata

23. Pedaliaceae

Sesamum indicum

24. Plumbaginaceae

Plumbago zeylanica

25. Poaceae

Bambusa bambos
Bothriochloa pertusa
Bromus hordeaceus
Cenchrus biflorus
Cenchrus ciliaris
Cenchrus setiger
Chrysopogon fulvus
Cyanodon dactylon
Desmostachya bipinnata
Eleusine indica
Imperata cylindrica
Paspalum distichum
Setaria intermedia
Setaria pumila
Setaria verticillata

26. Portulacaceae

Portulaca grandiflora
Portulaca oleracea
Portulaca pilosa

27. Putranjivaceae

Putranjiva roxburghii

28. Rhamnaceae

Ziziphus mauritiana
Ziziphus nummularia
Ziziphus oenoplia

29. Rutaceae

Citrus limon

30. Simaroubaceae

Ailanthus excelsa

31. Solanaceae

Datura innoxia
Solanum nigrum
Solanum surattense
Solanum virginianum

32. Ulmaceae

Holoptelea integrifolia

33. Verbenaceae

Lantana camara
Lantana montevidensis

34. Zygophyllaceae

Tribulus terrestris

Site Photographs



Photo 1 –DMRC team discussing the proposed alignment with Dr D K Pandey from JST (Location: ABWLS ESZ)



Photo 2 –Existing Sub Station of Power Grid Corporation at the Eco-sensitive Zone



Photo 3 –Transmission tower located inside the Eco-Sensitive Zone. The proposed alignment passes beneath the open ground.



Photo 4 – Boundary wall of Tughlakabad Air Force Station which is located inside the Eco-Sensitive Zone. The line drawn in red on the boundary wall indicates the location of proposed underground tunnel.



Photo 5 – Gate of Sub Station which is located inside the Eco-Sensitive Zone.



Phot0 6 –Air Force Station Staff Quarters which are located inside the Eco-Sensitive Zone.

ESZ Notification

रजिस्ट्री सं० डी० एल०-33004/99

REGD. NO. D. L.-33004/99



भारत का राजपत्र

The Gazette of India

असाधारण

EXTRAORDINARY

भाग II—खण्ड 3—उप-खण्ड (ii)

PART II—Section 3—Sub-section (ii)

प्राधिकार से प्रकाशित

PUBLISHED BY AUTHORITY

सं. 2622]

नई दिल्ली, मंगलवार, सितम्बर 12, 2017/भाद्र 21, 1939

No. 2622]

NEW DELHI, TUESDAY, SEPTEMBER 12, 2017/BHADRA 21, 1939

पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय

अधिसूचना

नई दिल्ली, 11 सितम्बर, 2017

का.आ. 2996(अ).—प्रारूप अधिसूचना भारत के राजपत्र असाधारण में सरकार के पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय की अधिसूचना सं. का.आ. 2114 (अ), तारीख 15 जून, 2016 द्वारा प्रकाशित की गई थी जिसमें ऐसे सभी व्यक्तियों से, जिनकी उससे प्रभावित होने की संभावना थी, उस तारीख से, जिसको अधिसूचना को अन्तर्विष्ट करने वाले राजपत्र की प्रतियां जनता को उपलब्ध करा दी गई थीं, साठ दिन की अवधि के भीतर आक्षेप और सुझाव आमंत्रित किए गए थे;

और, उक्त अधिसूचना के राजपत्र, की प्रतियां जनता को तारीख 15 जून, 2016 को उपलब्ध करा दी गई थीं;

और, प्रारूप अधिसूचना के उत्तर में सभी व्यक्तियों और पणधारियों से प्राप्त आक्षेपों और सुझावों पर केन्द्रीय सरकार द्वारा विचार कर लिया गया है;

और, राष्ट्रीय राजधानी राज्यक्षेत्र, दिल्ली में अवस्थित असोला भाटी बन्धन्यजीव अभयारण्य 19.57 वर्ग किलोमीटर के क्षेत्र में फैला हुआ है और 28° 23' 00" उ. से 28° 30' 00" उ. अक्षांश तथा 77° 11' 00" पू. से 77° 17' 00" पू. देशांतर के बीच अवस्थित है।

और, असोला भाटी बन्धन्यजीव अभयारण्य पूर्वी, दक्षिणी और दक्षिण-पश्चिमी दिशाओं में हरियाणा राज्य के साथ अपनी सीमा को साझा करता है और यह अधिसूचना राष्ट्रीय राजधानी राज्य क्षेत्र दिल्ली के असोला भाटी बन्धन्यजीव अभयारण्य के आसपास पारिस्थितिकी संवेदी जोन को अधिसूचित करने के लिए है;

और, यह अभयारण्य प्रचुर वनस्पति और जीवजन्तु जैविक महत्व का प्रतिनिधित्व करता है। जीवजन्तु विविधता में स्तनधारियों की 17 प्रजातियां, आवासी और प्रवासी पक्षियों की लगभग 201 प्रजातियां, सरीसृपों की 12 प्रजातियां, उभयचरों की 5 प्रजातियां, तितलियों की 63 प्रजातियां और व्याघ्र पतंगों की 05 प्रजातियां का प्रतिनिधित्व है और संरक्षित क्षेत्र में मुख्य प्रजातियां जैसे नीलगाय (ब्रोसलाफुस टरायोक्मेलेस), बनबिलाब (फेलिस चाउस), छोटा भारतीय मुसंग (कीचेरिंकुला इंडिका), नेबला (हेरपेसटेस अयरोपुन्कटाटुस), सियार (कनिस अयरेउस), भारतीय साही (हायस्ट्रीक्स इंडिका), पांच नग गिलहरी (फुनामबुलुस पेन्नाटी), चीतल (अकीनॉयक्स जुवाटुस) आदि प्रजातियां पाई जाती हैं;

और, पूर्वोक्त अभयारण्य में वनस्पति की देशी और विदेशी की मिश्रित प्रजातियां हैं और यह वृक्षों की लगभग 83 प्रजातियां, झाड़ियों की लगभग 30 प्रजातियां, जड़ी-बूटियों की लगभग 95 प्रजातियां, घासों की लगभग 18 प्रजातियां और नरकट की लगभग 4 प्रजातियों के बास स्थान के लिए जानी जाती है; मूल वनस्पतियों में अकैशिया की विभिन्न प्रजातियां शामिल हैं जैसे अकैशिया नीलोटीका, अकैशिया

5639 GI/2017

(1)

ल्यूकोफ्लोएआ, अकैशिया कटेचु, अकैशिया सेनेपल, अकैशिया मोडेसटा, बुटिया मोनोस्पर्म, कैशिया फिट्टुला, मल्बादोरो प्रिमा और कुछ छोटे गोलाशम वाली छोटी-छोटी पहाड़ियों में अनोएजेसम पेंडुला के कुछ बिखरे हुए वृक्ष भी पाए जाते हैं; इस क्षेत्र में पाए गए कुछ अन्य वृक्षों में दल्बर्गिया सीसोओ, फिकुस रेलीगिओस, मोरस इंडिका, अजादिराह्दा इंडिका, पॉगामिया पीनाटा आदि शामिल हैं;

और, असोला भाटी बन्यजीव अभयारण्य के चारों ओर के क्षेत्र को, जिसका विस्तार और सीमाएं इस अधिसूचना के पैरा 1 में विनिर्दिष्ट हैं; पर्यावरण और पारिस्थितिकी की दृष्टि से पारिस्थितिकी संवेदी जोन के रूप में सुरक्षित और संरक्षित करना तथा उक्त पारिस्थितिकी संवेदी जोन में उद्योगों और उद्योगों के वर्गों और उनके प्रचालन तथा प्रसंस्करण को प्रतिषिद्ध करना आवश्यक है ;

अतः, अब, केन्द्रीय सरकार, पर्यावरण (संरक्षण) नियम, 1986 के नियम 5 के उपनियम (3) के साथ पठित पर्यावरण (संरक्षण) अधिनियम, 1986 (1986 का 29) की धारा 3 की उपधारा (1) और उपधारा (2) के खंड (v) और खंड (xiv) और उपधारा (3) द्वारा प्रदत्त शक्तियों का प्रयोग करते हुए, राष्ट्रीय राजधानी राज्यक्षेत्र, दिल्ली में असोला भाटी बन्यजीव अभयारण्य की सीमा से 1 किलोमीटर तक के क्षेत्र को असोला भाटी बन्यजीव अभयारण्य पारिस्थितिकी संवेदी जोन (जिसे इसमें इसके पश्चात् पारिस्थितिकी संवेदी जोन कहा गया है) के रूप में अधिसूचित करती है, जिसके ब्यौरे निम्नानुसार हैं, अर्थात् :-

1. पारिस्थितिकी संवेदी जोन का विस्तार और उसकी सीमाएं-(1) असोला भाटी बन्यजीव अभयारण्य के चारों ओर 1 किलोमीटर तक के विस्तार के साथ 15.55 वर्ग किलोमीटर का होगा और असोला भाटी बन्यजीव अभयारण्य सीमाओं का वर्णन और पारिस्थितिकी संवेदी जोन के निर्देशांकों को **उपाबंध I** में दिया गया है।

(2) सीमा के ब्यौरे तथा अक्षांश और देशान्तर के साथ पारिस्थितिकी संवेदी जोन की सीमा का मानचित्र **उपाबंध II** के रूप में उपाबद्ध है।

(3) पारिस्थितिकी संवेदी जोन में आने वाले ग्रामों की सूची **उपाबंध III** के रूप में उपाबद्ध है।

2. पारिस्थितिकी संवेदी जोन के लिए आंचलिक महायोजना -(1) राज्य सरकार, पारिस्थितिकी संवेदी जोन के प्रयोजन के लिए, राजपत्र में इस अधिसूचना के प्रकाशन की तारीख से दो वर्ष की अवधि के भीतर, स्थानीय व्यक्तियों के परामर्श से और राज्य सरकार के विचारार्थ और अनुमोदनार्थ इस अधिसूचना में दिए गए अनुबंधों का पालन करते हुए आंचलिक महायोजना तैयार करेगी।

(2) राज्य सरकार द्वारा पारिस्थितिकी संवेदी जोन के लिए आंचलिक महायोजना ऐसी रीति जो इस अधिसूचना में विनिर्दिष्ट है तथा सुसंगत केंद्रीय और राज्य विधियों के अनुरूप और केंद्रीय सरकार द्वारा जारी मार्गनिर्देशों, यदि कोई हों, द्वारा तैयार होगी।

(3) आंचलिक महायोजना, पारिस्थितिकी और पर्यावरणीय संबंधी बातों को समाकलित करने के लिए राज्य सरकार के निम्नलिखित विभागों के परामर्श से तैयार की जाएगी, अर्थात्:-

- (i) पर्यावरण;
- (ii) वन;
- (iii) शहरी विकास;
- (iv) पर्यटन;
- (v) नगरपालिक;
- (vi) राजस्व;
- (vii) कृषि ;
- (viii) दिल्ली राज्य प्रदूषण नियंत्रण बोर्ड;
- (ix) सिंचाई;
- (x) लोक निर्माण विभाग।

(4) आंचलिक महायोजना अनुमोदित विद्यमान भू-उपयोग, अवसंरचना और क्रियाकलापों पर कोई निर्बंधन तब तक अधिरोपित नहीं करेगी जब तक कि इस अधिसूचना में इस प्रकार विनिर्दिष्ट न हो और आंचलिक महायोजना सभी अवसंरचना और क्रियाकलापों में जो अधिक दक्षता और पारिस्थितिकी अनुकूल हों, का संबन्धन करेगी।

(5) आंचलिक महायोजना में अनाच्छादित क्षेत्रों के जीर्णोद्धार, विद्यमान जल निकायों के संरक्षण, आवाह क्षेत्रों के प्रबंधन, जल-संभरों के प्रबंधन, भूमिगत जल के प्रबंधन, मृदा और नदी संरक्षण, स्थानीय समुदायों की आवश्यकताओं तथा पारिस्थितिकी और पर्यावरण से संबंधित ऐसे अन्य पहलुओं, जिन पर ध्यान देना आवश्यक है, के लिए उपबंध होंगे।

(6) आंचलिक महायोजना सभी विद्यमान पूजा स्थलों, ग्रामों और नगरीय बस्तियों, वनों के प्रकार और किस्मों, कृषि क्षेत्रों, ऊपजाऊ भूमि, हरित क्षेत्र जैसे उद्यान और उसी प्रकार के स्थान, उद्यान कृषि क्षेत्र, फलोउद्यान, झीलों और अन्य जल निकायों का अभ्यन्तन करेगी और इस योजना के मानचित्रों के साथ विद्यमान और प्रस्तावित भूमि उपयोग विशेषताओं के द्यौरे संलग्न होंगे।

(7) आंचलिक महायोजना पारिस्थितिकी संवेदी जोन में विकास को विनियमित करेगी तथा स्थानीय समुदायों की आजीविका सुरक्षा के लिए, पारिस्थितिकी अनुकूल विकास सुनिश्चित करेगी।

(8) आंचलिक महायोजना इस अधिसूचना के उपबंधों के द्वारा मानीटरी के अपने कृत्यों को करने के लिए, मानीटरी समिति के लिए एक संदर्भ दस्तावेज होगी।

3. राज्य सरकार द्वारा किए जाने वाले उपाय- राज्य सरकार इस अधिसूचना के उपबंधों को प्रभावी करने के लिए निम्नलिखित उपाय करेगी, अर्थात्:-

(1) **भू-उपयोग** -पारिस्थितिकी संवेदी जोन में वनों, उद्यान-कृषि क्षेत्रों, कृषि क्षेत्रों, आमोद-प्रमोद के प्रयोजन के लिए चिन्हित किए गए पार्कों और खुले स्थानों का वाणिज्यिक और औद्योगिक संबद्ध विकास क्रियाकलापों के लिए उपयोग या संपरिवर्तन नहीं होगा:

परंतु पारिस्थितिकी संवेदी जोन के भीतर कृषि भूमि और अन्य भूमियों का संपरिवर्तन मानीटरी समिति की सिफारिश पर और राज्य सरकार के पूर्व अनुमोदन से, जो स्थानीय निवासियों की आवासीय जरूरतों को पूरा करने के लिए है तथा निम्नलिखित क्रियाकलापों के लिए है जैसे:-

(i) विद्यमान सड़कों को चौड़ा करना और उन्हें सुदृढ़ करना तथा नई सड़कों का संनिर्माण;

(ii) बुनियादी ढांचों और नागरिक सुविधाओं का संनिर्माण और नवीकरण;

(iii) प्रदूषण उत्पन्न न करने वाले लघु उद्योग;

(iv) कूटीर उद्योगों जिसके अंतर्गत ग्रामीण उद्योग हैं; सुविधाजनक भण्डार और स्थानीय सुविधाओं जो पारिस्थितिकी पर्यटन में सहायक हों, ग्रह बास हों; और

(v) संबन्धित क्रियाकलाप पैरा 4 में दिए गए हैं:

परंतु यह और कि राज्य सरकार के पूर्व अनुमोदन तथा संबिधान के अनुच्छेद 244 और तत्समय प्रवृत्त विधि जिसके अंतर्गत अनुसूचित जनजाति और अन्य परंपरागत वन निवासी (वन अधिकारों की मान्यता) अधिनियम, 2006 (2007 का 2) भी है, के उपबंधों के अनुपालन के बिना, वाणिज्यिक और औद्योगिक विकास क्रियाकलापों के लिए जनजातीय भूमि का उपयोग अनुज्ञात नहीं होगा:

परंतु यह भी कि पारिस्थितिकी संवेदी जोन के भीतर भू-अभिलेखों में कोई त्रुटि, मानीटरी समिति के अभिगत प्राप्त करने के पश्चात् राज्य सरकार द्वारा प्रत्येक मामले में एक बार ठीक की जाएगी और उक्त त्रुटि के संशोधन की सूचना केंद्रीय सरकार के पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय को दी जाएगी।

परंतु यह और भी कि उपर्युक्त त्रुटि को ठीक करने में इस उप पैरा के अधीन यथा उपबंधित के सिवाय किसी भी दशा में भू-उपयोग का परिवर्तन सम्मिलित नहीं होगा;

परंतु यह और भी कि हरित क्षेत्र जैसे वन क्षेत्र, कृषि क्षेत्र आदि में कोई पारिणामिक कटौती नहीं होगी और अनप्रयुक्त या अनुत्पादक कृषि क्षेत्रों में पुनः बनीकरण करने के प्रयास किए जाएंगे।

(2) **प्राकृतिक झरने** - आंचलिक महायोजना में सभी प्राकृतिक झरनों की पहचान की जाएगी और उनके संरक्षण और पुनरुद्भूतकरण के लिए योजना सम्मिलित होगी और राज्य सरकार द्वारा ऐसे क्षेत्रों में या उनके निकट विकास क्रियाकलाप प्रतिपिद्ध करने के लिए ऐसी रीति से मार्गनिर्देश तैयार किए जाएंगे।

(3) **पर्यटन** - (क) पारिस्थितिकी संवेदी जोन के भीतर पर्यटन संबंधी क्रियाकलाप पारिस्थितिकी संवेदी जोन के लिए पर्यटन महायोजना के अनुसार होंगे।

(ख) पर्यटन महायोजना को राज्य पर्यटन विभाग द्वारा राज्य के पर्यावरण और वन विभागों के परामर्श से तैयार किया जाएगा।

(ग) पर्यटन महायोजना आंचलिक महायोजना के एक घटक के रूप में होगा।

(घ) पर्यटन संबंधी क्रियाकलाप निम्नानुसार विनियमित होंगे, अर्थात् :-

(i) असोला भाटी बन्यजीव अभयारण्य की सीमा 1 किलोमीटर के भीतर या पारिस्थितिकी संवेदी जोन के विस्तार तक, इसमें जो भी निकट हो, होटलों और रिसोर्ट के नए संनिर्माण अनुज्ञात नहीं होंगे और बन्यजीव अभयारण्य की सीमा से एक किलोमीटर की

दूरी से परे पारिस्थितिकी संवेदी जोन के विस्तार तक नए होटल और रिसोर्टों की स्थापन को पूर्व परिभाषित और पदाभिहित क्षेत्रों में ही पारिस्थितिकी पर्यटन महायोजना के अनुसार अनुज्ञात किया जाएगा;

(ii) पारिस्थितिकी संवेदी जोन के भीतर सभी नए पर्यटन क्रियाकलापों या विद्यमान पर्यटन क्रियाकलापों का विस्तार केन्द्रीय सरकार के पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय द्वारा जारी मार्गदर्शक सिद्धांतों के द्वारा तथा राष्ट्रीय व्याघ्र संरक्षण प्राधिकरण, द्वारा जारी पारिस्थितिकी पर्यटन (समय-समय पर यथा संशोधित) मार्गदर्शक सिद्धांतों के अनुसार, पारिस्थितिकी पर्यटन, पारिस्थितिकी शिक्षा और पारिस्थितिकी विकास को महत्व देते हुए पारिस्थितिकी संवेदी जोन की बहन धमता के अध्ययन पर आधारित होगा;

(iii) आंचलिक महायोजना का अनुमोदन किए जाने तक, पर्यटन के लिए विकास और विद्यमान पर्यटन क्रियाकलापों के विस्तार को वास्तविक स्थल विनिर्दिष्ट संवीक्षा तथा मानीटरी समिति की सिफारिश पर आधारित संबंधित विनियामक प्राधिकरणों द्वारा अनुज्ञात किया जाएगा।

(4) **नैसर्गिक विरासत** -- पारिस्थितिकी संवेदी जोन में महत्वपूर्ण नैसर्गिक विरासत के सभी स्थलों जैसे सभी जीन कोश आरक्षित क्षेत्र, शैल विरचनाएं, जल प्रपातों, झरनों, घाटी मार्गों, उपवनों, गुफाएं, स्थलों, धमण, अश्वरोहण, प्रपातों आदि की पहचान की जाएगी और उन्हें संरक्षित किया जाएगा तथा उनकी सुरक्षा और संरक्षा के लिए इस अधिसूचना के अंतिम प्रकाशन की तारीख से छह मास के भीतर, उपयुक्त योजना बनाएगी और ऐसी योजना आंचलिक महायोजना का भाग होगा।

(5) **मानव निर्मित विरासत स्थल** - पारिस्थितिकी संवेदी जोन में भवनों, संरचनाओं, शिल्प-तथ्य, ऐतिहासिक, कलात्मक और सांस्कृतिक महत्व के क्षेत्रों तथा उपक्षेत्रों की पहचान की जाएगी और इस अधिसूचना के प्रकाशन की तारीख से छह मास के भीतर विरासत संरक्षण की योजना तैयार की जाएगी तथा ऐसी योजना आंचलिक महायोजना में समाविष्ट की जाएगी।

(6) **ध्वनि प्रदूषण** -- पारिस्थितिकी संवेदी जोन में ध्वनि प्रदूषण की रोकथाम और नियंत्रण का ध्वनि पर्यावरणीय (संरक्षण) अधिनियम, 1986, और उसमें किए गए संशोधनों के अधीन प्रदूषण (विनियमन और नियंत्रण) नियम 2000 के अनुसार अनुपालन किया जाएगा।

(7) **वायु प्रदूषण** -- पारिस्थितिकी संवेदी जोन में, वायु प्रदूषण की रोकथाम और नियंत्रण वायु (प्रदूषण निवारण और नियंत्रण) अधिनियम, 1981 (1981 का 14) के उपबंधों और उसके अधीन बनाए गए नियमों और उनमें किए गए संशोधनों के अनुसार अनुपालन किया जाएगा।

