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MUMBAI METRO LINE-3
GENERAL CONSULTANT

Mumbai Metro Rail Corporation Ltd
MUMBAI METRO LINE 3 (Colaba-Bandra-SEEPZ)

# Part-I: Updated Environmental Impact Assessment

Feburary, 2020

AECOM PADECO

MAPLE Consortium - General Consultant for Mumbai Metro Line 3
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MUMBAI METRO LINE 3

Updated Environmental Impact Assessment Report

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EXECUTIVE SUMMARY

0.1 INTRODUCTION

Mumbai Metropolitan Region (MMR) is one of the fast growing metropolitan regions in India. In MMR, public transport systems are overcrowded and the road network is congested as there is a large gap between the demand and supply. To decongest the existing public transport systems and increase mobility across the Region, MMRC through MMRC commissioned the services of RITES to prepare a DPR and Environmental/Social Impact Assessment study for the corridor of Colaba – Bandra – SEEPZ covering total length of 33.508 km. MMRC has planned to get fund from Japan International Cooperation Agency (JICA) for the construction of Mumbai Metro Line III. The scope of the study is framed as per JICA guidelines for Environmental and Social considerations, 2011.

0.2 SALIENT FEATURES OF PROJECT

The salient features of the project are discussed below:

- Design Speed: 80 kmph
- Scheduled speed: 30 kmph
- Power Demand (MVA): 89.46 MVA (2016)
- Sub Station: Colaba, Race course & Dharavi
- Capacity of 8 coach unit: 2406 Passengers
- Signaling & Train Control: Computer Based Interlocking signaling, automatic
- Fare Collection: Automatic Fare collection system
- Depot location: Arey Milk Colony (26.407 Hac)
- Train operation: 19 hours of the day (5 AM to 12 PM, i.e. midnight)
- Headway: 4.3 minutes (Colaba-Bandra), 6.7 minutes (Bandra-SEEPZ)
- Max.PHPDT: 25700 (2016)
- Project Cost: Rs. 243,400 Million
- Power requirement: 89.46 MVA (2016), 105.99 MVA (2021), 119.38 (2031)

Updated: Salient Features of Project (EIA Feb. 2020)

The updated salient features of the project as below:

- Gauge (Standard) - 1435 mm
- Maximum Permissible Speed- 85 kmph
- Route Length (End to end of station)- Fully Underground (33.5 km)
- Traffic Forecast

PHPDT and Daily Ridership for Colaba - Bandra - SEEPZ Corridor

Corridor	2016		2025		2031	
	Maximum PHPDT	Daily Ridership (in Lakh)	Maximum PHPDT	Daily Ridership (in Lakh)	Maximum PHPDT	Daily Ridership (in Lakh)
Colaba-Bandra-SEEPZ-(Aarey)	25,711	10.06	38,930	13.87	42,021	16.99

- Rolling Stock

Broad Features of Rolling Stock

Car	Length	Width at Door	Height
Driver Trailer car	22.60 m (Max)	3.2 m (max)	4048 mm (Max Locked down pantograph height)
Trailer/Motor car	22.24 m (Max)	3.2 m (max)	
Coach construction	Aluminum or austenitic stainless steel of grade SUS301L to JIS G4305 or equivalent international standard		
Tare Weight	Total 8 car tare weigh should not exceed 336 tones		
Axle load	17 T (Max)		
Propulsion system	3 phase drive system with VVVF control		
Type of traction supply	25kV ac Overhead collection		

- Train Operation Plan

Year	Total Rakes (Cars)	Trains in Peak Hour Operation	Maximum Ridership PHPDT		No. of Loops	Peak Hour Operating Headway		Transport Capacity PHPDT*		Maximum Standing Density (Nb. > 6 per m^2) #	
			CP - BKC	BKC - AMC		CP - BKC	BKC - AMC	CP - BKC	BKC - AMC	CP - BKC	BKC - AMC
2021	31 x 8 car (248 cars)	28	32,375	20,094	1	4'24''	4'24'	32,234	32,234	6.03 (1)	3.22 (0)
					2	3'39''	7'18'	38,871	19,435	4.77 (0)	6.25 (2)
2025	36 x 8 car (288 cars)	32	38,930	22,732	1	3'51''	3'51''	36,839	36,839	6.42 (2)	3.18 (0)
					2	3'11''	6'22''	44,424	22,212	5.09 (0)	6.17 (3)
2031	42 x 8 car (336 cars)	37	42,021	26,619	1	3'19''	3'19''	42,595	42,595	5.90 (0)	3.23 (0)
					2	2'45''	5'30''	51,365	25,682	4.66 (0)	6.27 (1)

* Train capacity of 2,360 (6 standing passengers / m^2).

\# Maximum standing density anywhere along the line: The figures in brackets show the number of inter-stations with standing densities > 6 per m^2.

- Maintenance Facilities

Depot- cum- workshop at Aarey Colony has been Planned in 30 Ha. Land

- Traction Power Supply

a)	Voltage	25 kV AC
b)	SCADA system	Overhead Rigid/Fixed Catenary System
c)	Current Collection	Provided

- Power Demand Estimation (MVA) for Colaba - Bandra – Aarey

	Designed Load
Traction (1-ph)	68.68
Auxiliary (3-ph)	75.66
Total	144.34

- Signalling, Telecommunication & Train Control

a) Type of Signaling	Radio Based CBTC (Communication Based Train Control) UTO (Unattended Train Operation) Driverless GoA 4
b) Telecommunication	(i) Integrated System with Fibre Optic cable, SCADA, Tetra Train Radio, PA system, CCTV, etc. (ii) Train information system, control telephones and Centralized Clock System.
c) Platform Screen Doors	PSD for all stations (full height doors for underground stations and half height doors for over-ground)

- Fare Collection

  Automatic Fare collection system with CMC (Common Mobility Card) and Smart card etc.

- Construction Methodology

  Underground Tunnel with Tunnel Boring Machine (TBM), station, cut & Cover (Bottom up) in constitution with New Austrian Tunneling Method (NATM) and cross passages NATM

- Project Completion Cost

Name of Corridor	Length (KMs)	Project Completion Cost Including Taxes (2021	Project Completion Cost Excluding Taxes (2021)
Colaba-Bandra-SEEPZ-(Aarey)	33.5	INR 334,058 Mn	INR 312,627 Mn

Construction of the underground running section shall be done by Tunnel Boring Machine (TBM) and stations will be constructed either by Cut and Cover or NATM method. The proposed project would be completed in 60 months and the completion cost of the project Urban Environmental Engineering Two alternatives were studied left of Cuffe Parade Road (Alt-I) and through Vidhan Bhawan (Alt-II) for analysis. Alternative II has been selected to serve additional catchment areas and avoid the sea route coming in Alternative I.Alternative sites studied for the depot location are Mahalaxmi Race Course, Kalina University land and Aarey milk colony land. Aarey milk colony land is found to be more suitable in view of future expansion.

0.3 ENVIRONMENTAL BASELINE DATA

The baseline data has been collected through primary and secondary sources. The core area of study is considered 100 m on either side of proposed alignment.

Land Environment: Parameters involved in land environment are, physiography, geology and soils, and seismicity. Geology and Soils: The entire Greater Mumbai area is occupied by Deccan basalt flows and the associated pyroclastics and the plutonic rocks of upper cretaceous to palaeogene age. The predominant soil cover in Mumbai city is sandy whereas in the suburban district, the soil cover is alluvial and loamy. The six soil samples were collected and tested for the quality of soil in the vicinity of the project site.

The test result shows that soil texture is sandy silt and having medium content

of nitrogen, phosphors & potassium. Seismicity: Mumbai lies in Seismic Zone III of the Bureau of Indian Standards (BIS), which means the city is at moderate risk.

Water Environment: Ground Water: The shallow water levels between 2 and 5 m bgl are observed in southern part, whereas moderate water levels in the range of 5 to 10m bgl are observed in northern part of the area during pre-monsoon. The water levels during post- monsoon in major part of the district range between 2 and 5 m bgl. Water Quality: Five water samples from different locations along the metro alignment have been collected and analyzed. Most of the parameters tested for Mahim Creek are more than permissible limit. At rest of the locations, the parameters are within limit as per IS 10500:1991.

Meteorology: The normal annual rainfall over the district varies from about 1800 mm to about 2400 mm. The mean minimum temperature is 16.3°C and the mean maximum temperature is 32.2°C at Santacruze observatory. The predominant wind direction is south/south-west in monsoon and north/north-east in winter.

Air Quality: The atmospheric concentration of air pollutants has been monitored at 5 Locations in January 2012. Air Monitoring was carried out for parameters $PM_{2.5}$, PM_{10} , NO_2, SO_2 , CO, and HC. The results show that except PM 10 and $PM_{2.5}$, all the parameters are within permissible limits.

Noise Environment: The survey has been conducted at five locations along the alignment. The result indicates that the equivalent noise levels at all the five locations are more than the limit prescribed for residential areas (CPCB Standards).

Soil Samples: 1- Caffe Parade, 2- Jacob Circle, 3- Worli, 4- International Airport, 5- SEEPZ & 6- Aarey Milk Colony.

Water Samples:1-Caffe Parade, 2-Jacob Circle, 3-Mahim, 4-Aarey Milk Colony, 5-SEEPZ, 6- Andheri East, 7-Mithi River, 8-Parsi Well.Air & Noise Quality Locations: 1-Mahim, 2-BKC, 3-SEEPZ, 4-Colaba, 5-Airport Urban Environmental Engineering

Vibration: The sources of the vibration are due to operation of Tunnel Boring Machine (TBM) during construction of tunnel and rolling stock during operation of Metro Rail. To know the impact of vibration due to TBM operation and metro train operation, the study has been conducted at six locations by selecting the sensitive area (structures) falling on the proposed metro line alignment. The hard rock structure has been considered while predicting the vibration impact. The vertical vibration at all location is between 110 VdB to 126 VdB.

Udated Baseline Environmental Monitoring(EIA Feb, 2020):

Fresh baseline Environmental monitoring has been carried out along the alignment at stations and allied locations for environmental parameters for air, noise and water during the period Dec 2016 to Feb 2017. Similarly vibration monitoring along the allignment at stations and allied activities has been carried out during the period March'19 to April '19.

Baseline monitoring for system packages at Wadala has been carried out for air, noise, water and soil environmental parameters during the period May 2019.

Ecology: Tree survey has been carried out along the alignment, at station locations and at depot. The type of species observed is Gulmohar, Peepal, Coconut Palms, Sirus, Pilkhan and Neem, etc. About 589 trees are observed along the station locations and about 1652 trees are observed at depot location (Aarey Milk Colony).

Update EIA Feb, 2020-

Stations and allied activities- As part of updation of EIA in the year, 2015 (EIA jan, 2016) the survey of trees along the alignment for stations was carried out in July-Aug, 2015 which identified 4255 number of trees. Thereafter, detailed engineering of the station plans and allied activities such as entry /exit, ventilation shaft etc was carried out by appointed civil contractors.Accordingly, total number of trees identified at stations and allied activities and at pylon, casting yards, ramp, traffic diversions, launching shafts etc are 5203. The species of trees observed are Coconut, Neem, Desibadam, Bhend, Asupalav, Sonmohar, Gulmohar, Rain tree, Umber, Pimple, Banyan tree etc.

Car shed depot- Fresh tree survey for car shed depot at Aarey colony area was conducted in the year May, 2017. Total number of trees observed are 3691. The species of trees observed are Rain tree, Kala umber, Banyan tree, Gulmohar, Dhaman, Kate saver, Pimple, Atrun, Subabul, Wawla, Australian babhul etc.

Landuse of Depot: The depot has been planned at Aarey Milk Colony covering an area of 26.407 Ha. A landuse map of 10 km radius with depot site at centre shows an area of Urbanisable zone 39.82%, Green zone 16.01%, Water body 14.38% and Industrial zone 7.14% etc.

Historical Sites: The proposed alignment is passing closer to three historical monuments viz, Chhatrapati Shivaji Terminus (formerly Victoria Terminus), Brihanmumbai Municipal Corporation Building and Western Railway Head Quarter located at 40 m, 22 m and 45 m from the centre of the proposed metro alignment.

Sensitive Receptors: The sensitive receptors within 100 m on either side of metro alignments have been identified, which are School (13), Hospitals (22), Temple (21), Mosque (05) Church (06), Monuments/Statue (08) and Nature

Park (01).

0.4 NEGATIVE ENVIRONMENTAL IMPACTS

Change of Land Use: The land requirement will be 45.81 hectare in which 4.72 hectare is private land and 41.08 hectare is government land.

Soil Erosion: Minor impact on soil erosion due to runoff from unprotected excavated areas may result in soil erosion.

Traffic Diversions: Partial road blocking will be required at some station locations during construction work.

Muck Disposal: About 5.40 Mmof muck will be generated.

Impact on Ground and Surface Water: A detailed hydrological investigation needs to be undertaken prior to the construction of tunnel to locate the ground water aquifer if any falling in the alignment.

Loss of Trees: About 673 trees are likely to be cut which will reduce the oxygen production of about 32977 kg.Air Pollution: The dust could be the problem during construction, as an ambient dust concentration is already 2.0 to 2.4 higher than the standard value.

Update EIA Feb, 2020 –

Stations and allied activities -

As per tree authority permissions granted under Maharashtra (Urban area) protection and preservation of trees act, 1975, out of 5203 number of trees observed, 1618 number trees are permitted to cut, 2098 number of trees are permitted for transplantion and 1487 number of trees would be retained. In addition to this, the proposals for 122 number of removal of trees are in process with MCGM tree authority and few more proposals are anticipated.

Car shed depot –

As per the permission granted by tree authority, total number of trees permitted for removal are 2646 (cut – 2185; transplant – 461 and retained- 1045).

Noise Pollution: No major impacts are anticipated due to noise pollution as the major construction works are underground. The Noise Level during operation at 15 m from track Centre Line at 25 km/h speed is 75.0± 10.0 while interior noise level is about 78.0±8.0.

Vibration Monitoring Locations:1-Lady Willington Building, 2-Narutamdas Bhau Jewelers, 3- Mittal Towers, 4-Central Assurance Building, 5-Parsees Well, 6-

Chatapati Shivaji Terminus Urban Environmental Engineering

The noise generated due to metro is limited within the tunnel and station area; hence no impact of noise on above ground is anticipated.

Vibration Impact: The vibrations due to TBM operation is found to be in between 143 VdB to 147 VdB. The prediction of vibration due to operation of metro is in between 65 VdB to 95 VdB. The predicted vibration level during construction and operation is higher than the standard limits, due to consideration of worst case scenario of having the subsoil condition as rocky structure and may be expected actually less than the predicted value.

Metro Station Refuse: About 20 cum/day of solid waste will be generated from all metro stations @ 0.5-1.0 cum/day/station.

Water Supply: The water requirement at station for drinking purpose and for AC, cleaning, chiller will be 6912 KLD.

Updated (EIA Feb, 2020): Impact due to Labour Camp: About 4860 skilled labour will stay in total at 14 labour camp sites at different places.. Other requirement will be met from local source. Three labour camps will be proposed at appropriate and suitable locations. The water requirement at camp will be 656 KLD, waste water generation 524 KLD & Municipal solid waste generation 2.18 ton per day.

IMPACTS DUE TO DEPOT

Water Supply: About 159 KLD of fresh water will be required at Depot for different uses which will be taken from borewell/Municipal Water Supply.

Effluent Treatment (Update EIA Feb,2020): About 38 KLD of domestic sewage and 48 KLD of trade effluent would be generated from activities at depot..

Solid Waste(Update EIA Feb,2020): It is estimated that about 0.6 Ton/day of MSW likely to be generated from the Depot.

Oil Pollution: The spilled oil should be trapped in oil and grease trap. The collected oil would be disposed off through authorised collectors, so as to avoid any underground/ surface water contamination.

0.5 POSITIVE ENVIRONMENTAL IMPACTS

Employment Opportunities: The project is likely to be completed in a period of about five years. About 5,000 persons are likely to work during construction and about 1510 persons @ 45/km for operation and maintenance of the proposed system.

Benefit to Economy: The reduction in number of buses and private vehicles due to operation of Mumbai metro rail will result in significant social and economic benefits.

Mobility: Passenger average time saved will be about 60 minutes by year 2031.

Safety: Mumbai accounts for 18.5% of total accidents in the country. Operation

of Mumbai Metro Rail will provide improved safety and lower the number of

accidents.

Traffic Congestion Reduction: There will be reduction in road traffic due to operation of Mumbai metro. Reduction in road vehicle trips will be 3.73 lakhs in the year 2016, 4.56 lakhs in the year 2021, 5.54 lakhs in the year 2031 and 6.65 lakhs in the year 2041 respectively.

Reduction in fuel consumption: The reduction in road traffic will save petrol & diesel consumption significantly. The petrol saved will be 2.25, 2.72 & 3.27 lakh litre in the year Urban Environmental Engineering 2021, 2031 & 2041 respectively. The saving in diesel consumption will be 0.19, 0.23 & 0.27 lakh litre in the year 2021, 2031 & 2041 respectively.

Reduction in Air Pollution: Reduction in traffic due to proposed metro rail could lead to reduced air pollution. An estimated reduction in pollution like CO 2 will be 6,800 tonnes in the year 2021, 8,256 tonnes in the year 2031 and 9,907 tonnes in the year 2041 as per DPR.

Similarly, CO will also get reduced by 4,327 tonnes in the year 2021, 5,254 tonnes in the year 2031 and 6,304 tonnes in the year 2041.

Reduction in Number of Buses: The requirement of buses is estimated to be 450 numbers to cater the additional ridership due to increase in traffic on road in absence of metro. This will save an amount equal to Rs. 2203 million towards capital cost of bus system.

Saving in Road Infrastructure: There will be net saving of 182 km road infrastructure which otherwise would require to cater the additional load over the present 1889 km road network. About 10% of road infrastructure will be saved.

Traffic Noise Reduction: Reduction in traffic volume of 10% & 50% reduces noise at the tune of 0.5 dB & 3.0 dB respectively. An introduction of proposed metro reduces the vehicular traffic substantially which ultimately reduces noise level.

Clean Development Mechanism (CDM) (Update EIA Feb, 2020): – Metro Line 3, model shift project- (MRTS-PoA-9863). The Metro Line-3 project is entitled as CDM Project under MRTS-POA-9863 and successfully registered with UNFCCC as a CDM project in December 2017. The MRTS PoA in India is being coordinated by DMRC as a coordinating and managing entity, which acts as an umbrella organization for all MRTS CDM projects in India. The ex-ante estimate of reductions of Carbon dioxide in crediting period of Ten years since the year 2021 is 26, 19,680 tonne of CO2e. The annual average emission reduction over the crediting period is 2, 61,968tonne CO2e. The Metro Line -3 Project would contribute in a global initiative of reducing the global warming effect by ensuring reduction in emissions of CO2 and other greenhouse gases.

0.6 ENVIRONMENTAL MANAGEMENT PLAN

Compensatory Afforestation: 673 trees are likely to be removed and 1072 trees are to be transplanted. Double the number of tree will be planted for each tree cut. The permission for cutting of tree will be taken from the Tree Authority of Mumbai under Maharashtra (Urban Areas) Protection and Preservation of Trees Act 1975. The total cost of compensatory afforstation and fencing is about Rs. 10.595 million. The recommended native plant species for afforstation includes gulmohar, neem, Pilkhan, Ashoka, Jamun, Desi
Badam etc. The cost of transplanting 1072 number of trees is about Rs. 53.60 million @ Rs. 50,000/- per tree. The location of trees to be transplanted will be done in consultation with MCGM. The management plans for transplantation of trees includes Preliminary root investigation, Health diagnosis, Soil condition, regular monitoring for fertilizer schedules, etc.

Update EIA Feb,2020
Handling of the trees for cutting and transplantation as per permissions received from Tree authority MCGM is started. Compensatory afforestation of trees has to be carried out in 1:3 ratio for station and allied activities and in 1:6 ratio in case of trees cut at car shed depot as per the permission received from Tree authority, MCGM.
Compensatory afforestation of trees in lieu of the trees cut is also initiated at various

locations within the jurisdiction of Municipal corporation of Greater Mumbai. Beside this, tree plantation under compensatory afforstations and corporate social responsibility program has been completed on the degraded forest at Sanjay Gandhi National Park(SGNP). The total tree plantation done so far is 23,990 includes plantation at SGNP and other locations within MCGM area . In addition to this plantation of about 3000 trees (total) to restore the green cover, would be carried out at 26 station sites after completion of station construction work and tree plantation of more than 9000 trees under Miyawaki concept/Method would be carried out at Goregaon site in Mumbai.
The progress on handling of the trees is regularly updated on MMRC web site on monthly basis.

Safety Management Measures: Project Authority has to establish the safety programmes following rules, regulations and guidelines prior to the construction. These would help to avoid and reduce the number of accidents.

Labour Camp: Labour camps with adequate health care facilities, sanitation facilities, shelter at workplace, canteen facilities, first aid facilities, preventive measures from infectious diseases like HIV/AIDS, day crèche will be provided. The waste water will be treated before disposal or may be connected to nearby sewerage network. A provision of Rs. 0.955 million would be made for water supply and sewerage system. A provision of Rs. 1.201 million would be made for disposal of 315 kg/day municipal solid waste.

Energy Management: Energy Management measures to conserve energy includes use of energy efficient motors and pumps, use of energy efficient lighting, energy efficient luminaries, adequate and uniform illumination level suitable for the task, and use of energy efficient air conditioner. Urban Environmental Engineering

Hazardous Waste Management: The contractor shall approach only Authorized Recyclers with MPCB for disposal of Hazardous Waste, under intimation to the MMRC.

Environmental Safeguard: General environmental sanitation shall be carried out by the contractor to ensure for good environmental sanitation at Work Site, Construction Depot, Labour Camp, Stores, Offices and toilets/urinals.

Utility: Utilities like sewers, water mains, storm water drains, telephone cables, electrical transmission lines will be maintained in working order during different stages of construction by temporary / permanent diversions or by supporting in position.

Historical & Cultural Monuments: Prior to the initiation of construction, MMRC will conduct condition survey of important historical structures in the vicinity of

alignment to identify the impact on the structures during construction and operation of the project. Any impact would be compensated by adequate management plan to preserve the structures

Air Pollution Control Measures: During construction period, the impact on air quality will be mainly due to increase in Particulate Matter (PM) and emission due to construction vehicles and construction machineries. Transportation during non-peak hours, use of RMC and pre-cast panels, optimisation of construction machinery's use, silent DG sets with pollution control device, sprinkling of water and covered Lorries are some measures which will be taken to reduce the air pollution during construction.

Noise Control Measures: The noise generated during construction will be minimized by using silent DG sets, acoustic enclosures, temporary noise barriers, job rotation to the extent possible for construction workers, and scheduling of truck loading, unloading and hauling operation.

Vibration Control Measures: Measures will be taken to minimize the vibration impact by continuous vibration monitoring during construction, periodic vibration during operation, vibration monitoring at site and at the top of building mainly for old structures and heritage buildings, pre-construction structural integrity inspections of historic and sensitive structures.

Traffic Diversion/ Management: The traffic at some station locations during construction needs to be diverted to avoid congestion situations. The traffic management plan includes advance traffic information on communication systems and partial blocking of road etc.

Muck Disposal Plan: About 5.40 million m3 of muck will be disposed by adopting five options as:

1. Use as fill material for JNPT Terminal 4,
2. Use as fill material for minor ports in Maharashtra.
3. Filling of abandoned quarries in Raigad and Thane district.
4. Recycle and Reuse and
5. Deep Sea Dumping

The cost of Muck Disposal will be kept as 3725.60 million which includes Environmental Study/Clearances, Transportation Cost (via road & sea), Plantation and Beautification works.

Sensitive Receptors: Construction contractor must provide a mechanism for receiving and responding to any complaints arising due to impacts on sensitive receptors.

Management Plans for Depot: About 159 KLD of water will be met either from Municipal Corporation or through tube well. The estimated cost of water supply plant is about Rs.5.0 million. About 38 KLD of domestic sewage and 48 KLD of trade effluent would be generated from activities at depot .of sewage/effluent is likely to be generated which has to be treated as per the requirement of regulatory pollution control agency of the state (MPCB). The estimated cost for sewage/effluent treatment plant is about Urban Environmental Engineering Rs.6.0 million. The storm water of the depot will be collected through the drain which will be connected to nearby disposal site. The solid waste of 1.8 tonne/ month will be taken by the cleaning contractor weekly and disposed to the Mumbai Municipal Corporation waste disposal site. The Rs 4.0 million has been kept in the cost estimate for the Green Belt Development. Treated sewage/ effluent in the best combination should be used for Green Belt Development. Roof top rainwater harvesting has also been proposed for 36,938 sq.m of Depot cum workshop area. A provision of Rs. 1.5 million has been kept in the cost estimate.

Training Programmes: The cost for National and International training programs will be kept as Rs. 21.61 million to acquire the latest know how about the construction, operation and maintenance of Metro Rail.

Environmental Enhancement Measures: Rs. 8.50 million has been kept forlandscaping & beautification, solar energy, renovation of Heritage structures & religious places, environmental awareness programmes, Utility facilities to unprivileged people as environmental enhancement purpose.

EMP Reporting Arrangement:

- Project Implementation Agency (PIA): Implementation of environmental mitigation measures.
- Project Management Consultant (PMC): The PIA will get the EMP implemented through the Project Management Consultant (PMC).
- Project Contractor: Project Contractor will implement the EMP measures, enhancement measures and measures as directed by PIA and PMC.
- Independent Monitoring Panel (IMP): MMRC will appoint IMP with the objective to ensure that JICA's policies related to social and environmental issues are followed.

0.7 DISASTER MANAGEMENT PLAN

Disaster can occur due to subsidence, accidents, fire hazards, etc. during construction wile system failure (power supply, break down etc), fire hazards and

accidents during operation stage. The DMP should include Preventive Action, Full Proof Communication System, Emergency Action Committee and Emergency Measures.

0.8 PUBLIC CONSULTATION

Public consultations at project and city level have been organized to collect the opinion/ views of the stakeholders for the proposed project.

Consultation at Project Level: About 93 people from different community participated in public consultation. Issues raised by the stakeholders were replied and their valuable suggestions were noted down for consideration into the report.

Consultation at City Level: Consultation meeting was organized with officers of concerned government department and non-government organizations (NGO) of district on 11th April 2012 vide newspaper Notification dated 5th April 2012. Public hearing was attended by 200 stakeholders and about 27 stakeholders raised their objection with suggestions.

0.9 ENVIRONMENTAL MONITORING PLAN

Ground water quality, soil, Air quality & noise monitoring will be conducted for one year before construction, during the construction and at least three year after the completion of the project.

Quality of Ground Water: Monitoring shall be carried out at 10 locations as per decision of Engineer in Charge for the parameters pH, Dissolved Oxygen, BOD, COD, TDS, Chlorides, Nitrates, Sulphates, Total Nitrogen, Total Phosphates, oils and grease etc. The cost kept for the monitoring will be Rs. 1.08 million.

Soil Monitoring: Soil quality shall be tested from the site of Depot, Labour camp, station location, dumping site and at random sampling of soil from the muck coming out during tunneling. During operation, monitoring shall be carried out at Depot location. The parameters to be monitored are pH, Sodium, Potassium, Chloride, Nitrogen, Phosphorous, Organic Matter, Heavy Metals, Oil and Grease. The cost kept for the monitoring will be Rs. 2.916 million.

Muck Monitoring: Excavated muck shall be tested at every kilometer during tunneling. The parameters to be monitored are pH, Electrical conductivity, Alkalinity, Moisture Content, Texture, Heavy Metals and Specific gravity. The cost kept for the

monitoring will be Rs. 0.63 million.

Air Quality & Noise: During construction, six locations have been proposed for monitoring including depot. The depot, Vidhan Bhawan station, CST Station, Dharavi station, CSIA (Domestic Airport) and MIDC station are proposed during operation. The cost kept for the monitoring will be Rs. 5.832 million.

Vibration Monitoring: Ambient Vibration (VdB) & Vibration due to TBM Operation (VdB) shall be carried out at CST, BMC Building, Lady Willingdon Building, Mittal Towers, DN Road and other locations as required during construction phase. Vibration due to Metro Train operation (VdB) shall be monitored at CST, BMC Building, WR Head Quarter, Girgaon station, Lady Willingdon Building, Mittal Towers & DN Road. The cost kept for the monitoring will be Rs.
9.45 million.

Ecological Monitoring: The project authority in coordination with the Department of Forest/MCGM shall monitor the status of ecology/trees at regular interval during construction & operation phase.

Environmental Monitoring Division: MMRC shall establish an Environment Division at the initial stage of the project itself. The division should be staffed with an Environmental Engineer/Officer and a Technical Assistant (environment background). The cost of Rs.
11.40 million Has been kept.

0.10 COST ESTIMATES

The environmental costs towards implementation of environmental management plan and mitigation measures during pre-construction, construction and operation of the proposed project are estimated to be Rs. 4379.845 million.

0.11 CONCLUSION

It can be concluded on positive note that after the implementation of Environmental Management Plan and Monitoring Plan, the project will have negligible impact on environment and will also lead to sustainable transport development of the city.

Chapter 1 Introduction

1.0 Introduction

Mumbai is the financial capital of India and witnessing phenomenal growth in population and employment. The job opportunities it offers have served as a major attraction for immigration from hinterland of Maharashtra as well as from all parts of the Country. Mumbai Metropolitan Region (MMR) is one of the fast growing metropolitan regions in India. It comprises of 7 municipal corporations, 13 municipal councils and 996 villages and extends over an area of 4,355 sq.km. MMR is projected to have population and employment in the year 2031 as 34.0 million and 15.3 million respectively. The dominant feature of the passenger movements in Mumbai is overwhelming dependence of travel on transport modes and walk. In MMR, public transport systems are overcrowded and the road network is congested as there is a large gap between the demand and supply. To decongest the existing public transport systems and increase mobility across the Region, DMRC in 2004 prepared a Metro Master Plan for Mumbai for a length of 149.97 km of network planned for MMR, to be implemented in three phases, Phase 1: 2005-2011, Phase II: 2011- 2016 and Phase III: 2016-2021.

Multimodal access to the airport passengers at CSIA was initially contemplated via line I (Versova – Andheri – Ghatkopar), but the spur line connection was not found feasible. The National Facilitation Committee (NFC), in its meeting held on September 3, 2009, decided that the metro connectivity to the CSIA be expedited and put in the phase 1, rather than in the phase 3 as per Metro Master Plan. This was decided to be achieved by merging Line 6 of Phase 3, named BKC – Kanjur Marg via Airport with the Line 3 of Phase I, i.e. Colaba – Mahim – Bandra and run through services from Colaba till SEEPZ as depicted in Figure 1.1.

With this background, MMRC through MMRC commissioned the services of RITES to update both the studies of DMRC conducted in 2007 for Colaba – Mahim – Bandra Metro Line and Mahim – BKC – Kanjur Marg (2010) and prepare a combined DPR and Environmental Impact Assessment for the running of through services on corridor - Colaba – Bandra – SEEPZ.

1.1 Updated Introduction (EIA Jan, 2016)

Mumbai is the financial hub of India and is the heart center of commercial and trade activities of the country where in excess of 124.42 laks people and still increasing, travels daily by Public Transport. The existing suburban rail system is under extreme pressure and the existing bus system has a limited capacity for providing feeder services to Suburban railways.

There are many constraints to expand the existing roads and rail network capacity and many pockets in the Island City and surrounding suburbs are not served by rail based mass

transport system. In order to provide rail based mass transit facility to people residing in the areas not connected by existing Suburban Rail System and to enable them to reach the stations within the walking distance of 0.5 km to 1 km, with proper interchange facilities, the metro master plan has been prepared.

In order to improve the overall traffic and transportation scenario in Mumbai/MMR and to cater the future travel needs, the Government of Maharashtra (GOM) through MMRDA has Undertaken several studies and has identified that the Metro Rail model as the most efficient, economically viable and environment friendly mass transport system. In major cities around the world the use of the Metro Rail mode of transportation has increased exponentially.

In 2004, DMRC prepared a Metro Master Plan for Mumbai to resolve the current traffic congestion status and also to increase mobility and efficiency across the Region. This master Plan proposed a total of 9 Metro Rail corridors of length 146.5 km which consisted of Phase I (3 Lines: 2005-2011), Phase II (2 Lines: 2011-2016) and Phase III (4 Lines: 2016-2021).
The revision of Phase I was initiated by a request from the Ministry of Civil Aviation, Government of India and Mumbai International Airport Pvt. Ltd. (MIAL) to the Government of Maharashtra in June 2008. In September 2009, it was decided by the National Facilitation Committee that the Metro access development to the MIAL International Terminal by combining Line 3 (Phase I) and Line 6 (Phase III) should be prioritized as a part of Phase I project.

The proposed Mumbai Metro Line 3 (MML3) connecting Colaba-Bandra-Santa Cruz Electronic Export Processing Zone (SEEPZ) is completely underground with a corridor length of about 33.5 km. The construction of this line will involve tunneling (both by Tunnel Boring Machine (TBM) and New Austrian Tunneling Method (NATM), station construction (both by cut &and cover and NATM), Temporary TBM launching/Retrieval/mucking shaft construction including a permanent ventilation shaft, ramp and embankment towards the Car Depot in AarayColony.

The entire length of 33.5 km underground MML 3 as envisaged in the DPR consisted of 26 underground station, 1 at-grade station in the Car Depot.

The Government of India has received a loan from Japan International Cooperation Agency (JICA) towards the cost of Mumbai Metro Line 3 Project. The JICA Loan Agreement (1st Tranche) was signed on 18th Sept. 2013. It is intended that part of the proceeds of this loan will be applied to eligible payments under the Contracts for MUMBAI METRO LINE 3 (COLABA-BANDRA-SEEPZ).

Due to ongoing land issues the at grade station, the at grade section beyond the SEEPZ ramp and the CAR depot works are currently under review. It is likely that the Depot will be shifted 11kilometers to the east with MML3 extended to this new location by an elevated viaduct with 8 elevated stations.

Under the Services of the Interim Consultant the remaining works have been divided into 7 packages, of around 4 kilometers of tunnel and 3 to 4 stations, and Tenders have been called and received for the 7 Design and Build Contracts for underground Tunnels and Stations.

The proposed metro line will start at Cuffe Parade (business district in the extreme south of the city), and will run through Nariman Point, Churchgate, CST, Girgam, Worli, Mahim, , Dadar, Bandra, Bandra-Kurla complex, past the international airport, through Andheri MIDC and SEEPZ (in the northwest). It will be an entirely underground railway line, traversing a distance of 33.5 km and will comprise of standard gauge as its track width. A total of 26 underground stations and 1 grade station are proposed along the entire stretch.

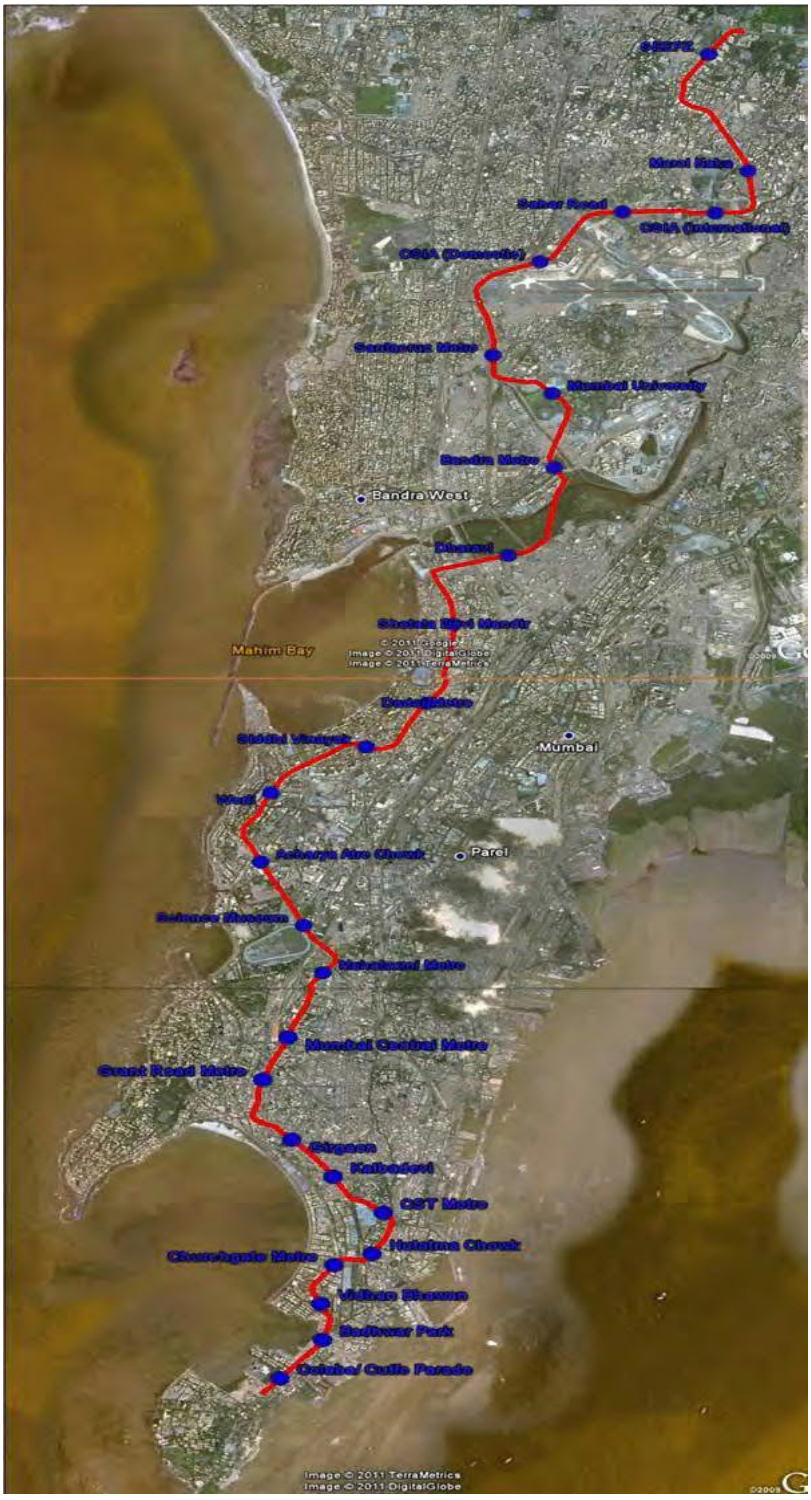
The land for the proposed project has been selected by considering three main aspects,

- Preferred Government/Public land instead of private land
- Preferred open land instead of habitation and building structures
- Preferred pavements and median of roads instead of structures

Land for the project is required for route alignment of rail tracks, station buildings, platforms, entry/exit structures, traffic integration, depot/car shed, power sub-stations, ventilation shafts, administrative buildings and temporary construction depots and work sites etc.

At present, the 27 proposed station locations have been identified wherein temporary and permanent acquisition of land would be required during the construction phase to facilitate the construction activities. The permanent land would be required for accommodating various above the ground structures such as entry/exit station structures, ventilation shafts (including mid-ventilation shaft) and ancillary building comprising cooling towers, air cooled chillers, water tank, pumps and Diesel Generator sets etc.

FIGURE 1.1 PROPOSED COLABA – BANDRA – SEEPZ METRO CORRIDOR



1.3 Objectives and Scope of Study

The objective of the study is to facilitate the Mumbai Metropolitan Region Development Authority (MMRDA) in the preparation EIA report as per requirement of regulatory and funding agency. The scope of EIA includes the impacts resulting from pre-construction, construction and operation phases of Line 3 Metro corridor, Depot and sub-stations. Mumbai Metro Rail Corporation Limited (MMRCL) has planned to get fund from Japan International Cooperation Agency (JICA) for the construction of Mumbai Metro Line 3.
The MoEF, Government of India, Notification of 14thSeptember 2006 and its amendment dated 1st December 2009 enlist projects in Schedule that require environmental clearance. However as per the said notification a metro project does not require environmental clearance from MoEF.

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.

1.4 Updated Scope of EIA Study (EIA Jan. 2016)

The scope of work for updating the EIA study comprises of:

- Reconnaissance survey to assess the existing environmental conditions in the project area, including the identification of sensitive environment and social receptors;
- Consultations with local community and other key stakeholders of the project to understand public perception and their expectations from project;
- Collection of information on forestry, flora and fauna, and natural habitats and species of special conservation/scientific interest through primary ecological survey of the study area;
- Collection of additional secondary environmental, social and demographic information;
- Identification and review of the applicable standards and identification of key issues;
- Preparation of Environmental Management Plan (EMP) and Social Management Plan (SMP) based on the findings of the EIA and SIA and develop procedures for mitigation and monitoring of environment and social impacts on an on-going basis and to identify any impacts/mitigation requirements that may occur subsequent to the completion of the EIA and SIA.
- Suggest appropriate institutional arrangement and capacity building needs for proper implementation of environmental and social management plan during

the pre-construction, construction and operation phase.

Based on the proposed activities, an impact analyses was carried out where potential direct and indirect impacts of the project activities have been considered. A detailed Environmental and Social Management and Monitoring Plan has been considered for the Project where measures are proposed to mitigate adverse impacts along with recommended good practices. Management plans such as Construction Labour Management Plan, Occupational Health and Safety Plan, Emergency Response Plan and Traffic Management Plan have also been prepared.

Limitations

The impact assessment study for the proposed project is largely based on the available project information, discussion with local community and other stakeholders and observations from various surveys and investigations undertaken in the study area. Professional judgment and subjective interpretation of facts has been applied for this study.

This impact assessment study has been undertaken for the alignment that was approved by MMRCL in May 2015. Any change in project location, alignment, proposed project components, proposed project activities is likely to result in variation of the impacts. It is to be noted that any technological advances during the course of construction and execution of the project will alter the extent and severity of impacts on the surroundings.

1.5 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) 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). The project has been classified according to its impacts on the environment.

BOX 1.1 EIA CATEGORIZATION SYSTEM IN JICA

Category A Projects is likely to have significant adverse impacts onthe environment and society. It includes projects in sensitive sectors or with sensitive characteristics and projects located in ornear 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.

Updated (EIA Jan. 2016)

The JICA Guidelines require project proponents to consider appropriate environmental and social aspects in projects funded by JICA, and implement them through various measures, so as to prevent or minimize the impact on the environment and local communities. It will thus contribute to the sustainable development of developing regions. 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 considered. The JICA Guidelines are formulated in reference to the World Bank Operational Policy.

JICA recognizes the following seven principles while undertaking co-operation projects:

- Addressing a wide range of environmental and social impacts
- Measures for environmental and social considerations must be implemented from an early stage up to the monitoring stage
- Ensuring accountability and transparency when implementing cooperation projects

- Incorporating stakeholder opinions into decision-making processes regarding environmental and social considerations by ensuring the meaningful participation of stakeholders
- Information disclosure on environmental and social considerations in collaboration with project proponents etc.
- Enhancing the comprehensive capacity of organizations and operations of project proponents
- Prompt implementation of projects while undertaking environmental and social considerations

1.6 World Bank's Operational Policies and Guidelines

The World Bank follows an operational policy statement (updated in February 2011), which stipulates that all operations are carried out in an environmentally responsible manner and that projects must comply with all local environment legal obligations and appropriate World Bank guidelines . The World Bank sets out its procedures and policies with regard to conducting environmental assessments in Operational Policy 4.01: Environmental Assessment (October 1991) and its updates and other pertinent Guidelines.

World Bank Environmental and Social Safeguard Policies provide ten (10) potential issues that may need to be considered in an ESIA, depending on the specific characteristics of each project.

Table 1.1 World Bank Operational Policy Requirements and Applicability

Safeguard Policy	Requirement
Environment Assessment (OP 4.01)	The Bank requires environmental assessment (EA) of projects proposed for Bank financing to help ensure that they are environmentally sound and sustainable, and thus to improve decision making. This policy applies to all projects requiring a Category (A) Environmental Assessment under OP 4.01. The project is also likely to have significant potential adverse environmental and social risks and impacts in its area of influence.
Natural Habitats (OP 4.04)	The Bank requires borrowers to incorporate into their development and environmental strategies analyses of any major natural habitat issues, including identification of important natural habitat sites, the ecological functions they perform, the degree of threat to the sites, priorities for conservation, and associated recurrent-funding and capacity-building needs. Northern end of the project area is located at a distance of approximately 2 km from the boundary of the Sanjay Gandhi National Park. The sole significantly large natural habitat within the project area is a part of the estuary of the Mithi River, together with its mangrove forests, while the massive forest of the Sanjay Gandhi National Park is the most significant natural habitat in close proximity to the project area.
Pest Management (OP 4.09)	In appraising a project that will involve pest management, the Bank assesses the capacity of the country's regulatory framework and institutions to promote and support safe, effective, and environmentally sound pest management. As necessary, the Bank and the borrower incorporate in the project components to strengthen such capacity.
Involuntary Resettlement (OP 4.12)	World Bank recognizes that Involuntary resettlement may cause severe long- term hardship, impoverishment, and environmental damage unless appropriate measures are carefully planned and carried out. The land required for the project has been acquired by the state government as per the procedures set forth in the Metro Rail Act and Land Acquisition Act. The project thus entails both physical and economic displacement. Hence the requirements under this Policy will be applicable for the project. A detailed Rehabilitation and Resettlement Plan has been prepared to be implemented by the project proponent.
Indigenous People (OP 4.10)	The Bank recognizes that the identities and cultures of Indigenous Peoples are inextricably linked to the lands on which they live and the natural resources on which they depend. This safeguard will not be applicable to this project.

Forests (OP 4.36)	If a project involves significant conversion or degradation of natural forests or related natural habitats that the Bank determines are not critical, and the Bank determines that there are no feasible alternatives to the project and its siting, and comprehensive analysis demonstrates that overall benefits from the project substantially Outweigh the environmental costs; the Bank may finance the project provided that it incorporates appropriate mitigation measures. The proposed project involves diversion of forest land at BKC and Dharavi. However the development will entail cutting of trees along the alignment right of and permission will be obtained from the Competent authority.
Physical Cultural Resources (OP 4.11)	The borrower needs to addresses impacts on physical cultural resources in projects proposed for Bank financing, as an integral part of the environmental assessment (EA) process. The proposed alignment is passing closer to three historical monuments, CST Railway Station (world heritage cultural property), BMC Building and Western Railway Head Quarter. Utmost care shall be taken so that no significant impact is anticipated on the historical structures due to project activities during construction and operation.
Safety of Dams (OP 4.37)	When the Bank finances a project that includes the construction of a new dam, it requires that the dam be designed and its construction supervised by experienced and competent professionals. This safeguard will not be applicable to this project.
Project in Disputed Areas (OP 7.60)	Projects in Disputed Areas may affect the relations between the Bank and its borrowers, and between the claimants to the disputed area. Therefore, the Bank will only finance projects in disputed areas when either there is no objection from the other claimant to the disputed area, or when the special circumstances of the case support Bank financing, notwithstanding the objection. This safeguard will not be applicable to this project.
Projects on International Waterways (OP 7.50)	The Bank recognizes that the cooperation and goodwill of riparians is essential for the efficient use and protection of the waterway. Therefore, it attaches great importance to riparians' making appropriate agreements or arrangements for these purposes for the entire waterway or any part thereof. This safeguard will not be applicable to this project.