(8) **बहिष्कार का निस्सारण** -- पारिस्थितिकी संवेदी जोन में उपचारित बहिष्कार का निस्सारण, साधारणों मानकों के अन्तर्गत पर्यावरणीय (संरक्षण) अधिनियम, 1986 और उसके अधीन बनाए गए नियमों के अधीन आने वाले पर्यावरणीय प्रदूषण के निस्सारण के लिए साधारण मानकों या राज्य सरकार द्वारा नियत मानकों, जो भी अधिक कठोर हों, के उपबंधों के अनुसार होगा।

(9) **टोस अपशिष्ट** -- टोस अपशिष्टों का निपटान निम्नलिखित रूप में होगा--

- (i) पारिस्थितिकी संवेदी जोन में टोस अपशिष्ट निपटान समय-समय पर संशोधित टोस अपशिष्ट प्रबंधन नियम, 2016, जो भारत सरकार के पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय की अधिसूचना सं. का.आ. 1357(अ) तारीख 8 अप्रैल, 2016 द्वारा प्रकाशित किए गए थे, के उपबंधों के अनुसार किया जाएगा;
- (ii) स्थानीय प्राधिकरण जैव निम्नीकरणीय और अजैव निम्नीकरणीय संघटकों में टोस अपशिष्टों के संपुष्टकन के लिए योजनाएं तैयार करेंगे;
- (iii) जैव निम्नीकरणीय सामग्री को अधिमानतः खाद बनाकर या कृमि खेती के माध्यम से पुनःचक्रित किया जाएगा;
- (iv) अकार्बनिक सामग्री का निपटान पारिस्थितिकी संवेदी जोन के बाहर पहचान किए गए स्थल पर किसी पर्यावरणीय स्वीकृत रीति में होगा;
- (v) पारिस्थितिकी संवेदी जोन में टोस अपशिष्टों को जलाना या भस्मीकरण अनुज्ञात नहीं होगा।

(10) **जैव चिकित्सीय अपशिष्ट**- पारिस्थितिकी संवेदी जोन में जैव चिकित्सीय अपशिष्टों का निपटान भारत सरकार के पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय की समय-समय पर यथा संशोधित अधिसूचना सं.का.नि 343 (अ) तारीख 28 मार्च 2016 द्वारा प्रकाशित जैव चिकित्सीय अपशिष्ट प्रबंधन नियम, 2016 के उपबंधों के अनुसार किया जाएगा।

(11) **यानीय परिवहन**: - परिवहन यानीय संचलन आवास के अनुकूल रीति में विनियमित होगा और इस संबंध में आंचलिक महायोजना में विनिर्दिष्ट उपबंध समाविष्ट किए जाएंगे और आंचलिक महायोजना के तैयार होने और राज्य सरकार के सक्षम प्राधिकारी द्वारा अनुमोदित किए जाने तक, मानीटरी समिति सुसंगत अधिनियमों और उसके अधीन बनाए गए नियमों और विनियमों के अनुसार यानीय संचलन के अनुपालन को मानीटर करेगी।

(12) **यानीय प्रदूषण:-** यानीय प्रदूषण की रोकथाम और नियंत्रण लागू विधियों के अनुसार की जाएगी और स्वच्छक ईंधन उदाहरण के लिए संपीड़ित प्राकृतिक गैस, आदि के उपयोग के लिए प्रयास किए जाएंगे।

(13) **प्लास्टिक अपशिष्ट प्रबंधन:-** पारिस्थितिकी संवेदी जोन में प्लास्टिक अपशिष्ट प्रबंधन भारत सरकार के पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय की समय-समय पर यथासंशोधित अधिसूचना सा.का.नि 340(अ), तारीख 18 मार्च, 2016 द्वारा प्रकाशित प्लास्टिक अपशिष्ट प्रबंधन नियम 2016 के उपबंधों के अनुसार किया जाएगा।

(14) **संनिर्माण और बिध्वंस अपशिष्ट प्रबंधन:-** पारिस्थितिकी संवेदी जोन में संनिर्माण और बिध्वंस अपशिष्ट प्रबंधन भारत सरकार के पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय की समय-समय पर यथासंशोधित अधिसूचना सा.का.नि 317(अ), तारीख 29 मार्च, 2016 द्वारा प्रकाशित संनिर्माण और बिध्वंस प्रबंधन नियम, 2016 के उपबंधों के अनुसार किया जाएगा।

(15) **ई-अपशिष्ट:-** पारिस्थितिकी संवेदी जोन में ई-अपशिष्ट प्रबंधन का निपटान भारत सरकार के पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय द्वारा समय-समय पर यथासंशोधित ई-अपशिष्ट प्रबंधन नियम, 2016 के उपबंधों के अनुसार किया जाएगा।

(16) **औद्योगिक ईकाइयां:-** (क) पारिस्थितिक संवेदी जोन के भीतर विधि के अनुसार स्थापित विद्यमान काष्ठ आधारित उद्योगों के सिवाय किन्हीं नए काष्ठ आधारित उद्योगों की स्थापना की अनुज्ञा नहीं दी जाएगी।

(ख) पारिस्थितिक संवेदी जोन के भीतर जल, वायु, मृदा, प्रदूषण कारित करने वाले कोई नए उद्योग स्थापित करने की अनुज्ञा नहीं होगी।

(17) **पहाड़ी ढलानों का संरक्षण:-** पहाड़ी ढलानों का संरक्षण निम्नानुसार होगा:

(क) आंचलिक महायोजना पहाड़ी ढलानों पर क्षेत्रों को वहाँ उपदर्शित करेगा जहाँ किसी भी संनिर्माण की अनुमति नहीं दी जाएगी।

(ख) विद्यमान खड़ी पहाड़ी ढलानों या कटाव के एक उच्च डिग्री वाले ढलानों पर किसी भी संनिर्माण की अनुमति नहीं दी जाएगी।

4. पारिस्थितिकी संवेदी जोन में प्रतिषिद्ध और विनियमित किए जाने वाले क्रियाकलापों की सूची - पारिस्थितिकी संवेदी जोन में सभी क्रियाकलाप पर्यावरण (संरक्षण) अधिनियम, 1986 (1986 का 29) के उपबंधों द्वारा शासित होंगे और नीचे दी गई सारणी में विनिर्दिष्ट रीति में विनियमित होंगे, अर्थात् :-

सारणी

| क्रम सं. | क्रियाकलाप | टीका-टिप्पणी |
|------------------------------|--|---|
| (1) | (2) | (3) |
| प्रतिषिद्ध क्रियाकलाप | | |
| 1. | वाणिज्यिक खनन, पत्थर की खदान और उनको तोड़ने की इकाइयां। | (क) नए खनन (लघु और वृहत खनिज), पत्थर उत्खनन और उनको तोड़ने की इकाइयां वास्तविक स्थानीय निवासियों की घरेलू आवश्यकताओं जिसमें निजी उपयोग के लिए मकानों के संनिर्माण या मरम्मत के लिए धरती को खोदना और मकान बनाने के लिए देशी टाइल्स या ईंटों का विनिर्माण करना भी सम्मिलित है, के सिवाय प्रतिषिद्ध होंगी ; (ख) खनन संक्रियाएं, रिट याचिका (सिविल) सं. 1995 का 202 टी.एन. गौडाबर्मन थिरुमूलपाद बनाम भारत सरकार के मामले में उच्चतम न्यायालय के आदेश तारीख 4 अगस्त, 2006 और रिट याचिका (सी) सं. 2012 का 435 गोवा फाउंडेशन बनाम भारत सरकार के मामले में उच्चतम न्यायालय के तारीख 21 अप्रैल, 2014 के आदेश के अनुसार की जाएंगी। |
| 2. | आरा मिलों की स्थापना। | पारिस्थितिकी संवेदी जोन के भीतर नई या विद्यमान आरा मिलों का विस्तार अनुज्ञात नहीं होगा। |
| 3. | किसी परिसंकटमय पदार्थों का उपयोग या उत्पादन या प्रसंस्करण। | लागू विधियों के अनुसार प्रतिषिद्ध (अन्यथा उपबंधित के सिवाय) होंगे। |
| 4. | जल या वायु या मृदा या ध्वनि प्रदूषण कारित करने वाले उद्योगों की स्थापना। | (क) पारिस्थितिकी संवेदी जोन में किसी नए प्रदूषण फैलाने वाले उद्योग या उसके विस्तार की अनुमति नहीं दी जाएगी। (ख) केन्द्रीय प्रदूषण नियंत्रण बोर्ड (सीपीसीबी) वर्गीकरण में हरित या श्वेत कृषि के रूप वर्गीकृत उद्योगों को जिनके अंतर्गत कृषि आधारित लघु उद्योग भी हैं विनियमों के अनुसार विनियमित किए जाएंगे। |

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| 5. | नई मुख्य तापीय और जल विद्युत परियोजना की स्थापना। | लागू विधियों के अनुसार प्रतिषिद्ध (अन्यथा उपबंधित के सिवाय) होंगे। |
| 6. | फर्मों, कंपनियों आदि द्वारा बड़े पैमाने पर वाणिज्यिक पशुधन संपदा और कुक्कुट फार्मों की स्थापना। | स्थानीय जरूरतों को पूरा करने के सिवाय लागू विधियों के अनुसार प्रतिषिद्ध (अन्यथा उपबंधित के सिवाय) होंगे। |
| 7. | प्राकृतिक जल निकायों या भूमि क्षेत्र में अनुपचारित बहिष्कारों के निस्सारण। | लागू विधियों के अनुसार प्रतिषिद्ध (अन्यथा उपबंधित के सिवाय) होंगे। |
| 8. | ईट भट्टों की स्थापना करना। | लागू विधियों के अनुसार प्रतिषिद्ध (अन्यथा उपबंधित के सिवाय) होंगे। |
| 9. | टोस अपशिष्ट निपटान स्थल की स्थापना और टोस और जैव चिकित्सा अपशिष्ट के लिए सामान्य जलाए जाने की सुविधा। | पारिस्थितिकी संवेदी जोन में टोस अपशिष्ट निपटान का कोई नया टोस अपशिष्ट निपटान स्थल और अपशिष्ट उपचारित/प्रसंस्करण सुविधा अनुज्ञात नहीं होगी और औद्योगिक प्रक्रिया तथा स्वास्थ्य स्थापन आदि से उत्पन्न किसी भी प्रकार के टोस अपशिष्ट के उपचार के लिए सामान्य या व्यक्तिगत जलावतरण की सुविधा का संस्थापन प्रतिषिद्ध होगा। |
| विनियमित क्रियाकलाप | | |
| 10. | होटलों और रिसोर्टों की वाणिज्यिक स्थापना। | पारिस्थितिकी पर्यटन क्रियाकलापों संबंधी लघु अस्थायी संरचनाओं के लिए संरक्षित क्षेत्र की सीमा से एक किलोमीटर भीतर या पारिस्थितिकी संवेदी जोन के विस्तार तक, इनमें जो भी निकट है, नए वाणिज्यिक होटल और रिसोर्ट अनुज्ञात होंगे, अन्यथा नहीं। परंतु, संरक्षित क्षेत्र की सीमा से एक किलोमीटर से परे या पारिस्थितिकी संवेदी जोन के विस्तार तक, जो भी निकट हो, सभी नए पर्यटन क्रियाकलापों या विद्यमान क्रियाकलापों का विस्तार पर्यटन महायोजना तथा लागू मार्गदर्शी सिद्धांतों के अनुरूप होगा। |
| 11. | संनिर्माण क्रियाकलाप। | (क) संरक्षित क्षेत्र की सीमा से एक किलोमीटर के भीतर या पारिस्थितिकी संवेदी जोन के विस्तार तक, जो भी निकट हो, किसी भी प्रकार का नया वाणिज्यिक संनिर्माण अनुज्ञात नहीं किया जाएगा; परंतु स्थानीय लोगों को पैरा 3 के उप पैरा (1) में सूचीबद्ध क्रियाकलापों सहित उनके आवासीय उपयोग के लिए उनकी भूमि में संनिर्माण करने की अनुमति भवन उपविधियों के अनुसार दी जाएगी। (ख) ऐसे लघु उद्योगों जो प्रदूषण उत्पन्न नहीं करते हैं, से संबंधित संनिर्माण क्रियाकलाप विनियमित किए जाएंगे और लागू नियमों और विनियमों, यदि कोई हों, के अनुसार सक्षम प्राधिकारी की पूर्ण अनुमति से ही न्यूनतम पर रखे जाएंगे। (ग) एक किलोमीटर से आगे यह आंचलिक महायोजना की अनुसार विनियमित होंगे। |
| 12. | प्रदूषण उत्पन्न न करने वाले लघु उद्योग। | फरवरी, 2016 में केन्द्रीय प्रदूषण बोर्ड द्वारा जारी उद्योगों के वर्गीकरण के अनुसार गैर-प्रदूषणकारी उद्योग और अपरिसंकेतमय लघु और सेवा उद्योग, कृषि, पुष्प कृषि उद्यान, जो पारिस्थितिकी संवेदी जोन से देशी सामग्रियों से बने उत्पादों का उत्पादन करते हैं, सक्षम प्राधिकारी द्वारा अनुज्ञात होंगे। |
| 13. | पारिस्थितिकी अनुकूल पर्यटन क्रियाकलापों के लिए, पर्यटकों के अस्थायी अधिभोग के लिए पारिस्थितिकी अनुकूल कुटीर जैसे टेन्ट, काष्ठ गृह आदि। | लागू विधियों के अधीन विनियमित होंगे। |

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| 14. | बुझों की कटाई। | (क) राज्य सरकार में सक्षम प्राधिकारी की पूर्व अनुमति के बिना वन, सरकारी या राजस्व या निजी भूमि पर बुझों की कोई कटाई नहीं होगी। (ख) बुझों की कटाई संबंधित केंद्रीय या राज्य अधिनियम या उसके अधीन बनाए गए नियमों के उपबंध के अनुसार विनियमित होगी। |
| 15. | वन उत्पादों और गैर काष्ठ वन उत्पादों का संग्रहण (एनटीएफपी)। | लागू विधियों के अधीन विनियमित होंगे। |
| 16. | विद्युत और संचार टावरों का परिनिर्माण और केबल बिछाना और अन्य अवसंरचनाएं। | लागू विधियों के अधीन विनियमित होंगे। (भूमिगत केबल को बड़ावा दिया जा सकेगा)। |
| 17. | नागरिक सुख सुविधाओं सहित बुनियादी ढांचे। | तृप्तीकरण के उपायों के साथ, लागू विधियों नियमों और विनियमों और उपलब्ध दिशानिर्देशों के अनुसार किए जाएंगे। |
| 18. | विद्यमान सड़कों को चौड़ा करना और उन्हें सुदृढ़ करना और नई सड़कों का संनिर्माण। | तृप्तीकरण के उपायों के साथ, लागू विधियों नियमों और विनियमों और उपलब्ध दिशानिर्देशों के अनुसार किए जाएंगे। |
| 19. | अन्य गर्म वायु गुब्बारों, हेलीकॉप्टर, ड्रोन, माइक्रोलाइटस पारिस्थितिकी संवेदी जोन क्षेत्र के ऊपर से उड़ना जैसे पर्यटन से संबंधित क्रियाकलाप करना। | लागू विधियों के अधीन विनियमित होंगे। |
| 20. | पहाड़ी ढालों और नदी तटों का संरक्षण। | लागू विधियों के अधीन विनियमित होंगे। |
| 21. | रात्रि में यानिक यातायात का संचलन। | लागू विधियों के अधीन वाणिज्यिक प्रयोजन के लिए विनियमित होंगे। |
| 22. | स्थानीय समुदायों द्वारा चलाई जा रही कृषि और बागवानी प्रथाओं के साथ डेयरियां, डेयरीकृषि, जल कृषि और मत्स्य पालन। | स्थानीय लोगों के उपयोग के लिए लागू विधियों के अधीन विनियमित होंगे। |
| 23. | प्राकृतिक जल निकायों या सतही क्षेत्र में उपचारित बहिर्वाह का निस्सारण। | बहिर्वाह का निस्सारण लागू विधियों के अनुसार विनियमित होगा। |
| 24. | सतही और भूजल के वाणिज्यिक निष्कर्षण। | लागू विधियों के अधीन विनियमित होंगे। |
| 25. | खुले कुआं, बोर कुआं, आदि के लिए कृषि और अन्य उपयोग। | विनियमित और उपयुक्त प्राधिकारी द्वारा क्रियाकलापों की सख्ती से मानीटरी की जाएगी। |
| 26. | ठोस अपशिष्ट प्रबंधन। | लागू विधियों के अधीन विनियमित होंगे। |
| 27. | पारिस्थितिकी पर्यटन। | लागू विधियों के अधीन विनियमित होंगे। |
| 28. | पोलिथीन बैगों का उपयोग। | लागू विधियों के अधीन विनियमित होंगे। |
| 29. | विदेशी प्रजातियों को लाना। | लागू विधियों के अधीन विनियमित होंगे। |
| संबंधित क्रियाकलाप | | |
| 30. | बर्षा जल संचयन। | सक्रिय रूप से बढ़ावा दिया जाएगा। |
| 31. | जैविक खेती। | सक्रिय रूप से बढ़ावा दिया जाएगा। |
| 32. | सभी गतिविधियों के लिए हरित प्रौद्योगिकी को ग्रहण करना। | सक्रिय रूप से बढ़ावा दिया जाएगा। |
| 33. | कुटीर उद्योगों जिसके अंतर्गत ग्रामीण कारीगर भी हैं। | सक्रिय रूप से बढ़ावा दिया जाएगा। |
| 34. | कृषि बानिजी। | सक्रिय रूप से बढ़ावा दिया जाएगा। |
| 35. | कौशल विकास। | सक्रिय रूप से बढ़ावा दिया जाएगा। |
| 36. | निष्प्रेरित भूमि या वन या बास की बहाली। | सक्रिय रूप से बढ़ावा दिया जाएगा। |
| 37. | पर्यावरणीय जागरूकता। | सक्रिय रूप से बढ़ावा दिया जाएगा। |
| 38. | जल संरक्षण उपाय। | सक्रिय रूप से बढ़ावा दिया जाएगा। |

5. मानीटरी समिति- (1) केंद्रीय सरकार, पारिस्थितिकी संवेदी जोन के प्रभावी मानीटरी के लिए एक मानीटरी समिति का गठन करेगी जो निम्नलिखित से मिलकर बनेगी, अर्थात् :-

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| (i) | मुख्य वन्यजीव वार्डन, वन और वन्यजीव विभाग, दिल्ली राष्ट्रीय राजधानी राज्यक्षेत्र सरकार | - अध्यक्ष; |
| (ii) | दिल्ली राष्ट्रीय राजधानी राज्यक्षेत्र सरकार द्वारा नामनिर्दिष्ट प्रत्येक मामले में तीन वर्ष की अवधि के लिए पारिस्थितिकी और पर्यावरण क्षेत्र का एक विशेषज्ञ | - सदस्य; |
| (iii) | पर्यावरण के क्षेत्र में कार्य करने वाले गैर सरकारी संगठनों (जिसके अंतर्गत विरासत संरक्षण भी है) का प्रत्येक मामले में तीन वर्ष की अवधि के लिए दिल्ली राष्ट्रीय राजधानी राज्य सरकार द्वारा नामनिर्दिष्ट एक प्रतिनिधि | - सदस्य; |
| (iv) | दिल्ली, प्रदूषण नियंत्रण समिति का प्रतिनिधि | - सदस्य; |
| (v) | राज्य जैव-विविधता बोर्ड का सदस्य | - सदस्य; |
| (vi) | उप वन संरक्षक (दक्षिण), वन और वन्यजीव विभाग, दिल्ली राष्ट्रीय राजधानी राज्यक्षेत्र सरकार | - सदस्य सचिव। |

6. निर्देश निबंधन (1) मानीटरी समिति इस अधिसूचना के उपबंधों के अनुपालन को मानीटर करेगी।

(2) इस अधिसूचना में मानीटरी समिति का कार्यकाल तीन वर्ष की अवधि के लिए होगा।

(3) भारत सरकार के तत्कालीन पर्यावरण और वन मंत्रालय की अधिसूचना सं. का.आ. 1533(अ), तारीख 14 सितंबर, 2006 की अनुसूची के अन्तर्गत आने वाले क्रियाकलापों और इस अधिसूचना के पैरा 4 के अधीन सारणी में यथा विनिर्दिष्ट प्रतिपिद्ध गतिविधियों के सिवाय आने वाले ऐसे क्रियाकलापों की दशा में वास्तविक विनिर्दिष्ट स्थलीय दशाओं पर आधारित मानीटरी समिति द्वारा संवीक्षा की जाएगी और उक्त अधिसूचना के उपबंधों के अधीन पूर्व पर्यावरणीय अनापत्ति के लिए केंद्रीय सरकार के पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय को निर्दिष्ट की जाएगी।

(4) इस अधिसूचना के पैरा 4 के अधीन सारणी में यथा विनिर्दिष्ट प्रतिपिद्ध क्रियाकलापों के सिवाय, भारत सरकार के तत्कालीन पर्यावरण और वन मंत्रालय की अधिसूचना संख्यांक का.आ. 1533(अ), तारीख 14 सितंबर, 2006 की अधिसूचना के अनुसूची के अधीन ऐसे क्रियाकलापों, जिन्हें अनुसूची में सम्मिलित नहीं किया गया है, परंतु पारिस्थितिकी संवेदी जोन में आते हैं, ऐसे क्रियाकलापों की वास्तविक विनिर्दिष्ट स्थलीय दशाओं पर आधारित निगरानी समिति द्वारा संवीक्षा की जाएगी और उसे संबद्ध विनियामक प्राधिकरणों को निर्दिष्ट किया जाएगा।