1.7 Applicable World Bank Group EHS Guidelines (EIA Jan. 2016)

The Equator Principle 3 requires follow up of the environmental, health and safety requirements as per the following guidelines released by International Finance Corporation (IFC) on 30th April, 2007. These guidelines ensure that the projects are developed in a manner that is socially responsible and reflects sound environmental management practices. EHS consideration into the site selection and plant design processes should be considered in order to maximize the range of options available to prevent and control potential negative impacts.

- Environmental, Health, and Safety Guidelines for railways

1.8 Legal, Policy and Institutional Frame Work

Since the adoption of The Kyoto Protocol in December 1997 which was entered into force on 16 February 2005, that developing countries are principally responsible for the current high level of GHG emission into the atmosphere due to industrial activities. This protocol commits the developed countries to reduce 5 percent pollution against 1990 level over the five years period 2008-12.

The need for a well-developed legal mechanism is to conserve resources, protect the environment and ensures the health and well-being of the people in India was felt. Keeping the pace with international laws, the Ministry of Environment and Forest 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 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)
- Noise Pollution (Regulation and Control) Rules, 2000 (Amendment 2002, 2006)
- Municipal Solid Waste Rules, 2000
- The Environment (Protection) Act, 1986, amended 1991.
- The Environment (Protection) Rules, 1986.

- The Indian Forest Act, 1927.
- Forest (Conservation) Act, 1980, amended 1988.
- Forest (Conservation) Rules, 2003.
- The Wild Life (Protection) Act 1972, Amendment, 2002
- The Metro Railway (Amendment) Act 2009
- Metro Railway (Construction of Works) Act, 1978
- Delhi Metro Railway (Operation and Maintenance) Act, 2002
- The Ancient Monuments and Archaeological sites and Remains (Amendment and Validation Act),2010

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). The Environmental Impact Assessment covers the proposed on-site activities as well as the transportation of the generated waste to the waste disposal sites.

1.8.1 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). Additionally, the water supplied to users for drinking shall also conform to the National Drinking Water Standard, IS-10500 (Appendix 1.1). Appendix 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 Appendix 1.3.

Off 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.

1.8.2 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 PM2.5, PM10, Sulphur dioxide, Oxides of Nitrogen, Carbon monoxide, Lead, Ozone, Ammonia, Benzene and Benzo pyrene with the intent of managing air quality for different category of areas (residential, industrial and sensitive). Ambient Air Quality Standards have been notified by the CPCB vide Gazette Notification dated 16th November 2009, refer Appendix 1.4

1.8.3 Noise Quality

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.

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 MoEF 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 (Leq). These are presented in Appendix 1.5.

1.8.4 Solid Waste Management

Project construction and operation generates solid waste at site. The MMRC would be responsible for collection and handling of solid waste as per the provisions of the Municipal Solid Waste Rules, 2000. The Hazardous Waste (Management and Handling) Rules, 2000 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.

1.9 Identification of the legal requirement (EIA Jan, 2016 & Feb, 2020)

Environmental regulations and legislations relevant to the project are presented below in Table 1.2.

Table 1.2: Legal Frame work

S. No.	Law/ Regulation/ Guideline	Salient Features	Applicability	Reason for applicability	Implementing/ Responsible agency
1.	The Environmental (Protection) Act 1986, and Rules as amended to date	• Umbrella legislation • Preparing manuals, codes or guides relating to prevention, control and abatement of environment pollution • Mandates that discharges from any industry or operation are not in excess of the standards and hazardous substances handling comply with the procedural safeguards	Yes	All environmental notifications, rules and schedules, primary water quality standards, general standards for disposal of wastewater are	MoEFCC, State Department of Environment, CPCB and MPCB
2.	The EIA Notification, 2006, as amended to date	• Provides for conducting Environmental Impact Assessment (EIA) studies and obtaining Environmental Clearance (EC) from Ministry of Environment and Forests (MoEF) or State Environment Impact Assessment Authority (SEIAA). • Provides for The Schedule with criteria for categorising projects into A and B categories based on the magnitude and scale of the impacts associated with the project and provides for incorporating environmental safeguards in the project planning phase.	No	Metro Railprojects does not attract provisions of EIA notification 2006	N/A
3.	The Water (Prevention and	• Provide for the Prevention and Control of Water Pollution	Yes, Depot	Casting Yard, RMC plant and Car shed activities are covered under R/O/G categorisation of CPCB	Maharashtra Pollution Control

S. No.	Law/ Regulation/ Guideline	Salient Features	Applicability	Reason for applicability	Implementing/ Responsible agency
	Control of Pollution) Act,1974 and as ammended to date	• Maintenance or restoration of the wholesomeness of water as per its best designated use • Any process or activity resulting in discharge of wastewater/effluent into the environment falls under the purview of this Act and requires the developer to take 'Consent to Establish' and/or 'Consent to Operate' under the Water Act.			Board (MPCB)

4.	The Water (Prevention and Control of Pollution) Cess Act 1977 and Cess Rules, 1978, as amended to date	The Water Cess Act, 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.	No Since 1st July 2017	The Ministry of law & Justice, Government of india, vide its taxation laws amendment Act,2017, has abolished the cess levied under the provisions of the water (prevention & control of pollution) cess Act, 1977, effective from date of implementation of GST i.e 1st July,2017 as per MPCB office order no. E-18 /2018 dated 07-02-2018.	---

5.	The Air (Prevention and Control of Pollution) Act, 1981 and as amended to date	• Implement measures devised for its effective prevention, control or abatement of air pollution. • Any Process or activity resulting in release of contaminants to the atmosphere requires a 'Consent to Establish' and/or 'Consent to Operate' under the Air Act. • Assign powers and functions to the CPCB and the	Yes,		MPCB

S. No.	Law/ Regulation/ Guideline	Salient Features	Applicability	Reason for applicability	Implementing/ Responsible agency
		SPCBs for prevention and control of air pollution and all other related matters.			
6.	Noise Pollution (Regulation And Control) Rules, 2000 and amended to date	• Every operating facility is required to take all possible steps to meet the ambient noise level standards prescribed in the Rules. • Prescribe maximum permissible values of day and night time noise levels for: Zone A - Industrial Zone B - Commercial Zone C – Residential Zone D – Silence	Yes	Due to use of construction machineries and vehicles.	MPCB
7.	Forest (Conservation) Act, 1980 as amended to date	The Act restricts the powers of the State in respect of de-reservation of forests and the use of forestlands for non-forest purposes. An advisory committee has been created to oversee the implementation of the statute. According to Section 2 of the Act " prior approval of the Central Government is required for: • De-reservation of a reserved forest • Use any forest land for any non -forest purpose • Assign any forest land to any private person or entity not controlled by the Government • Clear any forest land of naturally grown trees for the purpose of using it for reforestation	Yes	Part of BKC and Dharavi metro stations sites are declared as Forest areas.	MOEFCC / State Forest Department
8	CRZ notification 2011 as amended to date	• Regulation of activities in CRZ area • To protect Coastal Environment and Coastal Streches.	Yes	Certain Stations, land parcels and part of the alignment falling in CRZ area, hence provisions of CRZ notification 2011 attracts.	Maharashtra Coastal Zone Management Authority /State environment impact assessment

S. No.	Law/ Regulation/ Guideline	Salient Features	Applicability	Reason for applicability	Implementing/ Responsible agency
9.	Wild Life Protection Act, 1972 as amended to date	• Provides protection of listed species of flora and fauna and establishes a network of ecologically important protected areas. • Empowers the Central and State Governments to declare any area to be a Wildlife Sanctuary, National Park or a closed area. • Blanket ban on carrying out any industrial process or activity inside any of these protected areas. • In case forestland within the protected areas network is to be diverted for any non-wildlife use, a no objection has to be obtained from the Indian Board of Wildlife and the State Legislature, before the final consideration by MoEF. • The schedules categorize animals, birds, and plants. Schedule I lists endangered species of mammals, reptiles, amphibians, birds, crustaceans and insects. Any possession, transportation etc. of these species without prior permission is offence under the Act.	No	Ecosensitive zone of Sanjay Gandhi National Park has been notified by MOEFCC vide notification dated 05-12-2016. The project activities of car shed depot at Aarey is outside ESZ.	--
10.	The Ancient Monuments and Archaeological sites and Remains (Amendment and Validation) Act, 2010 and as amended to date	To protect and conserve Cultural and historical remains found.	Yes	The alignment is passing closer to three historical monuments, CST Railway Station (world heritage cultural property), BMC Building and	Archaeological Survey of India, Dept. of Archaeology

S. No.	Law/ Regulation/ Guideline	Salient Features	Applicability	Reason for applicability	Implementing/ Responsible agency
				Western Railway Head Quarter.	
11.	Hazardous and Other Wastes (Management and Transboundary Movement) Rules 2016	Requirement for handling and managing hazardous wastes categories as under the schedule. • Authorisation for collection, reception, storage, transportation and disposal of hazardous wastes • Filing of annual return under the rules • Other compliance under the rules • Authorisation by Central Pollution Control Boards to vendors accepting waste/used oil • Liability of the occupier, transporter and operator of a facility Fine as levied by the State Pollution Control Board with the approval of the Central Pollution Control Board for any violation of the provisions under these rules.	Yes	Hazardous wastes shall be generated due to activities like maintenance and repair work of vehicles / equipments / machineries,	MPCB
12	Solid Waste Management Rules, 2016	Every waste generator shall segregate and store the waste generated in three separate streams namely bio-degradable, non-bio degradable and domestic hazardous wastes in suitable bins and handover segregated wastes to authorized rag-pickers or waste collectors	Yes	Organic and recyclable Waste from Construction depots, Admin offices and Labour Colonies of all packages.	MCGM/MPCB

13	Biomedical Waste Management Rules 2016	These rules shall apply to all persons who generate, collect, receive, store, transport, treat, dispose, or handle bio-medical waste in any form. • It is the duty of every occupier of an institution generating bio-medical waste which includes a hospital, nursing home, clinic, dispensary, veterinary institution, animal house, pathological laboratory, blood bank, etc., to take all steps to ensure that such waste is handled without any adverse effect on human health and the environment. • Bio-medical wastes have to be separated from solid wastes. • Provision for requisite bio-medical waste treatment facilities like incinerator, autoclave, microwave system for the treatment of waste, etc., needs to be made, or, requisite treatment of waste at a common waste treatment facility or any other waste treatment facility has to be ensured.	Yes	Bio-medical waste will be generated from Occupational Health Centre and first Aid Centre from all contractor site office.	MPCB

14	Construction and Demolition Wastes Management Rules, 2016	• Every waste generator shall prima-facie be responsible for collection, segregation and storage of construction and demolition (C & D) Waste generated, as directed or notified by the concerned local authority in consonance with these rules. • The generator shall ensure that other waste (such as solid waste) does not get mixed with this waste and is stored and disposed separately. • Any activity that generates 20 tonnes per day or 300 tonnes per project in a month has to prepare a Waste Management Plan. • Waste generator either has to store the waste within the premises or has to supply to the city level collection centre and should avoid all kinds of obstruction to traffic/public or in drains.	Yes	Construction and Demolition waste from the project activities.	MCGM/MPCB
15	Plastic Waste Management Rules, 2016	• Requirements for plastic waste management in the urban local bodies include: – Recycling of plastics as per IS 14534:1998. – Thermo set plastics shall be processed and disposed as per the guidelines. – Open burning of waste should not take place.	Yes		MCGM/MPCB
16	Maharashtra Non – Bio - degradable Garbage (Control) Act, 2006 and Notification no Plastic - 2018/CR-24/TC-4 dated 23-03-2018.	• Ban on manufactore usage, transport, distribution, wholesale & retail sale and storage, impact of plastic bags and single use / disposable products manufactured from plastic & thermocol	Yes		MCGM/MPCB

17	E-Waste (Management) Rules, 2016	• Rule applies to every manufacturer, producer, consumer, bulk consumer, collection centres, dealers, e-retailer, refurbisher, dismantler and recycler involved in manufacture, sale, transfer, purchase, collection, storage and processing of e-waste or electrical and electronic equipment listed in Schedule I, including their components, consumables, parts and spares which make the product operational.	Yes	E-waste would be generated from offices and site offices.	MPCB
18.	The Motor Vehicle Act. 1988 and as amended to date	Empowers State Transport Authority to enforce standards for vehicular pollution. From August 1997 the "Pollution Under Control Certificate is issued to reduce vehicular emissions.	Yes	Vehicle fitness certificate, pollution under control certificate (PUC).	State Motor Vehicles Department
19.	Development Control Regulations, 1991, Under MCGM Act, 1988.	Conservation of listed buildings, areas, artifacts, structures and precincts of historical and/ or aesthetical and / or architectural and/ or cultural value (heritage building and heritage precincts).	Yes	Development permission to be obtained near world heritage structures as well as Hertitage sites.	Mumbai Heritage Committee ,MCGM
20.	Resettlement and Rehabilitation	The RandR policy of the Government of Maharashtra for MUTP was formulated and in its objectives it sought	Yes	The proposed Mumbai metro rail project shall	State Government,

S. No.	Law/ Regulation/ Guideline	Salient Features	Applicability	Reason for applicability	Implementing/ Responsible agency
21	Policy for Mumbai Urban Transport Project (MUTP), 1997 Amended in Dec 2007.	Minimum resettlement by exploring all the viable alternatives. It also aimed at assisting people during resettlement and also in improving or at least restoring their former standards of living and income earning capacity. The objectives envisaged active community participation and retaining existing community links. The RandR policy also aimed at providing compensation for economic losses by firstly, locating the resettlement site nearer. The compensation for increase in expenditure due to increased travel distance was to be paid, for a year's travel. If the person was to lose the present occupation or source of income, the person was to be provided a compensation for a year's income. Vulnerable households were to get additional packages. It also offered to give employment information and training facilities to those losing their source of income.		cause involuntary displacement of people along the alignment.	Maharashtra
22.	The Metro Railway (Amendment) Act 2009	It governs the operations of metro rail systems in India. The law was first promulgated as an Ordinance on 29 October 2002. When it was first enacted in 2002, the Act applied only to the National Capital Territory of Delhi. It was amended in 2009 to permit the Central Government to extend the Act to any metropolitan city or area, after consultation with the concerned State Government. However, the amendment specifically prohibits the Centre from extending the Act to the metropolitan city of Kolkata. The Act grants the Metro Railway Administrator (MRA) four main powers:	Yes		

S. No.	Law/ Regulation/ Guideline	Salient Features	Applicability	Reason for applicability	Implementing/ Responsible agency
		• to acquire, hold and dispose of all kinds of properties owned by it, both movable and immovable • to improve, develop or alter any property or asset held by it • to develop any Metro railway land for commercial use • to execute any lease or grant any license in respect of the property held by it.			
23.	The Petroleum Act,1934 and the Rules 2002	Petroleum act is an act related to the import, transport, storage, production, refining and blending of petroleum. Petroleum may be any liquid hydrocarbon or mixture of hydrocarbons, and inflammable mixture (liquid, viscous or solid) containing any hydrocarbon, and includes natural gas and refinery gas	Yes	MML3 project will involve storage and transportation of fuel for operation of construction machinery.	Chief Controller of Explosive

24.	The Maharashtra (Urban Areas) Protection & P reservation ofTrees Act, 1975 (As modified upto Ist January 2016.	It deals with regulation on feeling of trees and liability of planting and preservation of trees. It specifies that in any urban area, notwithstanding any custom, usage, contract or law for the time being in force, no person shall fell any tree or cause any tree to be felled in any land, whether of his ownership or otherwise, situated within that urban area except with the previous permission of the Tree Officer.	Yes	MML3 project involves removal of trees coming in the proposed construction of station box, entry, exit, launching shaft, traffic diversion, casting yard and car shed depot etc.	Tree Authority, MCGM, Mumbai

1.10 Applicable International Conventions (EIA Jan, 2016)

Environmental problems which migrate beyond the jurisdiction (Trans-boundary) require power to control such issues through international co-operation by either becoming a Contracting Party (CP) i.e. ratifying treaties or as a Signatory by officially signing the treaties and agreeing to carry out provisions of various treaties on environment and social safeguards. The relevant international conventions are as provided in Table 1.3 below.

Table 1.3: Applicable International Conventions

S.No.	International Conventions	Salient Features
1	Montreal Protocol on Substances That Deplete the Ozone Layer (and subsequent Amendments)	India signed the Montreal Protocol along with its London Amendment on 17-9-1992 and also ratified the Copenhagen, Montreal and Beijing Amendments on 3rd March, 2003.
2	Kyoto Protocol	The Kyoto protocol was signed by India in August 2002 and ratified in February 2005. The convention pertains to the United Nations framework on Climate Change.The 3rd Conference of the Parties to the Framework Convention on Climate Change (FCCC) in Kyoto in December 1997 introduced the Clean Development Mechanism (CDM) as a new concept for voluntary greenhouse-gas emission reduction agreements between industrialized and developing countries on the project level.
3	The Rotterdam Convention on the Prior Informed Consent (PIC) Procedure	The Rotterdam Convention on the Prior Informed Consent (PIC) Procedure for Certain Hazardous Chemicals & Pesticides in international Trade was adopted by India at the Conference of Plenipotentiaries at Rotterdam in 1998
4	International Labour	India has also ratified many of the International Labour Organization conventions that are relevant to the

	Organization conventions	Project including: • C1 Hours of Work (Industry) Convention, 1919 (14:07:1921, ratified); C5 Minimum Age (Industry) Convention, 1919 (09:09:1955, ratified): • C11 Right of Association (Agriculture) Convention, 1921 (11:05:1923, ratified): • C14 Weekly Rest (Industry) Convention, 1921 (11:05:1923, ratified); • C29 Forced Labour Convention, 1930 (30:11:1954, ratified) & C105 Abolition of Forced Labour Convention, 1957 (18:05:2000, ratified); • C100 EqualRemuneration Convention, 1951 (25:09:1958

1.11 Clearances Requirement for the Project (EIA Jan, 2016 & Feb, 2020)

MMRC shall ensure that all necessary approvals/clearances are in place before implementation. Before commencement of the construction the necessary permissions required for the project is given in Table 1.4 below.

Table 1.4: Clearance requirement for the Project

Parameter	Project Stage	Approval Authority	Responsibility
Permission for Tree Cutting	90 days before tree removal	The Tree Authority MCGM, Mumbai	MMRC/contractor
CRZ Clearance	Before construction activity	MCZMA/SEIAA	MMRC/
Forest Clearance	Before constructuion	State Forest Department /MoEFCC	MMRC/
Development permission near World Heritage Structures	Before construction	Mumbai Heritage committee, MCGM. (MCGM Act, 1988)	MMRC
Muck disposal permission	Before construction	District administration / Local Planning Authority/other.	Contractor
Resettlement permission	Before construction	State Government, Maharashtra	MMRC
Consent to Establish	Before establishment for Casting Yards, RMC plants and Car Shed depot	Maharashtra State Pollution Control Board	Contractor/MMRC
Consent to Operate	Before Operations for Casting Yards, RMC Plant and Car Shed	Maharashtra State Pollution Control Board	Contractor /MMRC
Authorisation for C&D Waste Storage and Disposal	For disposal of C&D waste	MCGM	Contractor

Authorisation for Bio-medical Waste storage and disposal	for storage and disposal	Maharashtra State Pollution Control Board	Contractor / MMRC
Authorisation for Handling Hazardous Waste	Before construction for RMC, casting yard and car shed depot under combine	Maharashtra State Pollution Control Board	Contractor / MMRC
Permission for extraction of ground water	Before construction	Central Ground Water Authority	Contractor / MMRC
Explosive license	Before construction	Chief controller of explosives	Contractor
PUC certificates for use of vehicles for construction	Before construction	Department of Transport	Contractor

1.12 INSTITUTIONAL FRAMEWORK

The Ministry of Environment and Forests (MoEF) 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 MoEF 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.

1.11.1 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.

(Update EIA Feb, 2020):

In India, the national level laws are formulated by the Ministry of Environment, Forests and Climate Change (MoEFCC) and state governments are required to consider these regulations as base level for implementation. The State Pollution Control Boards (SPCBs) are responsible for securing compliance under the Environmental Protection Act, 1986, the umbrella legislation regulating environmental issues in the country. The SPCBs are empowered by the Central Pollution Control Board (CPCB) to frame state specific environmental legislations for exercising the same or more stringent provisions as prescribed under the Act

1.12 APPROACH AND METHODOLOGY

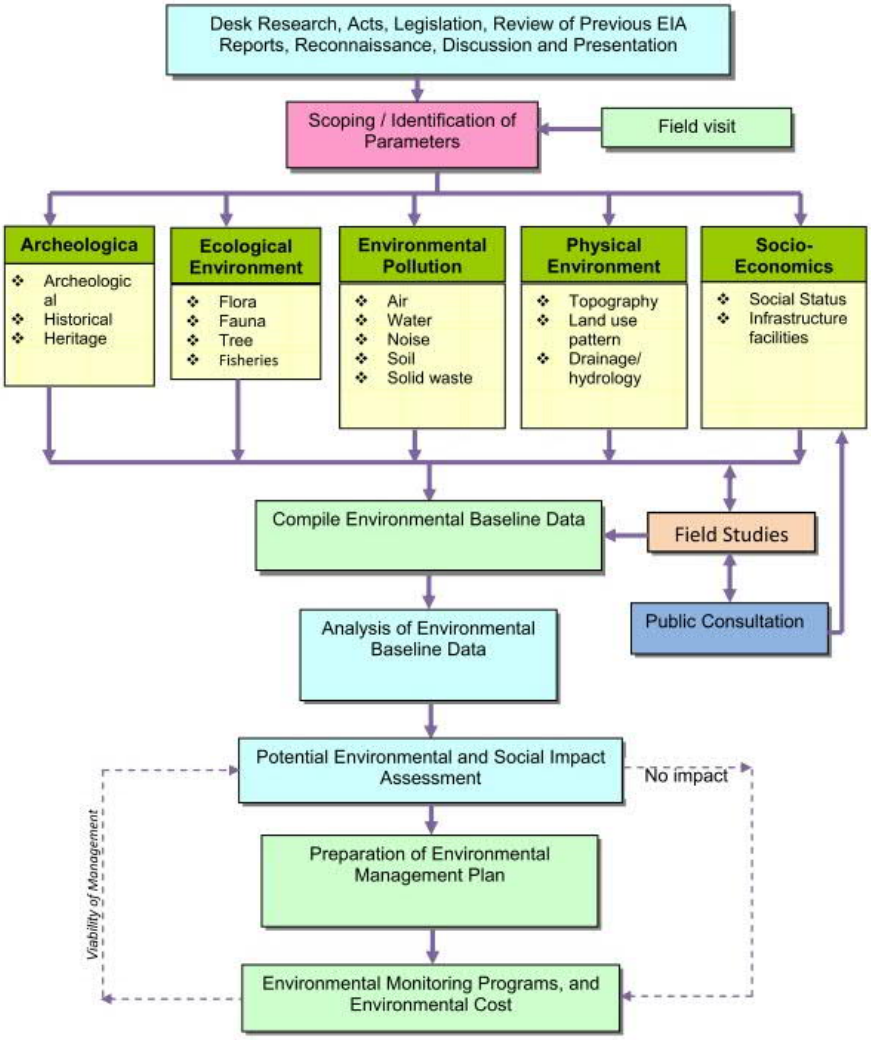
The proposed alignment has been fixed based on Technical Feasibility, Socio-economic acceptability, and Environmental sustainability for Metro Corridors. The environmental study is carried out for the final alignment proposed by MMRC. The approach is to follow the sequence of steps adopted in an EIA 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 identification of parameters for data generation and impact assessment are important. The accurate analysis of assessment depends upon the reliable data generated/ available on environmental attributes. RITES has documented the baseline data for various parameters of physical (physiographic and soils), ecological (forestry, fisheries and wildlife), 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 are estimated and budgeted for. The approach for the study is presented in Figure-1.2.

FIGURE 1.2

METHODOLOGY FOR THE EIA STUDY



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 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.

Update (EIA Jan, 2016): The Environmental Impact Report and a Social Impact Assessment (SIA) Study Reports were submitted for the proposed MML3 project by RITES Limited in September 2012.

GC reviewed the reports and highlighted the gaps in DPR and EIA.

Following documents were reviewed by the GC in view of current situations and employer requirements:

1. Detailed Project Report (Chapter 9 on Environment), by RITES 2012
2. EIA report by RITES in 2012
3. Environmental and Social Management Plan, by IC 2014
4. Environmental Baseline Monitoring Plan, by IC 2014
5. Addendum to Environmental and Social Management Plan, by IC 2015

The review of these previous reports, GC comments and recommends way forward which were taken up on formal agreement with the employer. The purpose of this report was to update the Environmental Impact Assessment from year 2012 onwards till 2015

The various aspects like design change; change in alignment, change in landuse etc shall have an impact on environment. These impacts have been envisaged in this and the corresponding mitigation measures and environment management plans have been provided.

1.12.1 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, surface run off; quantity and quality of water. These will facilitate to decide various uses such as drinking, irrigation etc.

Air and Noise quality is an important consideration during construction and operation phases. Ambient air quality and noise levels were monitored in and around project area to develop present baseline levels in the area. The literature reviews were conducted to establish past air pollution and noise levels in the project area. The future air and noise quality were predicted using mathematical modelling.

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

Update (EIA Jan, 2016)

The changes in land use have been updated in this report. The change in land use for TBM worksites, casting yards and quarry sites have been updated in sections below. For updating the EIA report secondary data for baseline monitoring has been referred.

For updating the data on ambient air quality, Maharashtra pollution control board website has been referred and the data is presented in the baseline chapters.

A detail geotechnical and well survey was carried out by IC during 2013 and the findings of these surveys have been updated in baseline chapter of this report.

A detail Muck disposal report was prepared by IC in March 2013, the summary of which has been updated in the relevant section of baseline chapter.

The tree survey had been conducted by IC during 2013 and has been re conducted by GC horticulturist during July- August 2015. The results have been provided in relevant sections.

The updated tree inventory after Contractors came on board and MCGM approved data is updated in the report.

(Update EIA Feb, 2020)

Fresh baseline monitoring for environmental parameters ; air, water, noise conducted before start of construction activities and for vibration, the baseline monitoring is carried out at comparable/ compatible developmental sites at stations along the alignment.

- Baseline monitoring Conducted for system packages for environmental parameter; air, noise, water and soil.
- Fresh survey for trees at car shed depot location at Aarey colony conducted in May,2017.

1.12.2 Environmental Impact Assessment

The objective of the study is to assess the impacts as a result of construction of the Mumbai metro corridors along with depot and 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 100 m on either side of proposed alignment. 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 cycles namely, location, design, construction and operation. The standard methodology was adopted for impact prediction and assessment. Prediction is essentially a process to forecast the future environmental conditions in the project area that might be expected to occur. The prediction of impacts can be through mathematical modelling, overlays/ super imposition of activity, or comparison of impacts observed. The environmental impact of the project includes changes in land use, soil, erosion, water quality, air quality and noise levels etc. The impact on soils due to disposal of waste water and erosion during storms were predicted. The impact on water quality in the water bodies was evaluated with the help of water quality analysis. The burning issue such as Carbon dioxide emission is also studied. More details on Environmental Impact Assessment are available in Chapter 4.

The Environmental impact assessment report has been updated for the period September 2012 to September 2015. The changes which happened during this period have been highlighted in this report.

The major updates on Station typology based on construction methodology, Tree data, CRZ clearance, Forest clearance for mangroves cutting etc. have been included in the EIA report. Further, these aspects are updated in EIA Feb, 2020

1.12.3 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. An environmental management strategy/ plans were developed to mitigate the adverse impacts. Efforts are made to enhance the quality of environmental attributes.

1.12.4 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.

1.12.5 Liaison with Authorities

For the preparation of this EIA, the project team and environmental experts have liaised with the MMRC, and JICA in order to discuss the proposed scope of the EIA, available data in the specific area on environmental attributes and general comments / observations that these authorities may have on the project and its environs. In addition, informal consultations were organized with individuals and nearby people, in order to present the project and collect their views on the perceived positive and negative impacts on the environment on account of this new development.

1.13 FORMAT OF THE REPORT

The main elements of the study are as follows: In Chapter-2 briefs about the proposed project description & alternatives. Chapter-3 summarises 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 Chapters-4 and 5 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, socio-economic and other problems due to the development of proposed Mumbai Metro Line-III. Based on the anticipated negative impacts, the project may bring about an environmental management strategy, which has been outlined in Chapter-6. The detail of Public Consultation for the proposed project has been given in Chapter-7.
Chapter-8 includes post project environmental monitoring programmes. 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. The costs of the environmental management and monitoring programmes are presented in Chapter-9. The conclusion of the EIA study conducted has been presented in Chapter- 10.

The literature, books, reports referred, is detailed in References. Where applicable, more detailed information on methods used is included in concerning paragraphs. The issue related to rehabilitation and resettlement and rehabilitation plan are available in separate report.

Appendix 1.1

DRINKING WATER QUALITY STANDARDS (IS 10500:1991)

S. No.	Substance or Characteristic	Requirement (Desirable Limit)	Undesirable Effect outside the Desirable limit	Permissible limit in the absence of alternate source
Essential Characteristics				
1	Colour, Hazen units, Max	5	Above 5, consumer acceptance decreases	25
2	Odour	Unobjectionable	-	-
3	Taste	Agreeable	-	-
4	Turbidity NTU, max	5	Above 5, consumer acceptance decreases	10
5	pH Value	6.5 to 8.5	Beyond this range the water will affect the mucous membrane and/or water supply system	No relaxation
6	Total Hardness (as $CaCO_3$) mg/l, Max	300	Encrustation in water supply strucute and adverse effects on domestic use	600
7	Iron (as Fe) mg/l, max	0.3	Beyond this limit taste/appearance are affected, has adverse effect on domestic uses and water supply structures and promotes iron bacteria	1.0
8	Chloride (as Cl) mg/l, Max	250	Beyond this limit, test, corrosion and palatability are affected	1000
9	Residual free Chlorine, mg/l, Min	0.2	-	-
10	Fluoride (as F) mg/l, Max	1.0	Fluoride may be kept as low as possible. High fluoride may cause florosis	1.5
11	Dissolved solids mg/l, Max	500	Beyond this palatability decreases and may cause gastro intestinal irritation.	2000
12	Calcium (as Ca) mg/l, Max	75	Encrustation in water supply structure and adverse effects on domestic use	200
13	Magnesium (as Mg) mg/l, Max	30	Encrustation in water supply structure and adverse effects on domestic use	100
14	Copper (as Cu) mg/l, Max	0.05	Astringent taste, discoloration and corrosion of pipes fitting and utensils	1.5
15	Manganese (as Mn) mg/l, Max	0.1	Beyond this limit taste/appearance are affected, has adverse effect on domestic uses and water supply structures	0.3

S. No.	Substance or Characteristic	Requirement (Desirable Limit)	Undesirable Effect outside the Desirable limit	Permissible limit in the absence of alternate source
Essential Characteristics				
16	Sulphate (as SO_4) mg/l, Max	200	Beyond this causes gastro intestinal irritation when magnesium or sodium are present	400
17	Nitrate (as NO_2) mg/l, Max	45	Beyond this methaemoglobinemia takes place	100
18	Phenolic compounds (as C_6H_5OH) mg/l, Max	0.001	Beyond this, it may cause objectionable taste and odour	0.002
19	Mercury (as Hg) mg/l, Max	0.001	Beyond this, the water become toxic	No relaxation
20	Cadmium (as Cd), mg/l, Max	0.01	Beyond this the water become toxic	No relaxation
21	Selenium (as Se), mg/l, Max	0.01	Beyond this the water become toxic	No relaxation
22	Arsenic (as As), mg/l, Max	0.05	Beyond this the water become toxic	No relaxation
23	Cyanide (as CN), mg/l, Max	0.05	Beyond this the water become toxic	No relaxation
24	Lead (as Pb), mg/l, Max	0.05	Beyond this the water become toxic	No relaxation
25	Zinc (as zn), mg/l, Max	5	Beyond this limit it can cause astringent taste and an opalescene in water	15
26	Anionic detergents (as MBAS), mg/l, Max	0.2	Beyond this limit it can cause a light froth in water	1.0
27	Chromium (as Cr^{+6}) mg/l, Max	0.05	May be carcinogenic above this limit	No relaxation
28	Plynuclear aromatic hydrocarbons (as PAH) g/l, Max	-	May be carcinogenic	-
29	Mineral oil mg/l Max	0.01	Beyond this undesirable and odour chlorination place	0.03
30	Pesticides mg/l Max	Absent	Toxic	0.001
31	Radioactive materials a) Alpha emitters Bq/l max b) Beta emitters pci/l, Max	- -	- -	0.1 1
32	Alkalinity mg/l Max	200	Beyond this limit taste becomes unpleasant	600
33	Aluminium (as Al), mg/l Max	0.03	Cumulative effect is reported to cause demntia	0.2
34	Boron, mg/l, mg/l Max	1	-	5

Appendix 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 temp.
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
27	Phenolic compounds (as C_6H_5OH), Max.	mg/l	1.0
28	Radioactive Materials α Emitters, μcurie/ml, Max. β Emitters, μcurie/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

Appendix 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 20^0C), 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), mg/l Max.	20	-	50	-	-
Free Ammonia (as NH_3), mg/l	-	-	-	1.2	-
Conductivity at 25^0 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	-	-

Source: *Central Pollution Control Board*

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.

Appendix 1.4

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), $\mu g/m^3$	Annual 24 Hours**	50 80	20 80
Nitrogen Dioxide as NO_2, $\mu g/m^3$	Annual 24 Hours**	40 80	30 80
Particulate Matter (size less than 10µm) or PM_{10} $\mu g/m^3$	Annual 24 Hours**	60 100	60 100
Particulate Matter (size less than 2.5µm) or PM2.5 $\mu g/m^3$	Annual * 24 Hours**	40 60	40 60
Ozone (O3) $\mu g/m^3$	8 hours** 24 Hours**	100 180	100 180
Lead (Pb) $\mu g/m^3$	Annual * 24 Hours**	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) $\mu g/m^3$	Annual * 24 Hours**	100 400	100 400
Benzene (C_6H_6) $\mu g/m^3$	Annual *	05	05
Benzo (a) pyrene (BaP) particulate phase only ng/m^3	Annual *	01	01
Arsenic (AS) ng/m^3	Annual *	06	06
Nickle (Ni) ng/m^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.*

Appendix 1.5

NATIONAL AMBIENT NOISE STANDARDS

Category of Zones	Leq in dB (A)	
	Day *	Night
Industrial	75	70
Commercial	65	55
Residential	55	45
Silence Zone **	50	40

Source: Central Pollution Control Board

* *Day Time is from 6.00 AM to 9.00 PM.*

** ***Silence Zone*** *is defined as an area up to 100m around premises of Hospitals, Educational Institutions and Courts. Use of vehicle horn, loudspeaker and bursting of crackers is banned in these zones.*

CHAPTER2 PROJECT DESCRIPTION

2.1 EXISTING SYSTEMS

Mass transport needs of Mumbai Metropolitan Region (MMR) are met by Suburban Trains and Buses. MMR consists of Greater Mumbai, Thane and Raigad districts. The proposed Metro Rail project is in Greater Mumbai where vehicular traffic consists of two wheelers, auto rickshaw, cars, taxis, buses, commercial vehicles and others. Population and growth rate of vehicles in Greater Mumbai for the year 2005 and 2008 are depicted in Table 2.1.

Table 2.1 GROWTH RATE OF VEHICLE IN GREATER MUMBAI

SL NO.	VEHICLES	NO. OF VEHICLES		GROWTH RATE (%)
		2005	2008	
1	Two Wheelers	647,892	865,466	11%
2	Auto Rickshaw	104,104	108,812	2%
3	Car	409,120	507,408	8%
4	Taxis	58,049	58,813	0.4%
5	Buses	12,290	13,239	3%
6	Commercial Vehicles	56,345	71,329	9%
7	Others	7,140,770	6,770	-2%
	Total	1,294,940	1,631,837	9%

2.2 PROPOSED METRO SYSTEM IN MUMBAI

There is no existing metro system in Mumbai. Line I from Versova to Ghatkopar is under construction. The Mumbai Metro line I is operational since July 2014. Line II (Charkop-Bandra-Mankhurd) is finalised and construction will be started as the CRZ clearance will be accorded for Depot. As per the Mumbai Master Plan prepared by DMRC, Table 2.2 depicts Mumbai Metro Corridors in three phases of execution which is shown in Figure 2.1. DPR studies for phase I metro corridors were carried out during the period 2005 -2009 (Line 1: Versova-Andheri-Ghatkopar, Line 2: Charkop–Bandra-Mankhurd and Line 3: Colaba -Bandra). In 2010, MMRC also carried out the DPRs of four lines of Phase II & III.

TABLE 2.2 MUMBAI METRO MASTER PLAN

LINE NO.	CORRIDOR	LENGTH (KM)	PHASE	IMPLEMENTATION
1	Versova – AndheriGhatkopar	15.0		
2	Charkop – Bandra Mankhurd	31.87	I	2005-2011

3	Colaba - Bandra	20.40		
4	Charkop – Dahisar (East)	7.5	II	2011-2016
5	Ghatkopar – Mulund	12.4		
6	BKC to Kanjurmarg via Airport	19.5		
7	Andheri (East) – Dahisar (East)	18.0		
8	Hutatma Chowk – Ghatkopar	21.8		2016-2021
9	Sewri – Prabhadevi	3.5	III	
		149.97		

Phase wise length of metro corridor as per Master Plan and as per amendment is depicted in Table 2.3.

TABLE 2.3 LENGTHS OF MUMBAI METRO PHASES

S.No.	Phase	Length (km) as Master Plan	Length(Km) as per amendment
1	Phase I	67.27	79.36
2	Phase II	19.90	19.90
3	Phase III	62.8	43.3
	Total	149.97	142.56

Update (EIA Feb, 2020)

A master plan for Mumbai was prepared in 2004, and implementation has been undertaken line by line, based on funding considerations and changed priorities. Accordingly Metro master plan and the line configurations were amended number of times. Finally, an integrated metro network with an aggregate length of 180.5 km has been identified by MMRDA. For Mumbai, parts of MMR as approved by the State Govt. remaining elevated metro corridors (2, 4, 7, 6) are proposed to be implemented with an approximate capital cost of Rs. 35,400 Crores (2005 prices).

Table 2.3: List of Revised Master Plan Corridors

Line	Corridor	Length(Km)
1	Versova – Andheri - Ghatkopar	11.4
2	Dahisar - DN Nagar (Line 2A) DN Nagar - Mandale (Line 2B)	18.00 22.00
3	Colaba-Bandra-SEEPZ(Andheri)	33.5
4	Wadala-Ghatkopar-Mulund-Thane- Kasarwadavli Wadala to GPO (to Conect Thane to South Mumbai)	32.00 8.00
5	Bhiwandi-Kalyan	23.1
6	JVLR-Vikroli link Road	11
7	Andheri (East) – Dahisar (East)	18
8	Sewri – Prabha Devi	3.5
	Total	180.5

Govt. of Maharashtra, through MMRDA has taken up implementation of the Line-I (Versova – Andheri – Ghatkopar) under BOT-PPP model with viability gap funding in 2006. Subsequently it was decided to establish Mumbai Metro Rail Corporation (MMRC) as a State Govt. company. However it was later decided to establish the Metro Rail Company as a fully owned entity of MMRDA, and the company was established in 2008 with an objective to implement all the future Metro rail systems in MMR. . Accordingly, the preparation of Detailed Project Reports (DPR) and implementation processes were undertaken through MMRC with MMRDA ascertaining the funding arrangements. Under this arrangement DPR studies for all the remaining metro corridors were taken up.

Following the successful award of Line 1 (Versova-Andheri) & Line 2 (Mankhurd-Bandra-Charkop) on BOT/PPP that has been foreclosed during the period of 2008-2012 MMRC has under taken various DPR studies for all the remaining corridors of Master Plan.

Project Description: Update (EIA Jan 2016)

The proposed MML3 connecting Colaba-Bandra-Santa Cruz Electronic Export Processing Zone (SEEPZ) Metro Corridor will facilitate the commuters to travel from south Mumbai to Airport via Mahim-Bandra Kurla Complex (BKC).It will also provide direct access to the economic hubs such as BKC, Maharashtra Industrial Development Corporation (MIDC) Industrial Estate, SEEPZ, and famous landmarks such as Kalina University, Mahalaxmi. The total length of the proposed metro corridor is 33.5 km. The entire Metro corridor is proposed to be constructed underground. Figure 2.1 illustrates the proposed routing of MML3.

The entire length of 33.5km is divided into 7 packages that collectively comprises of underground 26 stations and 1 station at grade level as detailed in figure 2.1.

Above Ground Structures

Above ground station structures for the proposed MML3, which will run underground include the following:

- Entry/Exit Structures
- Ventilation Shafts
- Ancillary Building

Station Entry/Exit Structures

Entry structures provide physical connectivity of the underground station box to the ground land for accessing the station; hence they are planned and oriented to suit the site conditions, with the intention of not obstructing the pedestrian or vehicular traffic movement at the street level. The provision of the entry structures needs significant land take on ground. Further points taken into consideration include strategic locations so as cater to maximum population density areas and to tap into areas with limited or poor existing public transportation.

Update (EIA Feb, 2020):

The proposed Colaba – Bandra – Aarey Colony Corridor (Mumbai Metro Line 3) is 33.5 km long and is planned to have 26 underground and 1 at-grade stations. The corridor shall connect southern Mumbai with the major activity areas like Bandra Kurla Complex (BKC), Airport (Domestic and International), SEEPZ (Industrial Hub) and areas along JVLR, which have got tremendous potential for new developments.

A dedicated Depot cum workshop facility for the maintenance of the rakes is proposed at Aarey colony land, which is located at the northern end of the corridor, about 1 Km North of SEEPZ station.

The alignment and the station locations (Ref. Figure 2.1) have been finalized after an extensive review of earlier reports and based on

i. Catchment areas
ii. Integration with other mass transit corridors
iii. Construction feasibility
iv. Joint site visits & consultations with MMRCL

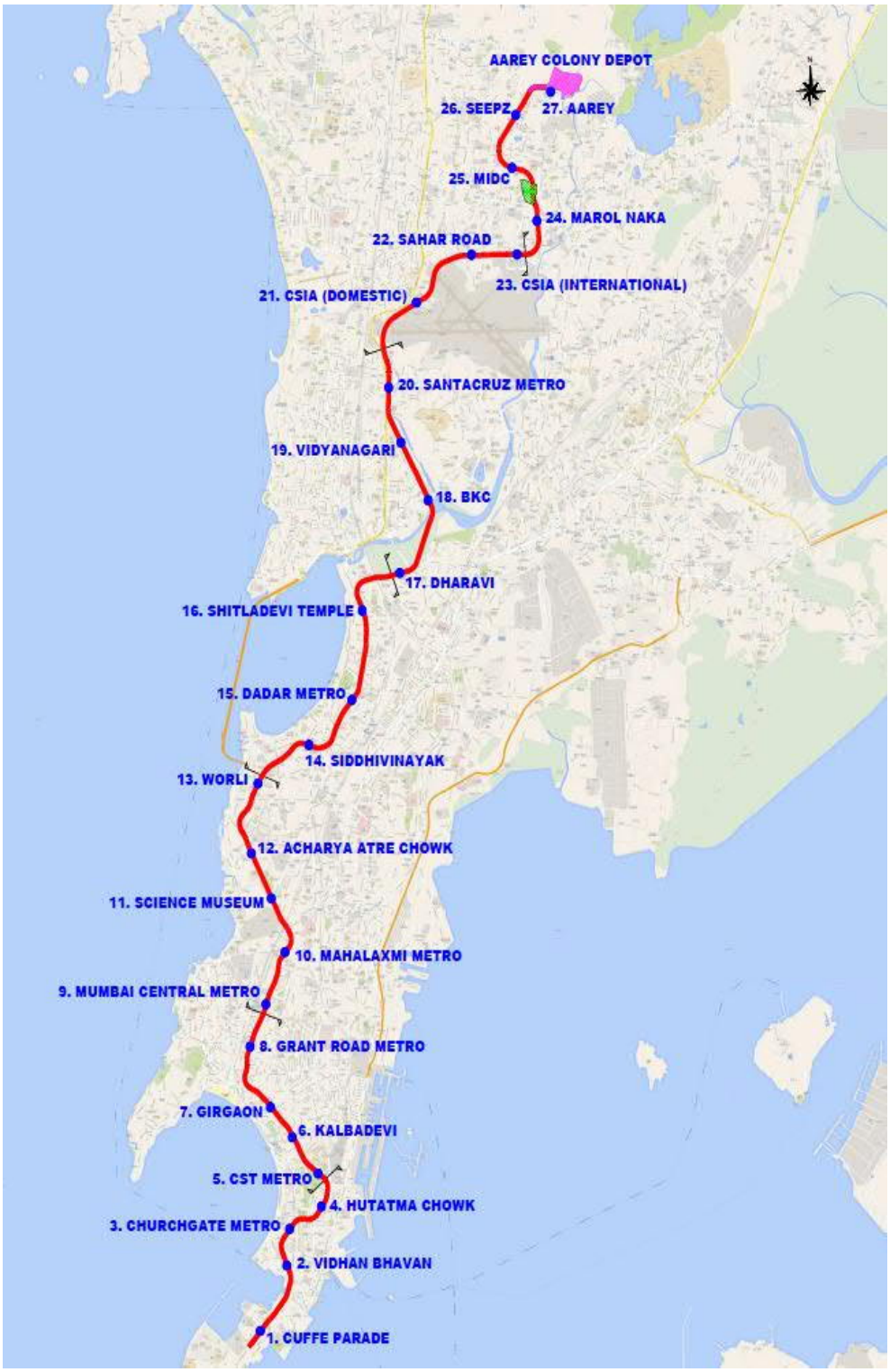
Stations have been located so as to serve major passenger catchment areas/ destinations and to enable convenient integration with other modes of transport. Stations vary in complexity along the route and have been located by an interactive process influenced by ridership forecasts, interchange requirements with other modes of transport, station spacing, alignment, utilities, road and pedestrian requirements, etc. A total of 27 stations have been planned along the alignment of 26 underground stations and 1 At-Grade station as indicated below (Table

2.1). The average interstation distance has been 1.29 Km, the shortest distance being 0.72 Km (between Kalbadevi and Girgaon) and the longest distance being 2.27 Km (between CSIA Domestic and Sahar Road).

In the present EIA, the following modifications have been done in respect of stations wrt those indicated in RITES EIA, 2012 as per rivised DPR.

- Badhwar Park Station has been deleted. The ridership figures of station are proportionately distributed between Cuffe Parade and Churchgate Metro Station.
- Bandra station is renamed as BKC
- Kalina University Station has been shifted to Vidyanagari.
- Aarey Colony Depot station has been added.