(5) मानीटरी समिति का सदस्य-सचिव या संबद्ध कलक्टर संबद्ध पार्क उपवन संरक्षक का ऐसे व्यक्ति के विरुद्ध, जो इस अधिसूचना के किसी उपबंध का उल्लंघन करता है, पर्यावरण (संरक्षण) अधिनियम, 1986 की धारा 19 के अधीन परिवाद फाइल करने के लिए सक्षम होगा।

(6) मानीटरी समिति मुद्दा दर मुद्दा के आधार पर अपेक्षाओं पर निर्भर रहते हुए संबद्ध विभागों के प्रतिनिधियों या विशेषज्ञों, औद्योगिक संगमों या संबद्ध पणधारियों के प्रतिनिधियों को अपने विचार-विमर्श में सहायता के लिए आमंत्रित कर सकेगी।

(7) मानीटरी समिति प्रत्येक वर्ष की 31 मार्च तक की अपनी वार्षिक कार्रवाई रिपोर्ट राज्य के मुख्य वन्यजीव वार्डन को **उपाबंध IV** में संलग्न रूप विधान के अनुसार उस वर्ष के 30 जून तक प्रस्तुत करेगी।

(8) केंद्रीय सरकार का पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय निगरानी समिति को अपने कृत्यों के प्रभावी निर्वहन के लिए समय-समय पर ऐसे निदेश दे सकेगा, जो वह ठीक समझे।

7. इस अधिसूचना के उपबंधों को प्रभावी करने के लिए केंद्रीय सरकार और राज्य सरकार, अतिरिक्त उपाय, यदि कोई हों, विनिर्दिष्ट कर सकेगी।

8. इस अधिसूचना के उपबंध भारत के माननीय उच्चतम न्यायालय या उच्च न्यायालय या राष्ट्रीय हरित प्राधिकरण द्वारा पारित किसी आदेश या पारित होने वाले किसी आदेश, यदि कोई हों, के अधीन रहते हुए होंगे।

[फा. सं. 25/196/2015-ईएसजेड/आरई]

ललित कपूर, वैज्ञानिक 'जी'

1. सू-निर्देशांकों के साथ असोला भाटी वन्यजीव अभयारण्य की सीमा का वर्णन

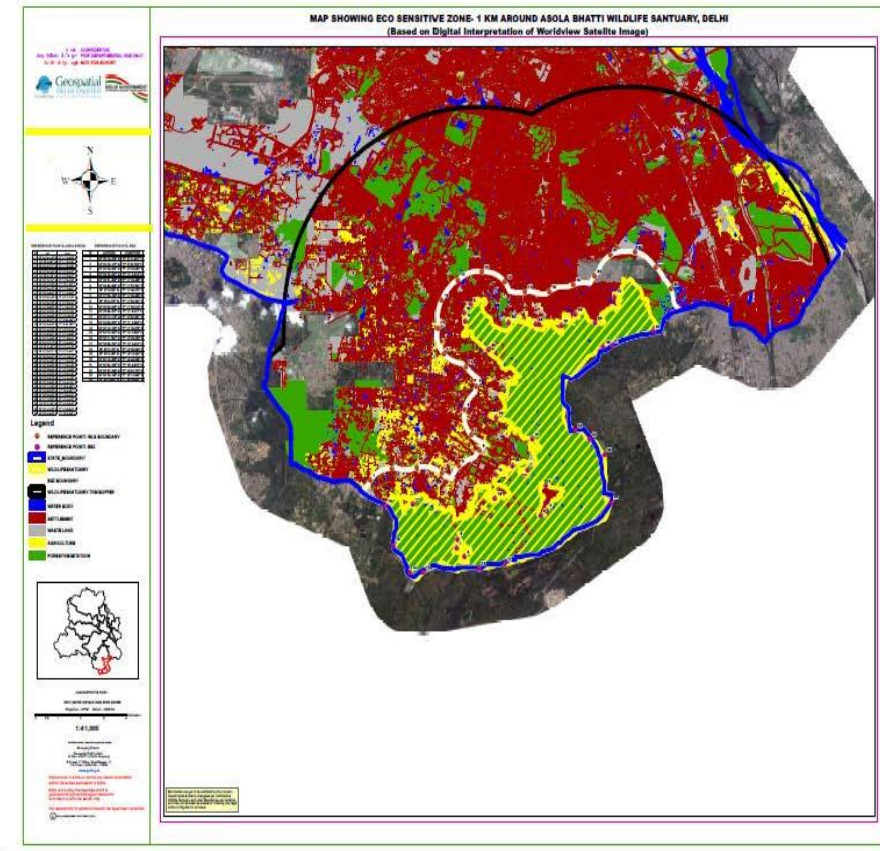
| आई डी | अक्षांश | देशांतर |
|-------|-----------------|------------------|
| 1. | 28°24'54.184" उ | 77°11'24.590" पू |
| 2. | 28°25'5.081" उ | 77°11'25.700" पू |
| 3. | 28°24'43.731" उ | 77°11'35.786" पू |
| 4. | 28°25'38.765" उ | 77°13'35.267" पू |
| 5. | 28°26'8.130" उ | 77°13'33.637" पू |
| 6. | 28°25'32.701" उ | 77°13'26.335" पू |
| 7. | 28°26'27.328" उ | 77°13'7.012 " पू |
| 8. | 28°29'25.475" उ | 77°11'36.861" पू |
| 9. | 28°29'44.864" उ | 77°11'44.864" पू |
| 10. | 28°29'54.109" उ | 77°15'12.762" पू |
| 11. | 28°24'35.220" उ | 77°12'33.916" पू |
| 12. | 28°24'30.685" उ | 77°11'56.703" पू |
| 13. | 28°24'25.334" उ | 77°10'37.736" पू |
| 14. | 28°24'24.846" उ | 77°10'18.539" पू |
| 15. | 28°24'58.337" उ | 77°09'54.346" पू |
| 16. | 28°25'44.976" उ | 77°09'42.783" पू |
| 17. | 28°25'46.300" उ | 77°10'23.248" पू |
| 18. | 28°25'53.061" उ | 77°12'19.850" पू |
| 19. | 28°26'21.060" उ | 77°12'20.344" पू |
| 20. | 28°26'32.212" उ | 77°12'45.691" पू |
| 21. | 28°27'3.152" उ | 77°13'14.179" पू |
| 22. | 28°27'28.721" उ | 77°12'21.847" पू |
| 23. | 28°28'50.633" उ | 77°12'10.975" पू |
| 24. | 28°29'34.359" उ | 77°11'35.268" पू |
| 25. | 28°29'23.485" उ | 77°12'40.109" पू |
| 26. | 28°29'20.946" उ | 77°13'19.080" पू |
| 27. | 28°29'19.352" उ | 77°13'55.770" पू |
| 28. | 28°29'32.579" उ | 77°14'16.189" पू |
| 29. | 28°29'22.606" उ | 77°14'44.761" पू |
| 30. | 28°29'12.158" उ | 77°16'8.562" पू |

| | | |
|-----|-----------------|------------------|
| 31. | 28°28'55.525" उ | 77°15'8.897" पू |
| 32. | 28°28'54.266" उ | 77°14'56.674" पू |
| 33. | 28°27'13.352" उ | 77°14'16.155" पू |
| 34. | 28°27'3.120" उ | 77°14'36.943" पू |
| 35. | 28°26'44.798" उ | 77°14'58.548" पू |
| 36. | 28°25'48.496" उ | 77°15'8.046" पू |

2. भू-निर्देशांकों के साथ असोला भाटी वन्यजीव अभयारण्य के पारिस्थितिकी संवेदी जोन की सीमा का वर्णन

| आई डी | अक्षांश | देशांतर |
|-------|-----------------|------------------|
| 1. | 28°26'14.374" उ | 77°9'21.602" पू |
| 2. | 28°26'29.137" उ | 77°9'52.708" पू |
| 3. | 28°26'29.909" उ | 77°10'28.680" पू |
| 4. | 28°26'23.091" उ | 77°11'3.318" पू |
| 5. | 28°26'31.459" उ | 77°11'28.485" पू |
| 6. | 28°26'49.684" उ | 77°11'57.991" पू |
| 7. | 28°27'8.026" उ | 77°11'46.272" पू |
| 8. | 28°27'38.186" उ | 77°11'36.488" पू |
| 9. | 28°28'6.279" उ | 77°11'53.381" पू |
| 10. | 28°28'30.625" उ | 77°11'38.319" पू |
| 11. | 28°28'46.087" उ | 77°11'6.227" पू |
| 12. | 28°29'17.115" उ | 77°10'57.891" पू |
| 13. | 28°29'49.903" उ | 77°11'2.969" पू |
| 14. | 28°30'14.183" उ | 77°11'26.575" पू |
| 15. | 28°30'23.530" उ | 77°12'0.890" पू |
| 16. | 28°30'11.591" उ | 77°12'34.250" पू |
| 17. | 28°29'59.750" उ | 77°13'3.415" पू |
| 18. | 28°30'0.133" उ | 77°13'38.540" पू |
| 19. | 28°30'8.198" उ | 77°14'13.562" पू |
| 20. | 28°30'18.655" उ | 77°14'44.046" पू |
| 21. | 28°30'43.185" उ | 77°15'6.876" पू |
| 22. | 28°30'47.304" उ | 77°15'42.773" पू |
| 23. | 28°30'29.148" उ | 77°16'12.663" पू |
| 24. | 28°30'2.959" उ | 77°16'34.687" पू |

ख- निर्देशकों के साथ अशोभा भाटी बायोजीव अभयारण्य के पारिस्थितिकी संवेदी जोन का मानचित्र



उपाबंध -III**पारिस्थितिकी संवेदी जोन के अंतर्गत आने वाले ग्रामों की सूची**

| क्र.सं. | ग्राम का नाम | अक्षांश | देशांतर |
|---------|--------------|----------------|-----------------|
| 1. | असोला | 28 26'34.311"उ | 77 13'8.718"पू |
| | | 28 26'53.776"उ | 77 12'13.910"पू |
| | | 28 27'20.910"उ | 77 11'38.499"पू |
| | | 28 26'56.166"उ | 77 12'55.083"पू |
| 2. | साहुरपुर | 28 27'35.663"उ | 77 12'13.664"पू |
| | | 28 27'41.570"उ | 77 13'3.098"पू |
| | | 28 27'50.010"उ | 77 12'26.283"पू |
| | | 28 27'23.845"उ | 77 12'43.011"पू |
| 3. | सतबरी | 28°27'51"उ | 77°12'53" पू |
| | | 28°28'12"उ | 77°12'0" पू |
| 4. | मैदान गढ़ी | 28 28'53.606"उ | 77 13'20.519"पू |
| | | 28 28'54.045"उ | 77 12'55.731"पू |
| | | 28 29'0.966"उ | 77 12'19.817"पू |
| | | 28 29'26.500"उ | 77 12'57.194"पू |
| 5. | तुगलकबाद | 28 30'15.454"उ | 77 15'35.514"पू |
| | | 28 29'17.408"उ | 77 16'19.757"पू |
| | | 28 28'49.951"उ | 77 14'56.175"पू |
| | | 28 29'21.756"उ | 77 14'54.317"पू |
| 6. | देवली | 28° 29'27.7"उ | 77°12'57"पू |
| | | 28° 28'54.4"उ | 77°13'22.5"पू |
| 7. | भट्टी | 28 25'20.285"उ | 77 12'15.992"पू |
| | | 28 25'19.788"उ | 77 11'39.259"पू |
| | | 28 25'52.459"उ | 77 12'34.091"पू |
| | | 28 26'4.663"उ | 77 11'53.371"पू |

उपाबंध IV**पारिस्थितिकी संवेदी जोन मानीटरी समिति - की गई कार्रवाई की रिपोर्ट का रूप विधान**

1. बैठकों की संख्या और तिथि।
2. बैठकों का कार्यवृत्त : कृपया मुख्य उल्लेखनीय बिंदुओं का वर्णन करें। बैठक के कार्यवृत्त को एक पृथक अनुबंध में उपाबद्ध करें।
3. आंचलिक महायोजना की तैयारी की प्रस्थिति जिसके अंतर्गत पर्यटन महायोजना।
4. भू-अभिलेख में सदृश्य वृत्तियों के सुधार के लिए ब्यौहार किए गए मामलों का सारांश।
5. पर्यावरण समाघात निर्धारण अधिसूचना, 2006 के अधीन आने वाली गतिविधियों की संविधा के मामलों का सारांश। ब्यौरे एक पृथक् उपाबंध के रूप में उपाबद्ध किए जा सकते हैं।
6. पर्यावरण समाघात निर्धारण अधिसूचना, 2006 के अधीन न आने वाली गतिविधियों की संविधा के मामलों का सारांश। ब्यौरे एक पृथक् उपाबंध के रूप में उपाबद्ध किए जा सकते हैं।
7. पर्यावरण (संरक्षण) अधिनियम, 1986 की धारा 19 के अधीन दर्ज की गई शिकायतों का सारांश।
8. कोई अन्य महत्वपूर्ण विषय।

MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE

NOTIFICATION

New Delhi, the 11th September, 2017

S.O. 2996(E).—WHEREAS, a draft notification was published in the Gazette of India, Extraordinary, vide notification of the Government of the India in the Ministry of Environment, Forest and Climate Change number S.O. 2114, dated the 15th June 2016, inviting objections and suggestions from all persons likely to be affected thereby within the period of sixty days from date on which copies of the Gazette containing the said notification were made available to the public;

AND WHEREAS, copies of the Gazette containing the said Draft notification were made available to the public on the dated the 15th June 2016

AND WHEREAS, objections and suggestions received from all persons and stakeholders in response to the draft notification have been duly considered by the Central Government;

AND WHEREAS, the Asola Bhatti Wildlife Sanctuary located in the National Capital Territory of Delhi is spread over an area of 19.57 square kilometers and sSanctuary is located between 28^o 23' 00'' N to 28^o 30' 00'' N latitude and 77^o 11' 00'' E to 77^o 17' 00'' E longitudes;

AND WHEREAS, the Asola Bhatti Wildlife Sanctuary shares its boundary with the State of Haryana in Eastern, Southern and South-Western directions and this notification is for notifying the Eco-sensitive Zone around the Asola Bhatti Wildlife Sanctuary of National Capital Territory of Delhi;

AND WHEREAS, the flora and fauna represent rich biological significance of this Sanctuary and the faunal diversity is represented by 17 species of mammals, around 201 species of resident and migratory birds, 12 species of reptiles, 5 species of amphibians, 63 species of butterflies and 05 species of dragonflies, and important species found in the protected area are Nilgai (*Boselaphus tragocamelus*), Jungle cat (*Felis chaus*), small Indian Civet (*Viverricula indica*), Mongoose (*Herpestes auropunctatus*), Jackal (*Canis aureus*), Indian porcupine (*Hystrix indica*), five striped palm squirrel (*Funambulus pennantii*), Cheetal (*Acinonyx jubatus*) etc;

AND WHEREAS, the ofoersaid sanctuary consists of a mixture of indigenous and exotic species of Flora and is known to harbor around 83 species of trees, around 30 species of shrubs, around 95 species of herbs, around 18 species of grasses and around 4 species of sedges;The native flora includes various species of *Acacia* such as *Acacia nilotica*, *Acacia leucophloea*, *Acacia catechu*, *Acacia senegal*, *Acacia modesta*, *Butea monosperma*, *Cassia fistula*, *Salvadora persica* and in the small boulder hillocks a few scattered trees of *Anogeissus pendula* are also found; some other trees found in the area include *Dalbergia sissoo*, *Ficus religiosa*, *Morus indica*, *Azadirachta indica*, *Pongamia pinnata* etc;

AND WHEREAS, it is necessary to conserve and protect the area, the extent and boundaries of which are specified in paragraph 1 of this notification, around the protected area of Asola Bhatti Wildlife Sanctuary as Eco-sensitive Zone from ecological, environmental and biodiversity point of view and to prohibit industries or class of industries and their operations and processes in the said Eco-sensitive Zone;

NOW THEREFORE, in exercise of the powers conferred by sub-section(1) and clauses (v) and (xiv) of sub-section (2) and sub-section (3) of section 3 of the Environment (Protection) Act, 1986 (29 of 1986) read with sub-rule (3) of rule 5 of the Environment (Protection) Rules, 1986, the Central Government hereby notifies an area with an extent upto one kilometer from the boundary of the Asola Bhatti Wildlife Sanctuary in the National Capital Territory of Delhi as the Asola Bhatti Wildlife Sanctuary Eco-sensitive Zone (hereinafter referred to as the Eco-sensitive Zone) details of which are as under, namely:-

1. Extent and boundaries of Eco-sensitive Zone.- (1) The Eco-sensitive Zone shall be of 15.55 square kilometers with an extent upto one kilometer from the Asola Bhatti Wildlife Sanctuary. And the description of the Ashola Bhatti Wildlife Sanctuary and eco-sensitive Zone with Geo- Coordinates is given in **Annexure-I.**

(2) The map of the Eco-sensitive Zone along with boundary details and latitudes and longitudes is appended as **Annexure-II.**

(3) List of villages falling in the in Eco-sensitive Zone in given at **Annexure-III.**

2. Zonal Master Plan for Eco-sensitive Zone.- (1) The State Government shall, for the purpose of the Eco-sensitive Zone prepare, a Zonal Master Plan, within a period of two years from the date of publication of this notification in the Official Gazette, in consultation with local people and adhering to the stipulations given in this notification for consideration and approval of the State Government.

(2) The Zonal Master Plan for the Eco-sensitive Zone shall be prepared by the State Government in such manner as is specified in this notification and also in consonance with the relevant Central and State laws and the guidelines issued by the Central Government, if any.

(3) The Zonal Master Plan shall be prepared in consultation with the following State Departments, for integrating the ecological and environmental considerations into the said plan:-

- (i) Environment;
- (ii) Forest;
- (iii) Urban Development;
- (iv) Tourism;
- (v) Municipal;
- (vi) Revenue;
- (vii) Agriculture;
- (viii) Delhi State Pollution Control Committee;
- (ix) Irrigation;
- (x) Public Works Department.

(4) The Zonal Master Plan shall not impose any restriction on the approved existing land use, infrastructure and activities, unless so specified in this notification and the Zonal Master Plan shall factor in improvement of all infrastructure and activities to be more efficient and eco-friendly.

(5) The Zonal Master Plan shall provide for restoration of denuded areas, conservation of existing water bodies, management of catchment areas, watershed management, groundwater management, soil and moisture conservation, needs of local community and such other aspects of the ecology and environment that need attention.

(6) The Zonal Master Plan shall demarcate all the existing worshipping places, village and urban settlements, types and kinds of forests, agricultural areas, fertile lands, green area, such as, parks and like places, horticultural areas, orchards, lakes and other water bodies with supporting maps and the Plan shall be supported by maps giving details of existing and proposed land use features.

(7) The Zonal Master Plan shall regulate development in Eco-sensitive Zone as to ensure eco-friendly development for livelihood security of local communities.

(8) The Zonal Master Plan shall be reference documents for the Monitoring Committee for carrying out its functions of monitoring *vide* the provisions of this notification.

3. **Measures to be taken by State Government.**-The State Government shall take the following measures for giving effect to the provisions of this notification, namely:-

- (1) **Land use.**- Forests, horticulture areas, agricultural areas, parks and open spaces earmarked for recreational purposes in the Eco-sensitive Zone shall not be used or converted into areas for commercial or industrial activities;

Provided that the conversion of agricultural and other lands within the Eco-sensitive Zone may be permitted on the recommendation of the Monitoring Committee, and with the prior approval of the State Government to meet the residential needs of the local residents and for activities such as:

- (i) widening and strengthening of existing roads and construction of new roads;
- (ii) construction and renovation of infrastructure and civic amenities;
- (iii) small scale industries not causing pollution;
- (iv) cottage industries including village industries; convenience stores and local amenities supporting eco-tourism including home stay; and
- (v) promoted activities given in paragraph 4

Provided further that no use of tribal land shall be permitted for commercial and industrial development activities without the prior approval of the of the State Government and without compliance of the provisions of article 244 of the Constitution or the law for the time being in force, including the Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 (2 of 2007):

Provided also that any error appearing in the land records within the Eco-sensitive Zone shall be corrected by the State Government, after obtaining the views of Monitoring Committee, once in each case and the correction of said error shall be intimated to the Central Government in the Ministry of Environment, Forest and Climate Change:

Provided also that the above correction of error shall not include change of land use in any case except as provided under this sub-paragraph.

Provided also that there shall be no consequential reduction in green area, such as forest area and agricultural area and efforts shall be made to reforest the unused or unproductive agricultural areas with afforestation and habitat restoration activities.

(2) **Natural springs.**- The catchment areas of all natural springs shall be identified and plans for their conservation and rejuvenation shall be incorporated in the Zonal Master Plan and guidelines shall be drawn up by the State Government in such a manner as to prohibit development activities at or near these areas which are detrimental to such areas.

(3) **Tourism.**- The activity relating to tourism activities within the Eco-Sensitive Zone shall be as per the Tourism Master Plan for the Eco-sensitive Zone.

(b) The Tourism Master Plan shall be prepared by the State Department of Tourism in consultation with State Departments of Environment and Forests.

(c) The Tourism Master Plan shall form a component of the Zonal Master Plan.

(d) The activities of eco-tourism shall be regulated as under, namely:-

(i) no new construction of hotels and resorts shall be permitted within one kilometer km from the boundary of the Ashola Bhatti Wildlife Sanctuary or upto the extent of the Eco-Sensitive Zone whichever is nearer and beyond the distance of one kilometer from the boundary of the said Wildlife Sanctuary till the extent of the Eco-sensitive Zone, the establishment of new hotels and resorts shall be permitted only in pre-defined and designated areas for eco-tourism facilities as per Tourism Master Plan.