Figure 2.1 : The alignment and the station locations (Update EIA Feb, 2020)



Stations		Site Characteristics
Package-1(Chainage 487.560 m- 3762 m): Starting from southern end of corridor to the southern end of CST metro station; includes 4-stations.		
1	Cuffe Parade	Starting point at southern most end. Entrances proposed to serve following catchment areas: • Ambedkar Nagar Dhobi Chawl, World Trade Centre and Navy Nagar • Residential Areas near BMC Park • Residential Areas near Parsi Dharamshala
2	Vidhan Bhawan	Station Planned near Maharishi Valmiki Chowk Proposed entrances cater to the following catchment areas: • Vidhan Sabha • Footpath near SBI • National Congress Party offices • Mittal Tower Compound • Southern area: catchment from Nariman Point, CBD, Manora MLA hostel, other residential areas • Eastern side: Dedicated connection to Mantralaya and other government offices
3.	Church Gate	• Station planned on Jamshedji Tata Road • Interchange station between existing suburban station and proposed metro underground station. • Multiple entrances to serve catchment to Fort area, Mantralaya area, sports stadium and tourist spots like Gateway of India and Marine Drive. • Another entrance adjacent to Eros cinema building to cater to personnel working at SEEPZ and other residential areas near Maharshi Karve road. • Subway to provide connection to Churchgate railway station at Ahaliya Bai Holkar Chowk.
4.	Hutatma Chowk	• Station located on historic and heritage street of Dr. Dadabhai Naoroji road • Proposed station is near Oriental Building. • The Martyr's Statue, which is located next to flora fountain is protected area and cannot be acquired for any utilities • Multiple entrances to cater to Khadi Gram Udyog bhawan, Jeevan Udyog Bhawan, Mumbai Stock Exchange. • Another entrance towards Colaba end inside Alice building as part of re-development scheme of heritage building.
Package -2 (Chainage 3762 m – 7811.38 m): Tunnels starting from the southern end of CST to the southern end of Mumbai Central Station. This package is divided in 5 stations:		
5.	CST	• Station is planned on open land of Azad Maidan alongside Mahapalika Marg. • Located east of existing CST suburban station. • Entrances catering to Mahapalika Marg, CST and other public and semi-public areas.

Stations		Site Characteristics
		• Subway connection with existing CST railway station
6.	Kalba devi	• Proposed station falls under Jagarnath Shankar seth (JSS) road • Densely populated area, entrance locations will be on acquired land areas • Will cater to residential and mixed land use along Shamaldas Gandhi Road, Marine Lines and Chandan Wadi road
7.	Girgaon	• Proposed station falls along JSS road with entry/exit points along footpaths • Densely populated area, entrance locations will be on acquired land areas • Will cater to residential area such as Girgaon Ekta housing society, Karel wadi, Vaidya wadi, Ambewadi, Thakurdwar, and Kranti Nagar on JSS
8.	Grant Road	• Station planned on Dr. Dadasaheb Bhadkamakar road. • Two entrances on opposite sides of the station
9.	Mumbai Central	Interchange station near Mumbai Central Bus Depot on Dr. A Nair road • Entrance in Mumbai Central Railway Station and another adjacent to Jahangir Boman Mehram and multiple entrances to cater to public and semi-public areas such as Maratha Mandir theatre, Mumbai Central Railway Station, RBI Staff Colony, College of Arts & Commerce, Mandanpura, Tardeo, Railway residential buildings, etc.
Package -3 (Chainage 12871.05- 18952.32): Tunnel starting from northern end of Worli Station to southern end of Dharavi station including 4 stations:		
10.	Mahalaxmi	• Station planned on Sane Guruji Marg, a multiple leg junction (one of seven). Interchange station planned to connect with existing Mahalaxmi suburban railway station. • A direct connection is proposed to Mahalaxmi suburban railway station through a dedicated underground passage. • Entrance structures are proposed to cater to catchment areas of Jacob circle, dhobi ghat, shanti nagar, adarsh nagar, etc.
11.	Science Museum	• Proposed station is adjacent to Mahalaxmi racecourse on East Moses Road, close to Nehru Science Museum • Multiple entrances at all ends of Science Museum station, two entrances on either side of Senapati Bapat Marg to cater to Gandhi Nagar, Ambika Mills, etc.
12.	Achrya Atre Chowk	• Station planned adjacent to Municipal Chawls and BMC office on East Moses Road • 7 entrances access all ends of the station • 2 entrances on either side of connecting Dr. Annie Besant road to get catchment from commercial and residential areas such as Bheem Nagar, IAMAI Mumbai

13.	Worli	• Station is planned on Dr. Annie Besant Road • 5 entrances access from all areas • 2 entrances have been planned on either sides of connecting Dr. Annie Besant road to get catchment from commercial as well as residential areas such as Worli Shivaji Nagar, Hanuman Nagar, Gopal Nagar, Centuary Bazar.

Stations		Site Characteris
		• Entry structures on eastern side of the box are planned inside residential compounds of worli shivaji nagar and worli shivsahi society. • Similar entrances on other side to cater to commercial and office spaces such as Glaxo Smith Clinic, Oberoi Land, Tecmaco Ltd., Indian Oil Building
Package – 4 (Chainage 12871.05 m – Chainage 18952.32 m): Tunnel starting from the northern end of Worli Station to the southern end Dharavi station including 3 stations:		
14.	Siddhivinayak	• Station located in open ground near Siddhi Vinayak Temple next to Ravindra Natya Mandir • Major entrance around the Mandir and multiple entrances to cater to institutional and residential buildings such as Ravindra Natya Mandir, Sane Guruji Garden, Adarh Nagar, Prabhadevi, etc.
15.	Dadar	• Station planned near Shiv Sena Bhawan on Gokhale Road. Interchange station planned to connect with existing Dadar suburban railway station. • Multiple entrances on either side of Gokhale Road and a direct connection to Dadar suburban railway station is proposed.
16.	Shitladevi Temple	• Station planned on Lady Jamshedji Marg • 6 entrances located on either side of Lady Jamsehdji Marg
Package -5 (Chainage 18952.32 m – Chainage 23896.19m): Tunnel starting from the southern end of Dharavi station to the northern end of mid ventilation shaft including 4 stations:		

17.	Dharavi	• Station planned on Mahim Sion Link Road • 5 entrances from all sides • Major entrance near Seepz end to cater to catchment from residential areas like Dharavi Village, T junction, Police Station, ONGC colony and numerous small scale industrial units within Dharavi • Another entrance on footpath along hutline on sixty futta road to get catchment from mixed land use areas of Dharavi. • Two additional entrances are proposed on footpath of western side along boundary of mangrove belt and nullah. • Similar entrances on wider footpaths on other side of road in front of Thevar Apartments to serve residential areas abutting Mahim Sion Link road.
18.	BKC	• Mid terminal station for the corridor located near Income Tax office • Major interchange between Metro Line 2 and 3 • 2 entrances near proposed station entrances for line 2 • 2 entrances near SEEPZ end of station • Another entrance near hutline and multi-stored residential towers like Yashree Apartment, etc. • Another entrance near Nanasaheb Dharmadhikari road to cater to office spaces and commercial sector • One entrance near TATA communal building to cater to office complex • Four entrances in vacant lands and wide footpaths

Stations		Site
		residential areas along with public and semi-public areas comprising of many government offices like MMRDA, IT office, family court, CMC house, Collector Office, Pay Account office, Stock Exchange and residential areas along Madhusudan Kalekar road, N Dharmadhikari road, Ramakrishna Paramahansa road and slums of St Dnyaneshwar Nagar. • Another entrance near Colaba end of station in Mahalekha Exam Central Audit Bhawan to cater to catchment from various offices along the stretch including RBI office, IT office, etc. • A dedicated underground passage has been

19.	Vidya Nagri	• Station adjacent to Government colony and Uttar Bharatiya Education Institute • One major entrance at Colaba end • Another entrance in Government colony at Colaba end • Another entrance towards SEEPZ end in defence land • Another entrance in open site next to cemetery, which could be extended upto Kalina University
20.	Santacruz	• Station planned east of Wakola flyover on Western Express highway • Entrances are planned to integrate with existing infrastructure such as subways, skyways and bus stops. • Point of interchange between Mumbai Suburban Western Railway (entrance proposed near Tholiya marketing building) • Entry structure on west of expressway towards Colaba on footpath opposite National Machine Tools • Another entrance near Hanuman temple integrating it with existing BEST bus stop on
Package -6 (Chainage 232896.19 m- Chainage 28347.55m): Tunnel starting from the northern end of mid- ventilation shaft to northern end of CSIA International station includes 3 stations: CSIA (Domestic), Sahar Road and CSIA (International) under discussion with MIAL authority.		
Package -7 (Chainage 28347.55 m- Chainage 32504.71m): Tunnel starting from the northern end of CSIA (international) station to the northern end of the alignment including 3 stations:		
24.	Marol	• Proposed station will be located partly in Chimat Pada hutment and partially on road towards Andheri-Ghatkopar near Marol fire station • Major point of interchange between MML1 and MML3. • Major entrance towards SEEPZ end adjacent to Marol Naka Fire Station • Second major entrance is planned beside Sahar Garden towards SEEPZ (Access to MML1). • Third entrance near Colaba end over Dawood and company • Fourth entrance is planned on footpath along

Stations		Site
		• Another major entrance is planned behind Hotel Host Inn along DP road towards Colaba.

25.	MIDC	• MIDC station in Senior Police colony partially Employers Estate Insurance Corporation compound • 3 entrances along Colaba end • Another entry opposite Sr. Police Officers building • One staircase entry each at Mumbai Hazare building, IDBI bank compound and Employers Estate Insurance Corporation Compound • Dedicated underground passage along road no.7 , near Akriti Center point building • Another entry structure adjacent to Lalji Godhu and
26.	SSEPZ	• Station adjacent to SEEPZ campus • Major entrance inside SEEPZ compound as catchment to SEEPZ campus and other office buildings on Colaba end • Another major entrance along BEST bus stand compound • Single staircase in front of ERIT building

(Update (EIA Jan, 2016)

Table2.1: Details of Proposed Stations (Update EIA Feb, 2020)

Sr No.	Station Name	Station Length	Chainage(m) Up	Rail Level (m)	Inter-station Distance(m)	Road/Landmark
1	Cuffe Parade	394.65	0	20.835 M	N/A	Captain Prakash Pethe/Foreshore Road/Woods Park
2	Vidhan Bhawan	224.00	1459.962	25.086 M	1600	Madam Cama Road/Between Vidhan Bhawan and MLA Hostels
3	Churchgate	250.00	2195.624	28.113 M	685	Jamshedji Tata Road/Near Eros Cinema/CCG Structure
4	Hutatma Chowk	233.00	3085.900	23.924 M	817	DN Road/Near Flora Fountain
5	CST	250.00	4025.808	18.733 M	854	Mahapalika Marg/near Azad Maidan/CSMT Railway terminus
6	Kalbadevi	201.18	4925.742	24.311 M	935	Jagannath Shankar Road (JSS) Road/ Near Parsi Temple
7	Girgaon	291.20	5644.813	24.980 M	725	Jagannath Shankar Road (JSS) Road/ Near Zaveri Bazaar
8	Grant Road	200.00	7180.354	24.860 M	1540	Dr. Lamington Road/ Near Municipal School
9	Mumbai Central	250.00	8226.194	21.552 M	911	Dr.A. Nair Road/near Mumbai Central Suburban station
10	Mahalaxmi Metro	250.00	9312.959	18.285 M	1149	Sane Guruji Marg/Jacob Circle
11	Science	250.00	10681.390	22.600	1100	E. Moses Road/Near

Sr No.	Station Name	Station Length	Chainage(m) Up	Rail Level (m)	Inter-station Distance(m)	Road/Landmark
	Museum			M		Mahalaxmi Racecourse
12	Acharya Atre Chowk	250.00	11521.870	20.869 M	1200	E. Moses Road
13	Worli	250.00	13003.830	23.641 M	1408	Dr.Annie Besant Road/Near Akashvani
14	Siddhivinayak	250.00	14630.120	23.742 M	1555	Sane Guruji Garden/Behind Ravindra Natya Mandir
15	Dadar	322.10	16022.700	26.688 M	1277	Gokhale Road/Ranade Road
16	Shitla Devi	240.80	17714.712	26.412 M	1769	Lady Jamshedji Marg / M M. Chhotani Marg / Shitla Devi Temple
17	Dharavi	250.80	19525.800	18.181 M	1781	Mahim – Sion Link Road
18	BKC	473.40	21349.774	20.211 M	1919	Sant Dnaneshwar Marg/ Near ITO
19	Vidyanagri	250.00	22601.256	20.719 M	1587	University Road/In University Area
20	Santacruz	251.00	23600.532	20.898 M	1215	East side service road of Western Express Highway
21	CSIA Domestic	196.00	25873.980	21.650 M	2272	In CSIA Area near Domestic Terminal
22	Sahar Road	217.80	27596.852	21.581 M	1607	In CSIA near Sahar Road
23	CSIA International	260.80	28548.694	23.792 M	1052	In CSIA Area near International Terminal
24	Marol Naka	237.80	29662.722	23.124 M	871	Chimatpada Slum Area, near Andheri Kurla Road
25	MIDC	240.00	30888.452	18.915 M	1396	Vikhroli Village Hutment Area
26	SEEPZ	240.00	32131.679	20.060 M	1321	Krantiveer Lakhuji Salve Marg/ Near SEEPZ Bus Depot
27	Aarey Colony	185.00	33613.601			JVLR, Aarey Colony.

Ventilation Shafts (Updated EIA Jan 2016)

A large amount of heat is generated in Mass Rapid Transit underground stations. It is, therefore, essential to provide mechanical cooling & ventilation in order to remove the heat to the maximum extent possible. This is achieved by Ventilation & Air conditioning systems. Further mechanical ventilation system is also designed for extracting the smoke from underground metro system in case of a fire.

Ancillary Buildings

Ancillary buildings are above/underground structures that accommodate services like DG sets, Water Tanks, Cooling towers, Chillers etc. for underground metro stations. An ancillary building is best located as close to the metro station as possible to reduce the length of the utility corridor. In general the footprint of a typical Ancillary building is approx. 500-550 sq.m.

Proposed metro will also include the following for which land requirement will be temporary:

- Station box and related facilities
- TBM work/support sites
- Construction Depots

Station Box and related facilities:

Station box and related facilities will comprise of entry/exit structures, ancillary building, and ventilations shafts. Some part of land of station box will be used for purposes such as barricading during construction, temporary traffic diversion/management, mucking, storage of construction material and plant & equipment at site etc.

TBM Worksites: (Updated EIA Jan 2016)

Activities proposed to be carried out at TBM worksites will include TBM operations like launching, retrieval, TBM maintenance operations, mucking, lining intake etc. TBM worksites are required to be located midway between stations at some places on tunnel alignment and at locations where mid shafts are located. 23 TBM worksites have been proposed for MML3, indicative nearest station to TBM work site is tabulated in Table 2.2.

Table 2.2: Description of TBM work sites of MML3

Sr. No.	TBM work sites	Area (m^2)	Location (indicative nearest station)
1	TWS 1	4538	Cuffe Parade Station
2	TWS 2	3988	Oval Maidan - Churchgate
3	TWS 3	3459	CST - Station
4	TWS 4	2352	CST - Station
5	TWS 5	7012	Mumbai Central Station
6	TWS 6	5130	Mumbai Central Station
7	TWS 7	2356	Race Course – Science Museum Station
8	TWS 8	4232	Race Course – Science Museum Station
9	TWS 9	33454	Worli Station
10	TWS 10	2100	Worli Station
11	TWS 11	24740	Siddhi Vinayak Station
12	TWS 12	1448	Dadar Station
13	TWS 13	3864	Mid-Shaft St Xavier College – Dharavi Station
14	TWS 14	1123	Dharavi Station
15	TWS 15	4408	Dharavi Station
16	TWS 16	8869	BKC Station
17	TWS 17	3513	BKC Station
18	TWS 18	3230	Mid Vent Shaft Agripada – Santacruz station
19	TWS 19	2820	Sahar Road Station
20	TWS 20	5693	Sahar Road Station
21	TWS 21	2624	CSIA International Station
22	TWS 22	500	CSIA International Station
23	TWS 23	12744	Mid Shaft BMC play ground – Marol Naka

Construction Depots

Construction depots will be centralized spaces for storage of contractor's materials, and plant & equipment etc. such as formation as reinforcement cages, heavy steel sections, cranes etc. needed during construction.

Details of Construction depot are given in the table 2.3 below:

Table2.3 : Description of Construction Depot sites of MML3

Sr. No.	Construction Depot	Area (m^2)	Location (Indicative nearby Station)
1	CD1	9854	Cuffe ParadeStation
2	CD2	3829	Cuffe Parade Station
3	CD3	9890	Cuffe Parade Station
4	CD4	6300	Azad Maidan – CST Station
5	CD5	12725	Mahalaxmi Station
6	CD6-A	10688	BKC Station
7	CD6-B	12018	Vidyanagri Station
8	CD7	15000	Sahar Station
9	CD8	12375	Depot Area – Seepz Station

Casting Yards

The Metro Line 3 being underground needs tunnel lining segments to be pre-casted to be assembled at site the length of tunnels for different packages are given below Table 2.4:

Table 2.4 Details of Tunnels and openings/Station Boxes

Contract	Station From	Starting Chainage	Station To	End Chainage	Interstation Distance	Openings/ Station Box Length (m)
UGC-01	STARTING	-487.56	Cuffe Parade	-317.54	170.02	440
	Cuffe Parade	122.541	Vidhan Bhavan	1310.65	1188.109	255
	Vidhan Bhavan	1565.65	Churchgate Metro	2061.011	495.361	285
	Churchgate Metro	2346.012	Hutatma Chowk	2968.681	622.669	252
	Hutatma Chowk	3220.682	CST Metro	3767.122	546.44	285
UGC-02	CST Metro	4052.058	Kalbadevi Station	4688.433	636.375	207
	Kalbadevi Station	4895.78	Girgaon Station	5359.861	464.081	298
	Girgaon Station	5657.439	Grant Road Metro	6943.432	1285.993	202
	Grant Road Metro	7145	Mumbai Central	7817.66	672.66	285
UGC-03	Mumbai Central	8102.769	Mahalakshmi	8912.92	810.151	285
	Mahalakshmi	9198.001	Science Museum	10096.398	898.397	365
	Science Museum	10461.49	Acharya Atray Station	11135.366	673.88	285
	Acharya Atray Station	11420.36	Worli Station	12592.364	1172.009	285
UGC-04	Worli Station	12877.37	Sidhi Vinayak Station	14162.029	1284.658	257
	Sidhi Vinayak Station	14419.09	Dadar Metro Station	15533.985	1114.895	324

	Dadar Metro Station	15857.68	Shitladevi Station	17250.274	1392.593	302
	Shitladevi Station	17551.86	Dharavi Station	18959.169	1407.311	285
UGC-05	Dharavi Station	19244	BKC Station	20674.709	1430.709	475
	BKC Station	21149.71	Vidyanagri	22010.356	860.648	285
	Vidyanagri	22295.36	Santacruz Station	23019.141	723.784	272
	Santacruz Station	23291.14	MID Ventilation Shaft	23877.038	585.896	26
	MID Ventilation Shaft	23903.02	CSIA Domestic	25198.61	1295.588	217

UGC-06	CSIA Domestic	25416.01	Sahar Road	26904.551	1488.542	220
	Sahar Road	27124.75	CSIA International	27813.599	688.847	314
	CSIA International	28127.7	Marol Naka Station	28842.203	714.499	277
UGC-07	Marol Naka Station	29119.2	MIDC Station	30033.245	914.043	255
	MIDC Station	30288.57	SEEPZ Station	31254.668	966.099	405
	SEEPZ Station	31659.67	END	32488.12	828.452	

As per IC Report, Aril 2013, there were about 14 sites were reviewed. Out of these 14 sites as per MMRC latest communication, only two sites are available viz., Wadala-Simplex Infrastructure Casting Yard Site and Wadala Monorail Casting Yard Site which can accommodate two packages. Additionally two sites were provided one on Kanjur Marg with a capacity to accommodate 2 packages and BKC near Mithi River that can accommodate one package. Due to the proximity of the packages, the sites suitable for Casting Yards allocated and the details are presented in Table below:

Table 2.5 : Details of allocation of Casting yards for different packages

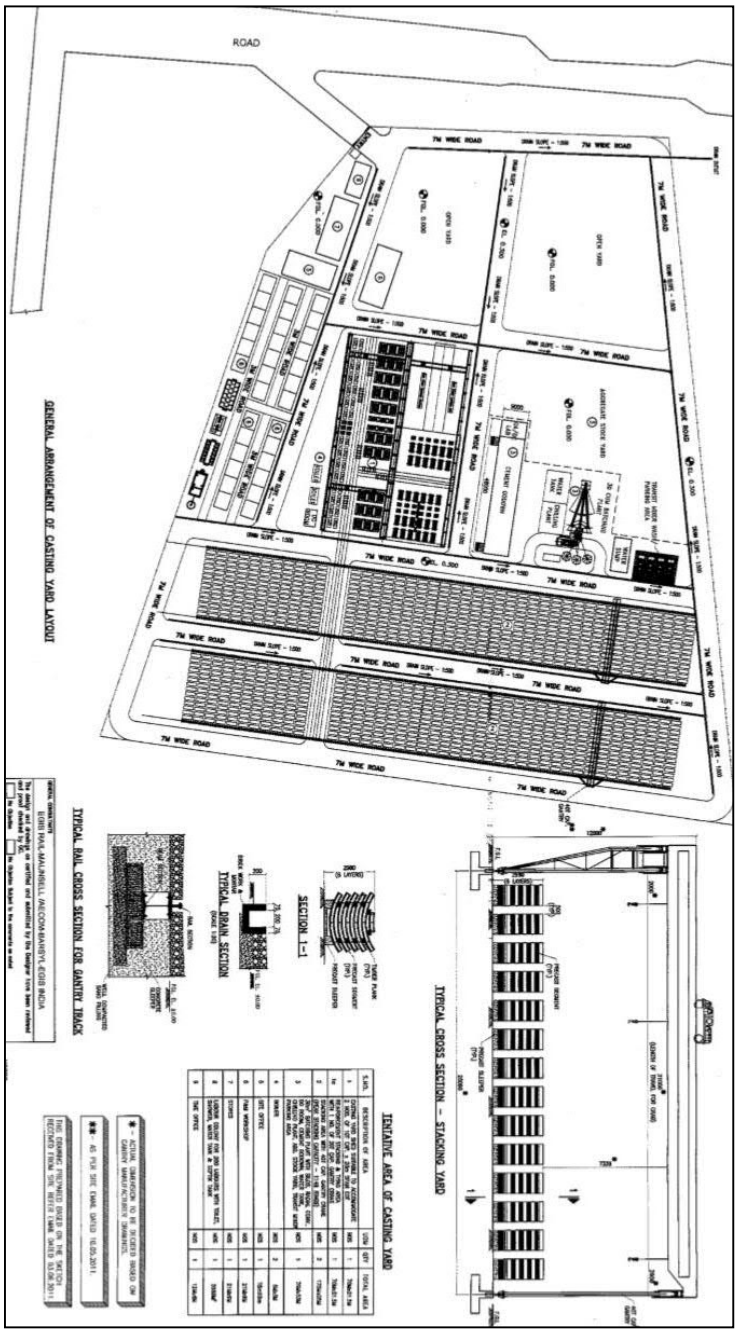
Location	Area m^2	Distance from Package	
		First	Second
Existing casting yard at Wadala – Simplex	81227	Package 1	Package 2
		16 km	14 km
Existing Monorail casting yard at Wadala	83150	Package 3	Package 4
		12 km	9 km
BKC near Mithi River	35028	Package 5	
		6 km	
Kanjur Marg Plot (Near Eastern Express Highway)	80576	Package 6	Package 7
		14 km	10 km

Table 2.6 : Details of Casting Yards proposed

Contract	Location	Size in Sq.m.	Distance (km)
UGC-01	Existing casting yard at Wadala – Simplex	36947	16
UGC-02	Existing casting yard at Wadala – Simplex	44280	15
UGC-03	Existing Monorail casting yard at Wadala	41575	12
UGC-04	Existing Monorail casting yard at Wadala	41575	9
UGC-05	BKC near Mithi River	35028	6
UGC-06	Kanjur Marg Plot (Near Eastern Express Highway)	40058	14
UGC-07	Kanjur Marg Plot (Near Eastern Express Highway)	40518	10

Figure 2.2: Typical Casting Yard for two Packages

Figure 2.3 Typical Casting Yard for one package



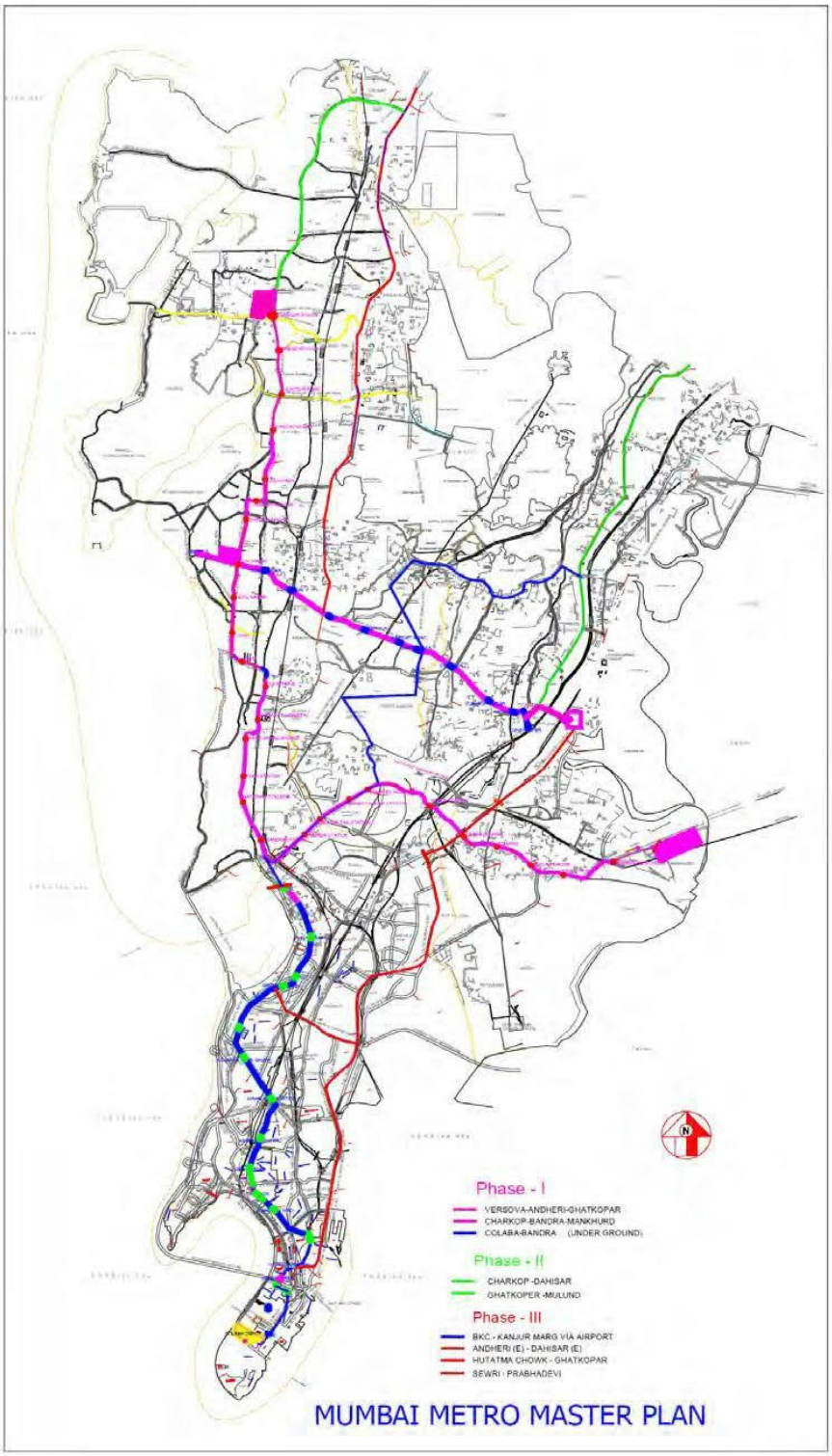
2.3 ANALYSIS OF ALTERNATIVES

2.3.1 Alignment planning

Selection of an optional alignment is a multi-disciplinary decision, with objectives which may conflict with one another. The selection of approach for resolving the problem is the multi- criteria analysis for the alternative to be analyzed. The principal objectives which were consider while selecting the metro-alignment are minimization of the impact on the environment & social, minimum land acquisition, optimization of the functionality of the alignment, minimization of construction time, minimization of construction and operational cost and maximization of the results of the economic investment. Minimization of construction time and construction and operational cost are amongst the criteria with the highest weighting factors in selecting the optimal alignment. While selecting the alignment of Mumbai Metro Rail corridors spread over in three phases and having total length of 149.87 km. Following parameters are taken into consideration:

- Catchment area,
- Integration with other mass transit corridors,
- Construction feasibility, and
- Environment and social aspects.

FIGURE 2.4
MUMBAI METRO MASTER PLAN



Detailed Project Report from Colaba to Bandra falling in Phase I was prepared by Delhi Metro Rail Corporation Ltd in 2007 and BKC to Kanjur Marg via Airport (Line VI) in Phase III was prepared by RITES Limited in 2011.

The present proposed alignment from Colaba to SEEPZ via BKC has been finalized by combining Line III and Line VI. Line III had been proposed underground from Colaba to Mahim and elevated from Mahim to Bandra. Line VI was underground from Mahim to ITO and elevated from ITO to Kanjur marg. Another alternative in this alignment was elevated from Mahim to ITO. Considering the environmental, social, traffic and land availability aspects, it was decided to keep the proposed alignment underground.

The National Facilitation Committee (NFC), in its meeting held on September 3, 2009, decided that the metro connectivity to the CSIA be expedited and put in the phase 1, rather than in the phase 3 as per Metro Master Plan. This was decided to be achieved by merging Line 6 of phase3, named BKC-Kanjur Marg via Airport with the Line 3 of phase I, i.e Colaba-Mahim-Bandra and run through services from Colaba till SEEPZ.

2.3.2 Proposed Alignment

The proposed alignment as mentioned in 2.4.1 was studied by RITES Ltd. During the study, RITES Ltd examined the proposed alignment to finalize it. Two alternatives were taken between Cuffe Parade Road and Vidhan Bhawan for analysis. These two alternatives were studied and their benefits and drawbacks were examined, which are depicted in subsequent para.

Alternative-I

From Cuffe Parade Road (fisherman colony), alignment takes left turn to cross the sea and follows the Jamnala Bajaj Road and passes in front of Vidhan Bhawan. The major disadvantage of the alignment is that the 600 m alignment was passing under sea.

Alternative-II

From Cuffe Parade Road, alignment follows Foreshore Road (Captain Prashant Pethe Marg) and takes left turn near Fire station and passes through State Govt. Barracks and between Vidhan Bhawan/SBI building. The merit of this alignment is that it is close to Mantralaya as well as Vidhan Bhawan. The major advantage is to serve the important catchment areas of Colaba localities. Also by selecting this alignment the route passing under sea in Alternative is avoided.

Hence, MMRC has decided to adopt Alternative II to serve additional catchment areas and avoid the sea route. The two alternatives are shown in Figure 2.5.

FIGURE 2.5
ALTERNATIVE ROUTES

2.4 Depot Planning

The proposed corridor would require a dedicated depot for the maintenance of the rakes. The inspection, overhauling and all maintenance facilities for P Way, S & T, OHE etc. will also be provided at the depot cum maintenance workshop. As per the preliminary assessment, train operation on Colaba-Bandra-SEEPZ corridor will require about 45 rakes of 4 cars to meet the traffic projection in the horizon year 2031. Depot cum workshop shall have necessary facilities viz stabling lines, schedule inspection lines, workshop for overhaul, unscheduled maintenance including major repairs, wheel profiling, and heavy interior/under frame/roof cleaning etc.

In addition, the Depot will also house for operation control centre (OCC), administrative building, maintenance facilities for civil-track, water supply; electrical-traction, E&M; signalling & telecomm; etc.

2.4.1 Car Depot Site Requirement

The pre requisites of coach maintenance depot site are as under-

- A plot size of adequate area- about 30 Ha,
- Proximity to alignment: Site must be located as close to the alignment as possible.
- Ease to movement: There should not be any obstruction to movement of rakes in either direction

2.4.2 Proposed Alternative sites for Depot

Following sites had been selected for the depot having requisite size along the alignment.

- Mahalaxmi Race Course
- Kalina University land
- Aarey milk colony land

Alternative I: **Mahalaxmi Race Course**

The land requirement of 19.2 Ha is available and it is well close to alignment. The rakes are easily placed & retrieved from depot from Science Museum station. However, the land requirement for depot is in possession of Rayal Western India Turf Club and the grandstand of the course is a designated heritage structure which requires additional clearance. However, The first option of Kanjurmarg, Eastern Expressway, suggested by the committee could not be adopted due to non- availability of land, technical and operational difficulties as well as financial implications.

Alternative II: Kalina University land

Kalina University is located at the western edge of BKC with a total vacant area available of 20 Ha and it is well close to the alignment i.e less than 1 km. The rakes are easily placed & retrieved from depot in either direction. However, it would be difficult to acquire land as the land is in possession of Kalina University and is meant for educational purposes. Also the part of the land is falls in CRZ-II, hence additional clearance will be required.

Alternative III : Aarey Milk Colony

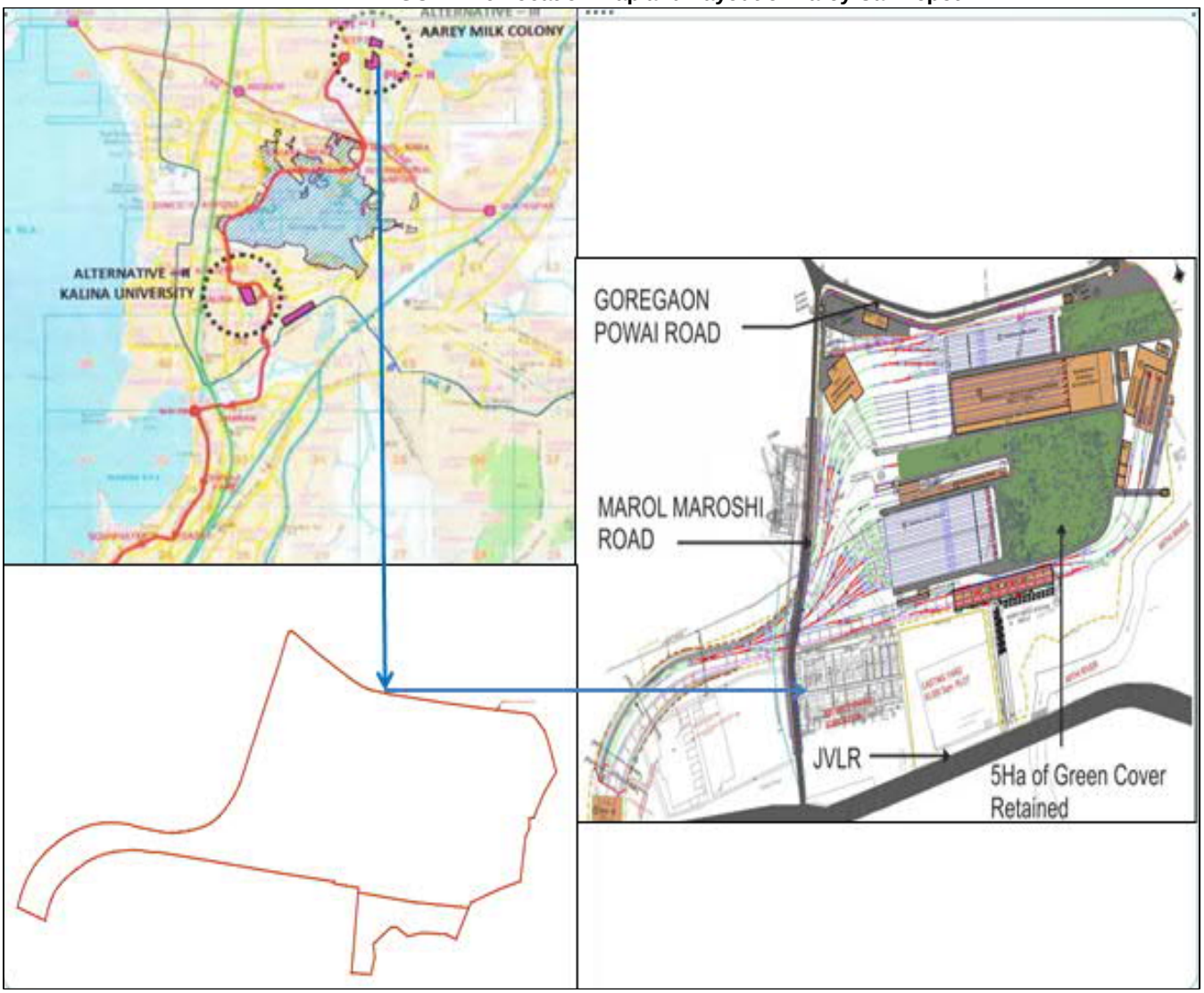
Aarey Milk Colony land is adequate in size for metro car depot located along JVLR opposite to SEEPZ. The proposed depot land is very close to the alignment. The depot can be constructed at-grade level. Only 25 ha. area is being used for the Car Depot which constitutes less than 2% of the total area of Aarey Colony and a conscious attempt has been made to retain the green cover in 5 Ha area within the car depot. The said land is surrounded by Jogeshwari-Vikhroli Link Road (JVLR),Goregoan-Powai Link Road (GPLR), No major complications are involved in shifting of public utilities. Also rakes can be easily placed & retrieved from depot. Furthermore future expansion would be possible as adequate land is available in the vicinity. However, only the corridor needs to be expanded for about 1 km for the depot accessibility.

Facility will be available the Car Depot in Aarey Colony:

- 35 stabling lines for parking of trains during non-working hours
- Operation Control Centre (OCC)
- Administrative Building
- Inspection and maintenance workshops

In view of the above, depot cum workshop is found to be more suitable at Aarey milk colony land. The area is also available for future expansion and the proper landscaping can be retained or enhanced the beauty of the area. The alignment is shown in the Figure 2.6.

FIGURE 2.6 Location Map and Layout of Aarey Car Depot.



2.5 Updates on Depot from September 2012 to September 2015 (Update EIA Jan, 2016)

The construction of depot is to be implemented by two contracts. At the initial stage, civil preparatory work awarded on 1st November, 2014 for Construction of Boundary Wall & Ground Development, PTR building and Diversion of water supply lines.

Recently, some sections of the society objected to the choice of the depot land. The main contention is that an estimated 2,200 plus trees will have to be cut, which will reduce the green cover in a city. The assertion of these groups is that any construction or development in this area will irreversibly affect the natural environment of the area which will have long term negative impacts on the surroundings.

Taking cognizance of these concerns raised by various citizens group the Government of Maharashtra, has constituted a Technical Committee regarding the Metro Line-3 (Colaba- Bandra-SEEPZ) Car depot at Aarey colony, Goregaon. The Committee is to evaluate facts and submit its recommendations to the State Government.

The Committee also studied objections and suggestions related to construction of the depot at Aarey Colony received by Authorities from the citizen groups. Primary concerns of citizen groups are about the damage the proposed depot at Aarey would cause to the tree cover, ecology and loss of open public spaces in the city.

Key Activities Performed by the Supervision Consultant

- The planning of car depot was done by International Consultant M/s PADECO- AECOM-LBG Ltd.
- Civil preparatory works are awarded and Contractors mobilised on site for all 3 packages.

Sr No	Name of Work	Tendered Cost	Work Order	Stipulated Time Period
Package 1-A	Construction of Boundary Retaining Wall, RCC Storm Water Drain, Ground development	Rs. 72.14 Cr	20/10/2014	24 Months (Including Monsoon)
Package 1-B	Construction of Playback Training Room (PTR) building (G+3)	Rs. 6.91 Cr	20/10/2014	18 Months (Including Monsoon)
Package 1-C	Diversion of 1200 mm & 600 mm diameter Water Supply Lines	Rs. 8.91 Cr	20/10/2014	18 Months (Including Monsoon)

- Site supervision
  - Co-ordination with Service Providers and external agencies
  - QA / QC Works
  - The alternate 36,000 Sqm (3.6 Ha) land is handed over by Aarey department for transplantation / new plantation of trees adjoining to car Depot on West side of Marol Maroshi Road
  - Survey of Trees, supervision and numbering of trees
  - Compliance of Tree Authority requirements
  - Coordination during MCGM Garden department officials site visit
  - Evaluation of Tree cutting & transplantation proposals submitted by the contractor.
  - Visits to nursery, identification of saplings for plantation, Monitoring Tree plantation
  - Tree presentation preparation to the members of Tree

Authority Brief Scope of the Committee is:

i. To study the alternatives for locating car depot, if possible,

ii. To minimize damage to the trees at Aarey depot site if suitable alternative is not found

iii. To suggest mitigating measures to minimize environmental damages to the Aarey colony.

The Committee is authorised to call experts as per the Committee's requirement. The Committee is to evaluate facts and submit its recommendations to the State Government. Mumbai Metro Rail Corporation (MMRC) is to assist the Committee in arranging the meetings with the various groups, site visits including technical & secretarial assistance. Logistics also shall be provided by Mumbai Metro Rail

Corporation as required by the Committee.

The Committee also studied objections and suggestions related to construction of the depot at Aarey Colony received by Authorities from the citizen groups. Primary concerns of citizen groups are about the damage the proposed depot at Aarey would cause to the tree cover, ecology and loss of open public spaces in the city.

Committee members, in small groups, carried out visits to various possible depot sites, consulted with the citizen groups as well as rail and metro experts to comprehensively understand and address the following key issues:

- Essential functions and facilities required to be housed within car depot for MML3
- Feasibility of alternative sites for locating car depot

- Measures to minimise damage to trees at Aarey depot site, if suitable alternative is not found.
- Recommendations to mitigate measures to minimize environmental damage to Aarey colony.

The Committee studied nine locations. Some of these locations were proposed by the citizen groups. In addition, various alternative arrangements and modifications within and around the existing site in the Aarey colony area were also explored.

The nine sites studied by the Committee are:

1. Backbay Reclamation, Colaba
2. Mumbai Port Trust
3. Mahalaxmi Race Course
4. Dharavi
5. Bandra Kurla Complex
6. Mumbai University, Kalina
7. Aarey Colony
8. Sariput Nagar
9. Kanjur Marg

The Committee followed a systematic process to screen and analyse the alternative locations based on pertinent factors such as:

- Adequate land to accommodate the depot
- Impact on trees, environment and social factors
- Cost and time impact of feasible alternatives

Based on the study of the reports and discussions with the domain experts following requirement were identified for the car depot for the project:

(i) Project Demand and Service needs:

- MML3 is projected to serve significant public transport needs of Mumbai and is forecasted to carry 17 lakh passengers per day by the year 2031.
- This would require 55 Rakes and 440 Coaches for its operations by 2031. However, within first 10 years of its operations, an estimated 47 Rakes and 282 coaches will be required.

(ii) Essential functions and facilities required to be housed within the car depot for MML3:

- Daily and periodic maintenance of these coaches and train sets are undertaken for safe operation. A depot has provisions for about 30 different facilities to help in the operations and maintenance of the system. Some of the important facilities in a depot are:

- Operation Control Centre (OCC)
- Stabling Lines for parking of trains in secure area while waiting to be put in operations
- Inspection Bay to inspect the train before putting it in operations
- Workshop to repair and maintain the trains
- Train washing plant
- Coach unloading area
- Wheel lathe plant for wheel profiling
- Maintenance units of traction/signalling/telecommunication and track systems along with their rail-road maintenance vehicles
- Test Track of 600 to 1000 m length to test the train after undertaking servicing
- Auxillary Substation (ASS)

(iii) Depot Location

- A depot should ideally be located close to a terminal points on the alignment, rather than at an intermediary location, so that it can facilitate efficient operations of the system including feeding of trains during peak period at required headway, allow quick turnarounds and cater to the demand needs to meet operational headway requirements.
- Location should be in proximity of the main alignment to avoid empty runs and waste of energy.
- The Land must be of a shape and size that will permit a feasible depot layout for the required depot facilities.

Considering these factors, the Committee assessed the merits and demerits of each of the alternative depot site. On consideration of the availability of adequate land, all of the sites at intermediate locations were found to be not feasible on these criteria itself as none of these were found to be close to meet the bare minimum sizing requirement. Only the following sites at or beyond the terminal points of the corridor met this requirement and were further studied:

i. Backbay Reclamation, Colaba

ii. Kanjur Marg

iii. Aarey Colony

The committee studied these sites in further

details. Conclusions:

Following are the conclusions of the Committee:

i. Mumbai Metro Line 3 is a critical Infrastructure project for Mumbai's public transportation needs. Government and Authorities cannot afford delay in commissioning of this project.

ii. Timely completion of the depot is necessary in order to bring in the trains, test them and keep them ready in time. Depot finalisation and construction is always on a critical path of the MRTS project schedule.

iii. Timely commissioning of Line 3 will have enormous impact on mobility, quality of life and larger overall environmental benefits. Commissioning of Line 3 will help reduce use of private vehicles and avoid worsening situation of congestion and air pollution impacts for the community.

iv. Equally important is the aspect of green development and need to avoid/minimise adverse impact on tree and green cover in the city. Therefore, balance between the need of project and on the impact on trees and the environment has to be achieved.

v. Out of the sites finalised for detailed consideration Backbay Reclamation site will have more environmental, social and administrative implications due to reclamation in sea, loss of 3.2 Ha of mangrove cover and serious R&R. Remaining six sites are not considered feasible on the basis of criteria discussed in item 1.9 of the report.

vi. Large open tracts of land towards Bhandup at Kanjur Marg does not have major tree cover and is considered a feasible option. But, the ownership of this land is in dispute and under various litigations with legal encumbrances. Such litigations and ownership issues need to be resolved to develop the depot without undue delay in the completion of the project.

vii. However, if a decision is made to locate the depot at Kanjur Marg, Line 3 will have to be extended by at least 7.5 Km with additional stations with an estimated additional fund requirements of approximately Rs. 1,700 crores. Extending Line 3 up to Kanjur Marg may delay commissioning of the Line 3 project if the subject land is not handed over to MMRCL within a 3 month period.

viii. An option is of double decked depot in Aarey colony near the present location. This option reduces the land requirement to 20.82 Ha and the impact on trees to about 446 trees if a full service depot is constructed. There is an advantage of constructing full depot at Aarey colony by double decking stabling facilities and with elevated test track.