(ii) all new tourism activities or expansion of existing tourism activities within the Eco-sensitive Zone shall be in accordance with the guidelines issued by the Central Government in the Ministry of Environment, Forest and Climate Change and the eco-tourism guidelines issued by National Tiger Conservation Authority (as amended from time to time) with emphasis on eco-tourism eco-education and eco-development and based on carrying capacity study of Eco-sensitive Zone;

(iii) till the Zonal Master Plan is approved, development for tourism and expansion of existing tourism activities shall be permitted by the concerned regulatory authorities based on the actual site specific scrutiny and recommendation of the Monitoring Committee.

(4) **Natural heritage.**- All sites of valuable natural heritage in the Eco-sensitive Zone, such as the gene pool reserve areas, rock formations, waterfalls, springs, gorges, groves, caves, points, walks, rides, cliffs, etc. shall be identified and preserved and plan for their preservation and conservation shall be drawn up within six months from the date of publication of this notification in the official Gazette and such plan shall form part of the Zonal Master Plan.

(5) **Man-made heritage sites.**- Buildings, structures, artefacts, areas and precincts of historical, architectural, aesthetic, and cultural significance shall be indentified in the Eco-sensitive Zone and plans for their conservation shall be prepared within six months from the date of publication of this notification in the official Gazette and incorporated in the Zonal Master Plan.

(6) **Noise pollution:** Prevention and Control of noise pollution in the Eco-sensitive Zone shall be complied with in accordance with Noise Pollution (Regulation And Control) Rules, 2000 under the Environment (Protection) Act, 1986 and amendments thereto.

(7) **Air pollution:** Prevention and control of air pollution in the Eco-sensitive Zone shall be complied with in accordance with the provisions of the Air (Prevention and Control of Pollution) Act, 1981 (14 of 1981) and rules made thereunder and amendments thereto.

(8) **Discharge of effluents:** Discharge of treated effluent in Eco-sensitive Zone shall be in accordance with the provisions of the General Standards for Discharge of Environmental Pollutants covered under the Environmental (Protection) Act, 1986 and rules made thereunder or standards stipulated by State Government whichever is more stringent.

(9) **Solid wastes.** - Disposal of solid wastes shall be as under:-

(i) the solid waste disposal in Eco-sensitive Zone shall be carried out in accordance with the Solid Waste Management Rules, 2016 published by the Government of India in the Ministry of Environment, Forests and Climate Change vide notification number S.O. 1357 (E), dated the 8th April, 2016 as amended from time to time;

(ii) the local authorities shall draw up plans for the segregation of solid wastes into biodegradable and non-biodegradable components;

(iii) the biodegradable material shall be recycled preferably through composting or vermiculture;

(iv) the inorganic material may be disposed in an environmental acceptable manner at site identified outside the Eco-sensitive Zone;

(v) no burning or incineration of solid wastes and establishment of landfills shall be permitted in the Eco-sensitive Zone.

(10) **Bio-medical waste.-** The bio-medical waste disposal in the Eco-sensitive Zone shall be carried in accordance with the Bio-Medical Waste Management Rules, 2016 published by the Government of India in the Ministry of Environment, Forest and Climate Change vide notification number GSR 343 (E), dated the 28th March, 2016 as amended from time to time.

(11) **Vehicular traffic.** - The vehicular movement of traffic shall be regulated in a habitat friendly manner and specific provisions in this regard shall be incorporated in the Zonal Master Plan and till such time as the Zonal Master Plan is prepared and approved by the competent authority in the State Government, the Monitoring Committee shall monitor compliance of vehicular movement under the relevant Acts and the rules and regulations made thereunder.

(12) **Vehicular pollution.-**Prevention and control of vehicular pollution shall be carried out in accordance with applicable laws and efforts shall be made for use of cleaner fuel for example CNG, etc.

(13) **Plastic waste management.-** The plastic waste management in the Eco-sensitive Zone shall be carried out as per the provisions of the Plastic Waste Management Rules, 2016 published by the Government of India in the Ministry of Environment, Forest and Climate Change vide notification number G.S.R. 340(E), dated the 18th March, 2016, as amended from time to time.

(14) **Construction and demolition waste management.-** The construction and demolition waste management in the Eco-sensitive Zone shall be carried out as per the provisions of the Construction and Demolition Waste Management Rules, 2016 published by the Government of India in the Ministry of Environment, Forest and Climate Change vide notification number G.S.R. 317(E), dated the 29th March, 2016, as amended from time to time.

(15) **E-waste.-** The e- waste management in the Eco-sensitive Zone shall be carried out as per the provisions of the E-Waste Management Rules, 2016 published by the Government of India in the Ministry of Environment, Forest and Climate Change and as amended from time to time.

(16) **Industrial units.-** (a) No establishment of new wood based industries within the Eco-sensitive Zone shall be permitted except the existing wood based industries set up as per the law.

(b) No establishment of any new industry causing water, air, soil, noise pollution within the proposed Eco-sensitive Zone shall be permitted.

(17) **Protection of hill slopes.-** The protection of hill slopes shall be as under:-

(a) the Zonal Master Plan shall indicate areas on hill slopes where no construction shall be permitted;

(b) no construction on existing steep hill slopes or slopes with a high degree of erosion shall be permitted.

4. **Prohibited, Regulated and Promoted Activities.-**All activities in the Eco sensitive Zone shall be governed by the provisions of the Environment (Protection) Act, 1986 (29 of 1986) and the rules made thereunder and shall be regulated in the manner specified in the Table below, namely:-

TABLE

| S.No. | Activity | Remarks |
|------------------------------|--|---|
| (1) | (2) | (3) |
| Prohibited activities | | |
| 1. | Commercial mining, stone quarrying and crushing units. | (a) new mining (minor and major minerals), stone quarrying and crushing units shall be prohibited except for the domestic needs of <i>bona fide</i> local residents including digging of earth for construction or repair of houses and for manufacture of country tiles or bricks for housing for personal consumption. (b) The mining operations shall strictly be in accordance with the orders of the Hon'ble Supreme Court dated the 4 th August, 2006 in the matter of T.N. Godavarman Thirumulpad Vs. Union of India in Writ Petition (Civil) No.202 of 1995 and order of the Hon'ble Supreme Court dated the 21 st April, 2014 in the matter of Goa Foundation Vs. Union of India in Writ Petition (Civil) No.435 of 2012. |
| 2. | Setting up of saw mills. | No new or expansion of existing saw mills shall be permitted within the Eco-sensitive Zone. |
| 3. | Use or production of any hazardous substances. | Prohibited (except as otherwise provided) as per applicable laws. |

| | | |
|-----------------------------|--|--|
| 4. | Setting up of industries causing water or air or soil or noise pollution. | (a) No new or expansion of polluting industries in the Eco-sensitive zone shall be permitted. (b) Industries categorised as Green or White in the Central Pollution Control Board classification including agro-based small scale industries shall be regulated as per the applicable regulations. |
| 5. | Establishment of new major thermal and hydro-electric projects. | Prohibited (except as otherwise provided) as per applicable laws. |
| 6. | Establishment of large-scale commercial livestock and poultry farms by firms, companies, etc. | Prohibited (except as otherwise provided) as per applicable laws except for meeting local needs. |
| 7. | Discharge of untreated effluents and solid waste in natural water bodies or land area. | Prohibited (except as otherwise provided) as per applicable laws. |
| 8. | Setting up of brick kilns. | Prohibited (except as otherwise provided) as per applicable laws. |
| 9. | Establishment of solid waste disposal site and common incineration facility for solid and bio medical waste. | No new solid waste disposal site and waste treatment or processing facility of solid waste shall be permitted within Eco -sensitive zone and installation of common or individual incineration facility for treatment of any form of solid waste generated from industrial process and health establishment, hospitals, etc. shall be prohibited. |
| Regulated activities | | |
| 10. | Commercial establishment of hotels and resorts. | No new commercial hotels and resorts shall be permitted within one kilometer of the boundary of the Protected Area or upto the extent of Eco-sensitive zone, whichever is nearer, except for small temporary structures for eco-tourism activities: Provided that, beyond one kilometer from the boundary of the Protected Area or upto the extent of Eco-sensitive zone, whichever is nearer, all new tourist activities or expansion of existing activities shall be in conformity with the Tourism Master Plan and guidelines as applicable. |
| 11. | Construction activities. | (a) No new commercial construction of any kind shall be permitted within one kilometer from the boundary of the Protected Area or upto extent of the Eco-sensitive Zone, whichever is nearer: Provided that, local people shall be permitted to undertake construction in their land for their residential use including the activities listed in sub -paragraph (1) of paragraph 3 as per building byelaws. (b) The construction activity related to small scale industries not causing pollution shall be regulated and kept at the minimum, with the prior permission from the competent authority as per applicable rules and regulations, if any. (c) Beyond one kilometer it shall be regulated as per the Zonal Master Plan. |
| 12. | Small scale non polluting industries. | Non polluting industries as per classification of industries issued by the Central Pollution Control Board in February 2016 and non-hazardous, small-scale and service industry, agriculture, floriculture, horticulture or agro-based industry producing products from indigenous materials from the Eco-sensitive Zone shall be permitted by the competent Authority. |
| 13. | Eco-friendly cottages for temporary occupation of tourists such as tents, wooden houses, etc. for eco-friendly tourism activities. | Regulated under applicable laws. |

| | | |
|----------------------------|--|--|
| 14. | Felling of trees. | (a) There shall be no felling of trees on the forest or Government or revenue or private lands without prior permission of the Competent authority in the State Government. (b) The felling of trees shall be regulated in accordance with the provisions of the concerned Central or State Acts and the rules made thereunder. |
| 15. | Collection of Forest produce or Non-Timber Forest Produce (NTFP). | Regulated under applicable laws. |
| 16. | Erection of electrical and communication towers and laying of cables and other infrastructures . | Regulated under applicable law (underground cabling may be promoted). |
| 17. | Infrastructure including civic amenities. | Shall be done with mitigation measures, as per applicable laws, rules and regulation and available guidelines. |
| 18. | Widening and strengthening of existing roads and construction of new roads. | Shall be done with mitigation measures, as per applicable laws, rules and regulation and available guidelines. |
| 19. | Under taking other activities related to tourism like over flying the Eco-Sensitive Zone area by hot air balloon, helicopter, drones, Microlites, etc. | Regulated under applicable laws. |
| 20. | Protection of hill slopes and river banks . | Regulated under applicable laws. |
| 21. | Movement of vehicular traffic at night. | Regulated for commercial purpose under applicable laws. |
| 22. | Ongoing agriculture and horticulture practices by local communities along with dairies, dairy farming, aquaculture and fisheries. | Permitted under applicable laws for use of locals. |
| 23. | Discharge of treated effluents in natural water bodies or land area. | The discharge of treated effluent shall be regulated as per applicable laws. |
| 24. | Commercial extraction of surface and ground water | Regulated under applicable law. |
| 25. | open well, bore well etc. for agriculture or other usage. | Regulated under applicable law. and the activity shall be monitored by the concerned authority. |
| 26. | Solid waste management. | Regulated under applicable laws. |
| 27. | Eco-tourism. | Regulated under applicable laws. |
| 28. | Use of polythene bags. | Regulated under applicable laws. |
| 29. | Introduction of Exotic species. | Regulated under applicable laws. |
| Promoted activities | | |
| 30. | Rain water harvesting. | Shall be actively promoted. |
| 31. | Organic farming. | Shall be actively promoted. |
| 32. | Adoption of green technology for all activities. | Shall be actively promoted. |
| 33. | Cottage industries including village artisans. | Shall be actively promoted. |
| 34. | Agro-Forestry. | Shall be actively promoted. |
| 35. | Skill development. | Shall be actively promoted. |
| 36. | Restoration of degraded land/ forests/ habitat. | Shall be actively promoted. |
| 37. | Environmental awareness. | Shall be actively promoted. |
| 38. | Water conservation measures. | Shall be actively promoted. |

5. Monitoring Committee.- (1) The Central Government hereby constitutes a Monitoring Committee for effective monitoring of the Eco-sensitive Zone, comprise of the following, namely:-

- | | | |
|-------|--|--------------------|
| (i) | Chief Wildlife Warden, Department of forests and Wildlife, Delhi, Government of National Capital Territory of Delhi | -Chairman; |
| (ii) | An expert in the area of ecology and environment to be nominated by the Government of National Capital Territory (National Capital Territory) of Delhi for a period of three year | -Member; |
| (iii) | One representatives of Non-Governmental Organisation (Working in the field of environment including heritage Conservation) to be nominated by the Government of National Capital Territory of Delhi for a period of three year | -Member; |
| (iv) | Representative of Delhi Pollution Control Committee | -Member; |
| (V) | Member State Biodiversity Board | -Member; |
| (vi) | Dy. Conservator of Forests (South), Department of Forests and Wildlife, Government of National Capital Territory of Delhi. | -Member Secretary. |

6. Terms of reference .-(1) The Monitoring Committee shall monitor the compliance of the provisions of this notification.

(2) Tenure of the Monitoring Committee shall be for three years.

(3) The activities that are covered in the Schedule to the notification of the Government of India in the erstwhile Ministry of Environment and Forests number S.O. 1533 (E), dated the 14th September, 2006, and are falling in the Eco-sensitive Zone, except for the prohibited activities as specified in the Table under paragraph 4 thereof shall be scrutinised by the Monitoring Committee based on the actual site-specific conditions and referred to the Central Government in the Ministry of Environment, Forest and Climate Change for prior environmental clearances under the provisions of the said notification.

(4) The activities that are not covered in the Schedule to the notification of the Government of India in the Ministry of Environment and Forests number S.O. 1533 (E), dated the 14th September, 2006, and are falling in the Eco-sensitive Zone, except for the prohibited activities as specified in the Table under paragraph 4 thereof, shall be scrutinised by the Monitoring Committee based on site-specific conditions and referred to concerned Regulatory Authority.

(5) The Member Secretary of the Monitoring Committee or the concerned Collector(s) or the concerned park Deputy Conservator of Forests shall be competent to file complaints under section 19 of the Environment (Protection) Act, 1986 against any person who contravenes the provisions of this notification.

(6) The Monitoring Committee may invite representatives or experts from concerned Departments, representatives from Industry Associations or concerned stakeholders to assist in its deliberations depending on the requirements on issue to issue basis.

(7) The Monitoring Committee shall submit the annual action taken report of its activities as on 31st March of every year by 30th June of that year to the Chief Wildlife Warden of the State as per pro forma appended at Annexure IV.

(8) The Central Government in the Ministry of Environment, Forests and Climate Change may give such directions, as it deems fit, to the Monitoring Committee for effective discharge of its functions.

7. The Central Government and State Government may specify additional measures, if any, for giving effect to provisions of this notification.

8. The provisions of this notification shall be subject to the orders, if any, passed, or to be passed, by the Hon'ble Supreme Court of India or the High Court the or National Green Tribunal.

[F. No. 25/196/2015-ESZ-RE]

LALIT KAPUR, Scientist 'G'

ANNEXURE-I**1. Boundary Description of Asola Bhatti Wildlife Sanctuary with Geo-co-ordinates**

| ID | Latitude | Longitude |
|----|-----------------|----------------|
| 1 | 28°24'54.184" N | 77°11'24.590"E |
| 2 | 28°25'5.081" N | 77°11'25.700"E |
| 3 | 28°24'43.731" N | 77°11'35.786"E |
| 4 | 28°25'38.765" N | 77°13'35.267"E |
| 5 | 28°26'8.130" N | 77°13'33.637"E |
| 6 | 28°25'32.701" N | 77°13'26.335"E |
| 7 | 28°26'27.328" N | 77°13'7.012" E |
| 8 | 28°29'25.475" N | 77°11'36.861"E |
| 9 | 28°29'44.864" N | 77°11'44.864"E |
| 10 | 28°29'54.109" N | 77°15'12.762"E |
| 11 | 28°24'35.220" N | 77°12'33.916"E |
| 12 | 28°24'30.685" N | 77°11'56.703"E |
| 13 | 28°24'25.334" N | 77°10'37.736"E |
| 14 | 28°24'24.846" N | 77°10'18.539"E |
| 15 | 28°24'58.337" N | 77°09'54.346"E |
| 16 | 28°25'44.976" N | 77°09'42.783"E |
| 17 | 28°25'46.300" N | 77°10'23.248"E |
| 18 | 28°25'53.061" N | 77°12'19.850"E |
| 19 | 28°26'21.060" N | 77°12'20.344"E |
| 20 | 28°26'32.212" N | 77°12'45.691"E |
| 21 | 28°27'3.152" N | 77°13'14.179"E |
| 22 | 28°27'28.721" N | 77°12'21.847"E |
| 23 | 28°28'50.633" N | 77°12'10.975"E |
| 24 | 28°29'34.359" N | 77°11'35.268"E |
| 25 | 28°29'23.485" N | 77°12'40.109"E |
| 26 | 28°29'20.946" N | 77°13'19.080"E |
| 27 | 28°29'19.352" N | 77°13'55.770"E |
| 28 | 28°29'32.579" N | 77°14'16.189"E |
| 29 | 28°29'22.606" N | 77°14'44.761"E |
| 30 | 28°29'12.158" N | 77°16'8.562"E |
| 31 | 28°28'55.525" N | 77°15'8.897"E |
| 32 | 28°28'54.266" N | 77°14'56.674"E |
| 33 | 28°27'13.352" N | 77°14'16.155"E |
| 34 | 28°27'3.120" N | 77°14'36.943"E |
| 35 | 28°26'44.798" N | 77°14'58.548"E |
| 36 | 28°25'48.496" N | 77°15'8.046"E |

2. Boundary description of the Eco-sensitive Zone of Asola Bhatti Wildlife Sanctuary with Geo-co-ordinates

| ID | Latitude | Longitude |
|----|-----------------|----------------|
| 1 | 28°26'14.374" N | 77°9'21.602"E |
| 2 | 28°26'29.137" N | 77°9'52.708"E |
| 3 | 28°26'29.909" N | 77°10'28.680"E |
| 4 | 28°26'23.091" N | 77°11'3.318"E |
| 5 | 28°26'31.459" N | 77°11'28.485"E |
| 6 | 28°26'49.684" N | 77°11'57.991"E |
| 7 | 28°27'8.026" N | 77°11'46.272"E |
| 8 | 28°27'38.186" N | 77°11'36.488"E |
| 9 | 28°28'6.279" N | 77°11'53.381"E |

[भाग II-खण्ड 3(ii)]

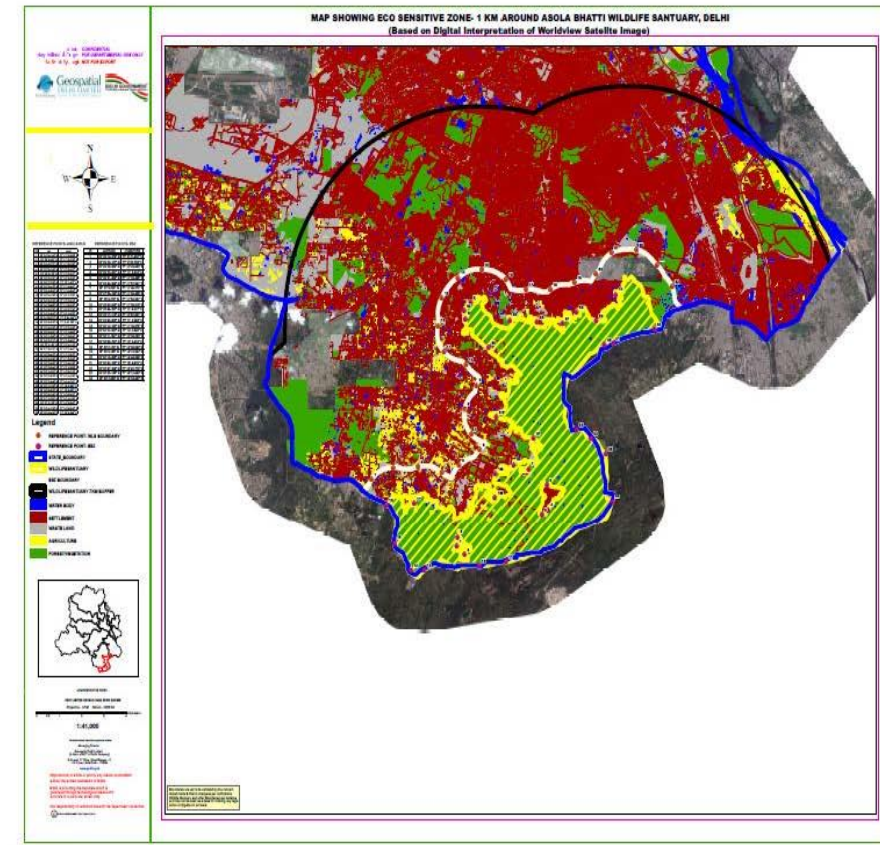
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| | | |
|----|-----------------|-----------------|
| 10 | 28°28'30.625" N | 77°11'38.319" E |
| 11 | 28°28'46.087" N | 77°11'6.227" E |
| 12 | 28°29'17.115" N | 77°10'57.891" E |
| 13 | 28°29'49.903" N | 77°11'2.969" E |
| 14 | 28°30'14.183" N | 77°11'26.575" E |
| 15 | 28°30'23.530" N | 77°12'0.890" E |
| 16 | 28°30'11.591" N | 77°12'34.250" E |
| 17 | 28°29'59.750" N | 77°13'3.415" E |
| 18 | 28°30'0.133" N | 77°13'38.540" E |
| 19 | 28°30'8.198" N | 77°14'13.562" E |
| 20 | 28°30'18.655" N | 77°14'44.046" E |
| 21 | 28°30'43.185" N | 77°15'6.876" E |
| 22 | 28°30'47.304" N | 77°15'42.773" E |
| 23 | 28°30'29.148" N | 77°16'12.663" E |
| 24 | 28°30'2.959" N | 77°16'34.687" E |

ANNEXURE-II

MAP OF ECO-SENSITIVE ZONE OF ASOLA BHATTI WILDLIFE SANCTUARY WITH CO-ORDINATES



Annexure-III**List of villages falling in Eco -sensitive Zone**

| S.No. | Name of village | Latitude | Longitude |
|-------|-----------------|----------------|----------------|
| 1. | Asola | 28 26'34.311"N | 77 13'8.718"E |
| | | 28 26'53.776"N | 77 12'13.910"E |
| | | 28 27'20.910"N | 77 11'38.499"E |
| | | 28 26'56.166"N | 77 12'55.083"E |
| 2. | Sahurpur | 28 27'35.663"N | 77 12'13.664"E |
| | | 28 27'41.570"N | 77 13'3.098"E |
| | | 28 27'50.010"N | 77 12'26.283"E |
| | | 28 27'23.845"N | 77 12'43.011"E |
| 3. | Satbari | 28°27'51"N | 77°12'53" E |
| | | 28°28'12"N | 77°12'0" E |
| 4. | Maidan Garhi | 28 28'53.606"N | 77 13'20.519"E |
| | | 28 28'54.045"N | 77 12'55.731"E |
| | | 28 29'0.966"N | 77 12'19.817"E |
| | | 28 29'26.500"N | 77 12'57.194"E |
| 5. | Tughlaqabad | 28 30'15.454"N | 77 15'35.514"E |
| | | 28 29'17.408"N | 77 16'19.757"E |
| | | 28 28'49.951"N | 77 14'56.175"E |
| | | 28 29'21.756"N | 77 14'54.317"E |
| 6. | Deoli | 28° 29' 27.7"N | 77°12'57"E |
| | | 28° 28' 54.4"N | 77°13'22.5"E |
| 7. | Bhatti | 28 25'20.285"N | 77 12'15.992"E |
| | | 28 25'19.788"N | 77 11'39.259"E |
| | | 28 25'52.459"N | 77 12'34.091"E |
| | | 28 26'4.663"N | 77 11'53.371"E |

ANNEXURE-IV**Performa of Action Taken Report: - Eco-sensitive Zone Monitoring Committee.-**

1. Number and date of meetings.
2. Minutes of the meetings: Mention main noteworthy points. Attach minutes of the meeting as separate Annexure.
3. Status of preparation of Zonal Master Plan including Tourism Master Plan.
4. Summary of cases dealt for rectification of error apparent on face of land record: Details may be attached as Annexure.
5. Summary of cases scrutinised for activities covered under the Environment Impact Assessment notification, 2006:Details may be attached as separate Annexure.
6. Summary of cases scrutinised for activities not covered under the Environment Impact Assessment notification, 2006:Details may be attached as separate Annexure.
7. Summary of complaints lodged under section 19 of the Environment (Protection) Act, 1986.
8. Any other matter of importance.

RAKESH SUKUL
 Digitally signed by RAKESH SUKUL
 Date: 2017.09.13 18:55:54 +05'30'

Uploaded by Dte. of Printing at Government of India Press, Ring Road, Mayapuri, New Delhi-110064
 and Published by the Controller of Publications, Delhi-110054.

Office Memorandum of Ministry of Environment Forest and Climate Change

F.No. 22-43/2018-IA.III
Government of India
Ministry of Environment, Forest and Climate Change
(IA Division)

Indira ParyavaranBhawan
JorBagh Road, Aliganj,
New Delhi – 110003

Dated: 8th August, 2019

OFFICE MEMORANDUM

Subject: Procedure for consideration of developmental projects located within 10 km of National Park/Wildlife Sanctuary seeking environmental clearance under the provisions of the Environmental Impact Assessment (EIA) Notification, 2006 - regarding.

The Hon'ble Supreme Court vide its Order dated 4.12.2006 in Writ Petition No. 460 of 2004 – Goa Foundation Vs. Union of India, has inter-alia directed that Ministry of Environment and Forests "(MoEF) would also refer to the Standing Committee of the National Board for Wildlife, under section 5(b) & 5(c) (ii) of the Wildlife Protection Act, 1972, the cases where environmental clearances has already been granted where activities are within 10km. zone" of the boundaries of the Sanctuaries and National Parks."

2. In this regard, the erstwhile MoEF vide Circular No. L-11011/7/2004-IA.II (I)(Part) dated 27.02.2007 and Office Memorandum No. J-11013/41/2006-IA.II(I) dated 02.12.2009 delineated a procedure for consideration of developmental projects located within 10 km of National Park/Wildlife Sanctuary for grant of environmental clearance under EIA Notification, 2006. As per the stipulated procedure, prior clearance from Standing Committee of the National Board for Wildlife (SCNBWL) would be required for the developmental projects located within 10km of the National Park/Wildlife Sanctuary.

3. Over a period of time, Ministry has notified number of Eco-Sensitive Zones (ESZs) around Protected Areas (PAs). Many of developmental activities are prohibited/regulated in these ESZs *inter-alia* including mining operations to be carried out in accordance with the order of the Hon'ble Supreme Court dated 4.08.2006 in the matter of T.N. Godavarman Thirumulpad Vs. UOI in

Page 1 of 3

W.P.(C) No. 202 of 1995 and dated 21.4.2014 in the matter of Goa Foundation Vs. UOI in W.P.(C) No. 435 of 2012 as per the notifications issued for their constitution.

4. In light of the aforesaid Orders passed by the Hon'ble Supreme Court, the issues related to the prior clearance from SCNBWL for the notified ESZs and the remaining areas have been examined in detail. In this regard, it has been decided by the Competent Authority in the Ministry to adopt a following procedure for consideration of developmental projects located within 10 km of National Park/Wildlife Sanctuary seeking environmental clearance under the provisions of the EIA Notification, 2006, in supersession of the earlier O.M.s dated 27.2.2007 and 2.12.2009:

- i. Proposals involving developmental activity/project located within the notified Eco-Sensitive Zones (ESZ) shall be regulated and governed by the concerned ESZ notification. However, for the developmental project/activity located within the notified ESZ and covered under the schedule of the EIA Notification 2006, prior clearance from Standing Committee of the National Board for Wildlife (SCNBWL) is mandatory. In such cases, the project proponent shall submit the application simultaneously for grant of Terms of Reference as well as wildlife clearance.
- ii. Proposals involving developmental activity/project located outside the stipulated boundary limit of notified ESZ and located within 10 km of National Park/Wildlife Sanctuary, prior clearance from Standing Committee of the National Board for Wildlife (SCNBWL) may not be applicable. However, such proposals from environmental angle including impact of developmental activity/project on the wildlife habitat, if any, would be examined by the sector specific Expert Appraisal Committee and appropriate conservation measures in the form of recommendations shall be made. These recommendations shall be explicitly mentioned in the environmental clearance letter and shall be ensured by the member secretary concerned.
- iii. Proposals involving developmental activity/project located within 10 km of National Park/Wildlife Sanctuary wherein final ESZ notification is not notified (or) ESZ notification is in draft stage, prior clearance from Standing Committee of the National Board for Wildlife (SCNBWL) is mandatory. In such cases, the project proponent shall submit the application simultaneously for grant of Terms of Reference/environmental clearance as well as wildlife clearance.

- iv. Proposals involving mining of minerals within the ESZ (or) one kilometer from the boundaries of National Parks and Sanctuaries whichever is higher is prohibited in accordance with the order of the Hon'ble Supreme Court dated 4.08.2006 in the matter of T.N. Godavarman Thirumulpad Vs. UOI in W.P.(C) No. 202 of 1995 and dated 21.4.2014 in the matter of Goa Foundation Vs. UOI in W.P.(C) No. 435 of 2012.
5. This issues with the approval of the Competent Authority.


(Sharath Kumar Pallerla)
Director

To

1. Chairman, Central Pollution Control Board (CPCB).
2. Chairman of all the Expert Appraisal Committees
3. Chairperson/Member Secretaries of all the SEIAAs/SEACs
4. All the Officers of I.A. Division
5. Chairpersons/Member Secretaries of all SPCBs/UTPCCs

Copy for information to:

1. PS to Hon'ble Minister for Environment, Forest and Climate Change
2. PS to Hon'ble MoS (EF&CC)
3. PPS to Secretary(EF&CC)
4. PPS to SS(AKJ)
5. PPS to AS (RSP)
6. PPS to JS (GM)/ JS(RS)/JS(AKN)
7. Website, MoEF&CC
8. Guard file.

Annexure 5.3

DETAILS OF SENSITIVE RECEPTORS

AEROCITY (UG) TO TUGHLAKABAD (UG)

| S. No. | Sensitive Receptor | Location (Chainage) | RHS/ LHS | Section (U/g-EI) | Distance from Edge of viaduct *(m) |
|--------|--------------------|--------------------------|----------|------------------|------------------------------------|
| 1 | Temple | 10820.108M TO 10834.643M | LHS | U/g | NA |
| 2 | School | 10955.315 TO 11008.259M | RHS | U/g | NA |
| 3 | School | 12465.504M TO 13189.884M | RHS | EI | 29 |
| 4 | Gurudwara | 13189.884M TO 14063.014M | RHS | EI | 14 |
| 5 | Temple | 13189.884M TO 14063.014M | RHS | EI | 32 |
| 6 | Church | 14063.014M TO 17639.304M | LHS | EI | 52 |
| 7 | Hospital | 14063.014M TO 17639.304M | LHS | EI | 98 |
| 8 | Hospital | 14063.014M TO 17639.304M | LHS | EI | 46 |
| 9 | School | 14063.014M TO 17639.304M | LHS | U/g | NA |
| 10 | Temple | 17639.304M TO 18927.934M | LHS | U/g | NA |
| 11 | School | 17639.304M TO 18927.934M | LHS | U/g | NA |
| 12 | Hospital | 17639.304M TO 18927.934M | RHS | U/g | NA |
| 13 | Temple | 18927.934M TO 20002.184M | LHS | U/g | NA |

*NA-Receptors at Underground stretch will not have impact of noise during operation

JANAKPURI WEST TO R.K. ASHRAM

| S. No. | Sensitive Receptor | Location (Chainage) | Remark (RHS/ LHS) | Section (U/g-EI) | Distance from Edge of viaduct *(m) |
|--------|--------------------|-----------------------|-------------------|------------------|------------------------------------|
| 1 | School | (-)-488.27M TO 987.0M | LHS | U/g | NA |
| 2 | Hospital | (-)-488.27M TO 987.0M | LHS | U/g | NA |
| 3 | Temple | (-)-488.27M TO 987.0M | RHS | U/g | NA |
| 4 | Temple | 987.0M TO 1836.60M | LHS | U/g | NA |
| 5 | Temple | 987.0M TO 1836.60M | LHS | U/g | NA |
| 6 | Temple | 1836.60M TO 3076.2M | LHS | U/g | NA |
| 7 | Temple | 3076.2M TO 4400.00M | CENTER | U/g | NA |
| 8 | Temple | 3076.2M TO 4400.00M | CENTER | U/g | NA |
| 9 | Mosque | 3076.2M TO 4400.00M | RHS | U/g | NA |
| 10 | Temple | 3076.2M TO 4400.00M | RHS | U/g | NA |
| 11 | Temple | 3076.2M TO 4400.00M | RHS | U/g | NA |
| 12 | Temple | 3076.2M TO 4400.00M | RHS | U/g | NA |

| S. No. | Sensitive Receptor | Location (Chainage) | Remark (RHS/ LHS) | Section (U/g-EI) | Distance from Edge of viaduct *(m) |
|--------|--------------------|-------------------------|-------------------|------------------|------------------------------------|
| 13 | Temple | 3076.2M TO 4400.00M | RHS | U/g | NA |
| 14 | Temple | 3076.2M TO 4400.00M | RHS | U/g | NA |
| 15 | School | 3076.2M TO 4400.00M | RHS | U/g | NA |
| 16 | Temple | 4400.00M TO 5592.30M | LHS | U/g | NA |
| 17 | Hospital | 4400.00M TO 5592.30M | LHS | U/g | NA |
| 18 | Temple | 4400.00M TO 5592.30M | RHS | U/g | NA |
| 19 | Temple | 5592.30M TO 6450.90M | LHS | U/g | NA |
| 20 | Temple | 5592.30M TO 6450.90M | LHS | U/g | NA |
| 21 | Temple | 5592.30M TO 6450.90M | RHS | U/g | NA |
| 22 | College | 5592.30M TO 6450.90M | RHS | U/g | NA |
| 23 | Institute | 5592.30M TO 6450.90M | RHS | U/g | NA |
| 24 | College | 6450.90M TO 7372.90M | RHS | U/g | NA |
| 25 | Temple | 6450.90M TO 7372.90M | RHS | U/g | NA |
| 26 | Temple | 7372.90M TO 8291.80M | LHS | EI | 8 |
| 27 | Mosque | 7372.90M TO 8291.80M | LHS | EI | 42 |
| 28 | Institute | 7372.90M TO 8291.80M | LHS | EI | 74 |
| 29 | Temple | 7372.90M TO 8291.80M | RHS | EI | 11 |
| 30 | Temple | 14699.70M TO 16227.50M | LHS | EI | 30 |
| 31 | Institute | 14699.70M TO 16227.50M | LHS | EI | 43 |
| 32 | Temple | 14699.70M TO 16227.50M | RHS | EI | 3 |
| 33 | Institute | 18301.90M TO 19545.70M | LHS | EI | 43 |
| 34 | School | 20445.50M TO 21358.70M | LHS | EI | 43 |
| 35 | Hospital | 20445.50M TO 21358.70M | LHS | EI | 45 |
| 36 | School | 20445.50M TO 21358.70M | RHS | EI | 45 |
| 37 | Institute | 22304.30M TO 23271.60M | RHS | EI | 8 |
| 38 | Hospital | 24463.90M TO 25136.80M | LHS | EI | 49 |
| 39 | School | 24463.90M TO 25136.80M | LHS | EI | 45 |
| 40 | School | 26403.30M TO 27311.50M | RHS | EI | 15 |
| 41 | School | 27311.50M TO 28432.580M | LHS | EI | 40 |
| 42 | Hospital | 27311.50M TO 28432.580M | LHS | EI | 104 |
| 43 | Gurudwara | 27311.50M TO 28432.580M | LHS | EI | 196 |
| 44 | Temple | 27311.50M TO 28432.580M | RHS | EI | 26 |
| 45 | School | 27311.50M TO 28432.580M | RHS | EI | 31 |

*NA-Receptors at Underground stretch will not have impact of noise during operation

MUJUNDPUR TO MAUJPUR

| S. No. | Sensitive Receptor | Location (Chainage) | Remark (RHS/LHS) | Section (U/g-EI) | Distance from Edge of viaduct* (m) |
|--------|--------------------|-------------------------|------------------|------------------|------------------------------------|
| 1 | Temple | 53680.040M TO 55166.20M | LHS | EI | 5 |
| 2 | SCHOOL | 53680.040M TO 55166.20M | LHS | EI | 56 |
| 3 | School | 53680.040M TO 55166.20M | LHS | EI | 60 |
| 4 | Hospital | 53680.040M TO 55166.20M | LHS | EI | 64 |
| 5 | Hospital | 53680.040M TO 55166.20M | LHS | EI | 61 |
| 6 | Hospital | 53680.040M TO 55166.20M | LHS | EI | 61 |
| 7 | Hospital | 53680.040M TO 55166.20M | LHS | EI | 61 |
| 8 | Hospital | 53680.040M TO 55166.20M | LHS | EI | 60 |
| 9 | Temple | 53680.040M TO 55166.20M | RHS | EI | 14 |
| 10 | Temple | 55166.20M TO 56621.80M | LHS | EI | 53 |
| 11 | School | 55166.20M TO 56621.80M | LHS | EI | 53 |
| 12 | Institute | 55166.20M TO 56621.80M | LHS | EI | 59 |
| 13 | Institute | 55166.20M TO 56621.80M | RHS | EI | 8 |
| 14 | School | 55166.20M TO 56621.80M | RHS | EI | 7 |
| 15 | School | 55166.20M TO 56621.80M | RHS | EI | 7 |
| 16 | Temple | 55166.20M TO 56621.80M | RHS | EI | 7 |
| 17 | Temple | 56621.80M TO 57714.70M | LHS | EI | 45 |
| 18 | School | 56621.80M TO 57714.70M | LHS | EI | 47 |
| 19 | School | 56621.80M TO 57714.70M | RHS | EI | 16 |
| 20 | Church | 63883.20M TO ABOVE | LHS | EI | 31 |

*NA-Receptors at Underground stretch will not have impact of noise during operation

EMISSION STANDARDS FOR CONSTRUCTION EQUIPMENTS

In India Emission standards for diesel construction machinery were adopted on 21st September 2006, and are denoted as Construction Equipment Vehicles, or CEV. The standards are structured into two tiers:

- Bharat (CEV) Stage II – These standards are based on the EU Stage I requirements, but also cover smaller engines that were not regulated under the EU Stage I.
 - Bharat (CEV) Stage III – These standards are based on US Tier 2/3 requirements.
- The standards are summarized in the following table:

Emission Standards for Construction Equipment Vehicle (CEV)

| Bharat Stage Norms | Category | Effective date | Test cycle | CO (g/kWh) | HC (g/kWh) | NOx (g/kWh) | HC+NOx (g/kWh) | PM (g/kWh) | 80% of full load smoke (m ⁻¹) |
|--------------------|--------------|----------------|--|------------|------------|-------------|----------------|------------|---|
| - | - | 18.01.96 | ISO 8178-4 "C1" 8 mode cycle | 14.00 | 3.50 | 18.00 | - | - | 3.25 |
| - | - | 28.07.00 | ISO 8178-4 "C1" 8 mode cycle | 14.00 | 3.50 | 18.00 | - | - | 3.25 |
| BS-II | kW<8 | 01.10.08 | ISO 8178-4 "C1" 8 mode cycle for Variable Speed Engines or | 8.00 | 1.30 | 9.20 | - | 1.00 | 3.25 |
| | 8 ≤ kW<19 | | | 6.60 | 1.30 | 9.20 | - | 0.85 | |
| | 19 ≤ kW<37 | | | 6.50 | 1.30 | 9.20 | - | 0.85 | |
| | 37 ≤ kW<75 | 01.10.07 | ISO 8178-4 "D2" 5 mode cycle for Constant Speed Engines | 6.50 | 1.30 | 9.20 | - | 0.85 | |
| | 75 ≤ kW<130 | | | 5.00 | 1.30 | 9.20 | - | 0.70 | |
| | 130 ≤ kW<560 | | | 5.00 | 1.30 | 9.20 | - | 0.54 | |
| BS-III | kW<8 | 01.04.2011 | ISO 8178-4 "C1" 8 mode cycle for Variable Speed Engines or | 8.00 | - | - | 7.50 | 0.80 | 3.25 |
| | 8 ≤ kW<19 | | | 6.60 | - | - | 7.50 | 0.80 | |
| | 19 ≤ kW<37 | | | 5.50 | - | - | 7.50 | 0.60 | |
| | 37 ≤ kW<75 | | ISO 8178-4 "D2" 5 mode cycle for Constant Speed Engines | 5.00 | - | - | 4.70 | 0.40 | |
| | 75 ≤ kW<130 | | | 5.00 | - | - | 4.00 | 0.30 | |
| | 130 ≤ kW<560 | | | 3.50 | - | - | 4.00 | 0.2 | |

The Road Transport Highways Ministry has issued a draft notification regarding emission standards for construction equipment vehicles, and agricultural tractors on 29th August, 2017.

Every diesel driven agricultural tractor and construction equipment vehicle and combine harvester shall be so manufactured that it complies with the following standards of gaseous pollutants emitted by them when tested on following duty cycle:

- ❖ For variable-speed engines, the 8-mode test cycle or the corresponding ramped modal cycle, and the Non Road Transient Cycle (NRTC).
- ❖ For constant-speed engines, the 5-mode test cycle or the corresponding ramped modal cycle.
- ❖ Emissions (g/kWh) shall be measured over Non Road Steady Cycle (NRSC) and Non Road Transient Cycle (NRTC) test cycle as per test applicability mentioned in Table 1 and Table 2. For NRTC test cycle, composite weighted emissions shall be computed by weighing the cold start results 10 per cent and the hot start results 90 per cent. Weighted composite results shall meet the limits.

Table 1
Bharat Stage (CEV/TREM) -IV
Applicable emission limit for Non Road Steady Cycle (NRSC) and Non Road Transient Cycle (NRTC) test cycle

| Category, kW | Applicable with effect from | CO | HC | NOx | PM | Test Cycle* |
|---------------|-------------------------------|--------|--------------|-----|-------|-------------|
| | | g/ kWh | | | | |
| 37 ≤ P < 56 | 1 st October, 2020 | 5.0 | 4.7 (HC+NOx) | | 0.025 | NRSC & NRTC |
| 56 ≤ P < 130 | | 5.0 | 0.19 | 0.4 | 0.025 | |
| 130 ≤ P < 560 | | 3.5 | 0.19 | 0.4 | 0.025 | |

*Test cycle as described in AIS: 137 and as amended from time to time.