But the double deck depot will cost approximately 750 crores more but would save trees and can be completed in time.

ix. Alternatively, the main depot with stabling and workshop of MML3 to be planned in the Kanjur Marg, with limited stabling facilities to be provided at Aarey colony. This Depot at Kanjur Marg will be common with then planned Jogeshwari-Kanjur Marg line. For such an arrangement to work, the new line will have to be planned and operated as a natural part of the MML3 for seamless operations. Both the lines will have to be designed with the same signalling system as well as other systems of telecommunication and Over Head Traction etc in an integrated manner. and controlled by the same OCC.

x. All the available sites and options have their merits and demerits and related consequences. Hence timelines of commissioning the project also be given importance.

xi. The committee is of the view that in the larger interest of the society and "benefit to the greatest number for the greatest good" must be achieved while at all times ensuring protection to trees, open spaces and environment.

Recommendations:

i. In the overall scenario when GOM is seriously considering construction of Kanjur Marg – Jogeshwari corridor and constructing a depot with lesser impact on trees, costs an additional amount of 750 Cr, the Committee consider that larger benefits will be achieved by adopting the following:

a) Construct the main depot of line 3 at Kanjur Marg by integrating Colaba-Seepz corridor (MML-3) with Jogeshwari-Kanjur Marg corridor.

b) This entire arrangement shall be totally integrated with same system specificationfor seamless operations and implemented by MMRC.

c) GOM to allot Kanjur Marg land within 3 months so that MMRC can proceed with further activities.

d) To maintain the operational efficiency of underground corridor of MML3, a small facility consisting only of 16 stabling lines shall be constructed within Aarey colony land. However MMRC will ensure that, this facility is developed on earth fill to economise on cost and total impact on trees should be less than 500.

ii. The committee further recommends that in case the land at Kanjur Marg is not made available for some reason, then the modified layout of a full service double decked depot at Aarey colony as suggested by DMRC near the present site as detailed in Item 1.17 of the Executive Summary may be considered. In this case the project cost will increase by approximately 750 crores due to civil construction in extension of underground corridor, in civil construction of double decking and also due to elevated test track, but the depot can be constructed without any uncertainty and within the time schedule of the project. The options entails a substantially smaller impact of only

446 trees, and the Depot area is also reduced to 20.82 Ha from the present area of 30 Ha.

Number of trees and the depot area may change a bit subject to detailed planning.

iii. The Committee recommends following measures to mitigate the environmental impact to the Aarey colony:

- Ground Water charging arrangements to be provided in the Depot
- Plantation of trees as per statuary requirements of 1:3 trees for every tree cut
- Trees above 10 feet height of native variety only to be planted
- Plantation to be undertaken by professional agencies only
- Annual audit of plantation by third party and reports posted on the Company's web site
- MMRC to maintain these trees for 5 years.

Update (EIA Feb. 2020)

The Colaba– Bandra- SEEPZ Corridor of Mumbai Metro Line 3 project would require a dedicated depot-cum workshop facility for the maintenance of the trains. With this objective, an extensive study of various possible sites for locating a dedicated depot-cum workshop was done by RITES. As such the following four locations have been identified.

a) Mahalaxmi Race course

b) Exhibition Ground at BKC

c) Kalina University land.

d) Aarey Milk Colony land

After taking into considerations the merits and demerits of each location, it was suggested to develop major depot-cum workshop in Aarey Milk Colony area. Further it was also suggested to develop a minor depot either in Kalina University area or near around Aarey Milk Colony itself to handle the maintenance requirements of additional train sets in future. Finally, after considering the various pros and cons, it was decided to develop only one depot in Aarey Milk Colony area with all facilities.

A single depot at one end of a 33.5 km long fully underground metro corridor pose many challenges in operations. Some of these challenges listed below as below shall be kept in mind while making operation plans.

- Criticality in quick introduction of morning trains and winding up of operations at the end of day.
- Increased empty running of trains for starting and winding up of train operations.
- Difficulties in removal of any defective train from the line, as it shall take more time and results in increased cancellations of services.
- Constraints in rescue and restoration works.

- Time taking to send a work train and clear the section in short time.
- Issues of smoke emissions when diesel engine is sent in the 33.5 kms long tunnel.

To ensure starting of the morning services, some rakes will have to be kept at terminal stations and stabling facilities for the remaining rakes will have to be provided at the depot. It is being planned to provide 2 stabling lines at Cuffe Parade, 1 at BKC and 2 covered sheds at Aarey Milk Colony for overnight stabling of train sets for commencement of morning services.

2.6 MAJOR SECTION OF PROPOSED METRO CORRIDOR (LINE III)

The proposed Metro corridor will facilitate the commuters to travel from South Mumbai to Airport via Mahim-BKC. It will also provide direct access to the economic hubs such as BKC, MIDC Industrial Estate, SEEPZ and famous landmarks such as Kalina University, Mahalaxmi etc. The proposed 33.51 km metro corridor has been divided into six sections
as depicted in Table 2.7.

TABLE 2.7 MAJOR SECTIONS OF METRO CORRIDOR (PHASE III)

S.NO.	MAJOR SECTIONS	LENGTH IN KM
1	Colaba/WTC/Cuffe Parade to CST	4.475
2	CST to Science Museum	7.000
3	Science Museum to Mahim	7.000
4	Mahim to Airport	7.000
5	Airport Region	5.000
6	Airport to SEEPZ	3.033
	Total	33.508

2.7 RIDERSHIP ON PROPOSED METRO CORRIDOR

The ridership has been estimated by MMRC based on the results of CTS Transport Demand Model considering the following points.

1. P3E3 land use scenario is considered in which growth to MCGM and RoR is allocated in equal proportion.
2. CTS proposed Road and Rail network is considered for horizon years 2016, 2021 and 2031.
3. Metro Fare is considered as 1.5 times the ordinary bus fare.
4. Speed of the metro is taken as 35 kmph.
5. Frequency of metro service is considered as 4 minutes for 2016 and 3 minutes for 2025 and 2.5 minutes for 2031 horizon years.

Based on the above consideration, the proposed Metro Corridor is expected to have a daily ridership of 16.99 Lakh and Maximum PHPDT of 42000 by 2031. These are shown in Table 2.8

TABLE 2.8 MAXIMUM PHPDT AND DAILY RIDERSHIP

YEAR	MAXIMUM PHPDT	DIAILY RIDERSHIP (IN LAKH)
2016	25700	10.06
2021	39000	13.87
2031	42000	16.99

Ridership: Update (EIA, Feb 2020):
The proposed Line 3 Metro Corridor is expected to have a daily ridership of 16.99 Lakh and a maximum PHPDT of 42,021 by 2031. The daily ridership and maximum PHPDT along the corridor for 2016, 2025 and 2031 are shown in below Table.

PHPDT and Daily Ridership for Colaba - Bandra - SEEPZ Corridor

Corridor	2016		2025		2031	
	Maximum PHPDT	Daily Ridership (in Lakh)	Maximum PHPDT	Daily Ridership (in Lakh)	Maximum PHPDT	Daily Ridership (in Lakh)
Colaba - Bandra - SEEPZ	25,711	10.06	38,930	13.87	42,021	16.99

Note : The PHPDT values shown above are the maximum values seen anywhere along the entire line (all sections and directions included). They are considered as a working basis for the Train Operation Plan.

The proposed corridor has two distinct sections in terms of passenger loading(i) Colaba-Bandra with higher peak section loads, and (ii) Bandra – SEEPZ with comparatively lower section loads. Hence a mid-terminal facility is proposed at Bandra Metro station to enable differential train frequencies in these two sections. The broad

PHPDT for the two sections are depicted in Table 2.9. These will be considered to work out the train operation plan, rake requirement etc.

TABLE 2.9 PHPDT FOR COLABA – BANDRA AND BANDRA - SEEPZ

SECTION/YEAR	2016	2021	2031
Colaba-Bandra	25000	36000	40000
Bandra-SEEPZ	16000	18000	21000

2.8 ROLLING STOCK, TRACTION AND SIGNALLING

The salient features of proposed Metro Corridor (underground) in respect of rolling stock, power supply, traction system and signalling are summarised in DPR and reproduced below:

- A short train consisting of 4 cars with high frequency service which can be increased to 6-cars and 8-car for increasing the Passenger Carrying Capacity of Trains with the consideration of matching the growing traffic demand.
- A short train consisting of 6 cars with high frequency service which can be increased to 8-car for increasing the Passenger Carrying Capacity of Trains with the consideration of matching the growing traffic demand.
- The rolling stock shall be Standard 1435 mm track gauge Section having maximum width of 3.20 m, Axle load of 17 tonnes and capacity of 4 coach unit as 1178 passengers. Seating arrangement will be longitudinal and AC class accommodation will be provided.
- The rolling stock shall be Standard 1435 mm track gauge Section having maximum width of 3.20 m, Axle load of 17 tonnes and capacity of 6 coach unit as 1775 passengers. Seating arrangement will be longitudinal and AC class accommodation will be provided.
- 25 KV AC 50 Hz Traction system is proposed to fulfil the power demand of 65 – 48 MVA in 2016. Three receiving stations have been proposed at Colaba (Cuffe Parade), Race Course and Dharavi.
- The system, under normal operating conditions, will be an automatically operated system utilizing Automatic Train Control and Automatic Train Protection (ATP) under the overall control of a train driver and OCC operators.
- Computer Based Interlocking (CBI) signalling and continuous automatic train control with Automatic Train Protection (ATP) is proposed, while telecommunication system is integrated with Optical Fiber Cable, LED/LCD based boards, Mobile Radio, Mobile system etc.
- Fare collection system is provided with automation in association with Contactless Smart Card and Retractable Flap Type Control Gates, Ticket Office Machine, TR, PTD etc.

No change in status regarding Power supply. The design will be finalized after Traction Simulation study.

Rolling Stock, Traction and Signalling Update (EIA Feb, 2020)

The Rolling Stock being procured for Colaba – Bandra – Aarey Metro is similar to the Rolling Stock being used in Delhi and Line - I of Mumbai Metro. The specifications of these rolling stock differ due to various technical & operational requirements.

Rolling stock system to operate the train in GoA2 initially however pre-dominant mode of operation shall remain GoA4. The broad features of Rolling Stock being procured for the present corridor are presented in Below table; the basis of which is given in the following paragraphs.

Broad Features of Rolling Stock

Sl. No.	Parameter	Colaba – Bandra – SEEPZ Corridor
1	Vehicle dimensions	
	Length (including coupler)	DT-M-M-M-M-M-M-DT 180000mm (Max) or any proposal by contractor
	Width	3200 mm (Max)
	Height	4048 mm (Max Locked down pantograph height)
2	Coach construction	Aluminum or austenitic stainless steel of grade SUS301L to JIS G4305 or equivalent international standard
3	Tare Weight	Total 8 car tare weigh should not exceed 336 tones
4	Axle load	17 T (Max)
5	Propulsion system	3 phase drive system with VVVF control
6	Type of traction supply	25kV ac Overhead collection

2.9 PASSENGER CARRYING CAPACITY

In order to maximise the passenger carrying capacity, longitudinal seating arrangement shall be adopted. Criteria for the calculation of standing passengers are 3 persons per square metre of floor area in normal state, 6 persons in crush state of peak hour and 8 persons in dense crush state of peak hour. Therefore, Driving Trailer with 21.84 m car body length, 3.2 m car body width and longitudinal seat arrangement conceptually have the capacity of 43 seated, 239 standing, thus a total of 282 passengers while a Motor car with 21.74 m car body length,
3.2 m car body width and longitudinal seat arrangement conceptually have the capacity of 50 seated, 257 standing, thus a total of 307 passengers for a car is envisaged considering a standee area of 6 persons per square metre. These are shown in Table 2.10.

TABLE 2.10 CARRYING CAPACITY A CAR

DESCRIPTION	DRIVINGTRAILER CAR		TRAILER CAR/ MOTOR CAR		4 CAR TRAIN	6 CAR TRAIN	8 CAR TRAIN
	Normal	Crush	Normal	Crush	Crush	Crush	Crush

Seated	43	43	50	50	186	286	386
Standing	120	239	129	257	992	1506	2020
Total	120	282	179	307	1178	1792	2406

Update (EIA Feb. 2020)

In order to maximize the passenger carrying capacity, longitudinal seating arrangement shall be adopted. The whole train shall be vestibule to distribute the passengers evenly in all the coaches. Criteria for the calculation of standing passengers are 3 persons/m2 of standing floor area in normal state, 6 persons/m2 in crush load (AW3) state and 8 persons/m2 in dense crush load(AW4) state of peak hour.

Therefore, Driving Trailer with 22.6 m car (including coupler), with 3.2 m car body width and longitudinal seat arrangement conceptually have the capacity of 50 seated, 230 standing thus a total of 280*(without considering space release for passengers due to removal of cab partition wall) passengers for a car, is envisaged considering a standee area of 6 person/sq. meter. Motor car (M1–M6) with 22.24 m car length (incl. coupler), with 3.2 m car body width and longitudinal seat arrangement conceptually have the capacity 50 seated, 250 standing thus a total of 300 for a car is envisaged considering a standee area of 6 person/sq. meter

Passenger Carrying Capacity:

	Driving Trailer Car (DT1 & DT2)			M1-M6		
	NM	CRS	DCRS	NM	CRS	DCRS
Seated	50	50	50	50	50	50
Standing	115	230	310	125	250	330
Total	165*	280*	360*	175	300	380

Updated (EIA Jan, 2016): Therefore, Driving Trailer with 21.99 m car body length, 3.2 m car body width and longitudinal seat arrangement conceptually have the capacity of 45 seated, 237 standing, thus a total of 282 passengers while a Motor car with 21.34 m car body length, 3.2 m car body width and longitudinal seat arrangement conceptually have the capacity of 48-51 seated,250- 257 standing, thus a total of 301-305 passengers for a car is envisaged considering a standee area of 6 persons per square metre. These are shown in updated Table 2.11.

TABLE 2.11 UPDATED CARRYING CAPACITY A CAR

DESCRIPTION	DRIVINGTRAILER CAR		TRAILER CAR/ MOTOR CAR		6 CAR TRAIN	8 CAR TRAIN
	Normal	Crush	Normal	Crush	Crush	Crush

Seated	45	45	48-51	48-51	288	390
Standing	119	237	125-129	250-257	1487	1987
Total	164	282	176-177	301-305	1775	2377

2.10 MAINTENANCE DEPOTS

The maintenance depot along with full workshop facilities has been proposed at Aarey Milk Colony for the proposed metro corridor. The facilities include for the maintenance of the Rakes, Track, Electrical – Traction (OHE), E & M, Signalling & Telecom, Automatic Fare Collection etc. It will house Operation Control Centre (OCC) and Administrative Building. All the systems at depot have been designed to cater for 55 rakes of 8 Car composition to take care of requirement beyond the horizon year 2031. In 2031, rake requirement is 55 with 6 coaches.

Update (EIA Feb, 2020)

The depot-cum- workshop is being planned to service all the trains sets for both major (IOH/POH) and minor schedules as well as all unscheduled repairs. The depot will also house Admin-cum-OCC-cum-Infrastructure Maintenance building for different systems' requirements, viz, Track, Signalling & Telecom, Power supply & OCS, Tunnel Ventilation System, E&M etc, apart from the other facilities viz stabling lines, Pit wheel shed, heavy interior/under frame/roof cleaning, automatic train wash plant, Blow Down Plant etc. for the Rolling Stock operational on the corridor.

In order to meet the maintenance requirement of increased train sets from 2025 and beyond facilities such as Stabling, Inspection and Heavy repairs, will have to be augmented. The facility augmentation in this very location would be inevitable as there is no provision identified or considered possible to develop additional maintenance depot elsewhere.
The main aspects of the maintenance philosophy based on current maintenance practices of other Metros are given below and configured in the form of schedules:

- Daily Safety checks
- A check- every 15 days.
- B check- every 45 days.
- C check- every 6 months.
- D check- every year.
- IOH- every 5,00,000 km. (approx. 4 years), &
- POH- every 10, 00,000 km. (approx. 8 years).
- Further, the following shall be practiced for a cost-effective maintenance.

a) Unit replacement and to get essential repairs done by the OEMs (Original Equipment Manufacturers), will be preferred. Unit Exchange of Bogies, Wheel sets, Traction Motors, HVACs (Heating, Ventilation & Air Conditioning) etc. can be planned.

b) For cost optimisation, certain activities of the workshop like housekeeping, road transportation of materials, manual cleaning of trains, etc. can be outsourced.

c) Monitoring of the performance of equipment by condition monitoring of key parameters.

d) Labour intensive procedures will be kept to the minimum. More automation with state of the art machinery, like auto train washing plant, synchronisation of shunter for wheel lathe work to ensure quality with reliability can be adopted.

e) Multi skilling of the Maintenance staff to ensure quality and productivity in their performance.

f) Energy conservation through solar panels, natural lighting and improved ventilation shall be given due attention.

Maintenance Facilities Setup

The projected Rolling Stock requirements for the corridor, as per the GC's Train Operation Report dated 9th Feb 2018:

Rolling Stock requirements for the corridor

Year	2021	2025	2031	2031+
Headway (seconds)*	260/400	180/360	150/300	150/300
No of Cars/Train	8	8	8	8
Trains Required	31	36	42	55
Cars Required	248	288	336	440

*Head way is given for sections Colaba- Bandra/ Bandra- SEEPZ.

The operation plan envisages 8 car trains operation at varying headway of 260 seconds to 150 seconds on Colaba- Bandra section and 400 seconds to 300 seconds on Bandra-SEEPZ section as the demand grows. As per train operation plan, the final train requirement is 55 trains of 8 car configuration for the horizon year beyond 2031. Accordingly, Maintenance Depot shall have necessary facilities for repair and maintenance of 55 trains of 8 car i.e. 440 cars.

2.11 POWER REQUIREMENTS

Power supply is required for the operation of Metro system for running of trains, station services, workshop, depot and other maintenance works within the premises of metro system. The power requirement is for peak hour demand for traction and auxiliary application. The power requirement is estimated on the basis of 8 car train operation at 150 second headway for Colaba-Bandra section and 300 second headway for Bandra-SEEPZ section considering requirement beyond the horizon year 2031. Some of assumptions to estimate the power supply are

- Specific energy consumption of rolling stock : 70 KWh per 1000 GTKM
- Train operation design :150 seconds headway on Colaba-Bandra and 300 seconds headway on Bandra-SEEPZ section

- Underground station : Design Load 3000 kW
- Depot auxiliary : Design load 3000 kW
- Power factor of load : 0.9 and Transmission losses @ 5%

Keeping in view the above norms, designed load and power requirement projected are depicted in Table 2.12

TABLE 2.12 POWER DEMAND IN MVA

PARTICULARS/YEAR	2016	2021	2031	TOTAL
Traction	24.13	32.49	37.71	55.88
Auxiliary	65.33	73.50	81.67	98.00
Total	89.46	105.99	81.67	153.88

Updated (EIA Jan, 2016): Power requirement with 13 trains from Colaba to BKC and 13 trains from Colaba to SEEPZ works out to 59 MVA. The headway will be 139 s in Colaba-BKC and 277 s in Colaba-SEEPZ.

The location of three RSSs is given at Colaba, Race Course/Mahalakshmi and Dharavi. The approx. chainage of these locations is 0.5, 9 and 19 km respectively. It is also mentioned that "In normal conditions, Colaba RSS will feed the section from Colaba to Mahalakshmi, Race Course RSS will feed from Mahalakshmi to Dharavi and Dharavi RSS will feed from Dharavi to SEEPZ".

It is normal practice to feed the electrical load on either side of the TSS from operational considerations (sectioning arrangements and impact of a breakdown) and also to reduce voltage drop etc.

The RSS/TSS at Colaba is located close to the South terminal. The RSS at Dharavi has a route of around 13 km to be fed as a cantilever, which also includes the Depot at Arey.

The locations of RSS/TSS and the zone to be fed by each RSS, therefore, do not appear, prima facie, to be optimum from point of view of distribution of power.

The locations of TSS should be preferably around chainage 4 -5, 13-14 and 25-28 km. However, this will require to be validated by Traction Simulation study.

Choice of incoming voltage of 100 / 110 kV, recommended by Tata Power is considered appropriate.

Since a number of Metro systems are being introduced in the island city which will be drawing power from the grid, the possibility of taking power for each metro from same pair of phases can be explored to avoid neutral section (neutral section will be required only at junction point of two metro supplies).The RSS/TSS with GIS switch gear

recommended is considered appropriate keeping in view requirement of less space, higher reliability and lower maintenance.

The Depot may have to be provided with 2 ASSs, keeping in view the proximity to machines drawing considerable power (Wheel lathe, washing plant, bogie washing tank etc).

The document of DMRC/L&T gives the span of 12 m up to speed of 80 km/h and 11 m for 95 km/h as against 10 m suggested.

Minimum height of bottom of contact wire as per SOD being prepared for Mumbai Metro Line 3 is 4318 mm (against 4324 mentioned) with Rolling stock height of 4048 mm.

Short duration clearance of 170/150 mm has been suggested based on IEC (minimum clearance of 200 mm is specified in ACTM). Though this clearance has been adopted in the SOD being made for Mumbai Metro Line 3; it will be desirable to keep the number of locations with clearance less than 200 mm as low as reasonably practicable in the interest of reliability of power supply.

The rating of Auxiliary Transformer has been specified as 50 MVA. Since 33 kV supply will have Ring configuration, and each RSS will have 2 Auxiliary transformers; in case of total failure of one RSS, the load can be met by 3 out of 4 transformers available at the two healthy RSS. The rating can be made 35 MVA. However confirmation will be required from Supply Company that the 2 Aux transformers at one RSS can draw power simultaneously.

Power supply requirements – Design is now proposed to be made with headway of 135 second.

(a) Traction -

The power demand for Colaba – SEEPZ section is calculated based on following parameters:

	Colaba – SEEPZ	Colaba - BKC
Number of trains	13 plus	13
Length of section, km	31.377	20.912
Average speed, km/h	35.1	34
SEC Wh/T.km	70	70
Gross tonnage/8 car	516#	516#
Power requirement MW	30.22	20.14

MVA with PF of 0.9	33.58	22.38
MVA including 5% losses	35.26	23.5

With average tare weight of 42 T/car and 3000 passengers (of 60 kg each) in 8 cars.

Total power requirement for Main Line Colaba – SEEPZ 58.76

MW. Traction Power requirement of Depot approx. 3 MW

Number of Substations proposed for Colaba-SEEPZ 3

Traction Transformer rating 30 MVA ONAN and 40+ MVA

ONAF# (One transformer on load, one standby)

Location of TSSs Preferred Chainages 4-5, 13-14 and 25-

28 km. Incoming voltage 100 kV

Under normal conditions, each transformer will be loaded to 2/3 of rated capacity with margin for higher requirement for short duration. With one transformer faulty or under repair in any TSS, the loading will remain same, in view of 100% standby. With total shut down of one TSS, TT at healthy substation will be able to take 50% extra load in ONAN and 100% extra load in ONAF mode.

Power Supply: Update (EIA Feb, 2020)

The alignment being fully underground, except for the last one kilometre, where a maintenance depot is located in at-grade position. Keeping in view of the ultimate traffic requirements, uniformity, standardization and other techno-economic considerations, 25 kV AC traction system is considered to be the best solution for the present case also and hence, proposed for adoption.

Power Requirement

Power supply is required for operation of Metro system for running of trains, station services (e.g. lighting, ventilation, air-conditioning, lifts, escalators, signalling & telecom, fire-fighting etc.,) and workshops, depots & other maintenance infrastructure within premises of metro system. The power requirements are determined by peak-hour demands of power for traction and auxiliary applications.

The Power supply system design for this corridor has been conceptualized considering 8 car rake composition/train operation at 120 sec. headway for Colaba-Aarey section having passenger carrying capacity of 3000 (standing @ 8 passengers/m^2).

Broad estimation of auxiliary and traction power demand is made considering:

- Specific energy consumption of rolling stock
- Train operation : (8 cars at 120 seconds headway)
- Depot auxiliary load

The designed load and power requirement projected for the ultimate operation are summarized in below Table

Power Demand Estimation (MVA) for Colaba – Bandra – Aarey

	Designed Load
Traction (1-	68.68
Auxiliary (3-	75.66
Total	144.34

2.12 SUB STATIONS

As per power supply network of Mumbai city, the city has 220 KV, 100 kV, 33/22 kV and 11 kV network to cater to various types of demand in the vicinity of proposed corridor. Out of these, 33 kV and 100 kV networks are highly reliable and stable to meet the power requirement of 33 kV and 25 kV for the proposed corridor as per the discussion with Tata Power Company Limited. Keeping in view the reliability requirements and considering the complete corridor of
33.508 m length with all underground stations, three receiving Sub-stations are proposed to avail power supply for traction as well as auxulliary services from three grid sub-stations at 100 kV voltage through cable feeders for Colaba-Bandra-SEEPZ Corridor. Sources of Power Supply are depicted as in Table 2.13

TABLE 2.13 SOURCES OF POWER SUPPLY

S NO.	GRID SUB-STATION	RECEIVING SUB-STATION	CABLES
1	Badhwar Park (100 kV)	Colaba (100/33/25 kV)	2 km 100 kV double circuit cables
2	Mahalaxmi (100 kV)	Race Course (100/33/25 kV)	1 km 100 kV double circuit cables
3	Dharavi (100 kV)	Dharavi (100/33/25 kV)	1 km 100 kV double circuit cables

Update (EIA Jan, 2016)

- The 100 kV power supply will be stepped down to 25kV single phase for traction purpose at the RSSs of metro authority and fed to 25kV Rigid OHE system through cable feeders.
- Similarly 100kV power supply received directly from M/s Tata Power will be stepped down to 33kV & distributed along the alignment through 33kV Ring main cable network for feeding Auxiliary loads.
- These cables will be laid in dedicated ducts/cable brackets along the tunnel.
- In normal conditions, Colaba RSS will feed the section from Colaba to Mahalakshmi.
- Race Course RSS will feed from Mahalakshmi to Dharavi
- Dharavi RSS will feed from Dharavi to SEEPZ.
- In case Colaba RSS fails, then Race Course RSS will feed from Colaba to Dharavi.
- In case of failure of Race Course RSS, the feed can be extended from Colaba RSS (feeding zone Colaba to Mahalakshmi) or Dharavi RSS (feeding zone Mahalakshmi to SEEPZ).
- In the eventuality of failure of Dharavi RSS, the Race course RSS will feed from Mahalakshmi to SEEPZ.
- In case of total grid failure, all trains may come to a halt but station lighting, fire and hydraulics & other essential services can be catered to by stand-by DG sets.

GCs comments

- The location of three RSSs is given at Colaba, Race Course/Mahalakshmi and Dharavi. The approx. chainage of these locations is 0.5, 9 and 19 km respectively. It is normal practice to feed the electrical load on either side of the TSS from operational considerations (sectioning arrangements and impact of a

breakdown) and also to reduce voltage drop etc.

- The RSS/TSS at Colaba is located close to the South terminal. The RSS at Dharavi has a route of around 13 km to be fed as a cantilever, which also includes the Depot at Arey.
- The locations of RSS/TSS and the zone to be fed by each RSS, therefore, do not appear, prima facie, to be optimum from point of view of distribution of power.
- The locations of TSS should be preferably around chainage 4 -5, 13-14 and 25-28 km. However, this will require to be validated by Traction Simulation study.

Substations – No change in status so far. The design will be finalized after Traction Simulation study.

Power Transmission (Grid sub-stations To Metro RSS)

- The 100 kV cables will be laid through public pathways from TATA Sub-stations to RSS of Metro Authority.

- Each RSS shall be provided with 2 nos. (one as standby) 100/25kV single phase transformers with 30 MVA Capacity to meet peak traction demand in case of outage of adjoining RSS.
- Indoor type 33kV and 25kV GIS switchgear for each RSS cum TSS to be located in approx. 50m x 40m (=2000 sqm) or (70x30 sqm.) land plot.
- 100kV Gas Insulated Switchgear (GIS) is recommended in view of the advantage of considerable less space requirement and reduced maintenance.

GC''s recommendation

- The recommendation to use Gas Insulated Switchgear is considered appropriate. Possibility of reducing the plot size will be explored during detailed design stage.

Auxiliary Supply arrangements for stations & depot

- Auxiliary sub-stations (ASS) are envisaged to be provided at each station for stepping down 33kV supply to 415V for auxiliary applications.
- The ASS will be located at mean line or platform level inside a room.
- The auxiliary load requirements have been assessed at 2000 kW for underground station as indicated in Table below which is likely to increase to 2500 kW in the year 2031.

Auxiliary substation (ASS) at Depot

- Apart from stations, a separate ASS is required at the depot. Accordingly, in order to meet the requirement of power for Property Development within the footprints of the station.
- Two transformers of 2500 kVA at each underground ASS for the underground stations with a provision to add third transformer at a later date are proposed to be installed (one transformer as standby).
- This will cater for future loads due to property development within the foot – prints of the stations.
- At Depots ASS will also be provided with 2x2500 kVA auxiliary transformers.

GC's recommendation

- Adequacy of one ASS for Depot will need to be examined during detailed design stage.

Electromagnetic interference (emi)

25kV ac traction currents produce alternating magnetic fields that cause induced voltages to be in any conductor running along the track. Booster Transformer and Return Conductor (BT/RC) system is proposed for EMI mitigation for elevated section.

GC's recommendation

- The need for BT/RC arrangement is specific to the relevant elevated section and will be known after Simulation study.

25kv Rigid OHE system (ROCS)

- The proposed 25kV Rigid OHE system in underground section is similar to the one installed in underground Metro Corridor of Delhi Metro.
- 25kV Rigid OHE system comprises a hollow Aluminum Conductor Rail of adequate cross section with 150 sq.mm copper contact wire held with elastic pinch.
- The Al conductor rail is supported by an insulator & cantilever arrangement attached to drop-down supports fixed to tunnel roof.
- The supports are located at every 10 metre and there is no tension in the conductors and hence, no tensioning equipment is required in tunnel.
- The design of 25kv rigid OHE system shall be in accordance to electrical clearances & contact wire height as per IEC 60913 and EN50122, which is summarized below:
- Contact wire height = 4324mm (with Panto locked down height of 4048mm).
- Structure to Live parts clearances = 270/170/150mm (Static/Dynamic/Abs. min dynamic).
- Vehicle to Live parts clearances = 290/190/150mm (Static/Dynamic/Absolute min dynamic

GC's recommendation

- The document of DMRC/L&T gives the span of 12 m up to speed of 80 km/h and 11 m for 95 km/h as against 10 m suggested. Since the maximum speed is limited to 95 km/h, span of 11 m can be adopted.
- Minimum height of bottom of contact wire as per SOD for Mumbai Metro Line 3 is 4318 mm (against 4324 mentioned) with Rolling stock height of 4048 mm.

- Short duration clearance of 170/150 mm has been suggested based on IEC (minimum clearance of 200 mm is specified in ACTM). Though this clearance has been adopted in

  the SOD for Mumbai Metro Line 3; it will be desirable to keep the number of locations with clearance less than 200 mm as low as reasonably practicable in the interest of reliability of power supply.

25 kv flexible Overhead Equipment (OHE) System

- 25 kV AC Flexible Overhead equipment system shall comprise 150 sq mm HD-copper contact wire and 65sqmm Cd-copper catenary wire.
- Return conductor (RC) shall be All Aluminum Conductor (AAC) of 233 sq mm cross section.
- From safety considerations, Hydraulic type Anti-Tensioning Device (ATDs) are proposed on mainlines which does not require use of balance weight for tensioning of OHE conductors.
- Proven catenary fittings are proposed similar to DMRC system.

GC's comments –

- Tramway type OHE can be adopted on Stabling lines and Depot inspection lines.

Rating of major items -

- 33kV and 25kV switchgear shall be rated for 1250 A being standard design.
- 33kV cable ring network shall be adequately rated to transfer requisite auxiliary power during normal as well as emergency situations. Accordingly 3 core x 400 mm^2 copper conductors XLPE insulated FRLSOH 33kV cable is proposed for ring main network.
- Transfer of traction power from Metro's RSS to 25kV Rigid OCS - Single-phase XLPE insulated cables with 240mm2 copper conductors are proposed for traction power.
- Based on current requirements, 2 cables are required for each of

  the six circuits to feed power to 25kV OHE.

GC's recommendation

- It will be appropriate to have 3 runs of 33 kV cables for each of the two circuits

and provide one spare cable. Number of cables to be provided for 25 kV circuit will be decided at detailed design stage.

Supervisory Control And Data Acquisition (SCADA) System

- The entire system of power supply (receiving, traction & auxiliary supply) shall be monitored and controlled from a centralized Operation Control Centre (OCC) through SCADA system.

- Modern SCADA system with intelligent remote terminal units (RTUs) shall be provided.
- Optical fibre cables provided for telecommunications will be used as communication carrier for SCADA system.
- Digital Protection Control System (DPCS) is proposed for providing data acquisition, data processing, overall protection control, interlocking, inter-tripping and monitoring of the entire power supply system consisting of 33kV ac switchgear, transformers, 25kV ac switchgear and associated electrical equipment.
- DPCS will utilize microprocessor-based fast-acting numerical relays & Programmable Logic Controllers (PLCs) with suitable interface with SCADA system.

GC's recommendation

- It may be appropriate to have a separate SCADA system for auxiliary supply. The details will be worked out during detailed design stage.

Maintenance Philosophy

- The performance of equipment by condition monitoring of key parameters. The concept is to evolve the need based maintenance regime, which can be suitably configured in the form of schedules like "Daily Safety checks","15 days check", "Monthly check", "6 Months Insp.", "AOH"& "POH" etc.
- Unit replacement and to get essential repairs done by the OEMs, will be preferred. Since the cost is a constraint, certain activities of the workshop can be outsourced.
- Multi skilling of the Maintenance staff to ensure quality and productivity in their performance.
- Energy conservation shall be given due attention

Source of Power Supply: Updated (EIA Feb, 2020)

Considering the high voltage power supply network of Mumbai city and Keeping in view of the reliability requirements for 33.50 km length with all underground stations, three Receiving Sub-stations are proposed to avail power supply for traction as well as auxiliary services from the following grid sub-stations at 110 kV voltage through cable feeders for Colaba – Bandra – SEEPZ corridor, up to Aarey Colony.

Corridor	Grid sub-station (with Input voltage)	Location of RSS of Metro Authority	Approx. length of 110 kV cables
Colaba – Bandra – SEEPZ-Aarey	Saki Receiving Sub Station of Tata Power (110 kV)	Aarey (110/ 33/ 25 kV)	4 km. 110kV (Double Circuit cables).
	Dharavi Receiving Sub Station of Tata Power (110 kV)	Dharavi (110/ 33/ 25 kV)	2 km. 110kV (Double Circuit cables).
	Mahalaxmi Metro Receiving Sub Station of Tata Power (110 kV)	Science Museum (110/ 33/25 kV)	1 km. 110kV (Double Circuit cables).

The summary of expected power demand at various sources is given in Table below M/s Tata

Power Demand Projection for various sources

Load	Peak Demand – Normal (MVA)		Peak Demand – Emergency (MVA)	
	Demand	Designed	Demand	Designed
Science Museum RSS (Feeding Zone Cuffe Parade - Worli 13.4 km)				
Traction	27.97	30/42	38.41	30/42
Auxiliary	30.32	32/45	44.16	32/45
Sub – Total (A)	58.29		82.57	
Dharavi RSS (Feeding Zone Worli-CSIA Domestic 12.4km)				
Traction	25.89	30/42	38.41	30/42
Auxiliary	25.05	32/45	46.79	32/45
Sub – Total (B)	50.94		85.20	
Aarey RSS (Feeding Zone Dharavi - Aarey 7.1 km)				
Traction	14.82	30/42	30.27	30/42
Auxiliary	20.29	32/45	28.87	32/45
Sub – Total (C)	35.11		59.14	
Total Load of Corridor				
Total Traction		68.68		
Total Auxiliary		75.66		
G.TOTAL(A+B+C)		144.34		

The 110 kV power supply will be stepped down to 25 kV single phase for traction purpose at the RSSs of metro authority and fed to 25 kV Rigid OCS system through cable feeders. Similarly 110 kV power supply received directly from M/s Tata Power will be stepped down to 33 kV &

distributed along the alignment through 33 kV Ring main cable network (one 3 phase circuit in each tunnel) for feeding Auxiliary loads. These cables will be laid in dedicated ducts/cable brackets along the tunnel.

The 110 kV cables will be laid through public pathways from TATA Sub-stations to RSS of Metro Authority. Each RSS shall be provided with 2 nos. (one as standby) 110/27.5 kV single phase transformers with 30/42 MVA (ONAN/ONAF) Capacity to meet peak traction demand in case of outage of adjoining RSS.

Indoor type 33kV and 25kV GIS switchgear is proposed for each RSS cum AMS cum TSS to be located in approx. 55m x 40m land plot. 110 kV Gas Insulated Switchgear (GIS) is adopted in view of the advantage of considerable less space requirement and reduced maintenance.

Auxiliary Supply Arrangements for Stations & Depot

Auxiliary sub-stations (ASS) are envisaged to be provided at each station for stepping down 33 kV supply to 415 V for auxiliary applications. The ASS will be located at concourse or platform level inside a room.

Apart from stations, two separate ASS are required at the depot. Feed for these two ASSs will be given at 33 kV from Aarey station.

Being an underground Metro system, higher level of safety is being achieved by using Gas Insulated Switchgear and dry type transformer; and adopting suitable protection scheme for transformer.

25 kV Rigid OCS System

25 kV Rigid OCS system comprises a hollow Aluminum Conductor Rail of adequate cross section with 150 sq.mm copper contact wire held with elastic pinch. The Al conductor rail is supported by an insulator & cantilever arrangement attached to drop-down supports fixed to tunnel roof. The supports are located at approximately every 10 metre intervals. The design of 25 kv rigid OCS system shall be in accordance to electrical clearances & contact wire height as per IEC 60913 and EN50122, which is summarized below:

- Contact wire height = 4318 mm (with Panto locked down height of 4048 mm)
- Structure to Live parts clearances = 270/170/150 mm (Static/Dynamic/Abs. min dynamic)
- Vehicle to Live parts clearances = 290/190 mm (Static/Dynamic)

25 V Flexible Overhead Contact System

25 kV ac Flexible Overhead Contact system will be provided in the at grade section, test track and entry / exit tracks. The system shall comprise of 150 sq. mm HD-copper contact wire and 65 sq. mm Cd-copper catenary wires. Suitable Auto Tensioning Device (ATDs) will be provided on Mainlines. Tramway type OCS will be provided in stabling lines and Heavy Washing shed of Depot. Retractable OCS will be provided on at least two lines in the Inspection shed.

Supervisory Control and Data Acquisition (SCADA) System

The entire system of power supply (receiving, traction & auxiliary supply) shall be monitored and

controlled from a centralized Operation Control Centre (OCC) and Backup Control Centre (BCC) through SCADA system. Modern SCADA system with intelligent remote terminal units (RTUs) shall be provided. Optical fiber cables provided for telecommunications will be used as communication carrier for SCADA system.

Energy Saving Measures

Energy charges of any metro system constitute a substantial portion of its operation & maintenance (O & M) costs. The proposed system of Mumbai Metro includes the following energy saving features:

i. Modern rolling stock with 3-phase VVVF drive and lightweight stainless steel coaches.
ii. Rolling stock has regeneration features.
iii. Effective utilization of natural light.
iv. Machine-room less type lifts with gearless drive.
v. Escalators will be provided with 3-phase VVVF drive.
vi. Energy efficient electrical equipment.
vii. Energy management is possible with modern SCADA system by way of maximum demand (MD) and power factor control.
viii. Roof top solar plant will be provided as per the space available on roof at Depot & RSS.

Electric Power Tariff

The annual energy consumption is assessed to be about 307 million units in initial years, which will increase to about 438 million Units by horizon year 2031. In addition to ensuring optimum energy consumption, it is also necessary that the electric power tariff be kept at a minimum in order to contain the O&M costs. The power tariff for Mumbai Metro will be at effective rate of purchase price (at 110 kV voltage level).

2.12 CONSTRUCTION METHODOLOGY

Construction of the underground section shall be done by Cut and Cover, NATM and Tunnel Boring Machine (TBM). Station will be constructed either by Cut and Cover or NATM method depending upon the availability of space.

2.12.1 Construction Strategy

Design and build contacts will be adopted for proposed corridor. There will be three major contracts 1. Civil Works, 2. System Contract and 3 Depot Contract. Under civil contact, Architectural finishes, firefighting and general electrification will be included along with the civil construction works. System contract will be on the basis of design, construct and installation which will include Traction and Power Supply, Signal and Telecommunication, Lifts, Escalators, Fare collection, Rolling Stock, Track and Signages. Layout, design and construction and general electrification comes under the Depot contract.

2.12.2 Construction Period

It is proposed to complete the project in a time period of 60 months.

2.12.3 Updates on Construction Period (EIA Jan, 2016)

The construction period of all the 7 packages are same 1638 days (around 4.5 years). The commercial date of operation is targeted at May 2020 for the entire corridor.

2.12.4 Construction methodologies: Update (EIA Jan, 2016)

i) Construction of station box by cut & cover method
ii) Construction of station box by New Austrian Tunneling Method (NATM)
iii) Construction of tunnels by Tunnel Boring Machine (TBM)

There are total twenty six underground stations planned for Mumbai Metro Line 3. Out of twenty six, nineteen stations are to be constructed by cut & cover method and seven will be built by NATM.Details of Station name and Construction Methodology is provided in below table 2.14.

TABLE 2.14: Details of Construction Methodology

S.No.	Station Name	Type of Construction
1	Cuffe Parade	Cut and Cover
2	Vidhan Bhavan	Cut and Cover
3	Churchgate	Cut and Cover
4	Hutatma Chowk	NATM
5	CST	Cut and Cover
6	Kalbadevi	NATM
7	Girgaon	NATM
8	Grant Road	NATM
9	Mumbai Central	Cut and Cover
10	Mahalaxmi	Cut and Cover
11	Science Museum	Cut and Cover
12	Acharya Atrey Chowk	Cut and Cover
13	Worli	Cut and Cover
14	Siddhi Vinayak	Cut and Cover
15	Dadar Metro	Cut and Cover
16	Sheetla Devi Temple	NATM
17	Dharavi	Cut and Cover
18	BKC	Cut and Cover
19	Vidya Nagari	Cut and Cover
20	Santacruz	NATM
21	Domestic Airport	Cut and Cover
22	Sahar Road	Cut and Cover
23	International Airport	Cut and Cover
24	Marol Naka	NATM
25	MIDC	Cut and Cover
26	SEEPZ	Cut and Cover

IC has recommended the following nineteen stations to be built by cut & cover:

i. Cuffe Parade
ii. Vidhan Bhawan
iii. Church Gate
iv. CST Metro
v. Mumbai Central
vi. Mahalaxmi
vii. Science Museum
viii. Acharya Atre Chowk
ix. Worli
x. Siddhi Vinayak
xi. Dadar
xii. Dharavi
xiii. BKC
xiv. Vidyanagri
xv. CSIA (Domestic)
xvi. Sahar Road
xvii. CSIA (International)
xviii. MIDC
xix. SEEPZ

The report was prepared by IC in May 2013 and since then no changes have been made in station location and size.

In this review, the construction methodology of each station will be examined and ensure that the specified method is the most suitable and cost effective. At the same time if any information is missing, it will be supplemented.

Two types of structural forms have been suggested for cut & cover stations namely a) C&C Type A (Cut & cover station box in open space) b) C&C Type B (Cut & cover station box

underneath the carriageway). MMRCL is proceeding with the acquisition of the open land parcels proposed for the stations.
There are six stations in open space where C&C Type A structural form is applicable where IC's report states only three. These stations are Cuffe Parade, CST Metro, Siddhi Vinayak, CSIA (Domestic), Sahar Road and CSIA (International).

a) The construction sequence for station by Bottom Up method will be as follows:

The main activities involved are

1. Barricading the work area
2. Identification and shafting of utilities and traffic diversion
3. Dismantling of structures
4. Removing of trees
5. Construction of walling system
6. Excavation up to strut level one
7. Strutting layer one
8. Excavation up to strut level 2
9. Strutting layer 2
10. Excavation up to base slab level
11. Strutting layer 3
12. Drainage layer for base slab
13. Waterproofing and protection concrete
14. Base slab concrete
15. Platform walls
16. External walls and columns from base slab to concourse slab
17. Staging for concourse slab
18. Concourse slab concrete
19. External walls and columns from concourse level to roof slab
20. Staging for roof slab
21. Roof slab concrete
22. Waterproofing and protection concrete
23. Backfill over roof slab and restatement works
24. Entry exit areas and Ancillary buildings
25. Finishing works

In Top Down construction, items 6, 7, 8 and 9 may include slabs or combination of slabs and struts.

b)Excavation in Cut & Cover Method

In all station boxes under this project, excavation of soil, weathered rock and hard rock is required. The following is the brief description of excavation in different strata:

i) Excavation in soil

Excavation up to 1.5 m from existing ground / road level will be carried out manually and

carefully in order to prevent damage to utilities, if any. Further excavation below 1.5 m depth will be carried out by deploying equipment- excavators, loaders, crane etc.

The excavation shall be done continuously till the first level of strut (level depending on the final design) is installed. Further excavation will be done only after the struts are installed, continuous monitoring of the deflection of the shoring and the settlement of adjacent ground will be done regularly.

ii) Excavation in weathered rock

The weathered rock layer is just below the soil/fill and will be excavated by the excavator with a pneumatic breaker attachment. The weathered rock must be broken down to such size that it can be easily and efficiently transported to the dumping location.

At the stations on the road the excavation will be done through the long boom excavator standing on the decking up to a depth of 6-7 m from the ground level, further excavation will be done using a crane and a bucket.

As the excavation proceeds further, as required, a layer of ground anchors will be installed at the base of the shoring depending on the final design and actual rock levels. The anchors will be installed, grouted till the fixed length and after the grout is set, the stressing will be done.

On further excavation in weathered rock depending on the rock type shotcrete and rock bolts will be installed.

iii) Excavation in hard rock

Substantial portion of the excavation of the cut & cover stations is in hard rock and hence one of the following techniques will be used for excavating in this strata:

a)Chemical method/Controlled Drill & Blasting

b)Mechanical Method

c)Chemical Method/Controlled Drill & Blasting

In this method emulsion based explosives are used in cartridge form as well as in bulk (site mixed emulsion). A blast design will be carried out considering parameters including bench stiffness (bench height/burden >2 and <4), burden, spacing, sub drilling, stemming, Charge factor/Powder Factor(PF), timing (delays) in order to have a blast function efficiently, safely and within reasonable vibration and air blast levels.

After blast design, trial blasts are conducted in similar strata in rock quarries in and around Mumbai to determine the vibration and AOP levels for various drill patterns, charges and blast patterns (using different types of explosives and initiation systems) by using blasting seismographs. The data is compiled and the most suitable type of blast is adopted at various sites depending on the controls to be adopted specific to each site of work.

If the trial blasting is done away from permanent construction area, a blasting trial shall be done within construction area for Blasting Risk Assessment and finalization of Blasting Risk Assessment Report.

The trial blast shall be done using gradual increase in vibration levels generated by blasts keeping in view not exceeding the specified values in the contract.