Table 2
Bharat Stage (CEV/TREM)- V
Applicable emission limit for Non Road Steady Cycle (NRSC) and Non Road Transient Cycle (NRTC) test cycle

| Category, kW | Applicable with effect from | CO | HC | NOx | PM | PN | Test cycle |
|---------------|-------------------------------|--------|---------------|-----|-------|--------------------|---------------|
| | | g/ kWh | | | | #/kWh | |
| P < 8 | 1 st October, 2023 | 8.0 | 7.5 (HC+NOx) | | 0.4 | ---- | NRSC |
| 8 ≤ P < 19 | | 6.6 | 7.5 (HC+NOx) | | 0.4 | ---- | |
| 19 ≤ P < 37 | | 5.0 | 4.7 (HC+NOx) | | 0.015 | 1×10 ¹² | NRSC and NRTC |
| 37 ≤ P < 56 | | 5.0 | 4.7 (HC+NOx) | | 0.015 | 1×10 ¹² | |
| 56 ≤ P < 130 | | 5.0 | 0.19 | 0.4 | 0.015 | 1×10 ¹² | |
| 130 ≤ P < 560 | | 3.5 | 0.19 | 0.4 | 0.015 | 1×10 ¹² | |
| P > 560 | | 3.5 | 0.19 | 3.5 | 0.045 | ----- | NRSC |

Hazardous Waste Management Rule 2016

SCHEDULE II [See rule 3 (1) (17) (ii)]

List of waste constituents with concentration limits

Class A: Based on leachable concentration limits [Toxicity Characteristic Leaching Procedure (TCLP) or Soluble Threshold Limit Concentration (STLC)]

| Class | Constituents | Concentration in mg/l |
|-------|--|-----------------------|
| (1) | (2) | (3) |
| A1 | Arsenic | 5.0 |
| A2 | Barium | 100.0 |
| A3 | Cadmium | 1.0 |
| A4 | Chromium and/or Chromium (III) compounds | 5.0 |
| A5 | Lead | 5.0 |
| A6 | Manganese | 10.0 |
| A7 | Mercury | 0.2 |
| A8 | Selenium | 1.0 |
| A9 | Silver | 5.0 |
| A10 | Ammonia | 50* |
| A11 | Cyanide | 20* |
| A12 | Nitrate (as nitrate-nitrogen) | 1000.0 |
| A13 | Sulphide (as H ₂ S) | 5.0 |
| A14 | 1,1-Dichloroethylene | 0.7 |
| A15 | 1,2-Dichloroethane | 0.5 |
| A16 | 1,4-Dichlorobenzene | 7.5 |
| A17 | 2,4,5-Trichlorophenol | 400.0 |
| A18 | 2,4,6-Trichlorophenol | 2.0 |
| A19 | 2,4-Dinitrotoluene | 0.13 |
| A20 | Benzene | 0.5 |
| A21 | Benzo (a) Pyrene | 0.001 |
| A22 | Bromodichloromethane | 6.0 |
| A23 | Bromoform | 10.0 |
| A24 | Carbon tetrachloride | 0.5 |
| A25 | Chlorobenzene | 100.0 |
| A26 | Chloroform | 6.0 |
| A27 | Cresol (ortho+ meta+ para) | 200.0 |
| A28 | Dibromochloromethane | 10.0 |
| A29 | Hexachlorobenzene | 0.13 |
| A30 | Hexachlorobutadiene | 0.5 |
| A31 | Hexachloroethane | 3.0 |
| A32 | Methyl ethyl ketone | 200.0 |
| A33 | Naphthalene | 5.0 |
| A34 | Nitrobenzene | 2.0 |
| A35 | Pentachlorophenol | 100.0 |
| A36 | Pyridine | 5.0 |
| A37 | Tetrachloroethylene | 0.7 |
| A38 | Trichloroethylene | 0.5 |

A-2.

ENVIRONMENTAL MONITORING FORMAT

1. Air Quality (Emission Gas/Ambient Air Quality)

| Item | Unit | Measured Value (Mean) | Measured Value (Max.) | Country's Standards | Referred International Standards (WB-EHS) | Remarks (Measurement Point, Frequency, Method, etc.) |
|-------------------|------|-----------------------|-----------------------|---------------------|---|--|
| PM ₁₀ | | | | | | |
| PM _{2.5} | | | | | | |
| SO ₂ , | | | | | | |
| NO _x | | | | | | |

2. A. Ground Water Quality (BIS : 10500)

| Item | Unit | Measured Value (Mean) | Measured Value (Max.) | Country's Standards | Referred International Standards | Remarks (Measurement Point, Frequency, Method, etc.) |
|------------------|------|-----------------------|-----------------------|---------------------|----------------------------------|--|
| As per BIS 10500 | | | | | | |

B. Water Quality (effluent / Wastewater / Ambient Water Quality)

| Item | Unit | Measured Value (Mean) | Measured Value (Max.) | Country's Standards | Referred International Standards | Remarks (Measurement Point, Frequency, Method, etc.) |
|--------------|------|-----------------------|-----------------------|---------------------|----------------------------------|--|
| pH | | | | | | |
| TSS | | | | | | |
| BOD | | | | | | |
| COD | | | | | | |
| Oil / Grease | | | | | | |
| DO | | | | | | |

3. Noise / Vibration

| Item | Unit | Measured Value (Mean) | Measured Value (Max.) | Country's Standards | Referred International Standards (FTA-vibration, WB EHS-Noise) | Remarks (Measurement Point, Frequency, Method, etc.) |
|-----------------|-------|-----------------------|-----------------------|---------------------|--|--|
| Noise level | dB(A) | | | | | |
| Vibration level | dBV | | | | | |

A-2.

4. Solid Waste

| Item | Unit | Measured Value (Mean) | Measured Value (Max.) | Country's Standards | Referred International Standards | Remarks (Measurement Point, Frequency, Method, etc.) |
|-----------------|------|-----------------------|-----------------------|---------------------|----------------------------------|--|
| pH | | | | | | |
| Total Phenols | | | | | | |
| lead | | | | | | |
| cadmium | | | | | | |
| chromium- VI | | | | | | |
| Copper | | | | | | |
| Nickel | | | | | | |
| Mercury | | | | | | |
| Zinc | | | | | | |
| Fluoride | | | | | | |
| Cyanide | | | | | | |
| Calorific value | | | | | | |
| Total Volatile | | | | | | |
| Moisture | | | | | | |
| Organic matter | | | | | | |
| Total Ash | | | | | | |
| Bulk Density | | | | | | |

5. Format for Flora Monitoring Report

| Local Name of Species | Scientific Name of the species | IUCN Category | Location | Height (m) | Girth (cm) | Quantity (No.) | Storage Detail |
|-----------------------|--------------------------------|---------------|----------|------------|------------|----------------|----------------|
| | | | | | | | |
| | | | | | | | |
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| | | | | | | | |

A-2.

Prior Information for Public Consultations

CIN: U74899 DL1995 GOI 068150

Tel...: 26692919
Fax :: 26692875
दिल्ली मेट्रो रेल कॉर्पोरेशन लि०
DELHI METRO RAIL CORPORATION LTD.

(A JOINT VENTURE OF GOVERNMENT OF INDIA AND GOVT. OF DELHI)

Office of the Executive Director/Civil/P-II,
 Press Enclave Road, Near Metro Station Malviya Nagar, New Delhi-110017

Date-27.01.2020

TO WHOMSOEVER IT MAY CONCERN

It is to inform that the public consultation and orientation program/ socio-economic survey for Delhi MRTS Tughlakabad to Aerocity corridor of phase-IV is scheduled to be conducted on 09.02.2020 to 10.02.2020 by Delhi Metro officials in your area at Shiv Mandir Ambedkar Nagar, Khanpur Market, Kendriya Vidhalaya Sangam Vihar. It is requested to kindly be available and cooperate.

जो कोई भी इससे संबंधित है उसके लिए

यह सूचित किया जाता है कि दिल्ली एमआरटीएस के तुगलकाबाद से एरोसिटी कॉरिडोर चरण -4 पर सार्वजनिक परामर्श कार्यक्रम/ सामाजिक-आर्थिक सर्वेक्षण आपके क्षेत्र (शिव मंदिर अम्बेडकर नगर, खानपुर मार्केट, केंद्रीय विध्यालय संगम विहार) में दिल्ली मेट्रो के अधिकारियों द्वारा 09.02.2020 से 10.02.2020 के बीच आयोजित किया जाना है। अनुरोध है कि कृपया उपलब्ध रहें और सहयोग करें।



 रवि कपूर
 कार्यकारी निदेशक/ परियोजना/II
 दिल्ली मेट्रो रेल कॉर्पोरेशन लि०

H.O. - Metro Bhawan, Fire Brigade Lane, Barakhamba Road, New Delhi-110001



CIN: U74899 DL 1995 GOI 068150

Tel. : 011-22754713

Fax : 011-22754657

दिल्ली मेट्रो रेल कॉर्पोरेशन लि०

DELHI METRO RAIL CORPORATION LTD.

(A JOINT VENTURE OF GOVERNMENT OF INDIA AND GOVT. OF DELHI)

Office of the Chief Project Manager-3/Line-7
Ground Floor, Mayur Vihar Phase-I Metro Station, Delhi-110091

Date-15.01.2020

TO WHOMSOEVER IT MAY CONCERN

It is to inform that the public consultation program/ socio-economic survey for Delhi MRTS at R.k. Ashram to Derawal Nagar corridor of phase-IV is scheduled to be conducted on 01.02.2020 to 02.02.2020 by Delhi Metro officials in your area (Chitra-Gupt road at R.K.Ashram, Pul Bangash metro station, Ghantagahar chowk, near Vyaamshala at Sadar Bazar). It is requested to kindly be available and cooperate.

जो कोई भी इससे संबंधित है उसके लिए

यह सूचित करना है कि दिल्ली एमआरटीएस के आर.के. आश्रम से डेरावल नगर कॉरिडोर चरण -4 पर सार्वजनिक परामर्श कार्यक्रम/ सामाजिक-आर्थिक सर्वेक्षण आपके क्षेत्र (आर.के. आश्रम पर चित्रा-गुप्त रोड, पुल बंगश मेट्रो स्टेशन, घण्टाघर चौक, सदर बाजार पर व्यमशाला के पास) में दिल्ली मेट्रो के अधिकारियों द्वारा 01.02.2020 से 02.02.2020 के बीच आयोजित किया जाना है। अनुरोध है कि कृपया उपलब्ध रहें और सहयोग करें।



संजीव कुमार

मुख्य परियोजना प्रबंधक -3

दिल्ली मेट्रो रेल कॉर्पोरेशन लि०

(मेट्रो भवन, फायर ब्रिगेड लेन, बाराखम्बा रोड, नई दिल्ली-110001)
Metro Bhawan, Fire Brigade Lane, Barakhamba Road, New Delhi-110001

A-2.

Annexure 9.2**Locations of Public Consultations along corridors of Delhi Metro Phase IV**

| Sl. No. | Date public consultation was conducted | Location public consultation was conducted |
|----------------|---|---|
| 1 | 14 August 2013 | Azadpur |
| 2 | 23 August 2013 | Peeragarhi |
| 3 | 23 August 2013 | Khanpur |
| 4 | 23 August 2013 | Rangpuri village Mahipalpur |
| 5 | 2 Sept.2013 | Jagatpur Village |
| 6 | 2 Sept.2013 | LNJP Hospital |
| 7 | 10 Sept.2013 | Sheikh Sarai |
| 8 | 10 Sept.2013 | Andrews Ganj |
| 9 | 7 Oct. 2013 | Bawana Industrial Area |
| 10 | 7 Oct.2013 | Anajmandi Narela |

A-2.

Public Consultation relating to environmental benefits of Delhi Metro Phase IV

FORMAT FOR PUBLIC CONSULTATION
Project: Delhi Metro Rail, Phase- IV

| Location | Date | Name of Stakeholder | Issues Discussed | Suggestion by Stakeholders |
|------------------|-----------|---------------------|--|--|
| Anojmardi, Narla | 7/10/2013 | | <p>Traffic issue</p> <p>Develop Market</p> <p>Pollution Control</p> <p>Eg Convenience</p> <p>Increase facilities</p> | <p>Due to Ghazana Railway crossing, traffic jam is too frequent. It will also cause traffic. Freeway of existing roadwork is not sufficient though Anojmardi is there, due to metro the existing market will be strengthen ✓</p> <p>Pollution due to vehicles is high & metro can reduce in air pollution. water quality is also not good. ✓</p> <p>Many people visiting to near delhi and there is inadequate transportation. Due to Metro, transportation will be easy.</p> <p>Population is increasing, crowd is increasing day by day. Due to Metro, other facilities will also develop. ✓</p> |

Signature of Stakeholders

1) Hemant Singh 9855442314

2) Pooja Singh

3) Munna Singh

4) Gaurav Singh 8586098858

5) Surabh Kumar 8285121883

6) Hanindar 9077873712

7) Ansh Kumar 9871252552

8) Nand Kumar 9818899107

9) Rahul 7836957566

10) Sandeep 9212012051

11) Manu 9756794412

FORMAT FOR PUBLIC CONSULTATION
Project: Delhi Metro Rail Phase- IV

Annexure-6.1

| Location | Date | Name of Stakeholder | Issues Discussed | Suggestion by Stakeholders |
|------------|-----------|---------------------|---|---|
| Peer Singh | 14/8/2015 | | Improvement in Metro Route Solving traffic jam Route Change | Need to connect both Punjabi bagh metro station underground for localization. Metro helps in saving time At this place, traffic jam is heavy relative phenomenon and there is urgent need of metro. (motivation in building) Kirti to Mansarovar connect by metro. <small>Wastage space traffic jam</small> The metro route will be good if it starts from Erawara to Gauraha & Marwa. |
| | | | Improvement in Metro Route. | |

Signature of Stakeholders

Sachin 99103498247
Rajson - 9888377907
Harsh Singh 9912891282
Navan Kumar 9540658014
Ashok Kumar 9911022909

S.P. Mishra 9910891234
M.D. Husain 9910311308
Sunil Ti 9268982419
Meera Anand 88029561244
Anam 9720986319

FORMAT FOR PUBLIC CONSULTATION
Project: Delhi Metro Rail, Phase- IV

| Location | Date | Name of Stakeholder | Issues Discussed | Suggestion by Stakeholders |
|----------|------------|---------------------|---|---|
| Azadpur | 14/08/2013 | | <p>Time taking</p> <p>Convenient transport</p> <p>Waiting time</p> <p>Improvement in corridor</p> | <p>In order to reach Urban Nagar and other areas crowded bus bays overloaded and air pollution everywhere.</p> <p>Existing mode of transport is not enough bus are overloaded.</p> <p>Industrial area is in Marla. waiting time is too much ranges from 30-60 minutes. Overloaded bus make commutation difficult.</p> <p>Marla to Indira border, there is need to extend corridor</p> |

Signature of Stakeholders

1) Surendra Kumar
2) Pradeep Jain
3) Babbar
4) Akash
5) Ravi
A Ali

Suresh Kumar

Ravikant Sir
Siv Kumar
Pappu Yadav
Rajit Kumar
Praveen

9708 366711
5643790861
9601801482
8375841845

FORMAT FOR PUBLIC CONSULTATION
Project: Delhi Metro Rail, Phase- IV


| Location | Date | Name of Stakeholder | Issues Discussed | Suggestion by Stakeholders |
|---|-----------|---------------------|--|---|
| Khanpur | 23/8/2016 | | <p>Heavy traffic reaching time too high</p> <p>Pollution</p> <p>Passenger too long to get in</p> <p>Time saving</p> <p>Development of local place.</p> | <p>from Sangar Vihar to Saket more heavily traffic affect. Saket is around 3km from Khanpur metro station from Sangar Vihar to Saket. This are facing transportation problem.</p> <p>Existing transportation is not adequate and heavy traffic jam make the things worst.</p> <p>Metro can save us from Pollution</p> <p>No of Passenger is too high & relief only an bus services is not enough.</p> <p>Due to traffic Jam & inadequate transportation.</p> <p>Due to metro local place, economy will develop.</p> |
| <p>Signature of Stakeholders</p> <p>① Nitoy Kumar Mishra, 9871040445, Noida</p> <p>② Mayank Kumar 8287072283</p> <p>③ Dhananjay Singh 952011176</p> <p>④ Rohit 9818586274</p> <p>⑤ Akbar Khan 8882433508</p> <p>⑥ Kuldeep JI: 5813981465</p> <p>⑦ Rajivkumar 9467022556, Jang Pundeh</p> <p>⑧ S.K. Sharma 9871097098</p> <p>⑨ Ajayshrestha 8826288343</p> <p>⑩ Riga</p> | | | | |

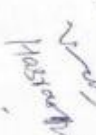
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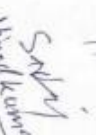
FORMAT FOR PUBLIC CONSULTATION
Project: Delhi Metro Rail, Phase- IV

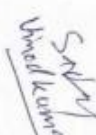
| Location | Date | Name of Stakeholder | Issues Discussed | Suggestion by Stakeholders |
|-------------------------------|------------|---------------------|--|---|
| Rangpuri V. Stage, Mathpalpur | 23/08/2013 | | <p>Easy transportation</p> <p>Waiting time</p> <p>Pollution issue</p> <p>Heavy traffic</p> <p>Compensation</p> | <p>It will easier to commute via road heavy, Mathpalpur, Tagarakotad, Sardaryang</p> <p>Waiting time for Badarpur is too much. Time saving</p> <p>Due to metro, pollution due to other vehicles will be reduced. At present due to diesel vehicles pollution level is too high.</p> <p>Mathpalpur to charpur crowd heavy crowd particularly at peak hour. Metro will help to reduce traffic upto great extent.</p> <p>Adequate compensation should be given where land will be taken for metro purpose.</p> |

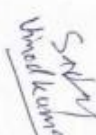
Signature of Stakeholders


① Deveder Sis 9871488572 

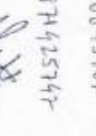
② Vinod 916184423 


③ A Hashrod Ag 9310442854 


④ Sanjay 9818553460 


⑤ Vinod Kumar 8595727070 

⑥ Praveen Chakrav 9116590092 

⑦ Anshul Prasad 9130843467 

⑧ Rajesh By Onake 9871425747 

⑨ Dev 8860471462 

⑩ Karan 987763701 

S.K

FORMAT FOR PUBLIC CONSULTATION
Project: Delhi Metro Rail, Phase-IV

| Location | Date | Name of Stakeholder | Issues Discussed | Suggestion by Stakeholders |
|-------------------|------------|---------------------|---|--|
| Jagajpur Village. | 21/03/2015 | | <p>Increased Facilities</p> <p>Metro Route Improvement</p> <p>Students Mobility</p> <p>Inadequate transport facilities.</p> | <p>If metro will be there, other infrastructure will also build up.</p> <p>As there is huge population residing in the area of Burali, Jagajpur village, Surghat, for long border, West Karawal Nagar, Gharipur, the route need to be changed from Surghat to West Karawal Nagar, [Jagajpur-Surghat] then Jagajpur village. This route will cover the both side population.</p> <p>Many of the Civil service apartment students are staying in Jagajpur a village & surrounding areas.</p> <p>There is no existing transportation DTC is not available.</p> |

Signature of Stakeholders

- 1) S. Aditi Singh 9818208330
- 2) Pradyumn Ti 8802135332
- 3) Ajay Kumar 9866748695
- 4) Sushil Kaurik 9811935455
- 5) Vipul Gaba 9555169007
- 12) Harshida 9210808346
- 13) Kandeep Singh 911814346

- 6) Sahyagrah 9811587086
- 7) Ravindra 8010579121
- 8) Anand Kumar 9871108182
- 9) Amit Kumar 959311370
- 10) Vikas Sr 9891565108
- 11) Navin Sr. 998042854

FORMAT FOR PUBLIC CONSULTATION
Project: Delhi Metro Rail, Phase-IV

| Location | Date | Name of Stakeholder | Issues Discussed | Suggestion by Stakeholders |
|--------------|-----------|---------------------|--|---|
| Sheikh Sarai | 10/9/2019 | | <p>Noting time is Time saving Public transport increase. Inadequate transportation Metro can reduce Pollution.</p> | <p>Presently only bus is there, nothing else is there It takes too much time to go anywhere from this place Metro fast is fast & safe Bus services is too slow, and there is urgent need of Metro. There is no bus stand, not organize This area is connected to industrial area, Old, Kalka Joginderpur, Faridabad, Noida, etc. There are industrial area in should be connected to this place Per The commuting population is too high for community so from Gurgaon, Kalkaji, Subarpur There are several colleges bus, which increase the traveler manifold.</p> |

Signature of Stakeholders:

- ① Madhawan 01-29583131
- ② Kamal Malik 595303245
- ③ Dhandra 9659911453
- ④ Hena 9911672457
- ⑤ Sangay 9821912144
- ⑥ Singh 881433535
- ⑦ Bahadur 9714258538
- ⑧ Abhishek 9371743132
- ⑨ Niga 9211787852
- ⑩ Anjali Prasad
- ⑪ Rakesh Singh 9150585765

FORM 7 FOR PUBLIC CONSULTATION
Project: Delhi Metro Rail, Phase IV

| Location | Date | Name of Stakeholder | Issue Discussed | Suggestion by Stakeholder |
|---------------|------------|---------------------|---|---|
| LITP Hospital | 21/04/2015 | | <p>Engaged with public (Genetic)</p> <p>Easy approach</p> | <p>People coming from left area of Delhi</p> <p>The existing one is already engaged and after more it will again more engaged.</p> <p>The existing traffic is too much. And people have to wait for time to reach hospital. People coming from Vasant Vihar, Gurgaon.</p> <p>One is existing Engage- understand more</p> <p>Some one is not frequent, waiting time is too much. By convenience according to different areas</p> |

Signature of Stakeholders

1) Mohan Meher 559252771

2) Deepak Kumar 9828172004

3) Pawan Singh 81021821

4) S.K. Sarda 910149811

5) Harish 5826162851

6) Manoj 592978777

7) Ashish 8722411238

8) Sudeep 923200321

9) Navin 582755425

10) Nishu Malik 92503728


11) Saurabh 98871852

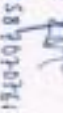
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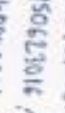
FORMER FOR PUBLIC CONSULTATION
Project: Delhi Metro Rail, Phase IV

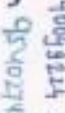
| Location | Date | Name of Stakeholder | Issues Discussed | Signature by Stakeholder |
|-----------------|------------|---------------------|---|---|
| Andhera Gurgaon | 10/01/2019 | | <p>Inadequate transport</p> <p>Cong. travelling</p> <p>Improvement in Peak</p> <p>State mode of travelling for ladies</p> <p>Time taking</p> <p>Reduction in pollution</p> <p>Heavy traffic</p> | <p>There are too many school colleges around and the existing transport system is inadequate.</p> <p>From Saket Nagar to Andhera Gurgaon.</p> <p>From Noida to Andhera Gurgaon is required. more transport mode is required. travelling time is too much from Noida to Andhera Gurgaon.</p> <p>Buses & other modes of transportable is not safe for ladies. Metro is safer than other modes of transportable.</p> <p>As compare to other mode of transport, Metro will save time. waiting time is less than 15-20 min.</p> <p>Due to heavy traffic, there are more air and noise pollution.</p> <p>Due to heavy traffic in MG Road, it is difficult to commute there.</p> |


Signature of Stakeholders


① Anshu -  9876543210


② Rajeev -  8765432109


③ Vinita -  7654321098


④ Anil -  6543210987


⑤ Anshu -  5432109876


⑥ Hemalata -  4321098765

⑦ Sunil Kumar -  9876543210

⑧ Farid -  8765432109

⑨ Gulshan Kumar -  7654321098

⑩ M.K. Gupta -  6543210987

⑪ P.N. Chaudhary -  5432109876

FORMAT FOR PUBLIC CONSULTATION
Project: Delhi Metro Rail, Phase-IV

| Location | Date | Name of Stakeholder | Issues Discussed | Suggestion by Stakeholder |
|-------------------------|------------|---------------------|---|--|
| Eastern Industrial area | 21/10/2013 | | <p>Increase connectivity</p> <p>Decrease in accident</p> <p>Develop local economy</p> | <p>Transportation through metro will be better, nearby villages & other places like Patia. Due to industrial area many people come here and it will be helpful for smooth transportation.</p> <p>Due to industrial area, there is lot of people coming & hence there is high level of accident.</p> <p>Due to improvement in transportation, local economy will boost.</p> |

Signature of Stakeholder

- 1) Mridha 9718808992
- 2) Manu 9310814771
- 3) Umesh 9654931103
- 4) Deepak 9114350182
- 5) Ashish Kumar 9711188574

Signature of Stakeholder

- 1) Vagat 99213335171
- 2) Mayabada Naha 918808337-
- 3) Shiv Gubakar 9316326148
- 4) Big Kumar 8163555349
- 5) Madaan 941955280182
- 6) Vicky 9654442702

Annexure 9.3

Minutes of Environmental Public Consultations**Contract -DC-07**

Sub: Minutes of Meeting of DMRC DC-07 Project officials with PAFs on 10th Feb 2020.

Venue: At Site Location Anandmayee Marg (Okhla Red Light, Lal Kuan).

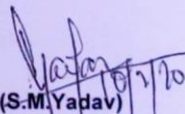
The meeting started at Okhla Red Light, Lal Kuan with brief introduction by the entire project related/affected members. It was attended by Shri S.M.Yadav, (PM/6A), Shri Siddharth Kashyap, (AEN 6A-2), Shri Ambuj Pandey, (JE), Shri Ajay Devanda, (JE) and Project Affected Families (PAF's).

Shri Siddharth Kashyap, (AEN) started the presentation on RPF (Resettlement Plan Framework). The presentation also consisted of salient features of DMRC Project DC-07, Compensation Matrix and Grievance Redressal Mechanism. These points were further elaborated in detail by Shri S.M.Yadav, PM/6A. The points related to land compensation matrix was raised by PAF Anandmayee Marg, which was answered in detail by officials of DMRC.

All the above questions were handled efficiently by PM/6A and other officials of DMRC. Most of the issues were sorted out in the meeting itself. Few queries, specially related to location where rehabilitation will take place was enquired by PAFs. They want resettlement nearby. It was explained to them that DMRC will pursue with the Delhi Urban Shelter Improvement Board (DUSIB), which is nodal agency for resettlement.

The meeting ended with vote of thanks by all officials to the PAFs of DMRC Project.

Encl: Attendance Sheet attached herewith

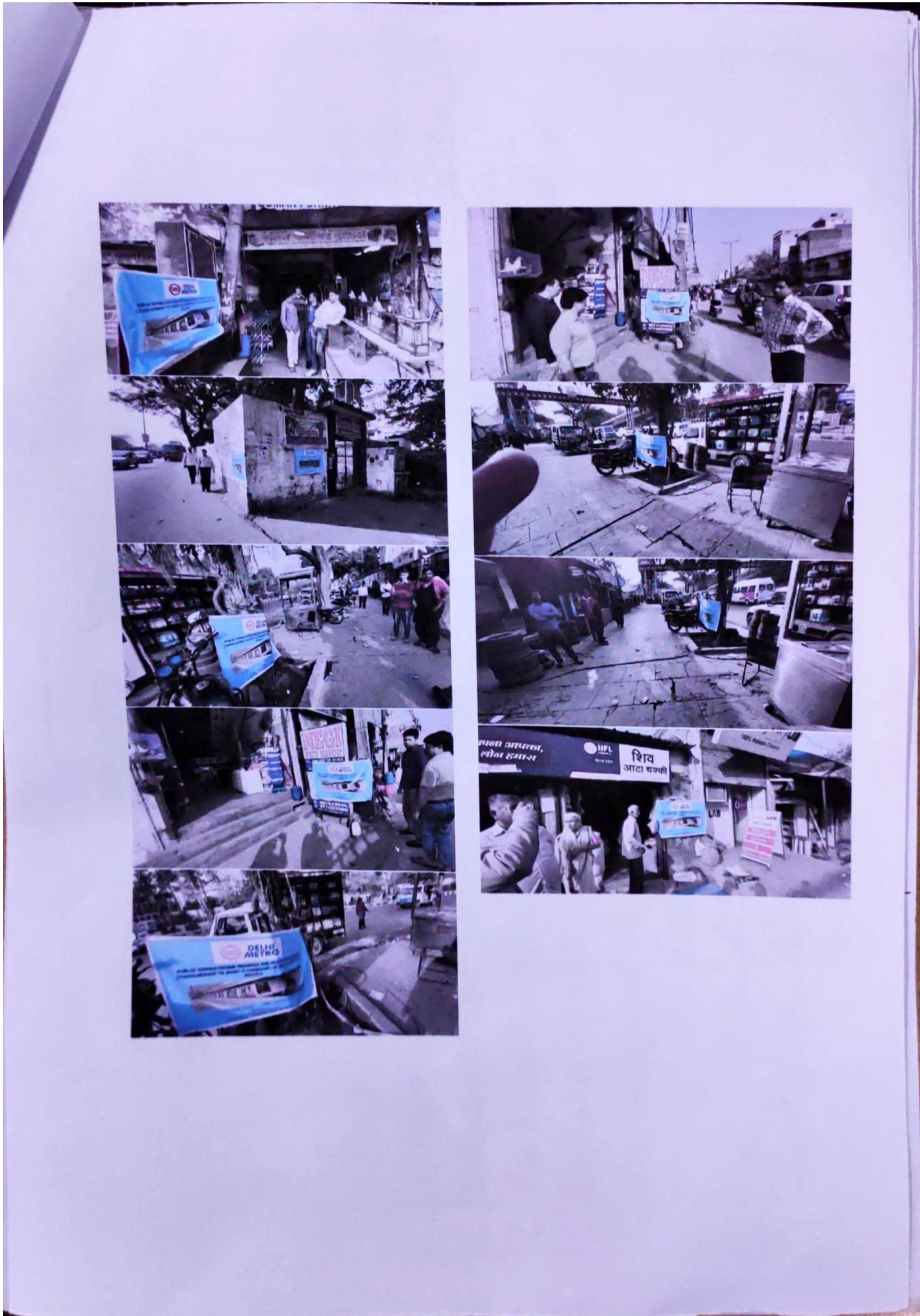

(S.M. Yadav)
Project Manager/6A

May kindly see
ED/C/P.2
seen
hp
10/2/20
pm/6A.

| Place & Date | Issues Discussed | Important views, questions & Suggestions | DMRC reply |
|------------------------------|--------------------------------------|---|---|
| Khanpur Market 09.02.2020 | On Environmental issues | <ul style="list-style-type: none"> - Construction should be environment and public friendly - Construction should be fast tracked near market area to minimize air and noise pollution - Noise barrier should be provided near residential areas during construction and operation - Precautions to be taken to prevent damage to archeological structures around Tughlakabad Fort area - Waste dumping around construction site to be avoided - Tree felling should be minimized, and compensatory plantation should be carried out. | <ul style="list-style-type: none"> - Phase-IV of Delhi Metro is planned and designed as per green building norms. Phase-IV construction will be environment and public friendly. - Excavation near residential and commercial areas will be fast tracked to minimize disturbances - Proper care will be taken so that noise pollution does not cross the permissible limits during construction this includes measures such as provision of noise barriers around construction site. Requirement of noise barrier will be studied. - Tughlakabad Fort is approx. 212m away from the alignment. There will not be any impact on the structure due to metro construction. Moreover, all precautions will be taken to avoid any mishap. - Waste from construction site will be disposed at authorized facility. - Felling of trees will be minimized to the extent possible. Ten saplings will be planted against every tree cut as per norms. |
| | On alignment, station design and R&R | <ul style="list-style-type: none"> - All shop keepers should be rehabilitated in the nearby area before demolition | <ul style="list-style-type: none"> - Shopkeepers will be rehabilitated within 500m distance. |
| | On other issues | <ul style="list-style-type: none"> - Construction should not affect day to day working of the market - Pedestrian problem should be taken care of | <ul style="list-style-type: none"> - Access to the shops will not be obstructed and care will be taken so that construction does not affect day to day working |

| | | | |
|-------------------------------|-------------------------|--|---|
| | | <ul style="list-style-type: none"> - Road should not be blocked during construction - Metro fares should be reduced to make it more accessible to all sections of society - E-Rickshaw services to be provided at stations | <ul style="list-style-type: none"> of nearby shops. - Proper barricading of works will be carried out for pedestrian safety. - Blockage of road will be avoided as far as possible. - Metro fares are decided by a committee and DMRC has no role in fare fixation - Possibility for providing Metro E-Rickshaw facility will be looked into. |
| Anandmayee Marg 10.02.2020 | On Environmental issues | <ul style="list-style-type: none"> - Dust and noise from construction should be mitigated - Malba (C&D Waste) from construction should not be dumped in the locality - Waste from the construction site should not pollute the area nearby - Rainwater harvesting needs to be carried out - Felling of trees should be minimized - Special precautions must be taken to protect animals during construction - | <ul style="list-style-type: none"> - Measures such as up to 10m high barricading, wheel washing, mist spraying and host of other measures will be taken during construction to minimize dust pollution - Proper care will be taken so that noise pollution does not cross the permissible limits during construction this includes measures such as provision of noise barriers around construction site - For recycling C&D waste, DMRC has set-up its recycling plant at Ranikhhera, Mundka. C&D waste from DMRC construction will be recycled at this plant. - Felling of trees will be minimized to the extent possible. Ten saplings will be planted against every tree cut as per norms. - No impact on fauna is anticipated as the project is in urban area where there is no wildlife. Snakes rescued from construction site will be handed over to Wildlife NGOs. |

| | | | |
|--|--------------------------------------|---|---|
| | On alignment, station design and R&R | <ul style="list-style-type: none"> - Jhuggies coming in the work area should be rehabilitated in the nearby area before demolition - FOT to be built during construction | <ul style="list-style-type: none"> - Jhuggies will be rehabilitated within the nearby area. - Possibility of providing FOT will be looked into. |
| | On other issues | <ul style="list-style-type: none"> - Change from one station to another should be 'old age people friendly' - Metro feeder bus facility should be available between residence and the metro stations - Pedestrian problem should be taken care of and construction should not affect day to day operation of their shops nearby - More rail cars to be increased during the peak hours. Special ladies bogies should be increased. - Metro should not damage the aesthetic view of the surrounding area. | <ul style="list-style-type: none"> - The Station design shall take into consideration the features which will make the station to old and disabled people friendly. - Possibility for providing Metro feeder bus facility will be looked into. - Access to the shops will not be obstructed and care will be taken so that construction does not affect day to day working of nearby shops. - People were informed that at the design stage itself, the basic unit of 6-car train is proposed for all the new upcoming corridors. The number of exclusive bogies for ladies, which is presently one, could be increased depending on the prevailing demand. - Stations will be designed aesthetically keeping in view of the surrounding area. |



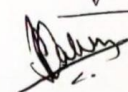
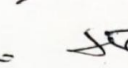



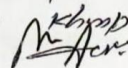



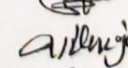
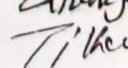
PUBLIC ORIENTATION PROGRAM
Corridor Sangam Vihar-Saket-'G' (DC-04)

Location: KHANPUR (M.B. Road)
Date: 09.02.2020

| S.No. | Name of the Person | Address | Mobile No. | Email ID | Signature |
|-------|--------------------|-----------------------|------------|----------|------------------|
| 1 | MAHESH CHAUDHARI | 27 Piti Kotli Khanpur | 9350317771 | | <i>M.E.</i> |
| 2 | DR. NAREYAN | 35 Poo Kotli | 9811077687 | | <i>Hangyas</i> |
| 3 | SATPAL | 7A KHANPUR | 9650722471 | | <i>Satpal</i> |
| 4 | ASHOK | 35 A KHANPUR | 9871982727 | | <i>Ashok</i> |
| 5 | MAHENDERSINGH | M.B. Road Khanpur | 9873001915 | | <i>Mahender</i> |
| 6 | RAJ KUMAR | 215 P.N.B Khanpur | 9810250668 | | <i>Raj Kumar</i> |
| 7 | Rajinder Chawla | D-56, Khanpur | 9810046457 | | <i>Rajinder</i> |
| 8 | Krishan Chandel | 54, Khanpur | 9810384857 | | <i>Krishan</i> |
| 9 | Ram Singh | P134 Khambra | 99040423 | | <i>Ram Singh</i> |
| 10 | Ashutosh | P156 Khambra | 9971534877 | | <i>Ashutosh</i> |
| | Ram Singh | P156/13 | 9810900850 | | <i>Ram Singh</i> |

| S.No. | Name of the Person | Address | Mobile No. | Email ID | Signature |
|-------|----------------------|---------------------------------------|------------|----------|-----------|
| 12 | Nirayan | R-36 Khepur | 9968911858 | | |
| 13 | Rajender | 3 Akm. f. p | 8730191887 | | |
| 14 | Sakhu | 56 D Khan | 9871011931 | | |
| 15 | Indo Sidhans | 815 S masRoa | 9871807510 | | |
| 16 | Angusi Devi (65 yrs) | Shop 38, Khampur, MS Road. | | | |
| 17 | Anita (28 yrs) | Shop 38, Khampur, MS Road | | | अनिता |
| 18 | Neelu (22 yrs) | Shop 37, Khampur, MS Road | | | नीलू |
| 19 | Pooja (40 yrs) | Shop 36, Khampur, MS Road | | | पूजा |
| 20 | Pritya (27 yrs) | Shop 35, Khampur, MS Road | | | प्रिया |
| 21 | Shweta (22 yrs) | Shop 33, MS Road, Khampur | | | श्वेता |
| 22 | Laxmi (26 yrs) | Shop 32, Khampur, MS Road | | | लक्ष्मी |
| 23 | Kajal (21 yrs) | Shop 31, Khampur, MS Road | | | काजल |
| 24 | Anju (30 yrs) | Shop 29, Khampur, MS Road | | | अंजु |
| 25 | Hemlata (25 yrs) | shops, Khampur, MS Road, Sheet 4 of 4 | | | हेमलता |

CP-20

| Name | Address | Signature | Mobile No (16) |
|--|-----------------------------|---|--------------------------|
| 1 H.C. SARKHUA | 56-D, Khampur |  | 9811011933 9811671933 |
| 2 H.C. SARKHUA | 56-D, Khampur |  | 9811043982 |
| 3 Ravi Kumar | 94 Shop Khampur - Ravi | | 9910160771 |
| 4 SHYAM YADAV | 97, M.B. Road, Khampur Shop | | 9810946847 |
| 5 Lalit Kumar | 94, M.B. Road Khampur Shop | | 9818720432 |
| 6 Yogendra | F-14 MB Road Khampur | | 9211632543 |
| 10 DEEPAK MALHOTRA | C-54 MB Road Khampur | | 9810464626 |
| 11 | C 54 MB Road MB 26 |  | 9211344401 |
| 12 VINAY AGGARWAL | C-54, Khampur Main Market |  | 7827070801 |
| 13 JAPSINGH | 11 KHAMPUR |  | 97183114 |
| 14 JAI KARAN | | | 9911200222 |
| 15 SHRI PAL | | | |
| 16 Rohul | | | |
| 17 Shyam Sunder | 22/231 M.B. Road Khampur | | 9654307503 |
| 18 A.K. JAIN | 20/223, M.B. Road Khampur |  | 9810298032 9810117742 |
| 19 Gaurishankar Gogoi (Gogoi Diamond Tools) | 22/227 M.B. Road Khampur | | |
| 20 Sanjeev Sikri | 38/4 M.B. Road Khampur |  | 9910326330 |
| 21 SANTAY GYAL | Shop No 22 MB Road Khampur | | 9810024056 |
| 22 Satish Jindal | 22/227 M.B. Road Khampur |  | 9818227393 |
| 23 ANIL TARA CHAND | 22/230 MB Road Khampur | | 9268376761 |
| 24 KRISHNA KUMAR | A-54 Khampur | | 9810384857 |
| 25 | A-54 Khampur | | 9810384857 |
| 26 Jitender Singh | D-56 Khampur |  | 9971109090 |
| 27 Nishant Singh | 3/56 Khampur |  | 8130400880 |
| 28 TILAK SINGH | 26 Khampur |  | 9310185887 |

Public Consultation Programme (Anandmayee Marg) Attendance Sheet



Date 10.02.2020

| S. No. | Name | Gender | Signature | Remarks |
|--------|---------------|--------|--------------|---------|
| 1.) | Sanjay Kumar | M | Sanjay Kumar | |
| 2.) | Ram Singh | M | | |
| 3.) | Sagar | M | Sagar | |
| 4.) | Sunny Padiyar | M | Sunny | |
| 5.) | Praveen Kumar | M | Praveen | |
| 6.) | Sunil Padiyar | M | Sunil | |
| 7.) | Mangal Rathor | M | Mangal | |
| 8.) | Ravi | M | Ravi | |
| 9.) | Pawan | M | Pawan | |
| 10.) | Baljeet | M | Baljeet | |
| 11.) | Sahil | M | Sahil | |
| 12.) | Danrath Bhab | M | Danrath | |
| 13.) | Mamta | F | Mamta | |
| 14.) | Golu | M | Golu | |
| 15.) | Geeta | F | Geeta | |
| 16.) | | | | |
| 17.) | Geeta | F | Geeta | |
| 18.) | Sonu | M | Sonu | |
| 19.) | Seema | F | Seema | |
| 20.) | Pinki Devi | F | Pinki Devi | |
| | Lali | F | LALI | |
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ATTENDANCE SHEET FOR PAFs AT PROPOSED ANADMAYEE STATION

Location- Okhla red light, Lal Kuan

Date- 10.2.2020

| S.NO | ATTENDEE | PHONE NO. | SIGNATURE |
|------|-----------------------------------|-------------|---|
| 1.) | Aasha (Israfi) daughter in law | 9971308617 |  |
| 2.) | Maya Devi | 9821188150 | माया देवी |
| 3.) | Sita | 844-8555671 |  |
| 4.) | Sunil | | |
| 5.) | Pinki Devi | 9717584421 | पिंकी देवी |
| | | | |
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NOTE

Dated: 03.02.2020

Sub: Minutes of Public Consultation

Location: Ghanta Ghar

Date: 02.02.2020

The Meeting was attended by Sh. Saurabh Sharma (PM-3A), Sh. Virender Kumar Sattawan (XEN), Lokesh (JE), Sachin Shakya (JE), Vijay Kumar (JE), Ashish Kumar (JE), Priyum Swarup (JE), Rohit Jamun (JE), Satinder (Surveyor) and project-affected people of the Ghanta Ghar locality. Attendance sheet is attached herewith.