The environmental impact of blasting is as follows:

i)Ground vibration

ii)Flying Rocks

i) Ground Vibration

The explosives when they detonate release two types of energy waves, these seismic waves which cause ground to vibrate and other is sound wave which causes air to compress resulting in air concussion normally termed as air over pressure.

Vibrations due to blasting shall be measured in terms of Peak Particle Velocity (PPV) and Vibrational Amplitude. Measurements shall be made with seismographs and accuracy of reading shall be checked before blasting is carried out.

Vibration Monitoring

Ground vibrations are an integral part of the process of rock blasting. The wave motion spreads concentrically from the blasting site, particularly along the ground surface, and is therefore attenuated, since its fixed energy is spread over a greater and greater mass of material as it moves away from its origin. Even though it attenuates with distance, the motion from a large blast can be received from far away.

The choice of the location and number of the monitoring points should take into consideration the main sensitive EBS from the blast area. Sensitive EBS are those structural areas, buildings, historical monuments, hospitals, residences, sites of geological, archaeological and ecological importance, and any other structures and sensitive land uses which could be affected by vibrations resulting from blasting.

Vibrometers are instruments used for measuring the intensity of shock waves caused by blasting operations. The magnitude of the shock depends on the kind of rocks, underground conditions and distance to the EBS to be protected.

Vibrations due to blasting shall be measured in terms of Peak Particle Velocity (PPV) and Vibrational Amplitude. The peak values shall be taken as the maximum resultant calculated by vector summation of the three orthogonal components of velocity and amplitude respectively measured as instantaneously as the resolution of the recording instrument permits.

The following limits on the PPV and vibration amplitude shall be followed:

Description	Max Allowable PPV (mm/sec)	Max allowable Vibration Amplitude (mm)
Structures in good condition and roads/pavements/open areas	25	0.2
Structures in fair condition	12	0.15
Structures in poor condition and Heritage structures/bridges and water supply structures	5	0.1
Fresh Concrete: Less than 2 days old 2 – 8 days old More than 8 days old	5 25 50	0.1 0.2 0.2

ii) Fly-rock

In general, fly rock results from one of two places in the shot, it either comes from the face of it or from the top. If fly-rock is originating from the face and flying considerable distances, it could be an indication that too little is used in the first row of blast holes or that clay or mud seams/ layers or other geological discontinuities are present within the blasted rock

Fly-rock and control measures:

Most of the fly rock, however, is not produced from the vertical/inclined face but is produced from the top surface of the blast. In such cases, the post appearance will be similar to a vertical cratering of holes.

There are occasions when to produce breakage, one must deliberately load the explosive higher and heavier than normally required in other holes. This is the case when the lengths of the blast holes are less than 2 times the burden particularly in massive rocks. In such cases the remedial measures includes covering the hole mouth by 1 to 1.2 meter of soil or putting 3 to 5 gunny bags filled with 30-40 kgs of soil free from rock pieces, to act as a 'blasting mat 'to contain the potential fly rock. However, it is not an effective method to contain fly-rocks. The most commonly blasting mat is made of woven wire or wire and rubber tires. The blasting mats are laid over the soil covered blast holes skin to skin. To prevent further possibility of flying even a small piece of rock from the gaps between the two blasting mats, a heavy textile piece of cloth or steel wire mesh (made from at least 3mm diameter steel wires) is laid skin to skin over the blasting mats. This prevents even small fly-rocks from ejecting into the atmosphere and travel tens of a meter.

Mechanical Methods of rock excavation

Road headers, Rotary drum cutters/Tunnel Excavators may be used in case the blasting technique cannot be deployed. Vibration free non-explosive agent like Quick Lime, Acconex, or using chiselling by Jackhammers may also be used. Road headers offer better option with the advancement in cutter head technology.

Rock Face Stabilization/Rock Support

No matter which method is used for rock excavation, rock face stabilization is essential for the stability of rock mass and must be carried out with minimum of delay.

Rock stabilization measures shall be adopted based on rock joint mapping reports. Rock dowel/anchors and shotcrete should be used for the rock support.

Instrumentation

Instrumentation and monitoring will be implemented to monitor the effects of construction works on the surrounding premises. Instrumentations will basically include:

- Groundwater monitoring equipped with piezometers and standpipes;
- Building settlement points – to monitor the movement of the existing buildings affected by the works;
- Ground settlement points – to monitor the ground surface movement;
- Utility settlement points – to monitor the movement of sensitive utilities affected by the works;
- Inclinometers – to monitor the lateral movement of the ground at different depths, particularly in areas where there are deep foundations in the close proximity to excavation works;
- Extensometers – to monitor the settlement of ground at different depths during Tunneling construction;
- Tilt plates – to monitor the tilting of structures.
- Tell Tale and/or crack gauges – to monitor the existing building crack and/or damage.

Conclusion

Success of underground work depends on the pace of excavation and efficient removal of excavated material. MML3 passes through very congested and crowded neighbourhood. The most challenging task is excavation of hard rock since all the stations and tunnels are embedded in the rock.

To meet the programme, controlled drill and blast methodology should be adopted where possible. Where it is not feasible, road headers should be used. Chemical splitting of rock can be utilized in case where very low vibration limit is allowed such as close to heritage buildings.

In order to ensure safety of people and property, a well-designed and well planned instrumentation programme must be instituted in case of excavation for station box and tunnel.

2.13 COST ESTIMATES

The completion cost of the project with all taxes, escalation & private land comes to Rs 243400.00 millions.

CHAPTER–3 ENVIRONMENTAL BASELINE DATA

3.1 ENVIRONMENTAL SCOPING

This chapter describes the existing environmental settings in the study area. 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. Data on land environment has been collected and compiled from various published sources and field focused surveys. Attributes of the physical environment like air, water, soil, and noise quality in the surrounding area were assessed, primarily through field studies, and by undertaking monitoring and analysis of samples collected from field. Information about geology, hydrology, prevailing natural hazards like earthquakes, etc. have been collected from literature reviews and authenticated information made available by government departments. Climatological data was collected from Indian Meteorological Department. The methodology adopted for data collection is highlighted wherever necessary. A scoping matrix along with the frequency adopted for data collection for environmental attributes is summarized in Table 3.1.

TABLE 3.1

ENVIRONMENTAL ATTRIBUTES AND FREQUENCY OF MONITORING

S. NO	ATTRIBUTE	PARAMETER	FREQUENCY	SOURCE
LAND ENVIRONMENT				
1.	Soil	Soil Characteristics	Once	Field studies and Detailed project report
2.	Geology	Geological Status	---	Literature review
3.	Seismology	Seismic Hazard	---	Literature review
WATER ENVIRONMENT				
4.	Water Quality	Physical, Chemical and Biological parameters	One Season	Field studies/literature review
AIR, NOISE AND METEOROLOGY				
5	Ambient Air Quality	PM2.5 , PM10, SO2, NOx, CO, HC	Two Season	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)	One Season	Field monitoring
8	Vibration	Vibrations in VdB	--	Field monitoring & modeling

SCIO-ECONOMIC				
9	Socio-economic aspects	Socio-economic	Once	Field Studies, Literature review.
Ecology				
10	Trees	Number/species	Once	Filed Studies

3.2 LAND ENVIRONMENT

The Project area is situated in Mumbai, the commercial capital of India. The average elevation of Mumbai plains is 14 m above the sea level (a-MSL). Mumbai is located along western Arabian cost of India from 18° 53' north to 19° 16 'north latitude and from 72° East to 72° 59' longitude. Parameters involved in land environment are, physiography, geology and soils, and seismicity. These are discussed in the following paragraphs.

3.2.1 Physiography

The physiographic feature of the Mumbai district is broad and flat terrain flanked by north – south trending hill ranges. The hill ranges from almost parallel ridges in the eastern and western part of the area. The Powai – Kanheri hill ranges are the other hill extending in the eastern and central part running NNE – SSW. The maximum elevation of the area is 450 m above mean sea level (amsl) at some of the peaks of hill ranges. Trombay Island has north – south running hills with maximum elevation of 300 m above mean sea level (amsl). Malbar, Colaba, Worli and Pali hills are the isolated small ridges trending north – south in the western part of the district. The Powai – Kanheri hills form the largest hilly terrain in the central part of the Salsette Island and are the feeder zone for the three lakes viz., Powai, Vihar and Tulsi.
There are a number of creeks, dissecting the area. Among them, Thane is the longest creek. Other major creeks are Manori, Malad and Mahim which protrudes in the main land and give rise to mud flangs and swamps. The area is drained by Mahim, Mithi, Dahisar and Polsar rivers. These small rivers near the coast, form small rivulets which intermingle with each other resulting in swamps and mud flats in the low lying areas

3.2.2 Geology and Soils

The entire Greater Mumbai area is occupied by Deccan basalt flows and the associated pyroclastics and the plutonic rocks of upper cretaceous to palaeogene age. The Deccan basalt of Mumbai Island is considered to be the youngest basalt of Eocene age. Overall the geology around Mumbai indicates presence of ultrabasic, basic and acid differentiates with intertrappean beds, agglomerates and tuffs. The ultrabasic differentiates are of limited occurance. Acid rocks include rhyolite and quartz trachyte. The agglomerate and tuff include reworked material as indicated by current bedding and graded bedding. The basalt

flows of the area have been grouped into compound flows (i.e pahoehoe type), simple flows and flows which do not fall in the above categories and hence termed as unclassified flows. The basaltic flows are typically of quartz and hypersthenes normative with minor amount of olivine

theolites. The lava of Mumbai is intern intruded by columnar jointed medium grained doleritic dykes.

The Deccan Trap basalt has been classified as Sahyadri Group which has been divided into three formations viz. the lower most Upper Ratangarh Formation followed by Elephanta Formation and topmost Borivali Formation. The Upper Ratangarh Formation is restricted to two patches, one from Kurla to Mulund and the other at SE of Kurla. The middle formation i.e Elephanta Formation comprising of simple and compound flows occur as small isolated patches in the SE corner of the city near Thane creek and covers very negligible area. The rest of the area is covered by rocks of Borivali Formation where it is not occupied by alluvium.

Normally, alluvium is restricted to the western half of the area. Laterite occurs as small isolated patches in the area north and east of Mulund.

Bauxite occurs within the Laterite in an irregular shape and is not of any economic importance. The Geological features of the Mumbai are shown in the Figure 3.1.

The predominant soil cover in Mumbai city is sandy whereas in the suburban district, the soil cover is alluvial and loamy. In order to ascertain the quality and nature of soil within the vicinity of the project site, six soil samples were collected. The location of soil samples is shown in the Figure 3.2. These samples were collected about 60 cm depth. The samples were tested for physical and chemical properties. The results of soil analysis are presented in Table 3.2. As per the test results it is observed that soil is tending to become alkaline. Soil has medium content of nitrogen, phosphors and potassium. At all places the soil texture is sandy silt.

TABLE 3.2

SOIL TEST

S.No.	PARAMETER	RESULTS LOCATION					
		Cuffe Parade	Jacob Circle	Worli	International Airport	SEEPZ	Aarey Colony
1	pH	7.10	7.60	7.87	7.19	6.80	6.28
2	Conductivity (mS/cm)	0.80	0.85	0.53	1.46	0.19	0.18
3	Sodium (As Na, mg/100gm)	22.61	21.02	35.59	18.34	7.62	3.45
4	Organic Matter (% By Mass)	1.80	1.48	1.37	0.90	1.15	1.53
5	Nitrogen (N, Kg/hectare)	121.99	33.77	28.81	10.09	32.72	41.57
6	Calcium(AsCa,mg/100gm)	329.94	648.09	710.94	487.05	263.16	141.40
7	Chloride(AsCl,mg/100gm)	450.63	404.54	289.29	262.86	299.22	208.55

	(AsMg,mg/100gm)						
9	Sand(%ByMass)	46.20	42.30	40.20	39.50	39.30	64.12
10	Silt (% By Mass)	35.10	32.10	30.10	28.10	28.10	25.83
11	Clay (% By Mass)	11.10	10.20	10.10	11.40	11.20	10.10
12	Potassium (As K, mg/100gm)	179.98	366.80	232.06	130.59	51.95	94.43
13	Phosphate (As Po4,kg/hectare)	23.68	16.24	24.27	14.87	14.87	13.01

3.2.3 Regional Geology : Updated (EIA Jan, 2016)

Introduction

Mumbai region is located in the great volcanic formation building up the Deccan plateau. The broad physiographic feature of the Mumbai region is broad and flat terrain flanked by North – South trending hill ranges. The hill ranges from almost parallel ridges in the Eastern and Western part of the area. The Powai – Kanheri hill ranges extend in the eastern and central part running NNE – SSW. The maximum elevation of the area is 450 m above mean sea level at some of the peaks of hill ranges. Trombay Island has North – South running hills with maximum elevation of 300 m above mean sea level.

Malbar, Colaba, Worli and Pali hills are the isolated small ridges trending North – South in the Western part of the district. The Powai – Kanheri hills form the largest hilly terrain in the central part of the Salsette Island and are the feeder zone for the three lakes viz., Powai, Vihar and Tulsi. There are number of creeks, dissecting the area. Among them, Thane is the longest creek. Other major creeks are Manori, Malad and Mahim which protrude into the mainland and give rise to mud flats and swamps.

The area is drained by Mahim, Mithi, Dahisar and Poisar rivers. These small rivers near the coast, form small rivulets which inter mingle with each other resulting in swamps and mud flats in the low lying areas. Two types of soils have been observed in the district viz., medium to deep black and reddish colored soils.

Deccan Trap Geology

A wide variety of Basalts and associated rocks such as volcanic breccia, black tachylytic Basalts, red tachylytic Basalts etc. occur in the area covered by Deccan trap Basalts. Most Basalts are either compact i.e., with no gas cavities, or amygdaloidal with gas cavities filled with secondary minerals, and vesicular Basalts with empty gas cavities. Zeolites are the commonest secondary minerals filling gas cavities, though silica, calcite and chlorophacite also occur as infillings.

The Basalt flows are essentially horizontal over most of the area and it is only at a few places such as Panvel, Mumbai, Western Saputaras, Khandesh etc., that the flows have beendisturbed from their original horizontality and show gentle dips. A major monoclinal flexure called the Panvel flexure is supposed to exist along the west coast, though there is no field evidence to prove its existence. However, lavas in large areas, which should have been dipping west if the flexure existed, have actually been observed to be horizontal, and over large areas, there are no observations of dips at all. Hence there is no field evidence to prove westerly dipping lavas and the Panvel flexure obviously does not exist atall.

Though faults are rare, vertical or steeply inclined fractures along which movement has taken place are widespread in the western parts of the Deccan trap outcrop. Water seeping along the cracks brings about decomposition of Basalts on both sides and the fracture is marked by a band of decomposed material 3 to 30 mm wide.

Figure 3.1: Geological map of Mumbai (After Ganpule & Ganpule, 1975)

Figure 1: Geological map of Mumbai (After Ganpule & Ganpule, 1975)

The zone of decomposition of a fracture looks superficially like the shear zones of tectonic areas, because of the closely spaced vertical planes of separation of the sheet jointing, and as a result, the fractures are commonly described as shear zones.

However it must be borne in mind that the vertical planes of separation seen in the

fractures are not planes of shear but are planes of sheet jointing resulting by the decomposition of Basalts, and no true shear zones occur in the Deccan trap area. The geological map of the area is attached.

Geology of Mumbai

Geologically, Mumbai presents a complex lithological combination showing large heterogeneity. Major rock types occurring in the area are fine grained, greenish Basalt to black colored, aphastilite. Compact Basalt and weathered amygdaloidal Basalt are also found as characteristic of the Deccan trap. They are associated with acidic and basic tuffs, volcanic breccia with fullaceous matrix, Trachyte and also occasionally, rhyolites. Inter trappean beds representing breaks in the tectonic volcanic activities are seen in the western ridges. Basaltic flows and inter trappean beds show westerly dip of 5° to 12°. These flows and pyroclastic rocks have been intruded by dolerite and Basaltic dykes.

Westerly hill ranges like Malabar, Cumballa, Tardeo and Worli show the presence of compact Basalt on the surface. Weathering effects are seen in the top of the hill. Basalts are underlain by inter trappean comprised of ash and thinly laminated carbonaceous shale. These inter trappean are again underlain by Basalt flows.

Eastern flank of the Tardeo hill presents green ash at the base followed by brown ash containing black Basalt fragments and a thin bed of black shale, compact aphanitic Basalt overlain the ash beds.

Gilbert hill situated along the western flank is composed of fine grained, hard, compact Basalt showing nearly 30 meters high, beautiful, near vertical columns developed by columnar jointing. Acidic ash is seen at the lower level in contact with the Basalt. Light brown coloured to light grey coloured trachyte occurs at Malad, Kordiwadi, Kandivali, Marve and Manori area. Marve and Manori area is separated by a creek.

Eastern hill ranges like Sion hill, Kurla hill, Salamti hill, Raoli hill and Antop hill show the presence of yellowish brown volcanic breccia lateralized at the top. Basaltic fragments appear to be embedded in this rock. Other types of rocks are volcanic grey ash, grey ash, hard and soft tuffs. Small Basaltic dyke appears passing through Raoli, Koliwada hills. Anotop hill shows the presence of Basalt and volcanic breccia.

Sewri fort hill which lies on the south of Antop hill is composed of highly chilled, fine-grained black Basalt. It is traversed by a dyke of 60 cm width. Bhoiwada hill shows presence of Basalt showing variation in colour and westerly tilt by 12°. Basalt flows are intercalated with stratified sedimentary rocks. Lower flows show pillow structure.

Though the low lands lying between the two ridges do not show any exposures, cutting and excavations made for various purposes reveal brownish and grey clay, greyish, brownish and greenish tuff, breccia, ash and other pyroclastic material along with highly weathered Basalts and inter trappean.

Coastal areas on the western shore of Mumbai consist of sandy beaches mixed with silt with shale fragments. The western shore is exposed to intense wave action of Arabian Sea resulting in the formation of sandy and rocky beaches (Colaba, Worli, Bandstand). It is known that near the Gateway of India, the sea meanders inside, and in the process intense wave action as noted on the western coast of Mumbai Island calms down. The relatively calm eastern shore line particularly, north of Mazagon exhibits mud flats and salt pans. The thick blue clay layer, very soft in nature is the result of silting over the geological years as a Consequence of relatively calm sea; which allowed finer clay particles to settle. This clay layer is followed by a very thin layer of coarse black sand at places, hardly about meter in thickness. By the nature of its deposition, the clay is unconsolidated and very soft in nature.

There were investigations done by IC and the reports prepared are

i. Geotechnical Factual Report prepared by Interim Consultants (2014)
ii. Geotechnical Interpretative reports prepared by Interim Consultants (2014)

Table3.3: Summary of available ground investigation data (Factual Report and GIR's by IC (2014)

Contract ID →	UGC-01	UGC-02	UGC-03	UGC-04	UGC-05	UGC-06	UGC-07	Depot
Number of Boreholes at Stations	20	16	22	11	20	11	12	15
Number of Boreholes along Bored Tunnels	11	12	11	20	12	14	10	-
Depth of Boreholes (m) below ground	5.5 m to 30m	10.5 m to 28.5m	8m to 28m	7.5m to 27m	6m to 29m	6.5m to 25m	11m to 25m	7m to 11.3m
Average Depth of Ground Water Table (m) below ground	3.2m	4.3m	5.1m	4.1m	3.5m	3.3m	3.6m	4.0m
Depth of Rock head (m) below ground	2.5m to 11m	5m to 12.3m	2m to 18m	4m to 14m	2m-12m	1.5m-8m	1m-8m	1.6m

Types of Rocks Observed	Basalt, Breccia	Basalt, Breccia	Basalt, Breccia, Shale, Tuff	Basalt, Breccia, Tuff	Basalt, Breccia, Tuff	Basalt, Breccia, Tuff	Basalt, Breccia	Basalt, Breccia

From the Table 3.3 above it is observed that some of the boreholes have been terminated at a relatively shallow depth. A summary of boreholes terminated above the rail level is given in Table 3.4 below.

Table 3.4 : Summary of Boreholes terminated well above rail levels

Contract ID	Number of boreholes terminated above rail level	
	Number of Boreholes at Stations (Total Boreholes)	Number of Boreholes along Bored Tunnels (Total Boreholes)
UGC-01	15 (20)	07 (11)
UGC-02	09 (16)	09 (12)
UGC-03	20 (22)	11 (11)
UGC-04	08 (11)	17 (20)
UGC-05	13 (20)	8 (12)
UGC-06	11 (11)	14 (14)
UGC-07	09 (12)	08 (10)
Depot[#]	0 (15)	

[#] Track is at grade

The boreholes which have been terminated well above rail level would be of value only to reveal the depth of soil-rock interface and the design of temporary works for cut and cover structures.

3.2.4 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.

Mumbai lies in the Bureau of Indian Standards (BIS) in Seismic Zone III, which means the city is at moderate risk. The last time Mumbai witnessed seismic activity was in 2005.

Three consecutive tremors of 4-5 magnitude were witnessed. Mumbai lies over more than 10 seismic fault lines. Major fault lines lie along the Thane creek, Ulhas river, the Manori and Malad creeks and the lakes. To the west, a fault line stretches from Colaba to Vasai,

touching Malabar hill. The seismic zoning map of India showing Mumbai region is given in the Figure 3.2

FIGURE 3.2

GEOLOGICAL MAP OF MUMBAI

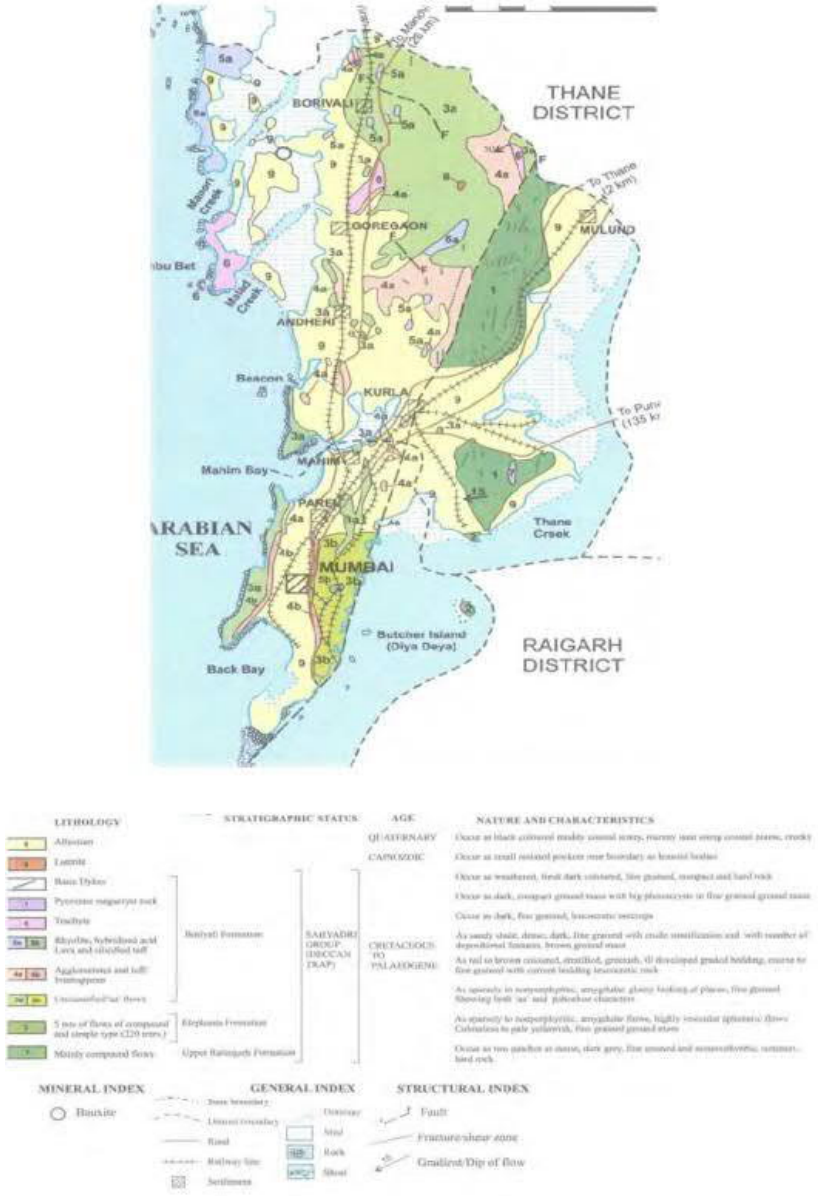
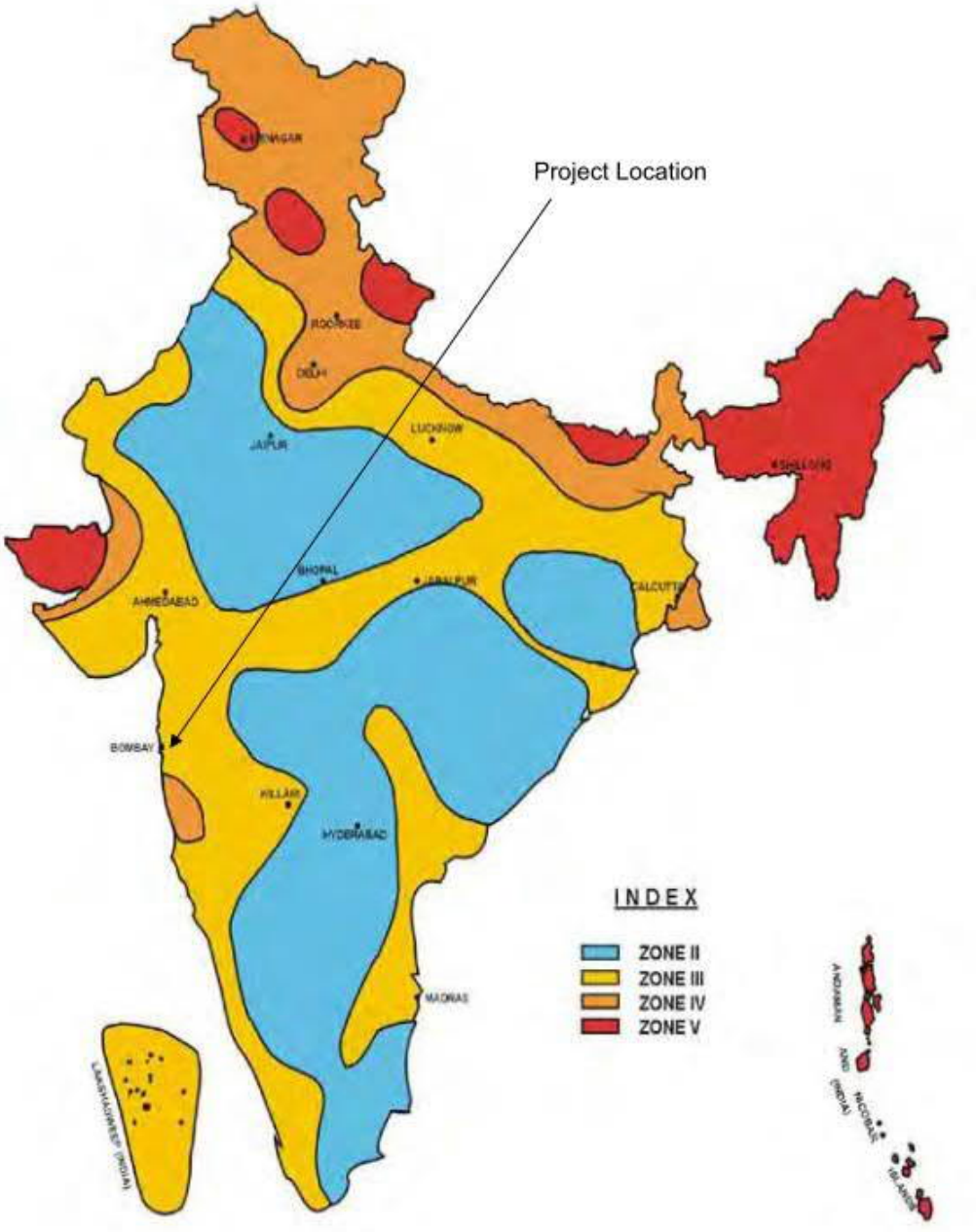


FIGURE 3.3
SEISMIC ZONING MAP OF INDIA



3.2.5 Updates on Seismicity: Updated (EIA Jan, 2016)

This section describes the occurrence and frequency of earthquakes in the MMR and gives a brief introduction on the seismic hazard of the area.

Earthquake History

In peninsular India; the state of Maharashtra (though not located on or near any plate boundaries) along with Gujarat and Madhya Pradesh, has suffered from frequent earthquakes, both deadly and damaging. All the earthquakes here, as in all of peninsular India, are intra-plate events. In the 20th century alone, three earthquakes with magnitudes on Richter scale greater than 6.0 were recorded in this area. The west coast along with the major cities of Mumbai and Pune both have been strongly shaken in the past in 1618 and 1764 respectively. Several faults have been identified in this region out of which many show evidence of movement during the Holocene epoch. The north- south trending West Coast and Chiplun Faults run along the coast and the Sahyadri range. The West Coast fault runs along the eastern shore of the Thane Creek in the Mumbai area, along the flanks of the Parsik Hills (Belapur-Vashi region). The Chiplun Fault runs from the mouth of Bombay Harbour to the Sangammeshwar area in Ratnagiri district. The southeast-northwest trending Upper Godavari Fault runs along the Godavari River from near Trimbakeshwar towards Marathwada. The Ghod River Fault trends in the same direction and runs from the Jawhar area in Thane district towards Bhigwan in eastern Pune district.
The Vidharbha region is intersected by a prominent fault called the Kadam fault which runs from Bhusawal into northern Andhra Pradesh. The northern section of the state is affected by east-west faults belonging to the Narmada Fault Zone.

However, it must be stated that proximity to faults does not necessarily translate into a higher hazard as compared to areas located further away, as damage from earthquakes depends on numerous factors such as subsurface geology as well as adherence to the building codes.

Seismic Hazard

The seismic hazard map of India (Figure 3) was updated in 2000 (6) by the Bureau of Indian Standards (BIS). The new map includes the central districts of Beed (Bir), Dharashiv (Osmanabad) and Latur, along with eastern sections of Ahmednagar, Pune, Satara and Sangli districts in Zone III. All of these areas lie in Zone I or II in the BIS 1984 map. The zones in the rest of the state are the same as in the previous map. The districts of Raigad, Ratnagiri and Satara are the only districts to lie in Zone IV, where the maximum expected intensity is VIII (MSK). The remaining western and north-

western districts all lie in Zone III. The central and eastern districts lie in Zone II. It must be noted that BIS estimates the hazard, based in part, on previous known earthquakes. Since the earthquake database in India is still incomplete, especially with regards to earthquakes prior to the historical period (before 1800 A.D.), these zones offer a rough guide of the earthquake hazard in any particular region and need to be regularly updated. According to GSHAP data, the state of Maharashtra falls in a region of moderate to high seismic hazard.

As per the 2002 Bureau of Indian Standards (BIS) map, Maharashtra also falls in Zones II, III & IV. Historically, parts of this state have experienced seismic activity in the Magnitude on Richter scale 6.0-6.5 range.

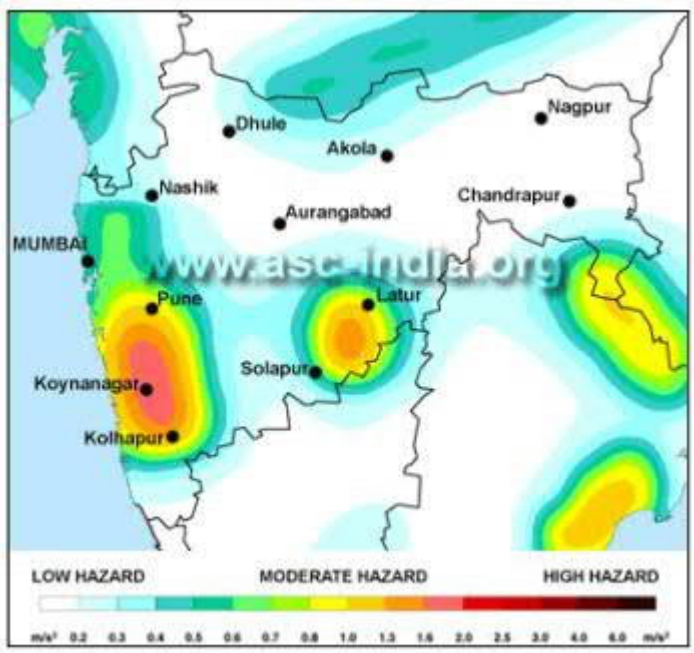


Figure 3: Seismic hazard map of Maharashtra

3.2.6 Environmental baseline Data Updation: (EIA Feb, 2020)

Fresh baseline surveys have been carried out along the alignment `Colaba-Bandra-SEEPZ' during the period Dec'16 to Feb'17 at stations and allied activities. Baseline Environmental Monitoring has been carried out to set up baseline data in terms of ambient air quality, ambient noise, and ambient water quality (Surface and Ground) through a MoEF&CC recognized and NABL accredited laboratory.

Monitoring of environmental baseline parameters was carried out for one season, i.e., three months starting from December'16 to February'17 along the alignment. Monitoring was carried out to assess the ambient air, water and ambient noise along the MML-3 alignment and to check their conformity with the standards specified by Central Pollution Control Board (CPCB) and Ministry of Environment, Forest and Climate Change (MoEF&CC).

Details of baseline survey carried out by MMRC through MoEF recognized laboratory is presented in the

updated EIA report, feb, 2020.

3.3 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. Anticipated impacts of the proposed project on water environment have also been addressed.

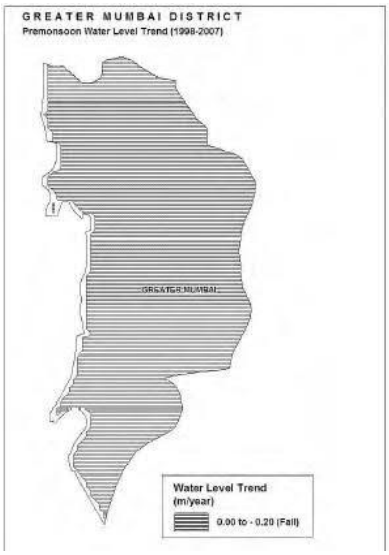
3.3.1 Water Resources

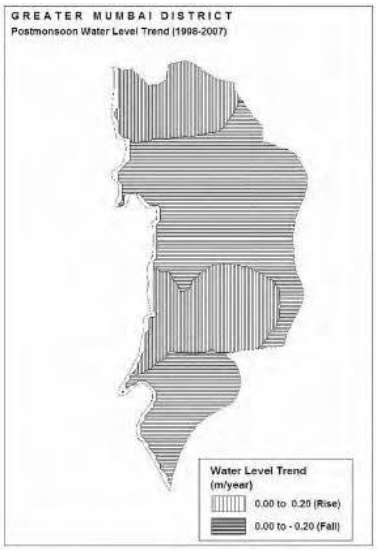
Water supply to Mumbai district are from various sources viz. Tulsi Lake (18 MLD), Vihar (110 MLD), Tansa (477 MLD), Vaitarna (1070 MLD) and Bhatsa (1475 MLD). The Central Ground Water Board, Ministry of Water Resources, Government of India monitored ground water depth in May 2007 which is reported in subsequent section.

3.3.2 Ground Water

The data of Central Ground Water Board (CGWB) from the year 1998 to 2007 shows decline in ground water levels in major parts of the district. The pre-monsoon and post monsoon trend maps were also prepared by CGWB are presented in Figure-3.4. During pre-monsoon period entire district shows fall in water level trend of up to 20 cm/year, whereas during post- monsoon period rise in water level trend of up to 20 cm/year is observed in extreme northern Part and central southern parts of the district.

FIGURE-3.4WATER LEVEL TREND (MAY AND NOV. 1998-2007)





DEPTH TO WATER LEVEL (PRE-MONSOON)

The depth to water levels during pre-monsoon has been depicted in Figure-3.5. The shallow water levels between 2 and 5 m bgl are observed in southern part, whereas moderate water levels in the range of 5 to 10m bgl are observed in northern part of the area.

Spatial variation in post-monsoon depth to water level is shown in Figure-3.6. The water levels in major part of the district range between 2 and 5 m bgl. Shallow water levels of < 2 m bgl are observed in small area in southern part, whereas water levels of 5 to 10 m bgl are observed in north central part of the district.

3.3.3 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. 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 use.

Central Ground Water Board in the year 2007 has monitored the ground water quality of the district through analysis of water samples collected by keeping objective to understand anoverall picture of ground water quality of the district. The result of chemical analysis shows that the ground water in the district is alkaline in nature. The suitability of ground water for drinking were checked with the standards proposed by the Bureau of Indian Standards (BIS)(IS-10500-91, Revised 2003). The concentrations of all the parameters in all the samplestested were within the Maximum Permissible Limit (MPL). Therefore, it can be concluded that the ground water quality in majority of the area were good for drinking purpose.

In order to collect baseline data on the existing water quality, water samples were collected from 5 different locations along the alignment in the project study area and analyzed as per the procedure specified in standard methods for examination of water and wastewater published by American Public Health Association and the Bureau of Indian Standards (APHA/BIS). The results of the physio-chemical analysis are summarized in the Table 3.5.

The test results when compared with the prescribed limits of various parameters as per IS 10500:1991 indicated that at some locations certain parameters are more than desirable limit. These values are shown in bold italics in the table. Most of the parameters tested for Mahim Creek (Location 3) are more than permissible limit. At rest of the locations, the parameters are within limit.

TABLE 3.5
WATER QUALITY AT PROJECT SITE

PARAMETER	LOCATION							
	1	2	3	4	5	6	7	8

pH	7.20	7.21	6.89	7.10	7.02	6.98	7.41	7.72
Total Hardness as CaCo3(mg/l)	48.0	6031.07	3500	140.00	44.00	444.72	126.48	379.44
Calcium (As Ca, mg/l)	8.02	11.22	480.96	38.48	9.62	107.93	107.93	55.60
Alkalinity (As CaCO3, mg/l)	51.08	52.39	2060.19	143.91	80.15	466.44	102.29	249.2
Chloride (As Cl, mg/l)	13.80	9.86	5518.86	25.62	11.83	181.99	58.71	68.49
Magnesium (As Mg, mg/l)	6.80	7.78	558.90	10.69	4.86	42.63	11.90	58.49
Total Dissolved Solid (mg/l)	123	155	15387.0	278.00	181.0	949.0	261.00	567.0
Sulphate (As So 4 , mg/l)	3.13	4.17	615.13	10.71	4.17	11.49	4.90	36.79
Fluoride (As F, mg/l)	0.11	0.21	3.11	0.36	0.27	0.47	0.15	0.41
Nitrate (NO 3 , mg/l)	0.11	0.42	0.34	0.02	0.46	0.34	0.29	0.19
Iron (As Fe, mg/l)	0.05	0.08	0.32	0.08	0.06	0.13	0.07	0.07
Aluminium (As Al, mg/l)	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Phenolic Compounds (mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc (As Zn, mg/l)	<0.10	<0.10	0.17	<0.10	<0.10	<0.10	<0.10	<0.10
Chromium (As Cr, mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper (As Cu, mg/l)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Manganese (As Mn, Mg/l)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium (as Cd, mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead (As Pb, mg/l)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic (As As, mg/l)	<0.00	<0.00	<0.00	<0.00	<0.00	<0.00	<0.05	<0.05
Mercury (as Hg, mg/l)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Sodium (As Na, mg/l)	16.00	50.00	3475.00	58.00	48.30	110.00	12.00	48.0
Potassium (As K, mg/l)	0.20	2.00	120.00	14.00	0.30	104.00	2.00	15.0
Phosphate (as PO4, mg/l)	<0.02	<0.02	1.39	0.01	<0.02	<0.02	<0.02	0.07
Total Suspended Solids (mg/l)	<5.0	<5.0	187.00	8.40	<5.0	21.00	27.00	<5.0

BiochemicalOxygen Demand at 20oC f4or 3 Days	<1.0	<1.0	144.00	<1.0	<1.0	14.40	15.60	<1.0
Chemical Oxygen Demand, (mg/l)	<5.0	<5.0	380.00	<5.0	<5.0	54.76	39.82	<5.0
Oil & Grease (mg)	<0.40	<0.40	0.60	<0.40	<0.40	<0.40	0.40	<0.20

Dissolved Oxygen (mg/l)	5.08	5.17	4.08	5.27	5.07	4.88	3.51	5.56
Nickel (as Ni, mg/l)	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Total Coliform (MPN/100 ml)	<2.0	<2.0	78.00	<2.0	<2.0	39.00	500.0	<2.0

Surface and Ground Water: Updated (EIA Feb, 2020)

Three (03) surface water samples from the existing surface water bodies and five (05) ground water samples collected from existing bore wells along the alignment for analysis of surface and ground water quality. The ground water samples were analyzed for parameters as per IS: 10500 standards and the analysis were undertaken as per IS 3025 and relevant APHA standard methods. Surface water samples were analyzed for parameters stipulated in Environment Protection (Rules), 1986.

The details of sampling locations are provided in below table.

Details of Surface and Ground Water Monitoring Locations

Monitoring Locations	Location Code	Metro Station	Site Co-ordinates
SURFACE WATER			
Surface Water (Nallah)	SW-1	Nayanagar (LS)	19° 2'45.83"N 72°50'50.70"E
Surface Water (Mahim Creek)	SW-2	Dharavi station	19° 3'10.36"N 72°51'31.11"E
Surface Water (Mithi River)	SW-3	BKC station	19° 3'17.18"N 72°51'16.85"E
GROUND WATER			
Azad Maidan Well water	GW-1	CST Metro Station	18°56'33.61"N 72°49'46.88"E
Near Vishwasis Building	GW-2	Siddhi Vinayak metro Station	19° 0'57.63"N 72°49'57.26"E
Store Near Swami Samarth medical	GW-3	Siddhi Vinayak metro Station	19° 1'21.38"N 72°50'20.33"E
Patil Maruti Devastun, Raneda Road, Dadar	GW-4	Dadar Metro Station	19° 1'24.62"N 72°50'19.32"E
Well at Siddhi Vinayak Building	GW-5	Siddhi Vinayak Metro Station	19° 0'53.92"N 72°49'58.80"E

Surface Water Quality Results

Parameters	Nallah (SW-1)	Mahim Creek (SW-2)	Mithi River (SW-3)
pH (at 25 ºC)	7.1	7.2	7.1
Total Dissolved Solids	2127	3650	433
BOD, 3 days 27 ºC	39	30	36
COD (as O_2)	127	159	127
Sulphate (as SO_4)	126	335	36
Lead (as Pb)	<0.1	<0.1	<0.1
Nitrate (as NO_3)	<0.2	<0.1	0.19
Oil & Grease	5	4	6
Total Iron (as Fe)	<0.1	0.15	0.2
Chloride (as Cl)	1014	2220	164
Phosphate (as PO4)	42.5	0.1	53
Calcium (as Ca)	97	81	48
Total Nitrogen	26	0.1	22
Salinity	3.48	4.7	0.6

Ground Water Quality Results

Parameters	GW-1	GW -2	GW -3	GW -4	GW -5
pH (at 25 ºC)	7.1	7.2	7.3	6.8	6.5
Total Dissolved Solids	364	509	428	442	541
BOD, 3 days 27 ºC	12	<5	<4	<5	6
COD (as O_2)	44	20	28	8	20
Sulphate (as SO_4)	35	12	2.5	23	21
Lead (as Pb)	<0.1	<0.1	<0.1	<0.1	<0.1
Nitrate (as NO_3)	<0.1	<0.1	<0.1	4	2.2
Oil & Grease	<4	<4	<4	<4	<4
Total Iron (as Fe)	<0.1	<0.1	<0.1	<0.1	<0.1
Chloride (as Cl)	40	45	21	41	53
Phosphate (as PO4)	<0.1	<0.1	0.1	<0.1	2.1
Calcium (as Ca)	101	129	93	105	113
Total Nitrogen	2	6	2	3.5	4
Salinity	0.5	0.5	0.5	0.6	0.8

Note:- All parameter except pH are in mg/l

3.3.4 Hydrogeology: Updated (EIA Jan, 2016)

Hydrogeology data was obtained from the ground water information report of the Greater Mumbai District published by the Ministry of Water Resources, Central Ground Water Board, and Government of India. As per this report, the hydrogeology of the Mumbai region may be summarized as follows:

Water bearing formation	Basalt – Jointed/Fractured/ Weathered/Vesicular and Massive. River/Marine alluvium

Pre-monsoon Depth of water level (May 2007)	2.77 to 6.42 m BGL
Post-monsoon Depth of water level (Nov 2007)	1.80 to 7.10 m BGL
Pre-monsoon water level trend (1998 – 2007)	Fall: 0.11 to 0.38 m/year
Post-monsoon water level trend (1998 – 2007)	Rise: 0.09 m/year Fall: 0.02 to 0.26 m/year

The entire area is underlain by Basaltic lava flows of upper Cretaceous to lower Eocene age. The shallow Alluvium formation of recent age also occurs as a narrow stretch along the major rivers flowing in the area. A map depicting the hydrogeological features is shown in Figure 2. It is convenient to study the hydrogeology of the area segregated as per the type of water bearing strata.

Hard Rock Areas

A typical feature of the lava flows in the area is a highly vesicular bottom layer having closely spaced horizontal joints and low thickness. The vesicles are generally filled with secondary minerals and green earths. In such cases, they do not serve as aquifers. However, if such vesicular zones are weathered (as the case is, in several parts), they become moderately permeable, and if the vesicles are not filled, they become highly permeable aquifers. This typical 'Pahoehoe' flow comprises of a basal vesicular zone, followed by a middle relatively massive portion followed by a vesicular top. These vesicles are generally not inter-connected and thus there is a variation in the water holding capacity from the base to the top of the flow. Ground water exists in fractures, joints, vesicles and in weathered zones of Basalt. The occurrence and circulation of ground water is controlled by vesicular unit of lava flows and through secondary porosity and permeability developed due to weathering, jointing, fracturing etc. of Basalt. The ground water occurs under phreatic, semi confined and confined conditions. The leaky confined conditions are also observed in deeper aquifers. Generally the phreatic aquifer ranges down to the depth of 15.0m below ground level. The water bearing zone down to the depth of 35 .0 m BGL forms the semi confined aquifer and below this deeper aquifer down to the depth of 60.0 m BGL is observed. It is expected that the potential of deeper aquifers would be much more limited as compared to the unconfined/phreatic aquifer.

Soft Rock Areas

River alluvium patches along the course of rivers and marine alluvium in the coastal area are highly potent aquifers but with limited areal extent. The ground water occurs under water table condition in sandy/gritty layers. The alluvial fill of low lying areas underlain by weathered Basalt has relatively better ground water potential.

Figure 3.7: Hydrogeology of Mumbai

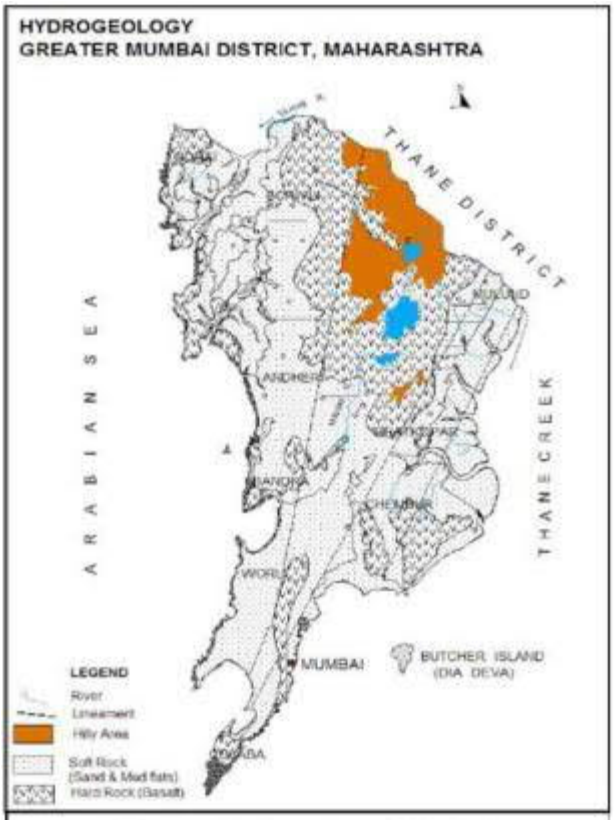


Figure 2: Hydrogeology of Mumbai

3.4 METEOROLOGY AND AIR ENVIRONMENT

Meteorology is an important parameter in an environmental impact assessment study. 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 meteorological data of Mumbai is collected from Regional Meteorological Centre (RMC) of India Meteorological Department (IMD) for the year 2009 to year 2011. The data has been collected at Colaba and Santacruz station. The meteorology and air environment of the area are discussed in subsequent sections.

3.4.1 Meteorology

Mumbai experiences tropical savanna climate. The climatic conditions in project area are experienced four distinct seasons mansoon (June-September), post monsoon (October-December), winter (December-February) and summer (March-May).

The normal annual rainfall over the district varies from 1800 mm to about 2400 mm. It is minimum in the central part of the district around Kurla (1804.9 mm). It gradually increases towards north and reaches a maximum around Santacruz (2382.0 mm). The relative humidity at Mumbai ranges between 54.5 % to 85.5%. Records of monthly total rainfall, mean maximum and mean minimum relative humidity of Mumbai obtained from Regional Meteorological Department (RMC),

Colaba and Santacruz has been presented in Table 3.6 to Table 3.8.

TABLE 3.6 MONTHLY TOTAL RAINFALL AT STATION: COLABA

PARAMETER	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEPT	OCT	NOV	DEC
MONTHLY TOTAL RAINFALL (MM)	2009	0.00	0.00	trace	0.00	0023	265.9	771.3	204.5	519.1	158.3	120.2	trace
	2010	trace	Trace	0.00	000.3	0.00	947.4	1099.0	849.8	272.9	122.4	053.7	0.00
	2011	000.0	000.1	0.00	000.0	000.7	461.2						

TABLE 3.7 MONTHLY TOTAL RAINFALL AT STATION: SANTACRUZ

PARAMETERS	YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
MONTHLY TOTAL RAINFALL (MM)	2009	0.000	000.0	000.0	000.0	000.3	216.4	1142.2	290.3	322.2	223.3	77.5	trace
	2010	000.0	Trace	000.0	000.7	000.0	712.1	1250.4	1036.5	328.9	064.0	047.2	000.0
	2011	000.0	000.0	000.0	000.0	trace	661.7						

TABLE 3.8 MONTHLY MEAN RELATIVE HUMIDITY AT STATION: COLABA

PARAMETERS	YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
MONTHLY MEAN RELATIVE HUMIDITY AT 08:30 HRS (%)	2009	81	86	79	79	79	85	93	91	92	86	85	84
	2010	80	85	88	83	84	92	96	96	90	85	86	78
	2011	80	85	81	83	77	92	--	--	--	--	--	--
MONTHLY MEAN RELATIVEHUMIDITY AT 08:30 HRS (%)	2010	61	64	63	67	67	75	88	81	83	76	72	64
	2011	63	62	70	74	72	84	91	90	82	72	73	59
	2012	63	62	58	74	68	84	--	--	--	--	--	--

TABLE 3.9 MONTHLY MEAN RELATIVE HUMIDITY AT STATION: SANTACRUZ

PARAMETERS	YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
MONTHLYMEAN RELATIVEHUMIDITY AT 08:30 HRS (%)	2009	78	77	73	70	69	74	88	84	79	79	77	75
	2010	65	76	79	69	71	83	91	90	86	84	79	77
	2011	77	77	72	77	71	78	--	--	--	--	--	--
MONTHLY MEAN RELATIVEHUMIDITY AT 08:30 HRS (%)	2010	49	44	49	56	63	68	84	77	77	64	61	55
	2011	47	52	54	61	66	75	84	83	75	68	69	57
	2012	45	46	45	65	65	79	--	--	--	--	--	--

TABLE 3.10 MONTHLY MEAN MAXIMUM AND MINIMUM TEMPERATURE AT STATION: COLABA

PARAMETERS	YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
MONTHLYMEAN RELATIVEHUMITY AT 08:30 HRS (%)	2009	32.0	30.7	32.6	34.2	34.7	33.8	29.5	31.2	31.1	32.7	32.8	32.2
	2010	32.0	30.4	32.1	34.3	35.3	32.4	29.9	29.9	31.7	33.0	33.3	30.9
	2011	30.7	31.2	33.6	33.2	34.2	31.8	--	--	--	--	--	--
MONTHLY MEAN RELATIVEHUMTY AT 08:30 HRS (%)	2010	19.4	19.5	22.5	24.6	26.7	27.7	25.6	26.2	25.8	24.6	23.8	22.3
	2011	21.3	21.8	24.2	26.5	28.5	26.6	25.3	25.6	25.9	25.9	24.9	20.6
	2012	18.6	20.8	23.4	25.3	27.6	26.7	--	--	--	--	--	--

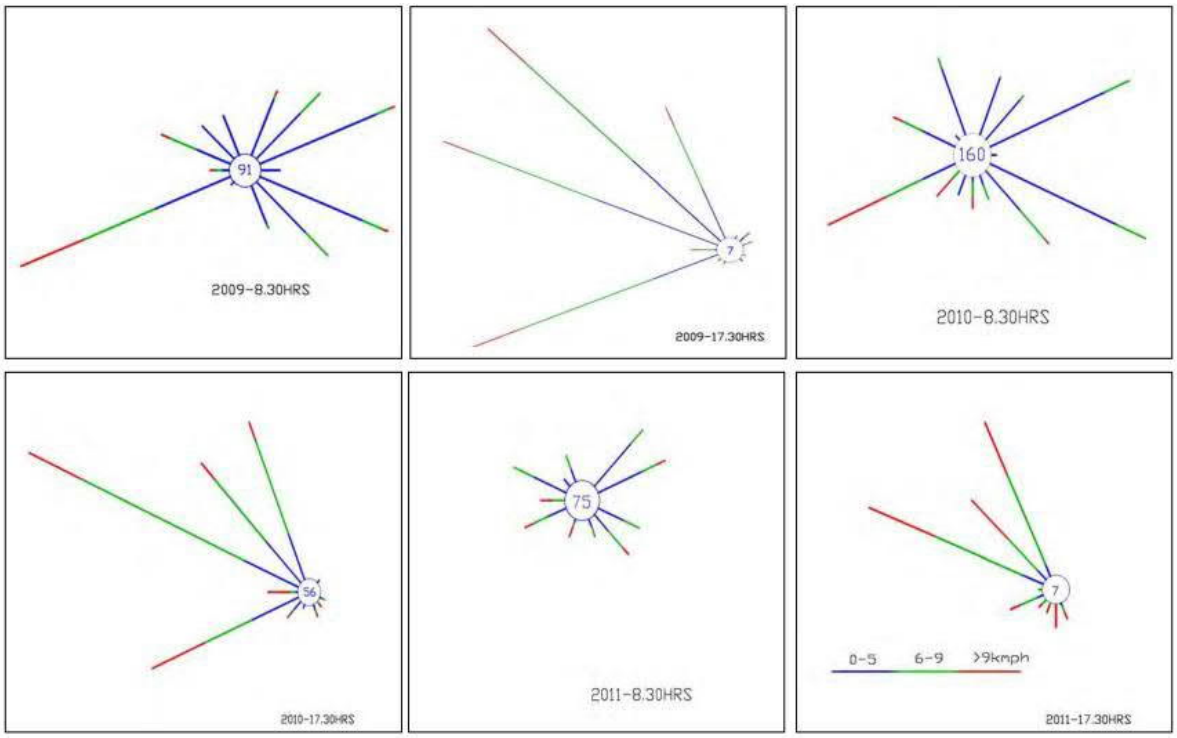
TABLE 3.11
MONTHLY MEAN MAXIMUM AND MINIMUM TEMPERATURE AT STATION: SANTACRUZ

PARAMETERS	YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
MONTHLYMEAN RELATIVEHUMITY AT 08:30 HRS (%)	2009	32.9	32.6	34.3	35.4	33.9	33.6	29.8	31.1	31.2	33.3	32.9	32.1
	2010	32.5	31.6	33.6	34.6	34.7	33.0	30.3	29.8	31.5	33.0	33.6	30.8
	2011	31.6	32.1	35.3	33.2	33.5	32.0	--	--	--	--	--	--
MONTHLY MEAN RELATIVEHUMTY AT 08:30 HRS (%)	2010	17.9	18.1	21.8	25.1	27.3	27.8	25.4	26.1	25.4	23.1	22.1	19.2
	2011	18.8	19.0	22.2	24.8	27.8	26.1	24.9	25.1	25.2	24.7	23.4	17.4
	2012	14.9	17.2	20.1	23.8	26.8	26.2	--	--	--	--	--	--

The mean minimum temperature is 16.3°C and the mean maximum temperature is 32.2°C at Santacruze. Records of mean maximum and mean minimum temperatures are given in Table 3.9 and Table 3.11 respectively.

The predominant wind direction is south/south-west in monsoon and north/north-east in winter. The windrose diagrams are prepared showing wind speed and direction at 8:30 and 17:30 hrs and placed at Figure 3.8.

FIGURE 3.8 WINDROSE DIAGRAMS



3.4.2 Air Quality

The atmospheric concentrations of air pollutants were monitored at 5 locations during January 2012 by setting up ambient air quality monitoring stations. The monitoring stations were selected to generate the representative samples for air quality covering residential, institutional and industrial area along the corridor. Locations of air monitoring stations are shown in Figure 3.2. Air Monitoring was carried out for parameters PM , PM10, NOx, SO2, CO, and HC. Results of the air quality monitoring are presented in Table 3.12. The results show that the concentration of PM10 and PM2.5 exceeds the standards at all locations whereas other parameters are within permissible limits at all the locations.

The updated ambient air quality data from 2012 onwards is updated in the section below and relevant graphs have been provided.

TABLE 3.12
AMBIENT AIR QUALITY RESULTS

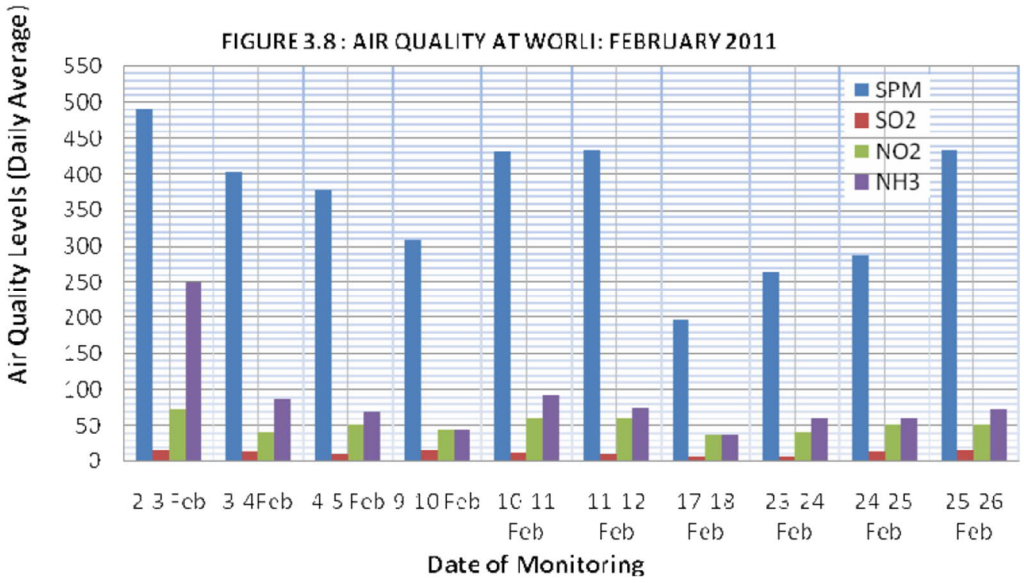
Location	Date	Timing	PM 10µg/m 3	PM 2.5 µg/m 3	NO x µg/m 3	SO 2 µg/m 3	(HC) (ppm)	CO(mg/m 3)

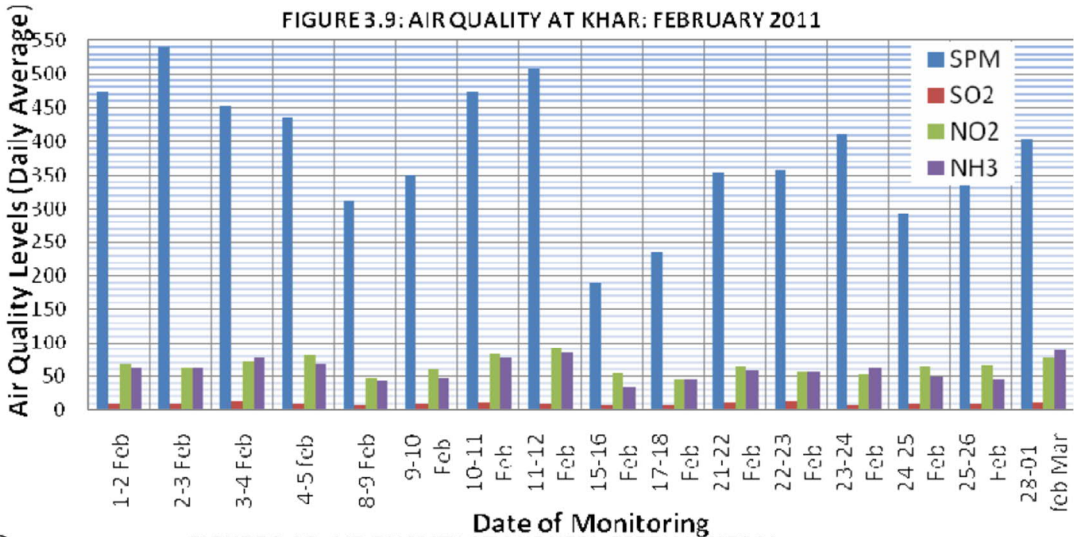
Limits As per CPCB (MoEF)			100	60	80	80	--	2
Mahim	10/01/2012 To 11/01/2012	01:30PMTo09:30 PM	247	151	40.1	12.3	3.4	1.35
		09:30 PM To 05:30 AM	143	85	20.0	< 5.0	2.5	1.13
		05:30 AM To 01:30 PM	211	124	32.2	8.4	3.1	1.22
BKC	11/01/2012 To 12/01/2012	03:00PM To 11:00 PM	235	140	31.2	6.2	3.0	1.28
		11:00 PM To 07:00 AM	138	81	26.5	< 5.0	2.4	1.11
		07:00 AM To 03:00 PM	304	135	37.1	9.4	4.1	1.43
SEEPZ	12/01/2012 To 13/01/2012	03:00PM To 11:00 PM	185	109	19.2	< 5.0	2.3	1.10
		11:00 PM To 07:00 AM	112	60	15.0	< 5.0	2.3	1.00
		07:00 AM To 03:00 PM	230	140	24.1	6.5	2.9	1.24
Colaba	13/01/2012 To 14/01/2012	04:00 PM To 12:00 AM	325	213	37.1	7.4	3.8	1.34
		12:00 PM To 08:00 AM	189	98	22.4	< 5.0	2.7	1.18
		08:00 AM To 04:00 PM	387	250	39.8	8.2	4.0	1.42
Airport	14/01/2012 To 15/01/2012	05:00PM To 01:00 AM	311	185	35.6	9.5	4.5	1.45
		01:00 AM To 09:00 AM	241	142	28.1	6.5	2.9	1.23
		09:00 AM To 05:00 PM	388	236	41.0	11.3	4.2	1.42

An ambient air quality data for pre monsoon (i.e months of February & March) and post monsoon (i.e months of September & October) for the year 2011 at Worli, Khar and

Andheri has been collected from Air Quality Monitoring and Research Laboratory, Khar and Maharashtra Pollution Control Board, Mumbai. The air quality data namely SPM, SO2, NO2.

and NH3 has been graphically presented in Figure 3.8" to Figure 3.27. The updated air quality data is presented in Figure 3.28 to 3.50.