DMRC team delivered a presentation on the Phase-IV project. The presentation touched upon the brief about R K Ashram – Janakpuri West corridor, construction schedule, silent features of DMRC project, positives and negatives about the project, project environment management, resettlement policy framework, entitlement matrix and grievance redress mechanism in DMRC. The project manager Sh. Saurabh Sharma further elaborated on these points and the team provided answers to questions raised by the affected people. Main questions raised by the PAF and reply given by the DMRC team are given below:

| Issues Discussed | Important views & Suggestions | DMRC reply |
|-------------------------|--|---|
| On Environmental issues | <ul style="list-style-type: none"> - Will the construction cause damage to Tripoliagate - Air and Noise pollution should be mitigated during construction - Will DMRC construct rainwater harvesting structures at metro stations - Safety during tunneling to be ensured - The excavation period needs to be fast tracked near residential colonies to minimize air and noise pollution - Construction should be environment and public friendly - The project should not cause global warming - Tree felling should be minimized, and compensatory plantation should be carried out. | <ul style="list-style-type: none"> - The Tripolia Gate is approx. 138m from the alignment. There will not be any impact on the structure due to metro construction. Moreover, before any construction work at this area; permission from ASI will be obtained. Moreover, all precautions will be taken to avoid any mishap. - Measures such as up to 10m high barricading, wheel washing, mist spraying and host of other measures will be taken during to minimize dust pollution - Proper care will be taken so that noise pollution does not cross the permissible limits during construction this includes measures such as provision of noise barriers around construction site - Excavation near residential and commercial areas will be fast tracked to minimize disturbances - Phase-IV of Delhi Metro is planned and designed as per green building norms. Phase-IV construction will be environment and public friendly. - DMRC will provide Rainwater harvesting system at stations - No activity which will cause the global warming is |

S SAURABH SHARMA
 PM-3A
 CPM-3 Office, Mayapuri Vihar-I
 Delhi Metro Rail Corporation

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| | | <p>anticipated.</p> <ul style="list-style-type: none"> - Only those trees which are falling on the alignment will be cut. Ten saplings will be planted against every tree cut as per norms. - Feeling of trees will be minimized to the extent possible. Ten saplings will be planted against every tree cut as per norms. |
| On other issues | <ul style="list-style-type: none"> - Metro fares should be reduced - Traffic congestion around station to be managed better - Metro feeder bus facility should be available between residence and the metro stations - More rail cars to be increased during the peak hours - Efforts should be made that people should face less difficulties as far as possible | <ul style="list-style-type: none"> - Metro fares are decided by a committee and DMRC has no role in fare fixation - Multi Model Integration (MMI) will be implemented to avoid congestion around operational metro station - Possibility for providing Metro feeder bus facility will be looked into. - People were informed that at the design stage itself, the basic unit of 6-car train is proposed for all the new upcoming corridors. The number of exclusive bogies for ladies, which is presently one, could be increased depending on the prevailing demand. - All efforts will be made to minimize the period of excavation during construction and all precautions will be taken to avoid air and noise pollution. |

Encl: a/a


 Saurabh Sharma
 Project Manager
SAURABH SHARMA
 PM-3A
 CPM-3 Office, Mayur Vihar-I
 Delhi Metro Rail Corporation

Attendance Sheet

Location: Ghanta Ghar

Date of meeting:

| Sl. No. | Name | Gender | Signature | Remarks |
|---------|------------------|--------|-------------|---------|
| 1. | Vivender Kumar | M | [Signature] | |
| 2. | Rakesh | M | [Signature] | |
| 3. | Rohit Juman | M | [Signature] | |
| 4. | Vijay Kumar | M | [Signature] | |
| 5. | Jitender Kumar | M | [Signature] | |
| 6. | Dharmender Kumar | M | [Signature] | |
| 7. | Sachin Shukya | M | [Signature] | |
| 8. | Nishant Sharma | M | [Signature] | |
| 9. | Man Mohan | M | [Signature] | |
| 10. | Rakesh | M | [Signature] | |
| 11. | Asha Sharma | F | [Signature] | |
| 12. | Priyam | M | [Signature] | |
| 13. | Ashish Kumar | M | [Signature] | |
| 14. | Manish Kumar | M | [Signature] | |
| 15. | Kapil Sharma | M | [Signature] | |
| 16. | Rakha Ishandev | F | [Signature] | |
| 17. | Karthik | M | [Signature] | |
| 18. | Amit Kumar | M | [Signature] | |
| 19. | Chandan Sahas | M | [Signature] | |
| 20. | Jitender Kumar | M | [Signature] | |
| 21. | Ramesh Chand | M | [Signature] | |
| 22. | Ravi Kant Kumar | M | [Signature] | |
| 23. | Saurabh Sharma | M | [Signature] | |
| 24. | Satinder Singh | M | [Signature] | |
| 25. | Nitin | M | [Signature] | |
| 26. | Poojit Kumar | M | [Signature] | |
| 27. | Ravi | M | [Signature] | |
| 28. | Andu Kumari | F | [Signature] | |
| 29. | Dev Kumar | M | [Signature] | |
| 30. | Ashok Kumar | M | [Signature] | |
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**NOTE**


Dated: 03.02.2020

Sub: Minutes of Stakeholder Consultation Meeting**Location: Pul Bangash****Date: 01.02.2020**

The Meeting was attended by Sh. Saurabh Sharma (PM-3A), Sh. Virender Kumar Sattawan (XEN), Lokesh (JE), Sachin Shakya (JE), Vijay Kumar (JE), Ashish Kumar (JE), Priyum Swarup (JE), Rohit Jamun (JE), Satinder (Surveyor) and project-affected people of the Pul Bangash locality. Attendance sheet is attached herewith.

DMRC team delivered a presentation on the Phase-IV project. The presentation touched upon the brief about R K Ashram – Janakpuri West corridor, construction schedule, silent features of DMRC project, positives and negatives about the project, project environment management, resettlement policy framework, entitlement matrix and grievance redress mechanism in DMRC. The project manager Sh. Saurabh Sharma further elaborated on these points and the team provided answers to questions raised by the affected people. Main questions raised by the PAF and reply given by the DMRC team are given below:

| Issues Discussed | Important views & Suggestions | DMRC reply |
|--------------------------------------|---|---|
| On Environmental issues | <ul style="list-style-type: none"> - DMRC should take measures to control air pollution during construction - Noise pollution should be controlled during construction - Felling of trees should be minimized - Safety of structures during tunneling should be ensured - Waste from the construction site should not pollute the area | <ul style="list-style-type: none"> - Measures such as up to 10m high barricading, wheel washing, mist spraying and host of other measures will be taken during construction to minimize dust pollution. - Proper care will be taken so that noise pollution does not cross the permissible limits during construction. This includes measures such as provision of noise barriers around construction site. - Felling of trees will be minimized to the extent possible. Ten saplings will be planted against every tree cut as per norms. - Proper safety measures will be taken during construction to avoid any mishappening. As a part of this extensive monitoring will be carried out during tunneling. - Waste from construction site will be disposed of only at authorized disposal facilities. For recycling C&D waste, DMRC has setup its own recycling plant . |
| On alignment, station design and R&R | <ul style="list-style-type: none"> - Private land acquisition should be avoided - Entry/Exit structure should be accommodated in the MCD dispensary | <ul style="list-style-type: none"> - Completely eliminating private land acquisition is practically not feasible. However, all efforts will be taken to minimize private land requirement |


SAURABH SHARMA
 PM-3A
 CPM-3 Office, Mayur Vihar-1
 Delhi Metro Rail Corporation

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| | | <ul style="list-style-type: none"> - Due to site constraints /land constraints, accommodating entry/exit structure in MCD dispensary is not feasible. |
| <p>On other issues</p> | <ul style="list-style-type: none"> - Pedestrian problem should be taken care of and construction should not affect day to day operation of their shops nearby. Walkways should be built for pedestrian movement - Traffic congestion around metro station should be controlled. - Underground parking area to be constructed - Construction should be completed fast - Metro should not damage the aesthetic view of the surrounding area | <ul style="list-style-type: none"> - During construction, a route plan will be developed in consultation with a traffic/transportation expert. Proper barricading of works will be carried out for pedestrian safety. Access to the shops will not be obstructed and care will be taken so that construction does not affect day to day working of nearby shops. - Provision of providing parking space depends on land availability. Where there is availability of land parking will be provided. - All efforts will be made to minimize the period of construction. - Stations will be designed aesthetically keeping in view of the surrounding area. |

Encl: a/a


 Saurabh Sharma
 Project Manager/3A
SAURABH SHARMA
 PM-3A
 CPM-3 Office, Mayur Vihar-I
 Delhi Metro Rail Corporation

Attendance Sheet

Location: Pol Bangash

Date of meeting:

| Sl. No. | Name | Gender | Signature | Remarks |
|---------|-----------------|--------|-------------|---------|
| 1. | Virender kumar | M | [Signature] | |
| 2. | hakesh | M | [Signature] | |
| 3. | Sachin sharma | M | [Signature] | |
| 4. | vijay yadav | M | [Signature] | |
| 5. | vivek | M | [Signature] | |
| 6. | vijay sharma | M | [Signature] | |
| 7. | Karan Singh | M | [Signature] | |
| 8. | Manish kumar | M | [Signature] | |
| 9. | Somit | M | [Signature] | |
| 10. | sateendar Singh | M | [Signature] | |
| 11. | Rahul kumar | M | [Signature] | |
| 12. | Raju | M | [Signature] | |
| 13. | Manu Thakur | M | [Signature] | |
| 14. | Irsad | M | [Signature] | |
| 15. | md. farq | M | [Signature] | |
| 16. | Nazim | M | [Signature] | |
| 17. | chandan sahu | M | [Signature] | |
| 18. | Ravi kumar | M | [Signature] | |
| 19. | Audhesh gupta | M | [Signature] | |
| 20. | Ajay sharma | M | [Signature] | |
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**NOTE**

Dated: 03.02.2020

Sub: Minutes of Stakeholder Consultation Meeting**Location: R K Ashram****Date: 01.02.2020**

The Meeting was attended by Sh. Saurabh Sharma (PM-3A), Sh. Virender Kumar Sattawan (XEN), Lokesh (JE), Sachin Shakya (JE), Vijay Kumar (JE), Ashish Kumar (JE), Priyum Swarup (JE), Rohit Jamun (JE), Satinder (Surveyor) and project-affected people of the R K Ashram locality. Attendance sheet is attached herewith.

DMRC team delivered a presentation on the Phase-IV project. The presentation touched upon the brief about R K Ashram – Janakpuri West corridor, construction schedule, silent features of DMRC project, positives and negatives about the project, project environment management, resettlement policy framework, entitlement matrix and grievance redress mechanism in DMRC. The project manager Sh. Saurabh Sharma further elaborated on these points and the team provided answers to questions raised by the affected people. Main questions raised by the PAF and reply given by the DMRC team are given below:

| Issues Discussed | Important views & Suggestions | DMRC reply |
|--------------------------------------|---|--|
| On Environmental issues | <ul style="list-style-type: none"> - Construction should be environment and public friendly - Construction should be fast tracked near market area to minimize air and noise pollution - Malba (C&D Waste) from construction should not be dumped in the nearby locality - Safety of structures during tunneling should be ensured - Compensatory plantation should be carried out - Sanitation facilities should be provided to workers at construction site | <ul style="list-style-type: none"> - Phase-IV of Delhi Metro is planned and designed as per green building norms. Phase-IV construction will be environment and public friendly. - All efforts will be taken to move the project on fast track project near residential and commercial areas. - Waste will be disposed at designated places only - Proper safety measures will be taken during construction to avoid any mishappening. As part of this extensive monitoring will be carried out during tunneling - Ten saplings will be planted against every tree cut as per norms. - Proper sanitation facilities will be provided with the construction site. |
| On alignment, station design and R&R | <ul style="list-style-type: none"> - Station location should be shifted 300m backwards to avoid any disturbance | <ul style="list-style-type: none"> - Due to site constraint, it is not feasible |
| On other issues | <ul style="list-style-type: none"> - Distance between the existing station and the new station should be minimized - DMRC should start its own E-Rickshaw service - All necessary precaution may be taken during construction to avoid any mishappening. - Efforts should be made that | <ul style="list-style-type: none"> - This will be taken into consideration during station design subject to availability of land - Possibility for providing Metro E-Rickshaw facility will be looked into - Safety is paramount for DMRC and all measures will be taken |


SAURABH SHARMA
 PM-3A
 CPM-3 Office, Mayur Vihar-I
 Metro Rail Corporation

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| | people should face less difficulties as far as possible - Area around metro station should be kept neat and clean | to avoid any mishap - Efforts will be made that people will face least difficulties during construction - All efforts will be taken to keep area around metro station neat & clean |
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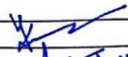

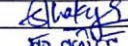
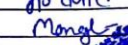

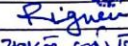
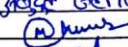
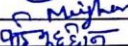
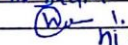
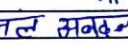
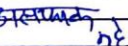

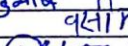
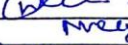
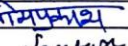
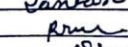
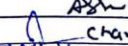
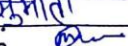
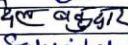
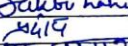
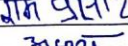
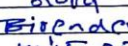
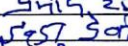
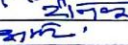
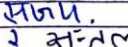
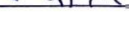














Encl: a/a


Saurabh Sharma
Project Manager/3A
SAURABH SHARMA
PM-3A
CPM-3 Office, Mayur Vihar-I
Delhi Metro Rail Corporation

Attendance Sheet

Location: R.K Ashram

Date of meeting:

| Sl. No. | Name | Gender | Signature | Remarks |
|---------|--------------------------|--------|---|---------|
| 1. | Virender kumar pattanjan | M |  | |
| 2. | Lokesh | M |  | |
| 3. | Satinder Singh | M |  | |
| 4. | Sachin shakya | M |  | |
| 5. | Md. Wakil | M |  | |
| 6. | Manglu | M |  | |
| 7. | Furq Alam | M |  | |
| 8. | Nitin Kohiya | M |  | |
| 9. | Rizwan shakil Alam | M |  | |
| 10. | Abdul Zail | M |  | |
| 11. | Mohan Kumar | M |  | |
| 12. | Mujhan Anwar | M |  | |
| 13. | Fayyaz uddin | M |  | |
| 14. | Vijay yadav | M |  | |
| 15. | Md. Jabuddin | M |  | |
| 16. | Janilaluddin | M |  | |
| 17. | Ashfaq | M |  | |
| 18. | Mahender singh | M |  | |
| 19. | Dinesh Singh | M |  | |
| 20. | Subhash | M |  | |
| 21. | Wasim | M |  | |
| 22. | Ishad | M |  | |
| 23. | Manglu | M |  | |
| 24. | Om prakash | M |  | |
| 25. | Pratish Kumar | M |  | |
| 26. | Prigam | M |  | |
| 27. | Ashish Kumar | M |  | |
| 28. | Chandan shu | M |  | |
| 29. | Sunait Kumar | M |  | |
| 30. | Munish Kumar | M |  | |
| 31. | Dil Bahadur | M |  | |
| 32. | Shakti debia | M |  | |
| 33. | Prudeep Kumar | M |  | |
| 34. | Ram prasad | M |  | |
| 35. | Ajay Sharma | M |  | |
| 36. | Birender Sharma | M |  | |
| 37. | Permad Rai | M |  | |
| 38. | Andru Devi | F |  | |
| 39. | Rinku Kumar | M |  | |
| 40. | Amit Rai | M |  | |
| 41. | Sanjay | M | | |
| 42. | Shant Lal | M | | |

Attendance Sheet

Location:

Date of meeting:

| Sl. No. | Name | Gender | Signature | Remarks |
|---------|-------------------|--------|-----------------|---------|
| 1. | Ma Nizumuddin | M | मो. निजामुद्दीन | |
| 2. | Birender Kushwaha | M | Birender | |
| 3. | Ma Moshim | M | मोशिम | |
| 4. | Agim | M | अगिम | |
| 5. | Amav | M | अमव | |
| 6. | Rohit Jaman | M | रहित | |
| 7. | Ravi Kant | M | रवि | |
| 8. | Jitenav kr. Yadav | M | जितेंद्र | |
| 9. | Rahul Dubey | M | राहुल | |
| 10. | Munaj | M | मुनाज | |
| 11. | Rakesh Kukkar | M | राकेश | |
| 12. | Nitha | M | निथा | |
| 13. | Anresh | M | अनरेश | |
| 14. | prudeep | M | प्रदुप | |
| 15. | Asha Devi | F | अशा देवी | |
| 16. | Prem Chand | M | प्रेमचंद | |
| 17. | Ramesh Chand | M | रमेश | |
| 18. | Ashok Kumar | M | अशोक | |
| 19. | Raj Kumar | M | राजकुमार | |
| 20. | prudeep Raj | M | प्रदुप राज | |
| 21. | Sushma Devi | F | सुशमा देवी | |
| 22. | Anurag | M | अनुराग | |
| 23. | Kamal Kumar | M | कमल | |
| 24. | Pangeev Jha | M | पंगेव | |
| 25. | Puneet Sharma | M | पुनेत शर्मा | |
| 26. | Komal wati | F | कमल देवी | |
| 27. | Ravi Sharma | M | रवि | |
| 28. | Lalit Kumar | M | ललित | |
| 29. | Joyti Kumari | F | ज्योती कुमारी | |
| 30. | Ram Singh | M | राम | |
| 31. | Rakesh Kumar | M | राकेश | |
| 32. | Arnav Singh | M | अरनव | |
| 33. | md. fazal | M | मद. फजल | |
| 34. | Rakesh | M | राकेश | |
| 35. | Sonu Kumar | M | सोनू | |
| 36. | Chintu Kumar | M | चिंतु कुमर | |
| 37. | Satinder pal | M | सतिंदर | |
| 38. | pnet kumal | M | पनेत कुमल | |
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**NOTE**

Dated: 03.02.2020

Sub: Minutes of Stakeholder Consultation Meeting**Location: Sadar Bazar****Date: 01.02.2020**

The Meeting was attended by Sh. Saurabh Sharma (PM-3A), Sh. Virender Kumar Sattawan (XEN), Lokesh (JE), Sachin Shakya (JE), Vijay Kumar (JE), Ashish Kumar (JE), Priyum Swarup (JE), Rohit Jamun (JE), Satinder (Surveyor) and project-affected people of the Sadar Bazar locality. Attendance sheet is attached herewith.

DMRC team delivered a presentation on the Phase-IV project. The presentation touched upon the brief about R K Ashram – Janakpuri West corridor, construction schedule, silent features of DMRC project, positives and negatives about the project, project environment management, resettlement policy framework, entitlement matrix and grievance redress mechanism in DMRC. The project manager Sh. Saurabh Sharma further elaborated on these points and the team provided answers to questions raised by the affected people. Main questions raised by the PAF and reply given by the DMRC team is given below:

| Issues Discussed | Important views & Suggestions | DMRC reply |
|-------------------------|---|---|
| On Environmental issues | <ul style="list-style-type: none"> - Safety of structures during tunneling should be ensured - Dust and noise pollution should be mitigated during construction - Construction should not affect sealing of tube-wells - What is the source of water for construction - Tree felling should be minimized, and compensatory plantation should be carried out. - Special precautions must be taken to protect animals during construction | <ul style="list-style-type: none"> - Proper safety measures will be taken during construction to avoid any mishappening. As part of this extensive monitoring will be carried out during tunneling. - Measures such as up to 10m high barricading, wheel washing, mist spraying and host of other measures will be taken during construction to minimize dust pollution. - Proper care will be taken so that noise pollution does not cross the permissible limits during construction this includes measures such as provision of noise barriers around construction site. - If tube-wells are coming on the alignment these tube-wells have to be sealed. However, alternate arrangements will be provided by DMRC. - Water requirement for construction will be met either by extracting groundwater or sourcing water from outside. - Only those trees which are falling on the alignment will be cut. Ten saplings will be planted against every tree cut as per norms. - No impact on fauna is |

SOURABH SHARMA
PM-3A
CPM-3 Office, Mayur Vihar-I
Delhi Metro Rail Corporation

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|--------------------------------------|---|---|
| | | <p>anticipated as the project is in urban area where there is no wildlife. Snakes rescued from construction site will be handed over to Wildlife NGOs.</p> |
| On alignment, station design and R&R | <ul style="list-style-type: none"> - The station should be constructed on the road - Shops for shop – All shop keepers should be rehabilitated by constructing market complex in the nearby area | <ul style="list-style-type: none"> - Due to site constraint, it is not feasible. - Compensation/ rehabilitation will be as per Entitlement matrix. |
| On other issues | <ul style="list-style-type: none"> - Construction should not affect day to day working of the market - Pedestrian problem should be taken care of - Road should not be blocked during construction - Construction should be fast tracked - UG parking to be provided | <ul style="list-style-type: none"> - Access to the shops will not be obstructed and care will be taken so that construction does not affect day to day working of nearby shops. Proper barricading of work sites will be carried out for pedestrian safety. - As far as possible, road blockage will be avoided - All efforts will be made to minimize the period of construction. - Provision of providing parking space depends on land availability. Where there is availability of land parking will be provided. |

Encl: a/a



Saurabh Sharma
 Project Manager/3A
SAURABH SHARMA
 PM-3A
 CPM-3 Office, Mayur Vihar-I
 Delhi Metro Rail Corporation

Attendance Sheet

Location: Sadar Bazar

Date of meeting:

| Sl. No. | Name | Gender | Signature | Remarks |
|---------|-----------------|--------|-------------|---------|
| 1. | Viveender kumar | M | [Signature] | |
| 2. | lokesh | M | [Signature] | |
| 3. | Vijay kumar | M | [Signature] | |
| 4. | Rohit Jannun | M | [Signature] | |
| 5. | Ashish kumar | M | [Signature] | |
| 6. | priyam | M | [Signature] | |
| 7. | Saurabh Sharma | M | [Signature] | |
| 8. | Chandan Sahas | M | [Signature] | |
| 9. | Ankit kumar | M | [Signature] | |
| 10. | Trilokinath | M | [Signature] | |
| 11. | Chauhan | M | [Signature] | |
| 12. | Surender Rajpal | M | [Signature] | |
| 13. | Ramesh | M | [Signature] | |
| 14. | Rajul | M | [Signature] | |
| 15. | Satpal Singh | M | [Signature] | |
| 16. | Patinder Singh | M | [Signature] | |
| 17. | Rampal | M | [Signature] | |
| 18. | Bhajan Lal | M | [Signature] | |
| 19. | Mahinder pal | M | [Signature] | |
| 20. | Manish kr | M | [Signature] | |
| 21. | Manu | M | [Signature] | |
| 22. | prudeep. kr - | M | [Signature] | |
| 23. | Mr. Shakil | M | [Signature] | |
| 24. | Rohit Sharma | M | [Signature] | |
| 25. | Audhesh Gupta | M | [Signature] | |
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