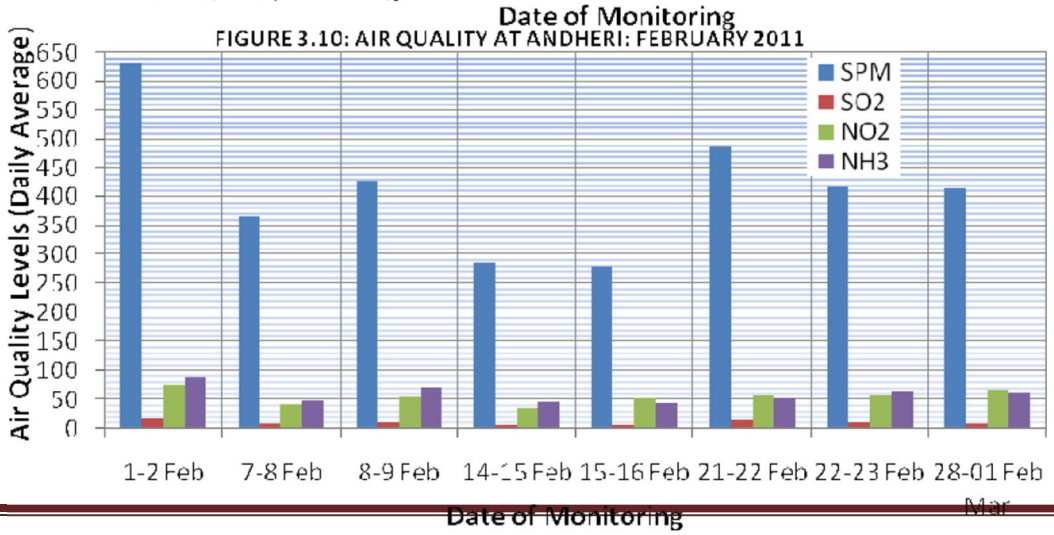


FIGURE 3.11: AIR QUALITY AT BANDRA: FEBRUARY 2011

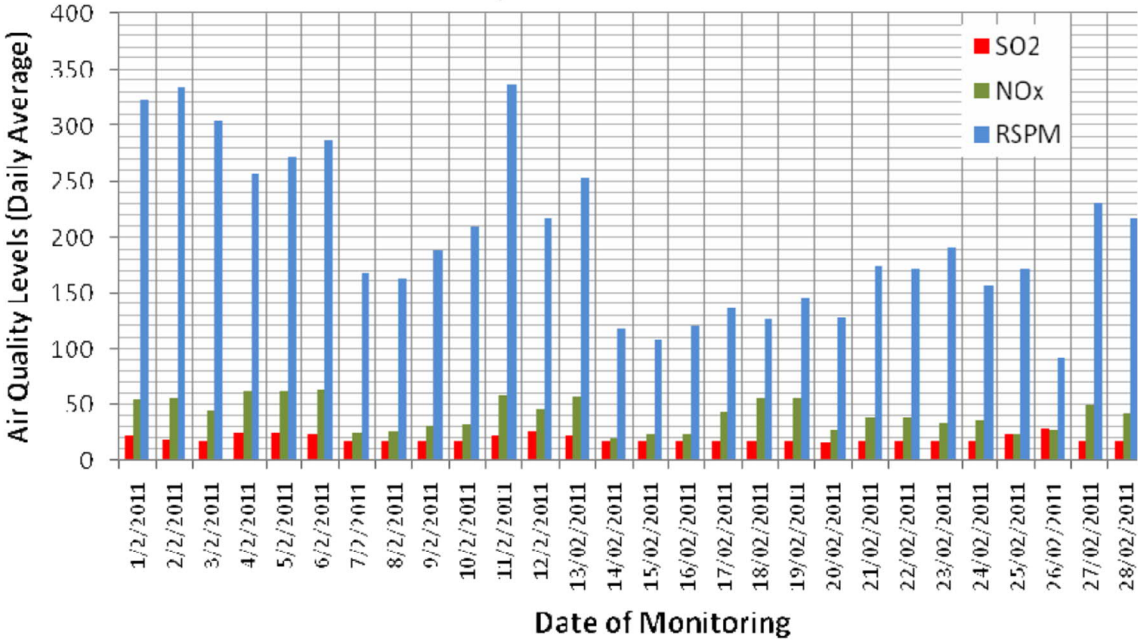


FIGURE 3.12: AIR QUALITY AT KALBADEVI: FEBRUARY 2011

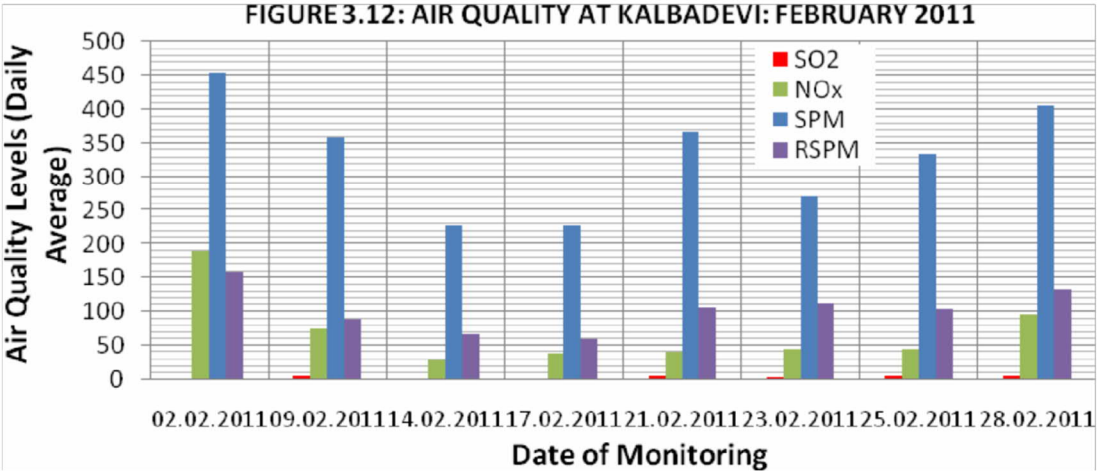


FIGURE 3.13: AIR QUALITY AT WORLI: MARCH 2011

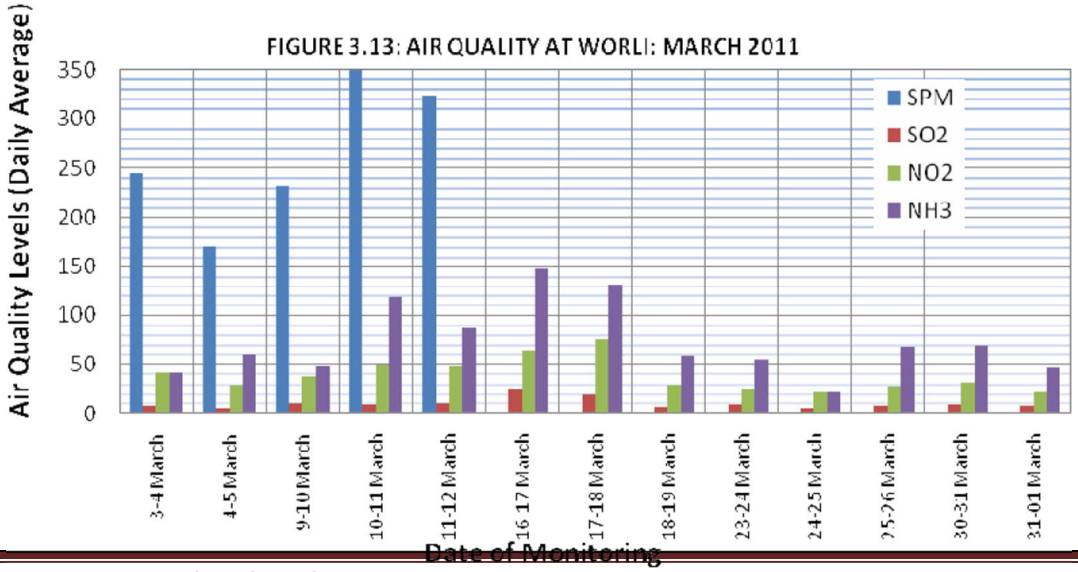


FIGURE 3.14: AIR QUALITY AT KHAR: MARCH 2011

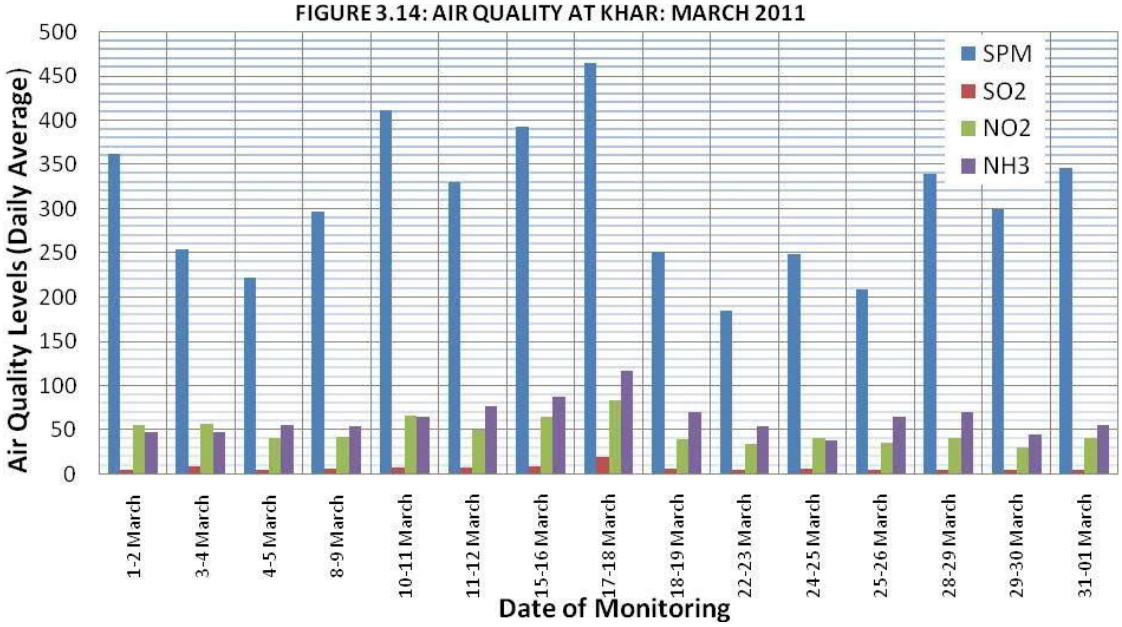


FIGURE 3.15: AIR QUALITY AT ANDHERI: MARCH 2011

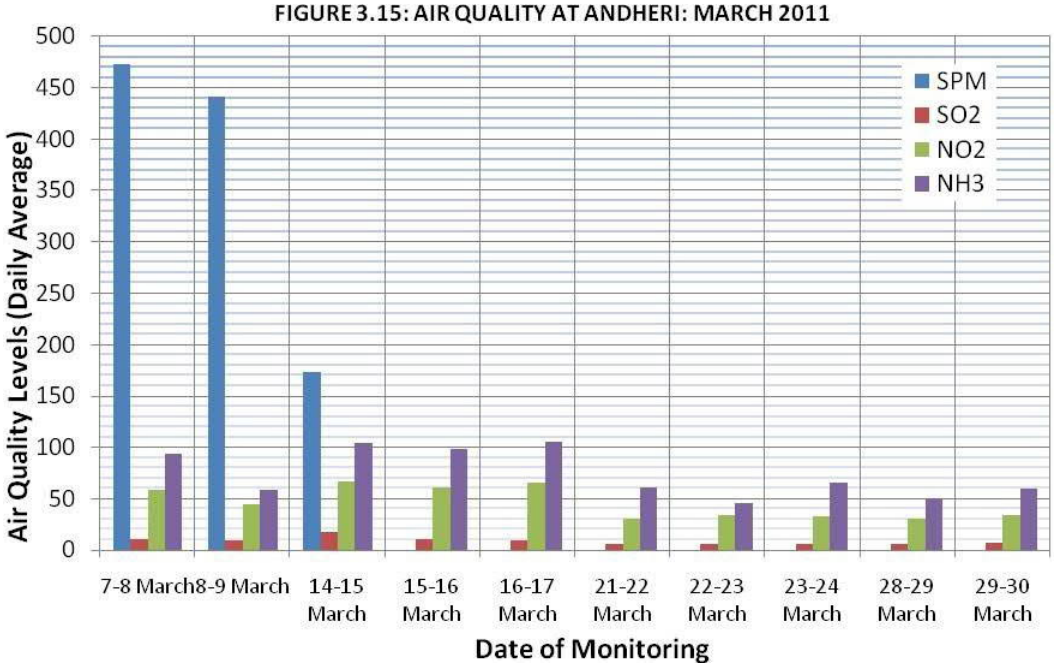


FIGURE 3.16: AIR QUALITY AT BANDRA: MARCH 2011

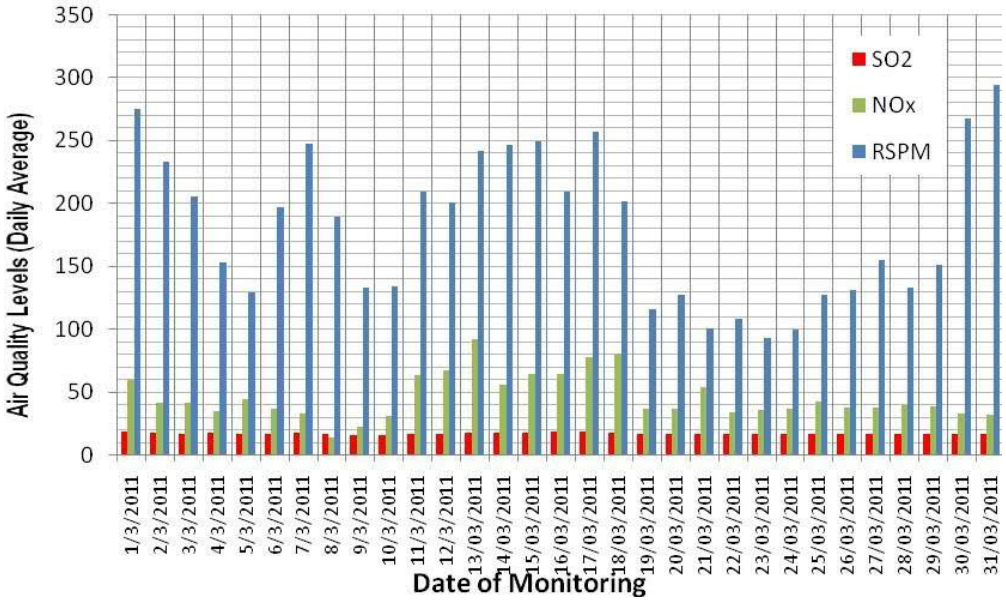


FIGURE 3.17: AIR QUALITY AT KALBADEVI: MARCH 2011

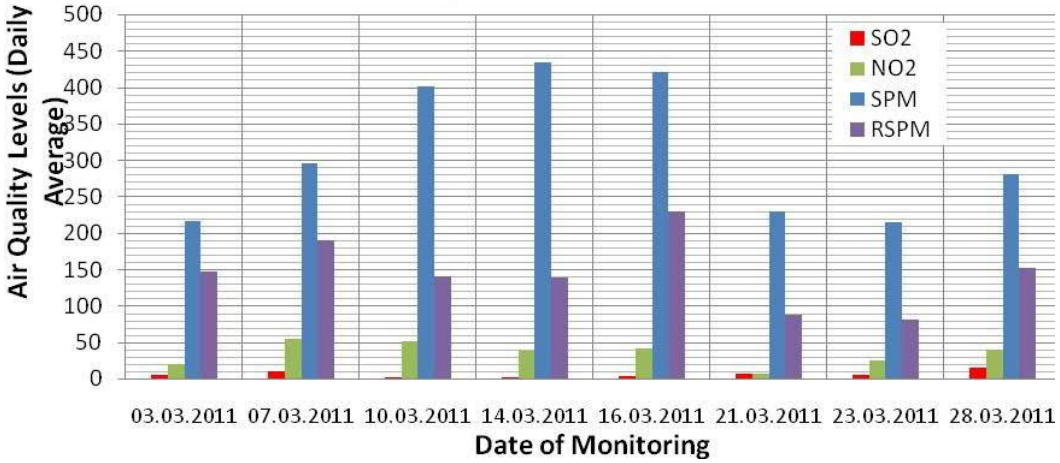


FIGURE 3.18: AIR QUALITY AT WORLI: SEPTEMBER 2011

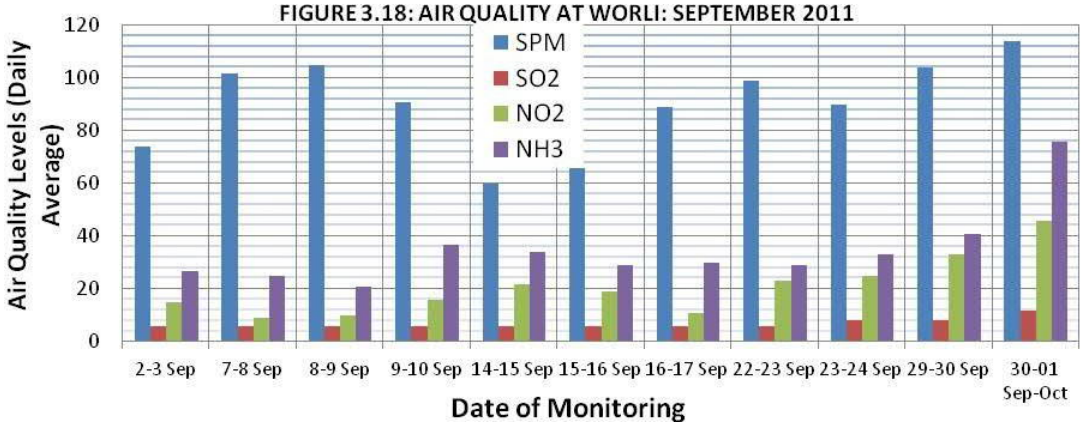


FIGURE 3.19: AIR QUALITY AT KHAR: SEPTEMBER 2011

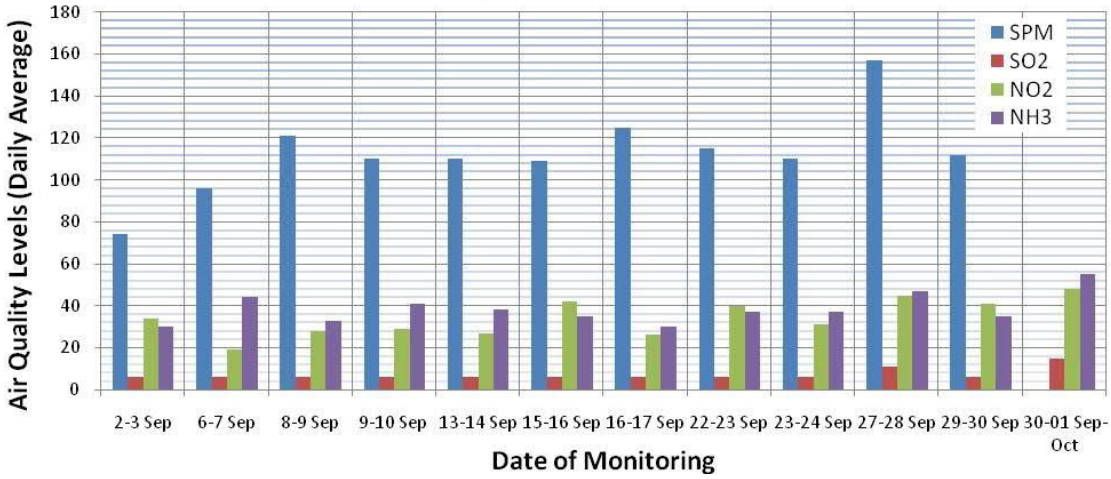


FIGURE 3.20: AIR QUALITY AT ANDHERI: SEPTEMBER 2011

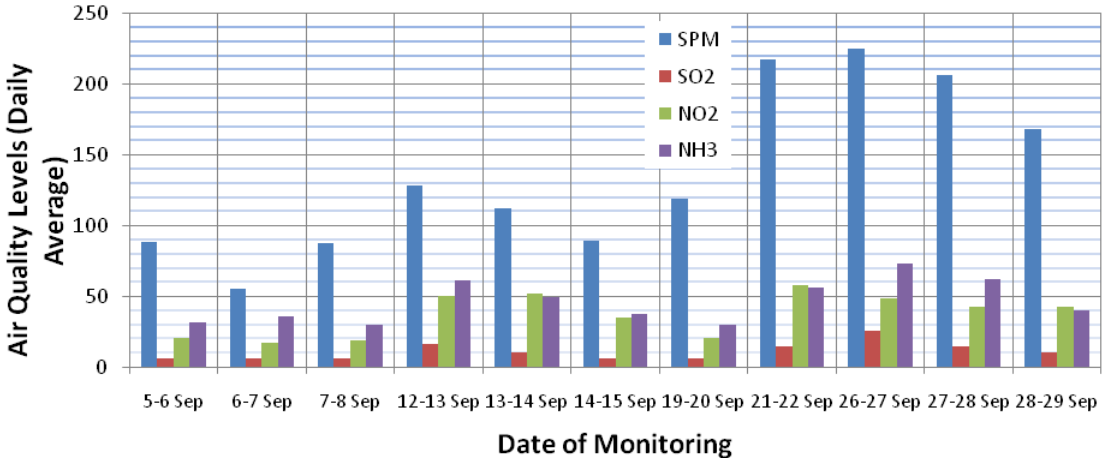


FIGURE 3.21: AIR QUALITY AT BANDRA: SEPTEMBER 2011

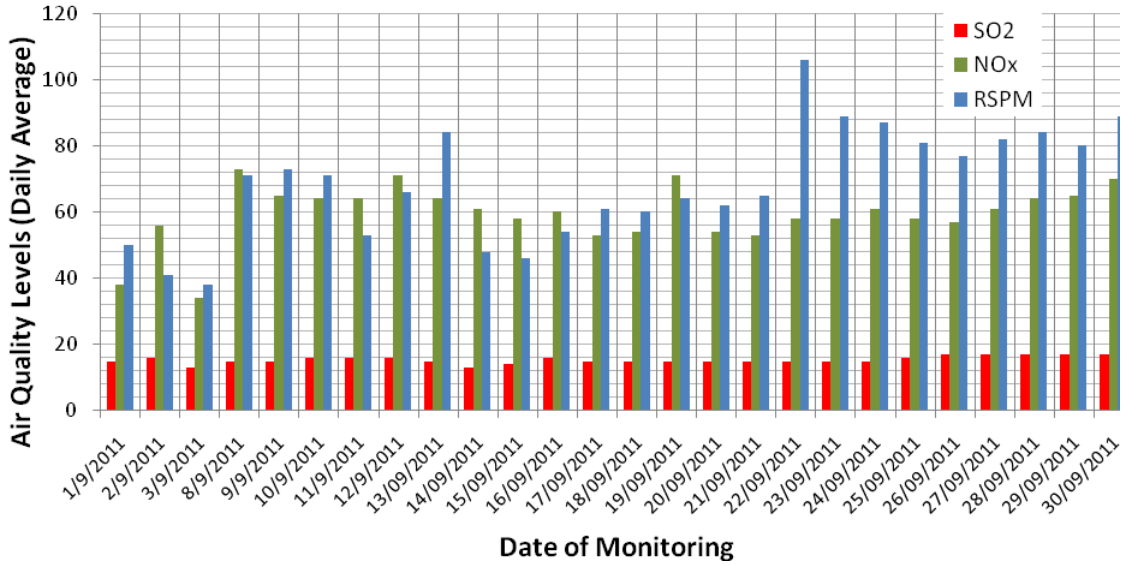


FIGURE 3.22: AIR QUALITY AT KALBADEVI: SEPTEMBER 2011

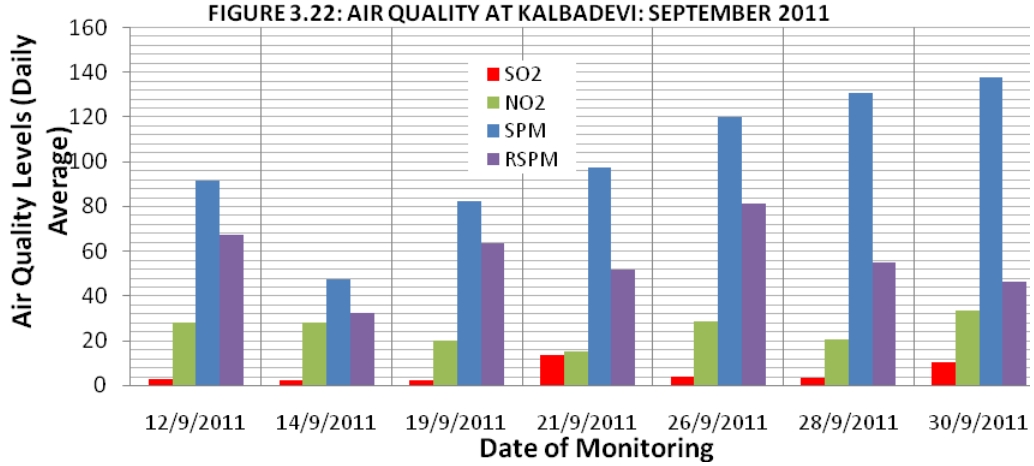


FIGURE 3.23: AIR QUALITY AT WORLI: OCTOBER 2011

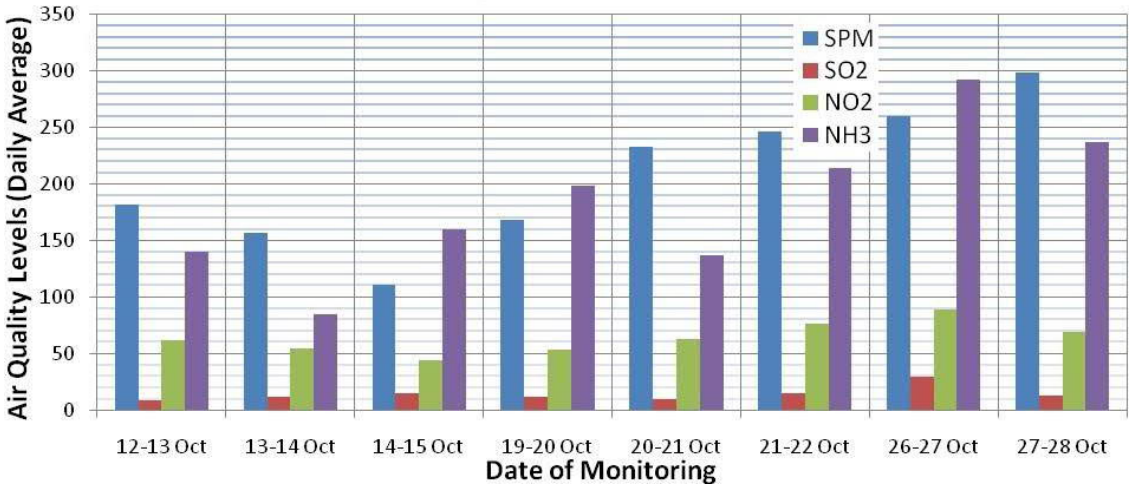


FIGURE 3.24: AIR QUALITY AT KHAR: OCTOBER 2011

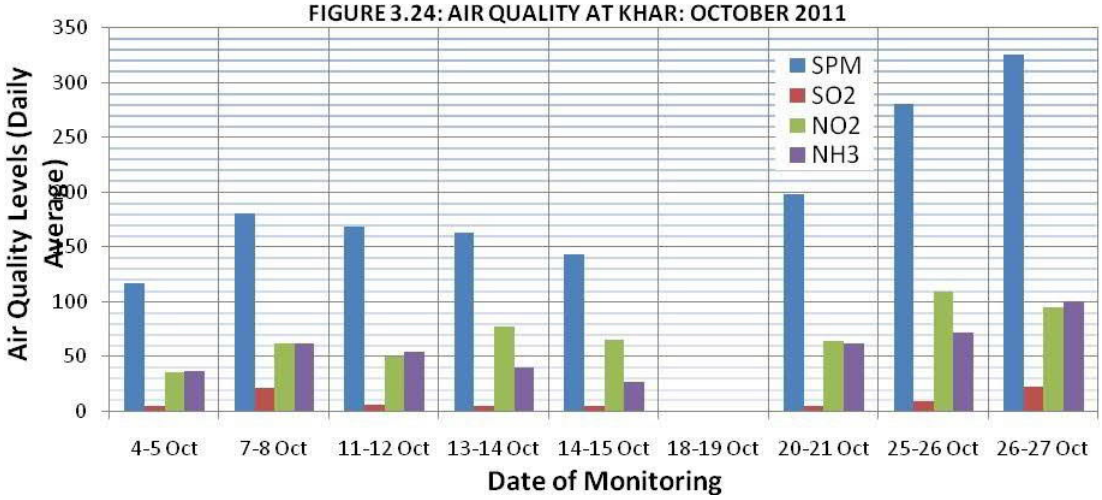


FIGURE 3.25: AIR QUALITY AT ANDHERI: OCTOBER 2011

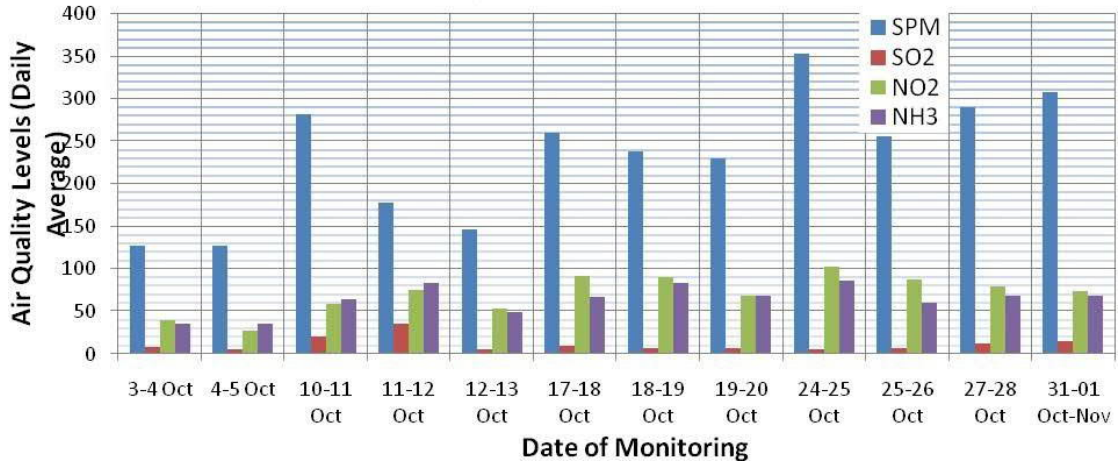


FIGURE 3.26: AIR QUALITY AT BANDRA: OCTOBER 2011

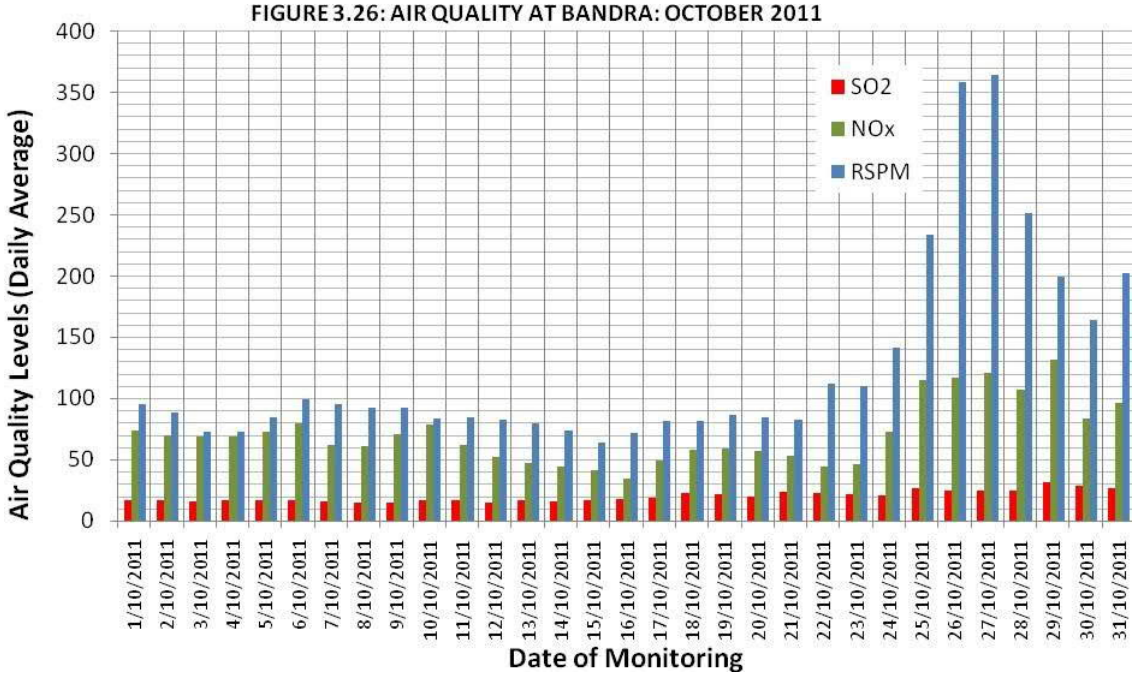


FIGURE 3.27: AIR QUALITY AT KALBADEVI: OCTOBER 2011

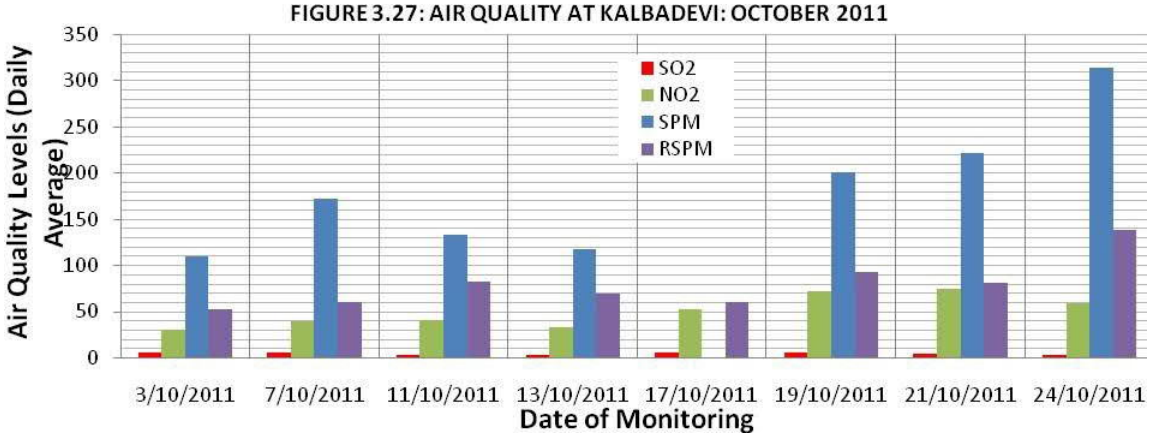


Figure 3.28 AAQ at Bandra, November 2013

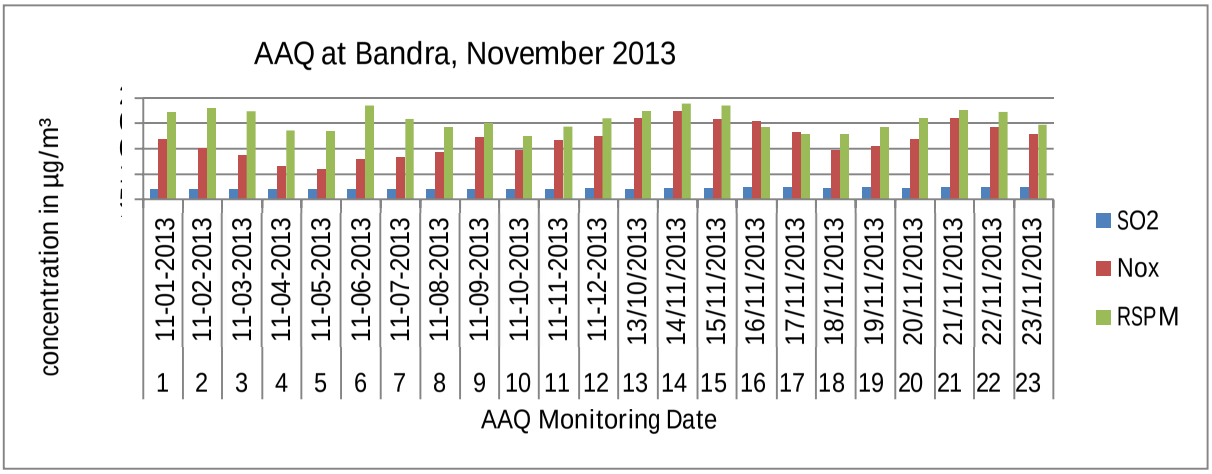


Figure 3.29 AAQ at Bandra, December 2013

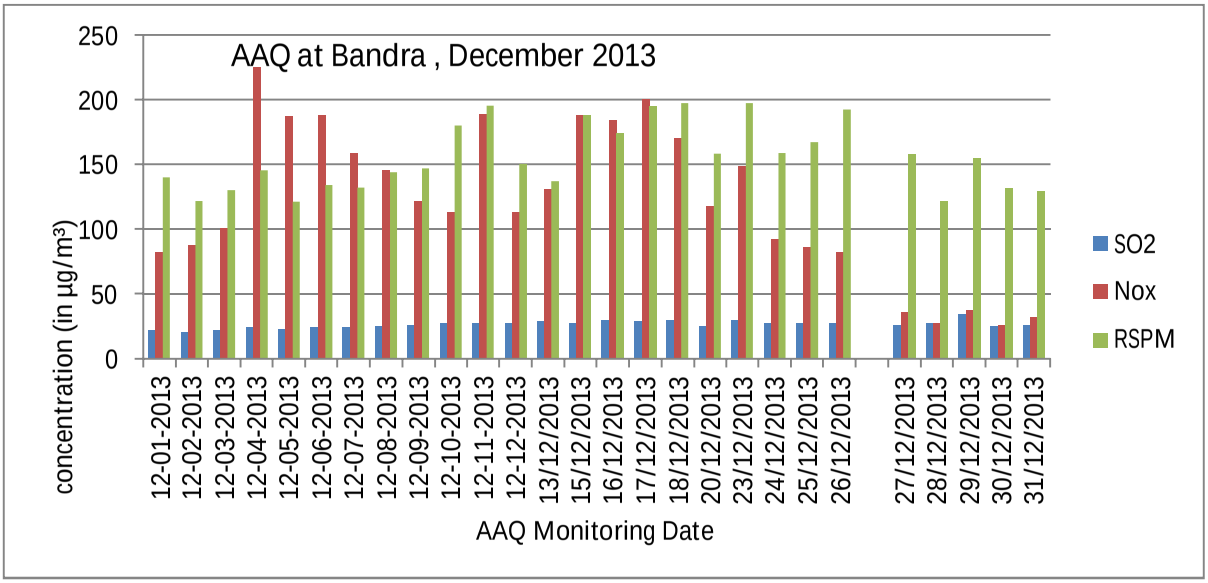


Figure 3.30 AAQ at Bandra, January 2014

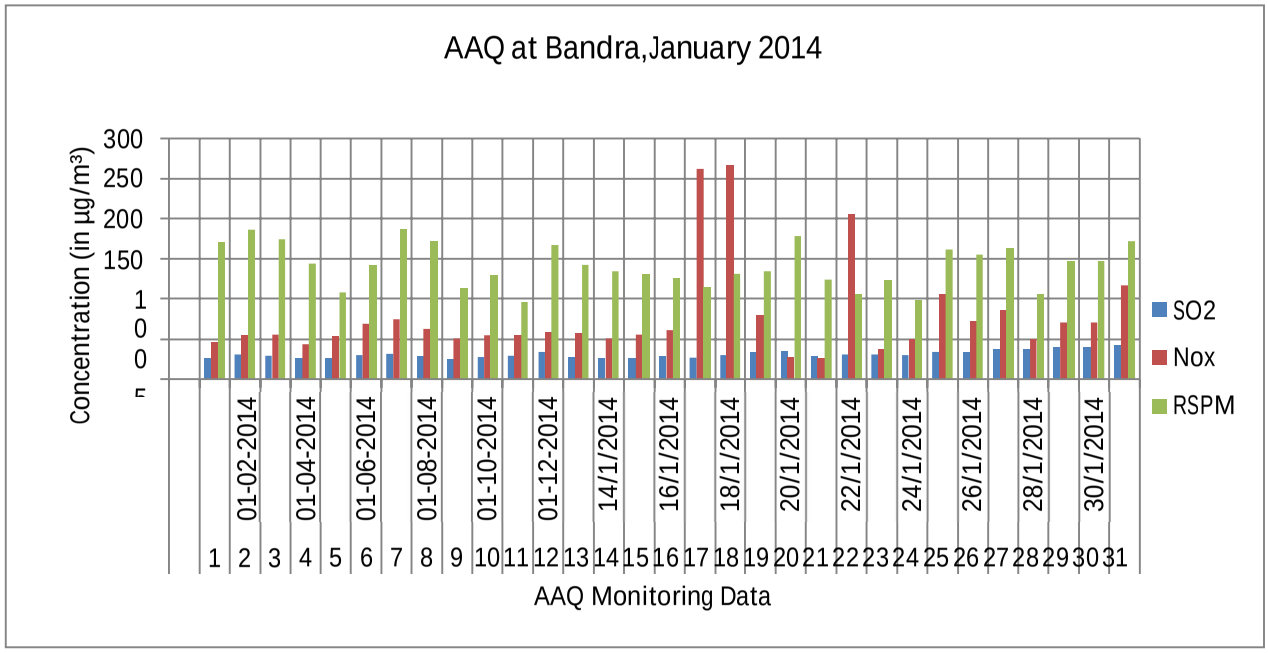


Figure 3.31 AAQ at Bandra, February 2014

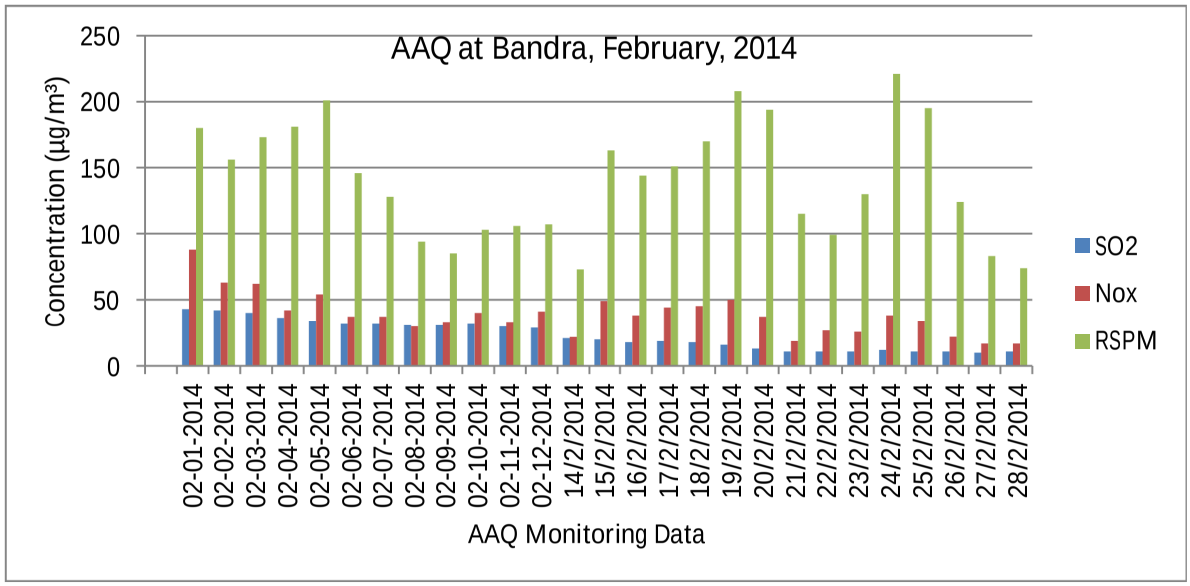


Figure 3.32 AAQ at Bandra, March 2014

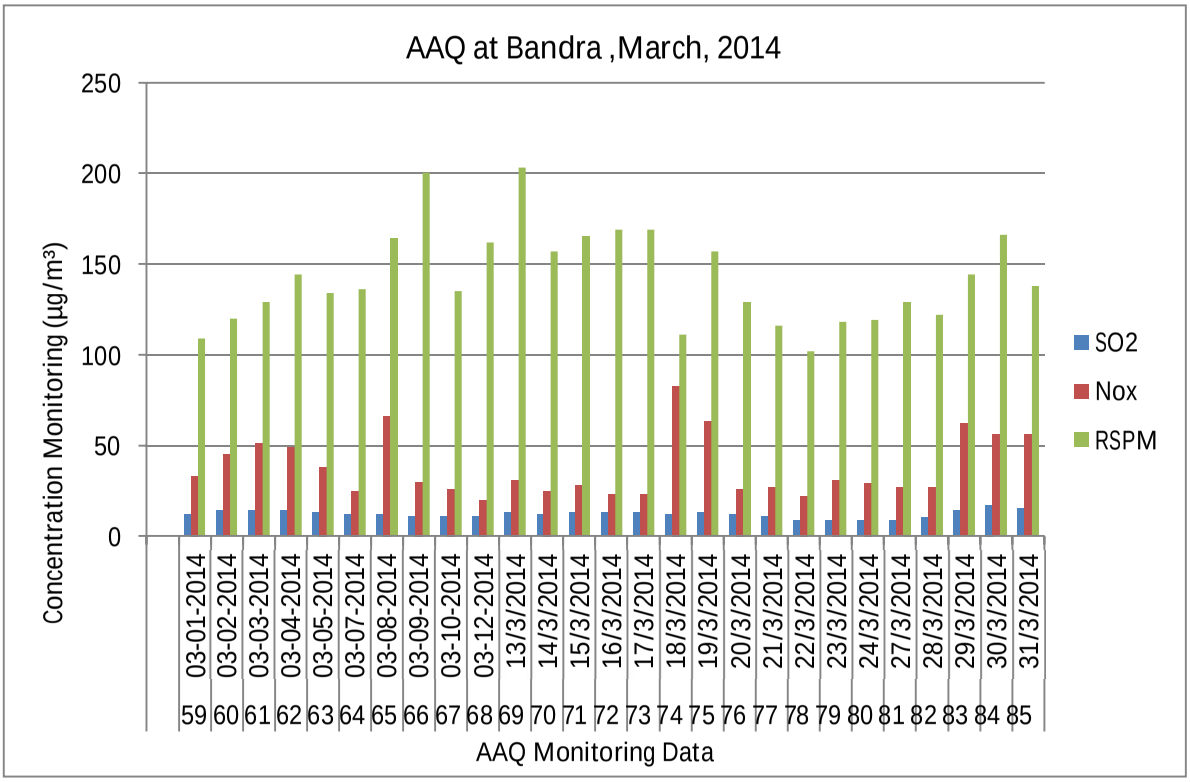


Figure 3.33 AAQ at Bandra, April 2014

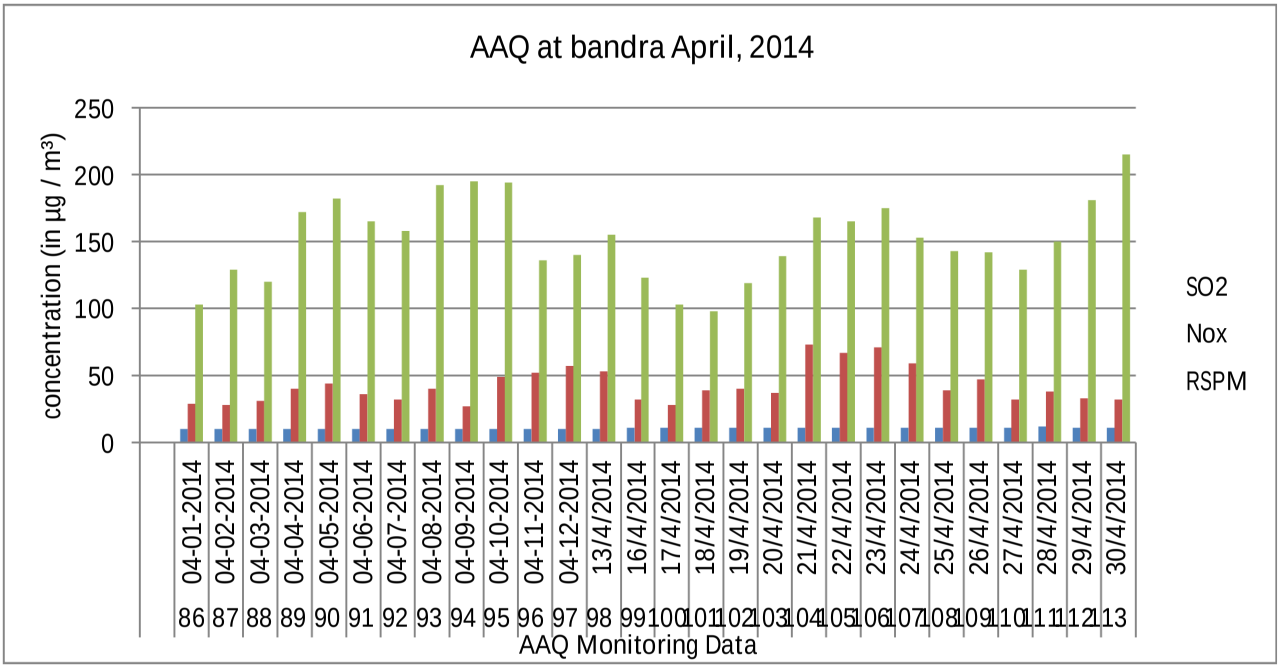


Figure 3.34 AAQ at Bandra, May 2014

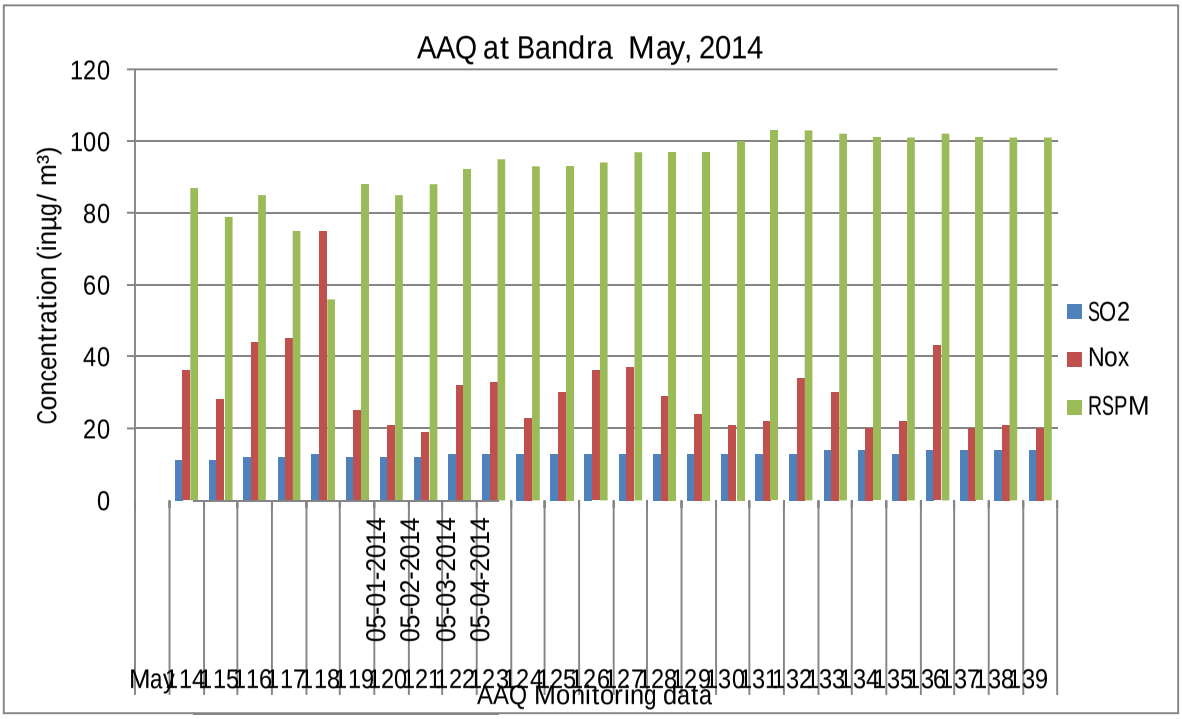
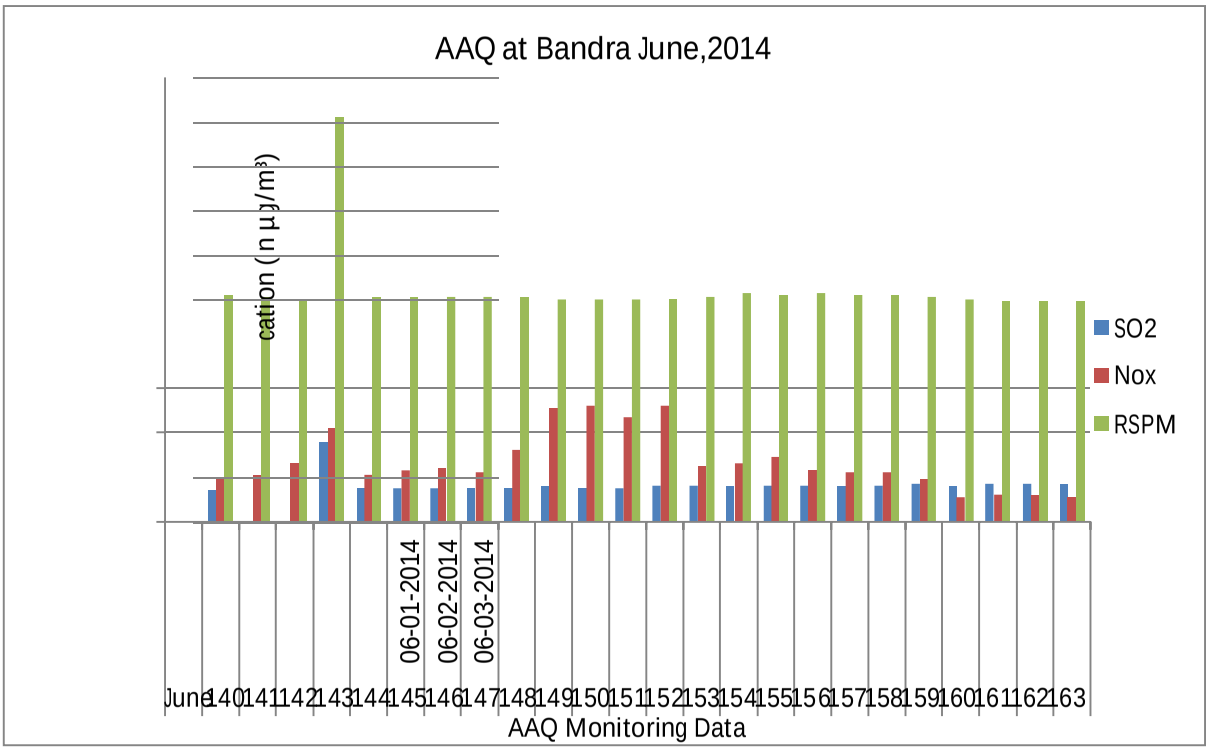


Figure 3.35 AAQ at Bandra, June 2014



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06-05-2014								05-09-2014
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06-09-2014								13/5/2014
06-10-2014								15/5/2014
06-11-2014								16/5/2014
06-12-2014								17/5/2014
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								31/3/2014

Figure 3.36 AAQ at Bandra, July 2014

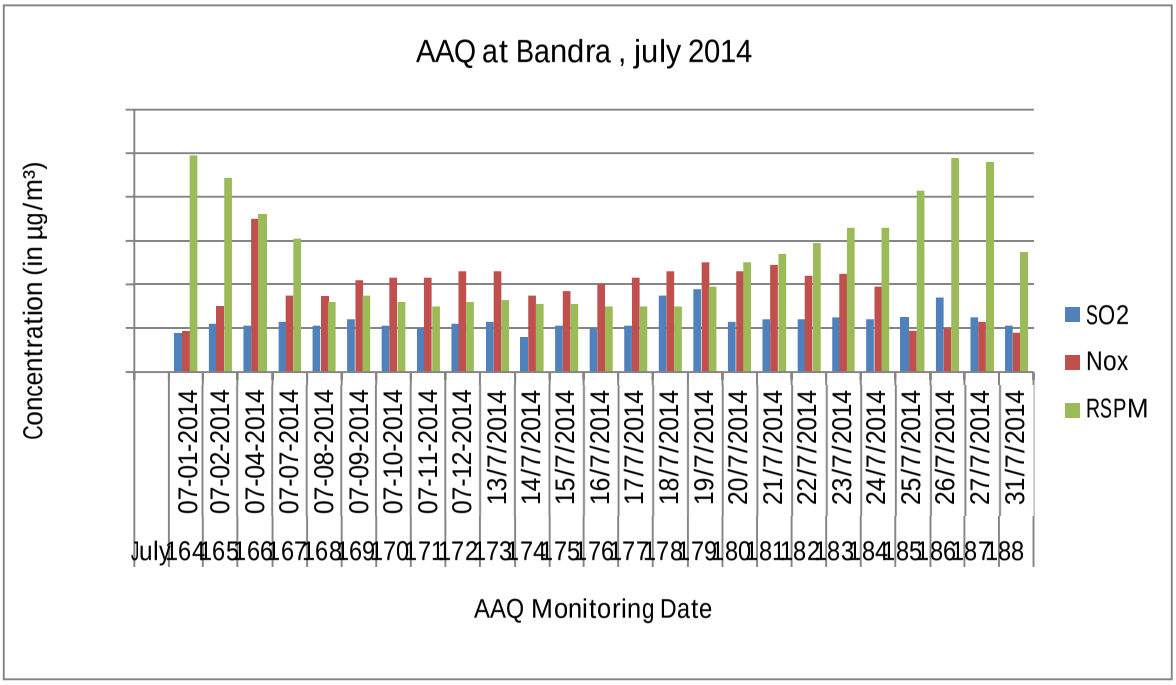


Figure 3.37 AAQ at Bandra, August 2014

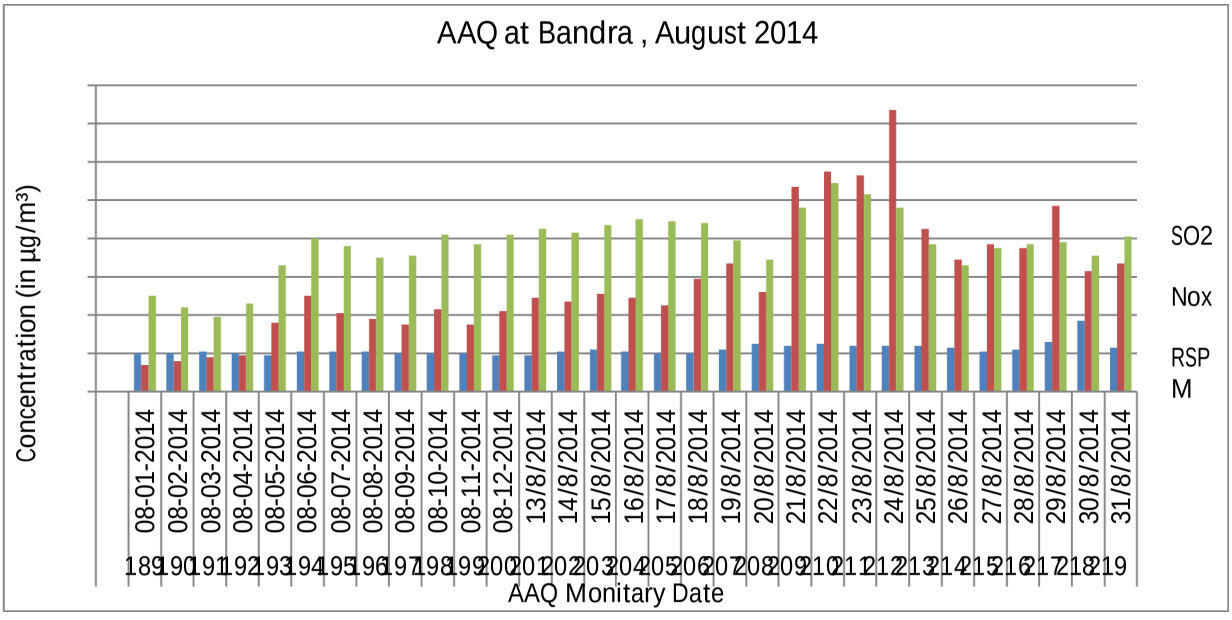


Figure 3.38 AAQ at Bandra, September 2014

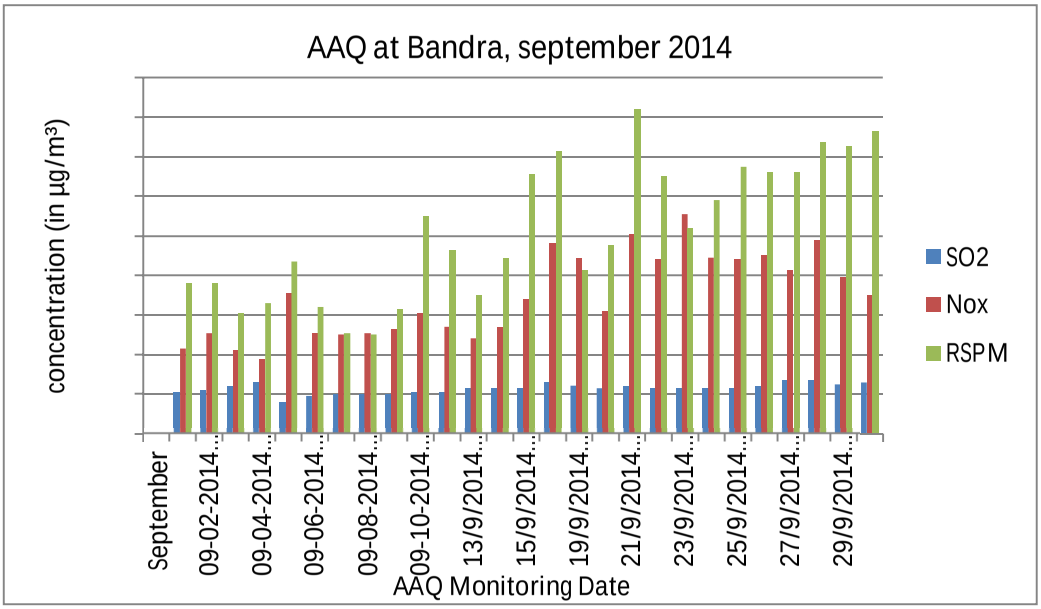


Figure 3.39 AAQ at Bandra, October 2014

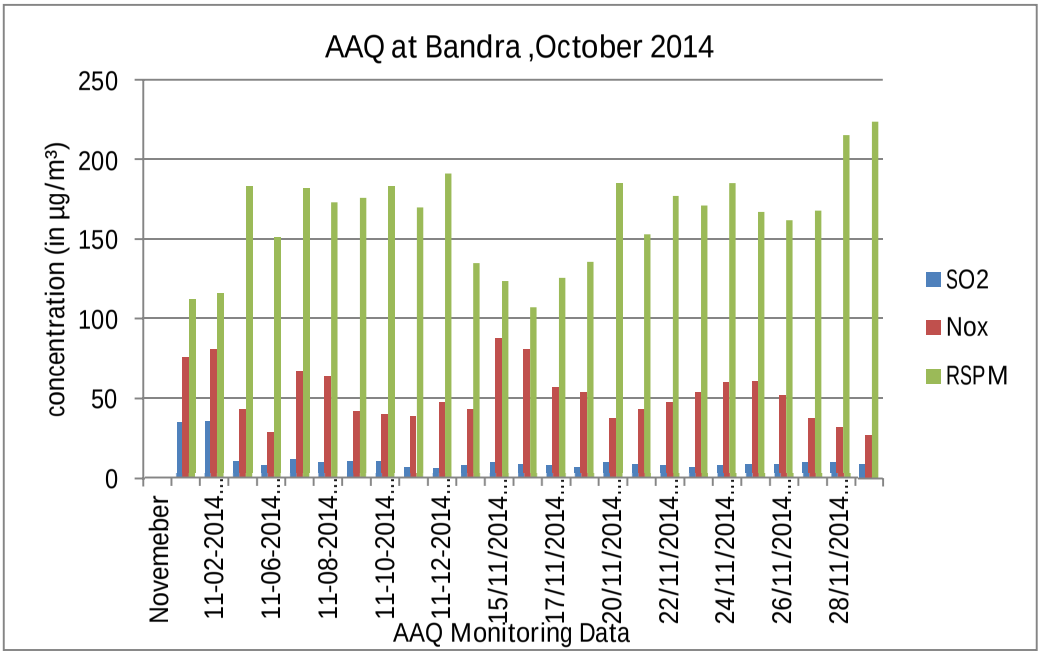


Figure 3.40 AAQ at Bandra, November 2014

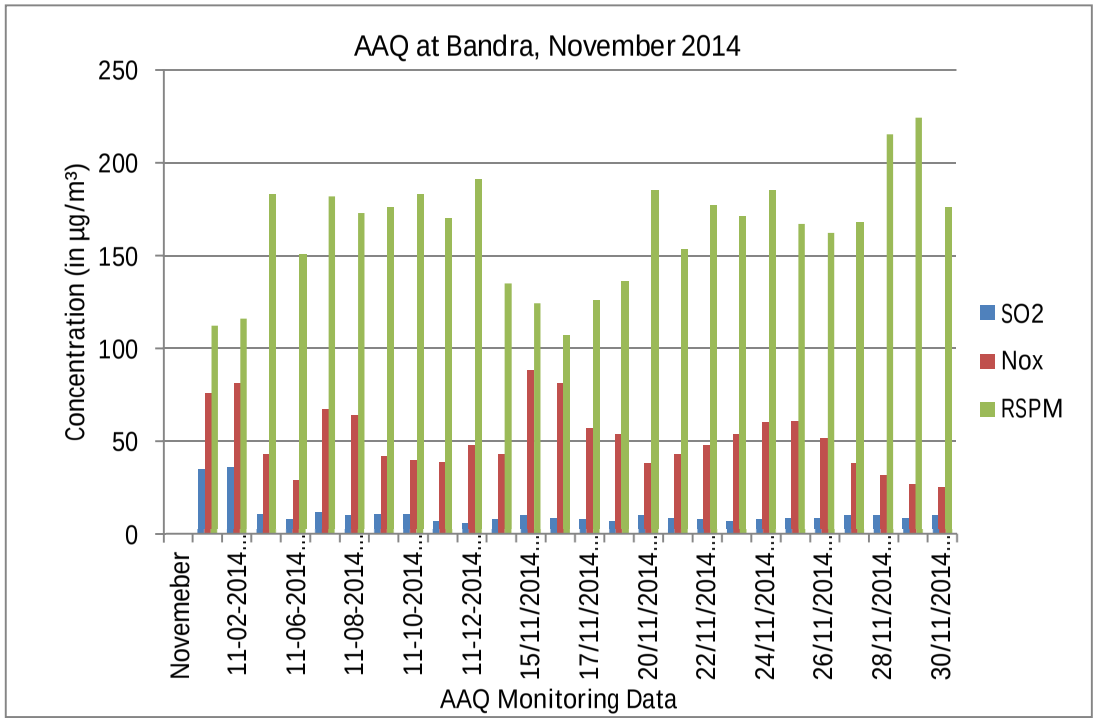


Figure 3.41 AAQ at Bandra, December 2014

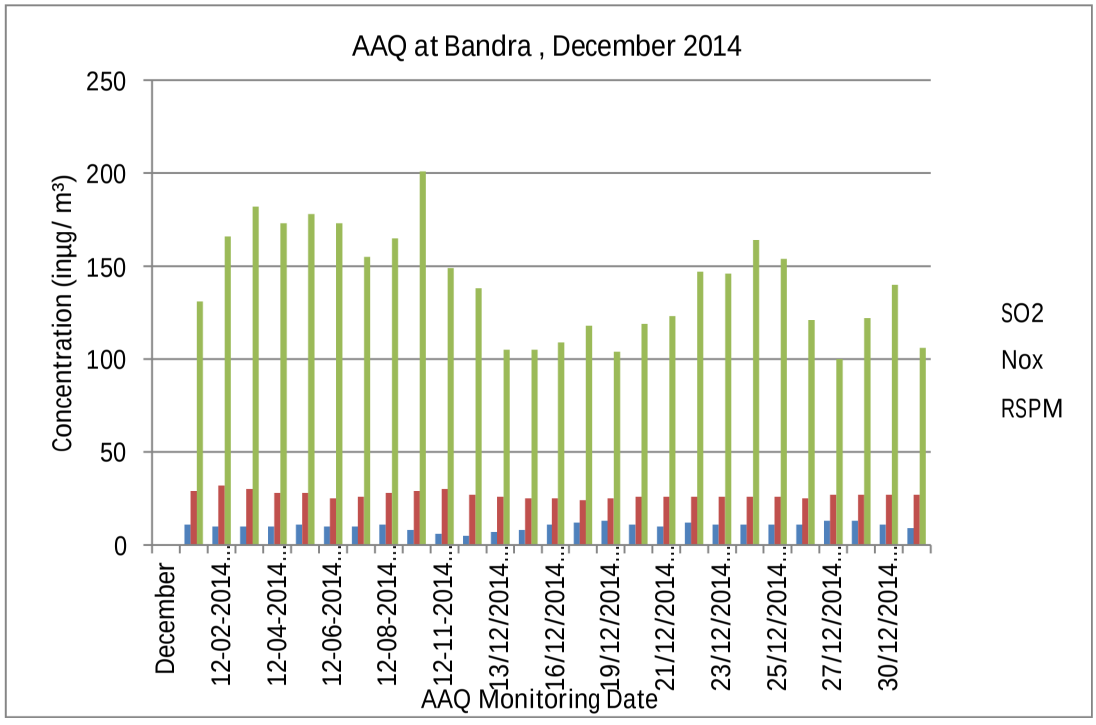


Figure 3.42 AAQ at Bandra, January 2015

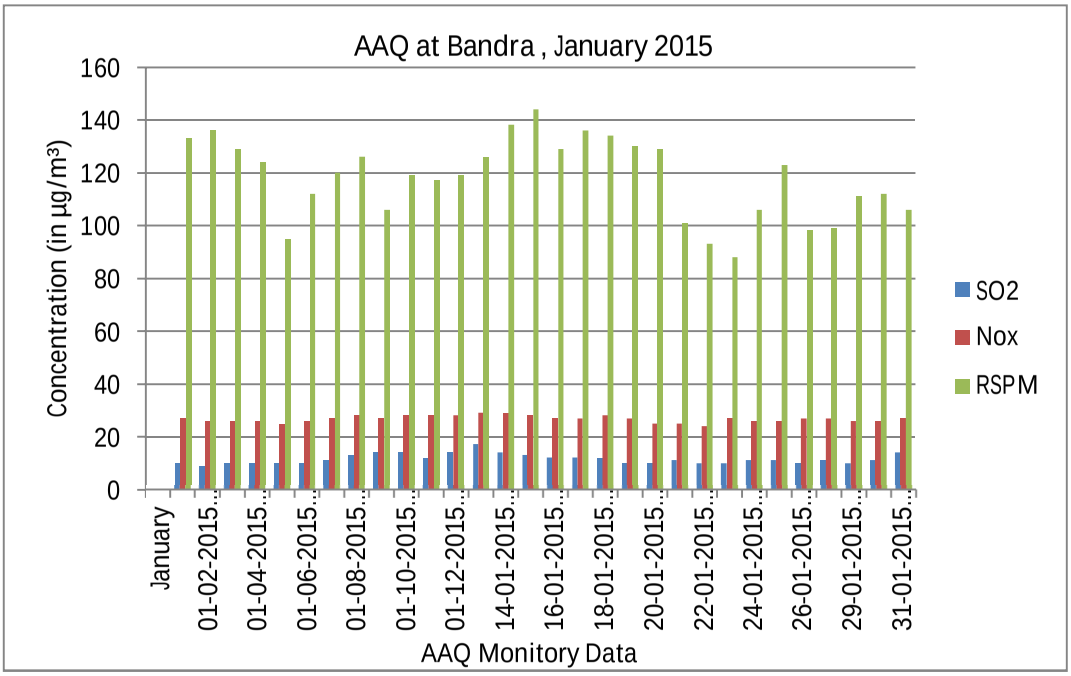


Figure 3.43 AAQ at Bandra, February 2015

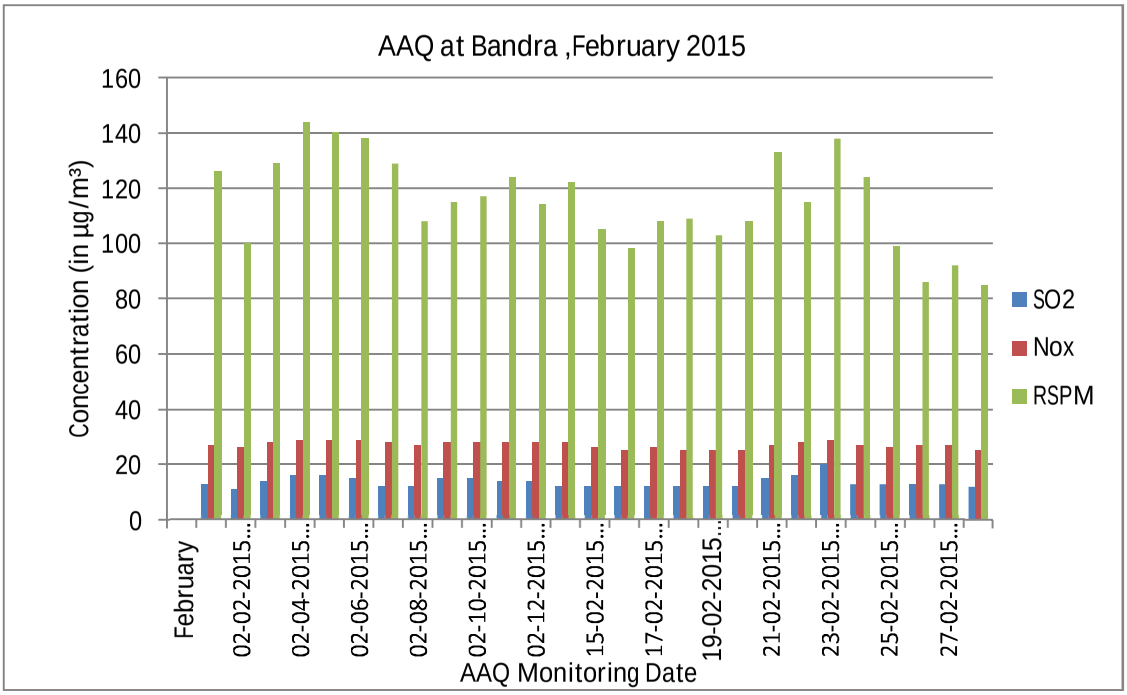


Figure 3.44 AAQ at Bandra, March 2015

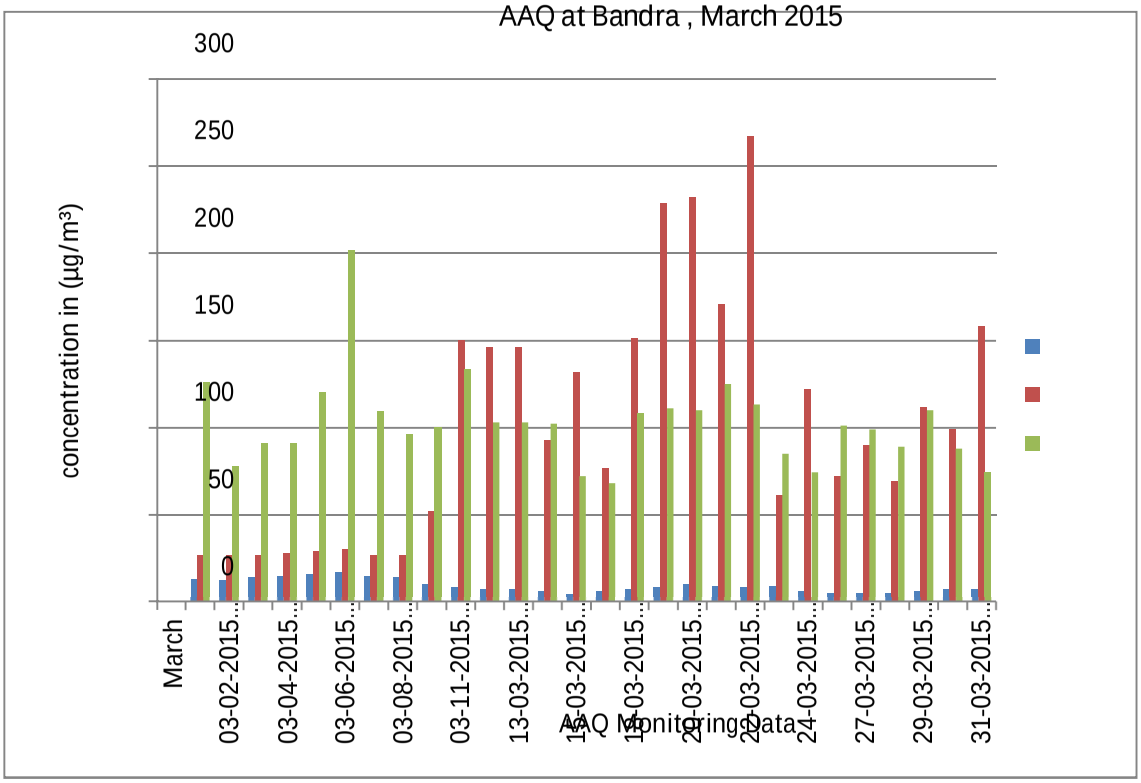


Figure 3.45 AAQ at Bandra, April 2015

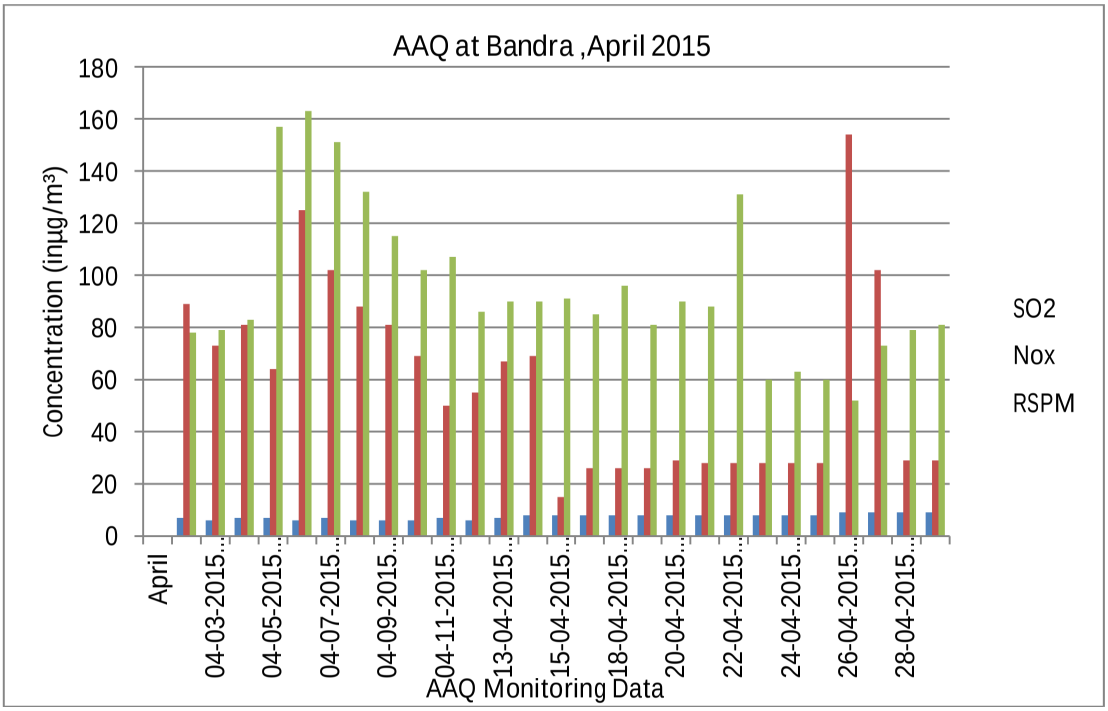


Figure 3.46 AAQ at Bandra, May 2015

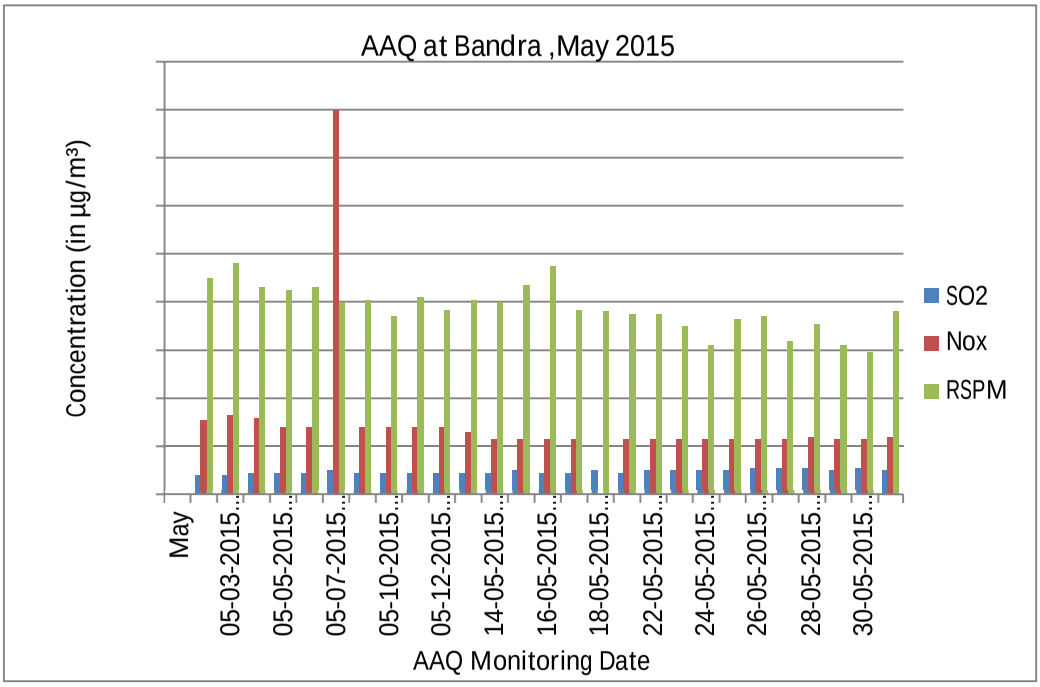


Figure 3.47 AAQ at Bandra, June 2015

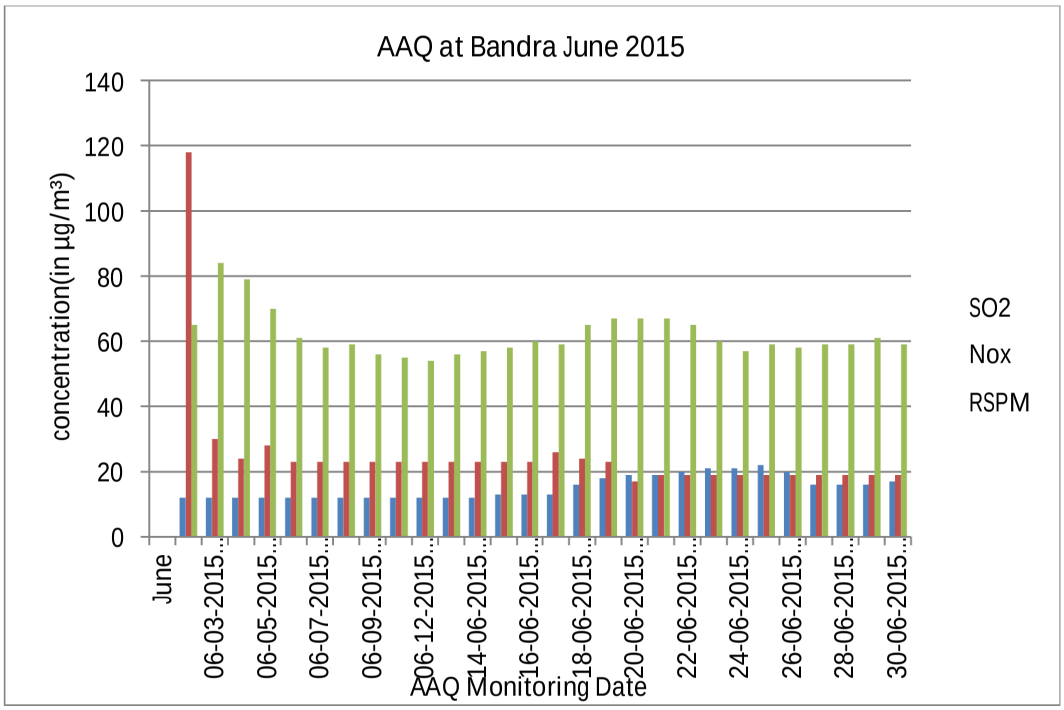


Figure 3.48 AAQ at Bandra, July 2015

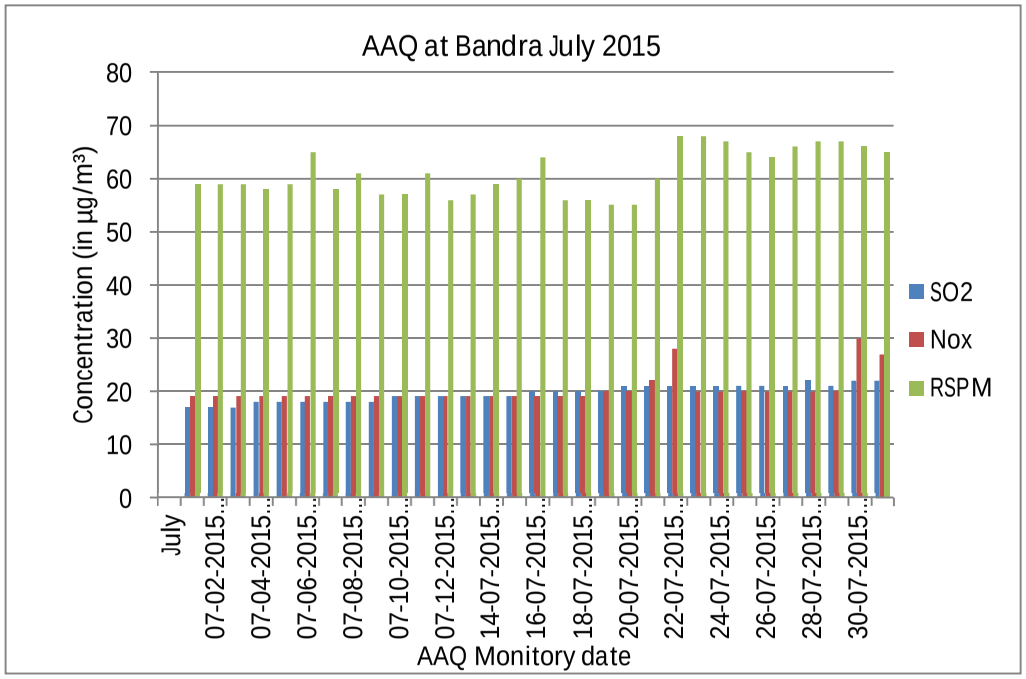


Figure 3.49 AAQ at Bandra, August 2015

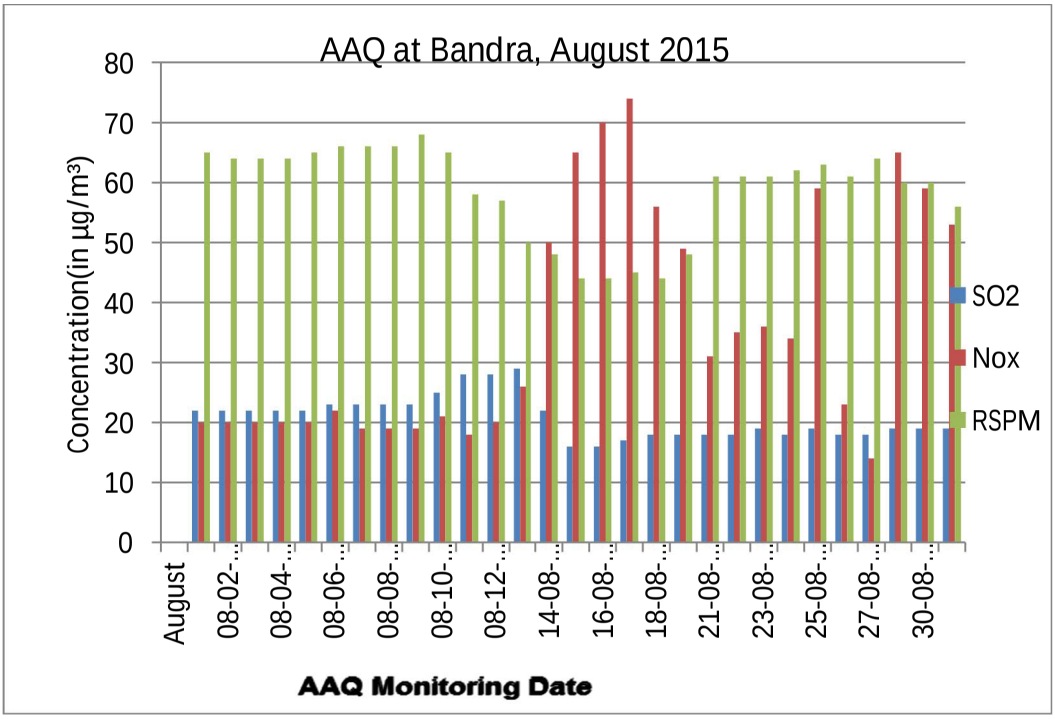
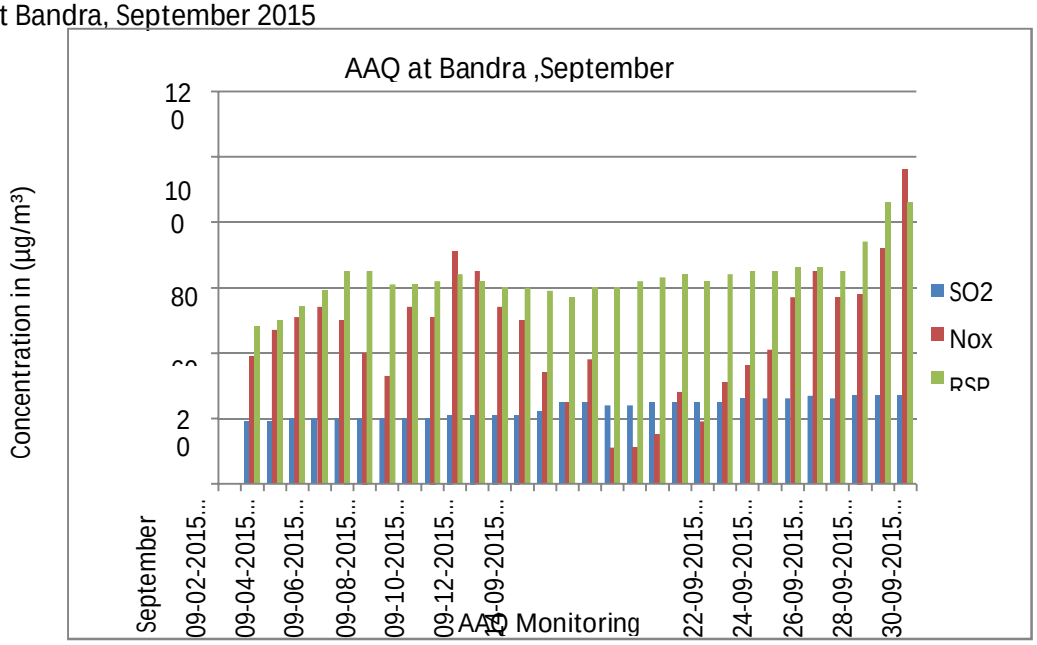


Figure 3.50 AAQ at Bandra, September 2015



Ambient Air Quality: Updated (EIA Feb, 2020)

The fresh baseline ambient air quality monitoring was undertaken twice a day for two weeks for one season. One set of 24 hour average samples were collected continuously for PM10, PM2.5, SO2, NO2 and 8 hourly samples were collected for CO and HC. The PM10 average concentration recorded at all ten monitoring locations ranges from 65 µg/m3 at Marine Drive to 188 µg/m3 at Internation airport.

The PM2.5 average concentration recorded at f 10 monitoring locations ranges from 55.3 µg/m3 at Marine Drive and 66.7 µg/m3 at Azad Maidan.

)..

The concentration of Sulphur dioxide (SO2) along the alignment observed within the CPCB limits of 80 µg/m3 at all monitoring locations.

The concentration of Nitrogen dioxide (NO2) observed within the prescribed CPCB norms of 80 µg/m3 at all locations.

The CO concentration observed along the alignment is within prescribed CPCB norms of 4 mg /m3 at all locations.

Parameters	Cuffe Parade	Near Vidhan Bhawan	Marine Drive Road	Press Club, Azad Maidan	Wilson College (Kalbadevi)	Siddhi Vinayak	Yashshree Building (BKC)	Uttar Bhartiya Bhawan	International Airport	(SEEPZ)
PM10 (in µg/m3)										
Max.	166	168	172	182	142	134	168	169	188	151
Min.	76	72	65	69	76	70	72	76	85	87
Average	120.2	111.6	101.5	128.3	104.2	99.6	103.1	108.5	115	109.1
Limits	100	100	100	100	100	100	100	100	100	100
PM2.5 (in µg/m3)										
Max.	88	89	88	94	84	82	88	88	92	79
Min.	45	42	30	37	36	46	32	42	48	42
Average	67.7	63.3	55.3	66.7	58.7	60.8	60.2	61.6	66.2	58.8
Limits	60	60	60	60	60	60	60	60	60	60
NO2 (in µg/m3)										
Max.	47.4	39.3	51.2	39.1	80	80	44	37.1	41.1	32.4
Min.	18.3	15.2	9.8	12	12.9	14.7	7.3	8.3	21.5	19.8
Average	33.8	28.1	29.3	29.3	27.3	25.3	23.9	25.3	31.9	25.8
Limits	80	80	80	80	80	80	80	80	80	80
SO2 (in µg/m3)										
Max.	41.7	29.4	56.5	29.9	80	80	21.2	28.3	23.7	14.2
Min.	14.6	10	14.2	14.4	8.8	10.1	8.9	9.4	14.1	8.2
Average	24.4	19.8	23.7	19.7	20.9	15.9	13.6	16.3	18.1	11.5
Limits	80	80	80	80	80	80	80	80	80	80
CO (mg/m3)										
Max.	1.5	1.5	1.6	1.5	4	4	1.3	1.5	1.3	1.3
Min.	0.7	0.7	0.7	0.7	0.6	0.6	0.5	0.5	0.8	0.8
Average	1.1	1.0	1.08	1.1	1.1	0.9	1.0	1.0	1.0	1.1
Limits	4	4	4	4	4	4	4	4	4	4
HC (ppm)										
Max.	0.0	0.0	0.2	1.1	0.1	0.0	0.2	0.0	0.1	0.0
Min.	0.0	0.0	0.1	0.1	0.1	0.0	0.1	0.0	0.1	0.0
Average	0.0	0.0	0.1	0.7	0.1	0.0	0.1	0.0	0.1	0.0

3.5 NOISE ENVIRONMENT

Noise pollution is caused by an unwanted sound that is produced by various natural or man- made sources such as oceans, construction, industrial, transportation etc. Noise can have any adverse affects such as hearing impairment; sleep disturbance, interference with speech communication, reduced performance, annoyance and harming physiological functions.

Noise pollution is regarded as a public nuisance under Sections 268, 290 and 291 of the Indian Penal Code. There are several other legislations relating to noise pollution such as The Factories Act, 1948 (under which 'noise induced hearing loss' is notified as a disease); Motor Vehicles Act, 1988 (which specifies rules for horns and silencers); Law of Torts (civil suits can be filed for claiming damages); The Air (Prevention and Control of Pollution) Act, 1981 (ambient noise standards have been given), The Environment (Protection) Act, 1986; Noise Pollution (Regulation and Control) Rules, 2000 and regulations in respect of Loudspeakers/Public Address System. Further, there are standards and guidelines for ambient noise quality, automobiles, domestic appliances and construction equipment, generator sets, and firecrackers as notified under the Environment (Protection) Act, 1986. In general, continued exposure to noise levels above 85 dB would cause hearing loss over time. However, noise above 140 dB could cause aural damage after just one exposure. As a safeguard against harmful noise level, the CPCB has specified standards (National Ambient Noise Standards) for various categories of areas as given below in Table3.13.

Table 3.13 NATIONAL AMBIENT NOISE STANDARDS

TEGORY OF ZONES	Leq IN dB (A)	
	DAY *	NIGHT
Industrial	75	70
Commercial	65	55
Residential	55	45
Silence Zone **	50	40

Noise level survey was conducted along the alignment with an objective to establish the baseline noise levels and assess the impacts of total noise expected due to the proposed metro. Noise levels has been measured at five locations as shown in Figure 3.2. Hourly Noise levels were recorded at 2 m away from source as per standard practice. Sampling duration were taken on hourly basis in the time bracket of 08-10,12-14,16-18,20-22 & 24-02 hours in order to have an assessment of the Day and Night time noise levels. The results of the noise quality has been reported as L , L10, L50, L90, Lmax, Lmin, Lday, Lnight., LDN. eq

The noise levels so obtained are summarised in Table 3.14. The results of observations indicate that the equivalent noise levels at all the five sites are more than the limit prescribed for residential areas.

TABLE 3.14

NOISE LEVELS AT VARIOUS LOCATIONS

Date: 10/01/2012 to

11/01/2012 Location:

Time	Hourly Leq dB (A)	Result dB (A)	
MIDNIGHT	52.8	Leq(24hrs.)	67.0
1:00 AM	50.2	L10	72.7
2	49.5	L50	69.5
3	52.9	L90	67.5
4	49.3	Lday	68.3
5	55.9	Lnight	60.9
6	59.7	Ldn	69.4
7	63.3	Lmax	74.1
8	65.1	Lmin	49.3
9	66.4		
10	68.2		
11	69.4		
12 NOON	73.2		
13	74.1		
14	68.3		
15	67.4		
16	69.2		
17	68.7		
18	65.3		
19	64.2		
20	63.4		

21	68.2
22	63.7
23	58.2

Date: 11/01/2012 to

12/01/2012 Location: BKC

Time	Hourly Leq dB (A)	Result dB (A)	
MIDNIGHT	51.2	Leq(24hrs.)	68.6
1:00 AM	49.4	L10	73.4
2	48.3	L50	71.4
3	47.1	L90	69.2
4	49.6	Lday	70.3
5	52.4	Lnight	53.0
6	58.9	Ldn	68.9
7	61.3	Lmax	74.3
8	65.3	Lmin	47.1
9	68.2		
10	72.4		
11	69.7		
12 NOON	74.3		
13	72.6		
14	73.1		
15	68.3		
16	72.8		
17	71.4		
18	70.1		
19	69.9		
20	68.6		
21	59.3		
22	52.7		
23	50.8		

Dat: 12/01/2012 to

13/01/2012 Location:

SEEPZ

Time	Hourly Leq dB (A)	Result dB (A)	
MIDNIGHT	45.3	Leq(24hrs.)	65.9
1:00 AM	43.9	L10	72.9
2	44.8	L50	68.9
3	45.7	L90	66.5
4	46.9	Lday	67.7
5	49.3	Lnight	46.5
6	52.7	Ldn	66.1
7	53.9	Lmax	73.9
8	55.6	Lmin	43.9
9	59.8		
10 62.5			
11 64.3			
12 NOON 65.9			
13	68.7		
14	66.5		
16	71.7		
17	73.9		
18	72.7		
19	64.3		
20	50.9		
21	49.4		
22	47.9		
23	45.1		

Date: 13/01/2012 to

14/01/2012 Location:

Colaba

Time	Hourly Leq dB (A)	Result dB (A)	
MIDNIGHT	49.3	Leq(24hrs.)	68.2
1:00 AM	48.4	L10	74.3
2	46.5	L50	71.1
3	43.8	L90	68.8
4	49.3	Lday	69.9
5	55.6	50.5	Lnight
6	57.4	Ldn	68.4
7	59.3	Lmax	74.9
8	63.5	Lmin	43.8
9	61.9		
10	65.9		
11	68.2		
12 NOON	70.8		
13	72.9		
14	74.3		
15	73.7		
16	68.0		
17	74.9		
18	73.0		
19	62.3		
20	58.2		
21	56.8		
22	52.1		
23	48.4		

Date: 14/01/2012 to

15/01/2012 Location:

Airport

Time	Hourly Leq dB (A)	Result dB (A)	
MIDNIGHT	52.3	Leq(24hrs.)	68.6
1:00 AM	55.1	L10	74.5
2	68.4	L50	71.3
3	70.2	L90	69.1
4	64.1	Lday	68.6
5	75.6	50.5	68.5
6	73.2	Ldn	74.6
7	69.2	Lmax	75.6
8	62.0	Lmin	49.6
9	71.8		
10	69.3		
11	63.2		
12 NOON	70.2		
13	65.2		
14	59.8		
15	63.4		
16	74.5		
17	70.1		
18	63.8		
19	59.2		
20	55.7		
21	52.1		
22	50.0		
	49.6		

Noise Level Quality : Updated Baseline (EIA Feb, 2020)

Noise Level Results:

Ambient Noise level was monitored at ten (10) locations including residential, commercial and sensitive areas along the alignment (stations, launching shafts, construction depot, and near sensitive receptors as hospital, school, college, etc.).

The noise levels were measured in dB (A) on hourly basis. The noise levels were analyzed as per CPCB /IS: 4954 – 1968 manual. The noise level data was processed for L10, L50, L90, and Leq and for L-day and L-night.

The noise levels at all the locations (Sensitive, Residential and Commercial) were found to be higher than prescribed CPCB standards for Leq day and Leq night time. The observation of noise monitoring was calculated as Leq day and Leq night.

Ambient Noise Results at Sensitive Locations

Locations	High Court	Science Museum	People Mobile Hospital	Siddhi Vinayak	St. Xaviers	Day time Standards dB (A)	Night time Standards dB (A)
Leq-Day	71.1	70.8	70.4	66.8	68.7	50	40
Leq-Night	62.1	60.5	62.9	57.4	61.3	50	40
Leq (Day-Night)	70.3	70.1	69.9	66.2	67.4	50	40

Ambient Noise Results at Residential Locations

Locations	Yashshree Building (BKC)	Uttar Bhartiya Sangh Bhawan	Day time Standards dB(A)	Night time Standards dB(A)
Leq-Day	66.1	66.8	55	45
LeqNight	58.6	59.9	55	45
Leq (Day-Night)	65.7	67.0	55	45

Ambient Noise Results at Commercial Locations

Locations	Azad Maidan	National Test House (SEEPZ)	International Airport	Day time Standards dB(A)	Night time Standards dB(A)
Leq-Day	72.1	68.6	67.4	65	55
Leq-Night	60.7	62.0	61.2	65	55
Leq (Day-Night)	72.6	70.1	68.4	65	55

3.6 Vibration

The source of the vibration and noise during construction of tunnel is due to operation of Tunnel Boring Machine (TBM) and due to metro train during operation phase. The vibration during operation is mainly due to the rolling stock, track and the interaction between them. Continuous effect of vibration on the buildings can cause damage to buildings. Building subjected to the vibration effect with more than 50 mm/s (154 VdB) would receive structural damage. Historic buildings are more susceptible to vibration effect due to type of building material and design. The vibration induced by the operation of train first causes the vibration of track structure as well as tunnel structure, and then, propagate through the strata to the surrounding environment.

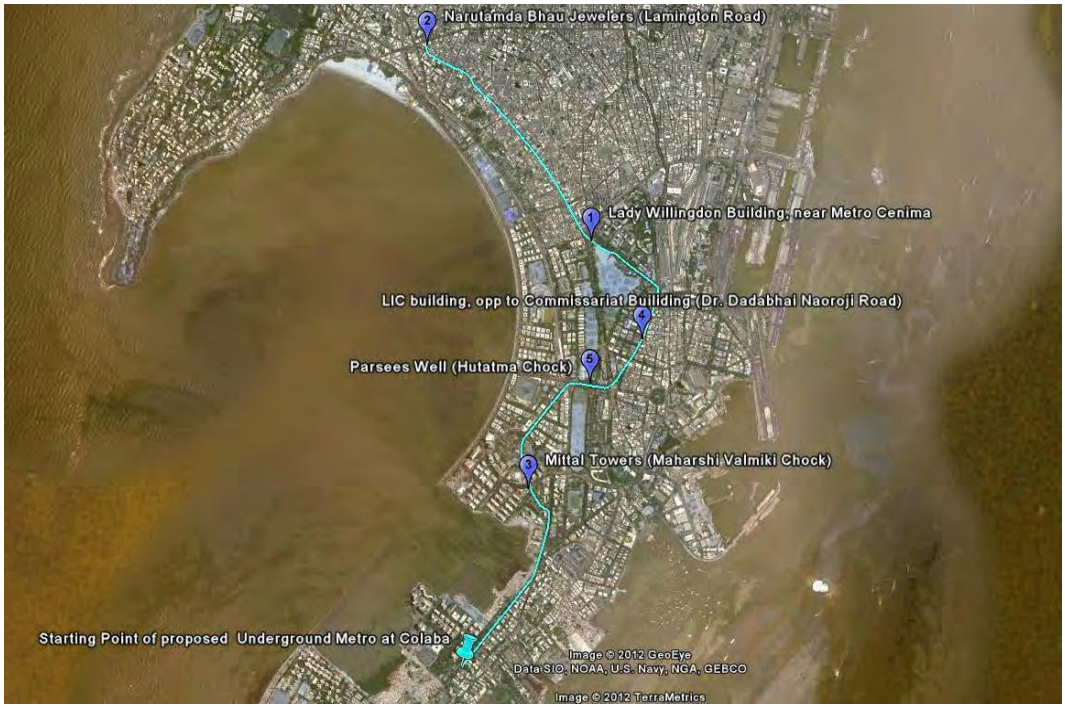
Human response to vibration is subjective and will be different for different people. When the vibrations reach the floors and walls it may result in perceptible vibration depending on the amplitude and frequency of the vibrations. People may be more annoyed if they are exposed to both noise and vibration compared to when only vibration is felt. According to the U.S. Department of Transportation, (1998) the perception threshold of humans for peak particle velocity is about 0.04 mm/s (65VdB with reference 1e-6 inch/sec).

To know the impact of vibration due to TBM operation on the existing structures along the alignment and due to metro train operation has been studied at six locations by selecting the most sensitive area falling on the proposed metro line alignment. The monitoring is carried out using the Nomis Seismographer equipment which can measure the radial, transverse and vertical vibration of ground borne vibration. The detail of location where vibration monitoring has been carried out is given in Table 3.15 and shown in Google map as Figure 3.51. The hard rock structure will be considered while predicting the vibration impact as the proposed metro is 18 to 20 m below the ground level.

TABLE 3.15
VIBRATION MONITORING LOCATION

SI	LOCATION	LATITUDE	LONGITUDE
1	Lady Willingdon Building, Dhobi Talao, near Metro Cenima. Mahapalika Road.	18° 56' 34.64" N	72° 49' 46.57" E
2	Narutamdas Bhau Jewelers, K.Gajanan Vertak Chowk, Lamington Road.	18° 57' 24.59" N	72° 48' 59.58" E
3	Mittal Towers, Maharshi Valmiki Chowk. Press Journal Marg.	18° 55' 30.94" N	72° 49' 30.37" E
4	Central Assurance Building, opp to Commissariat Building, Dr. Dadabhai Naoroji Road.	18° 56' 9.74" N	72° 50' 1.24" E
5	Bhikha, Behram, Parsees Well, Hutatma Chowk.	18° 55' 58.24" N	72° 49' 46.95" E
6	Chhatrapati Shivaji Terminus (CST), Mumbai. DN Road.	18° 56' 23.30" N	72° 50' 06.01" E

FIGURE 3.51
LOCATION OF VIBRATION MONITORING



The vibration study has been conducted to know the existing vibration cause due to the road traffic. The study has been conducted during the busy traffic hours at morning and evening time. The detail description of field monitoring vibration at each monitoring location is given in the subsequent section.

3.6.1 Vibration Monitoring at Location 1: Lady Willingdon Building, DhobiTalao

The Lady Willingdon Building at Dhobi Talao, Mumbai was constructed in 1934; the building won an award from the Heritage Society in 1993 for being in good shape even though it was more than 60 years old at the time. The vibration monitoring has been carried out in front of the building for about 8 hr on 23/01/2012. The location of the monitoring point is shown in Figure 3.52. The monitoring location falls at chainage no. 4400.00 of proposed metro alignment. As per the field observation about 3400 vehicles per hour pass by this chowk, that includes all type of vehicles including two, three and four wheelers.

FIGURE 3.52
VIBRATION MONITORING AT LOCATION LADY WILLINGDON BUILDING, DHOBI

TALAO

The graph has been plotted for the radial, transverse and vertical vibration and shown in old Figure numbers 3.30, Figure 3.31 & Figure 3.32 respectively. The monitoring result shows that, the average radial vibration is 85 VdB which are quite normal vibration due to road traffic. At one point, we have observed peak radial vibration of 119 VdB, this may be due to some passage of heavy vehicle. The average transverse vibration is found to be between 87.5 VdB and the peak transverse vibration is 118 VdB. The average vertical vibration is 88 VdB and the peak vertical vibration is found to be 113.9 VdB and.

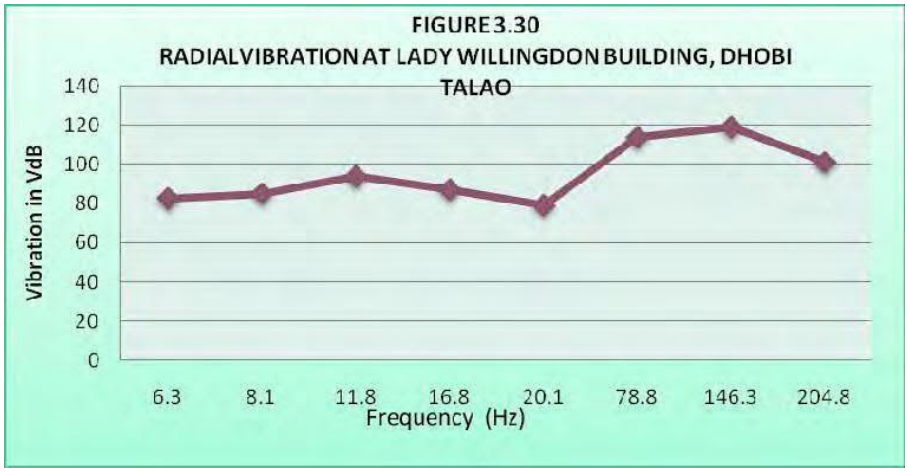


FIGURE 3.30
RADIAL VIBRATION AT LADY WILLINGDON BUILDING, DHOBI TALAO
Vibration in VdB
140
120
100
80
60
40
20
0
6.3
8.1
11.8
16.8
20.1
78.8
146.3
204.8
Frequency (Hz)

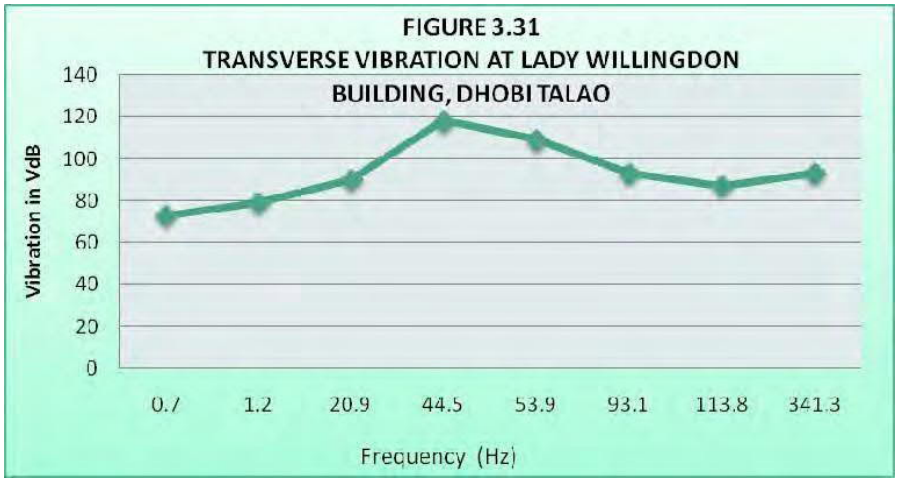


FIGURE 3.31
TRANSVERSE VIBRATION AT LADY WILLINGDON BUILDING, DHOBI TALAO
Vibration in VdB
140
120
100
80
60
40
20
0
0.7
1.2
20.9
44.5
53.9
93.1
113.8
341.3
Frequency (Hz)

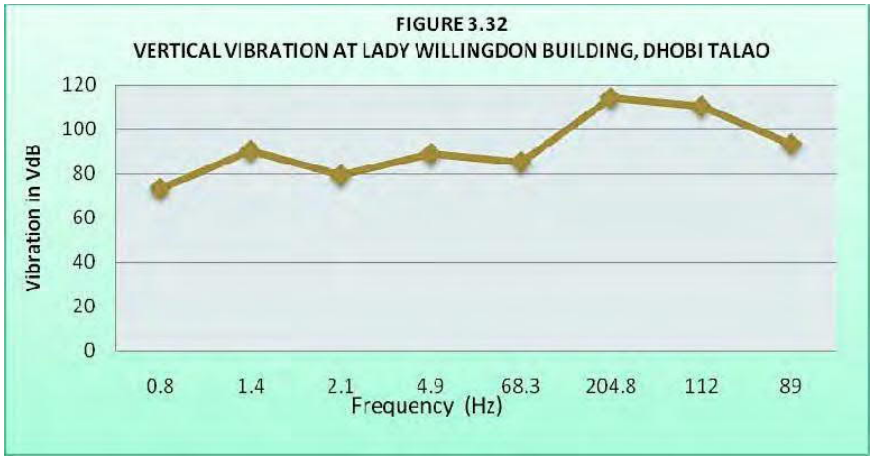


FIGURE 3.32
VERTICAL VIBRATION AT LADY WILLINGDON BUILDING, DHOBI TALAO
Vibration in VdB
120
100
80
60
40
20
0
0.8
1.4
2.1
4.9
68.3
204.8
112
89
Frequency (Hz)

3.6.2 Vibration Monitoring at Location 2: Narutamdas Bhau Jewelers, K.Gajanan Vertak Chowk, Lamington Road

Narutamdas Bhau Jewelers building is more than 100 year old located at the K. Gajanan Vertak Chowk. There are many old structures that are closely located at this chowk. The monitoring location falls at chainage no. 6500.00 of proposed metro alignment. As per the field observation about 3000 vehicles per hour pass by this chowk that includes all type of vehicles including two, three and four wheelers. The location of the monitoring is shown in Figure 3.53.

FIGURE 3.53
VIBRATION MONITORING AT LOCATION LAMINGTON ROAD

The graph of the radial vibration, transverse and vertical vibration has been plotted and shown in old Figure numbers 3.34, Figure 3.35 & Figure 3.36 respectively. The result of the monitoring shows the average radial vibration is 90 VdB, which is because of variation in traffic flow as well as the source is closely located with the point of monitoring. The peak radial vibration is around 101 VdB. The average transverse vibration is found to be 87.5 VdB and the peak transverse vibration is 105 VdB. The average vertical vibration is 105 VdB. The peak vertical vibration is found to be 123.5 VdB this may be due to passing of heavy vehicle.

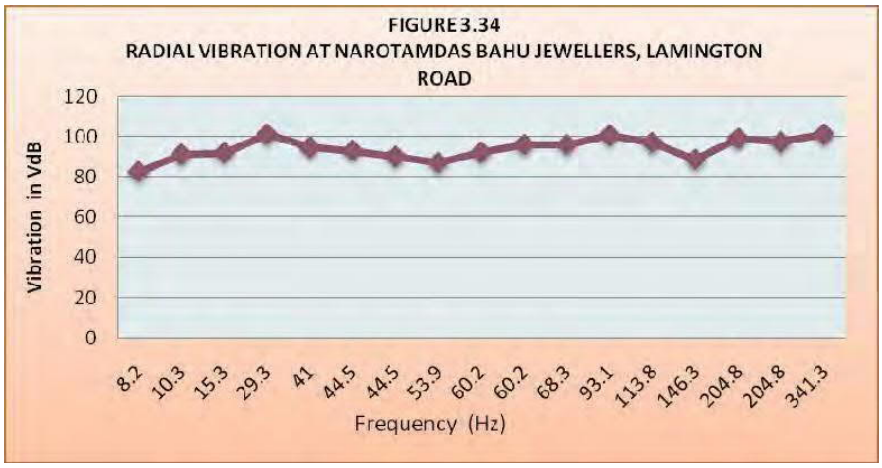


FIGURE 3.34
RADIAL VIBRATION AT NAROTAMDAS BAHU JEWELLERS, LAMINGTON ROAD
Vibration in VdB
120
100
80
60
40
20
0
8.2
10.3
15.3
29.3
41
44.5
44.5
53.9
60.2
60.2
68.3
93.1
113.8
146.3
204.8
204.8
341.3
Frequency (Hz)

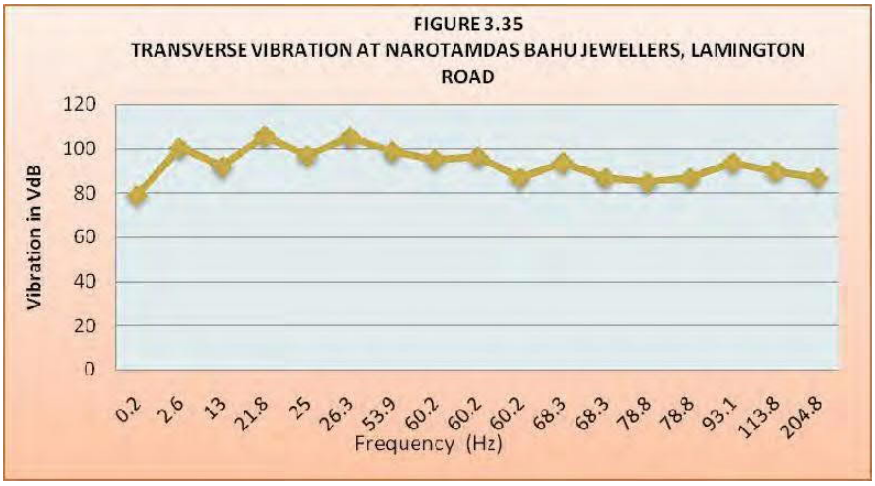


FIGURE 3.35
TRANSVERSE VIBRATION AT NAROTAMDAS BAHU JEWELLERS, LAMINGTON ROAD
Vibration in VdB
120
100
80
60
40
20
0
0.2
2.6
13
21.8
25
26.3
53.9
60.2
60.2
60.2
68.3
68.3
78.8
78.8
93.1
113.8
204.8
Frequency (Hz)

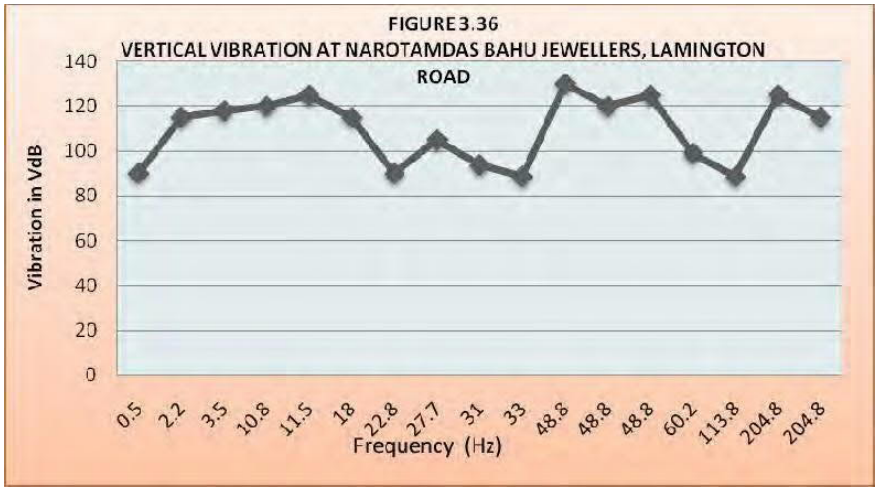


FIGURE 3.36
VERTICAL VIBRATION AT NAROTAMDAS BAHU JEWELLERS, LAMINGTON ROAD
Vibration in VdB
140
120
100
80
60
40
20
0
0.5
2.2
3.5
10.8
11.5
18
22.8
27.7
31
33
48.8
48.8
48.8
60.2
113.8
204.8
204.8
Frequency (Hz)

3.6.3 Vibration Monitoring at Location 3: Mittal Towers, Maharshi Valmiki Chowk

The proposed metro line is passing through the Sh. Maharshi Valmiki chowk near to SBI building and opposite to Mittal towers. Here metro line is passing through the road in between Vidhan Sabha and State Bank of India building. The location of the monitoring is shown in Figure 3.54. The monitoring location falls at chainage no.1600.00 of proposed metro rail alignment. As per the field observation about 1500 vehicles per hour pass by this chowk that includes two, three and four wheelers.

FIGURE 3.54
VIBRATION MONITORING AT LOCATION AT MITTAL TOWERS

The graph has been plotted for radial vibration, transverse and vertical vibration and shown in Old Figure 3.38, Figure 3.39 & Figure 3.40 respectively. The result of the monitoring shows that, the average radial vibration is between 82 to 85 VdB and the peak radial vibration is around 102 VdB. The average transverse vibration is found to be between 83.5 VdB and the peak transverse vibration is 105 VdB. the average vertical vibration is 104 VdB and the peak vertical vibration of the study location is found to be 126 VdB.

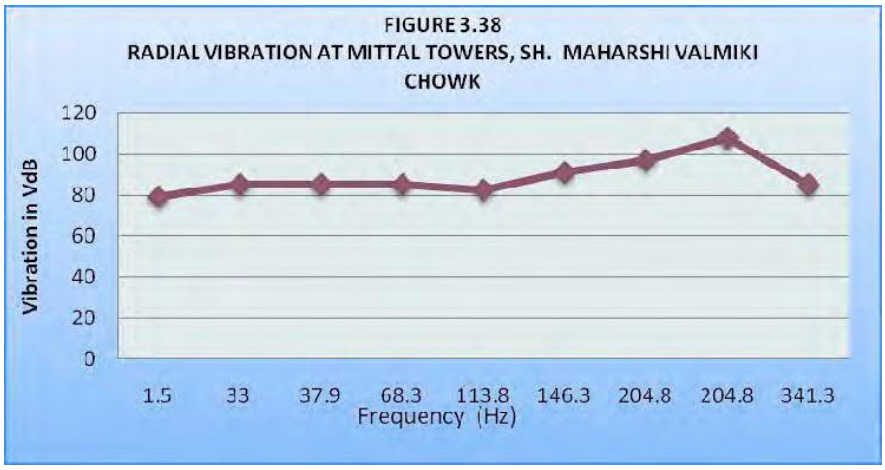


FIGURE 3.38
RADIAL VIBRATION AT MITTAL TOWERS, SH. MAHARSHI VALMIKI CHOWK
Vibration in VdB
120
100
80
60
40
20
0
1.5
33
37.9
68.3
113.8
146.3
204.8
204.8
341.3
Frequency (Hz)

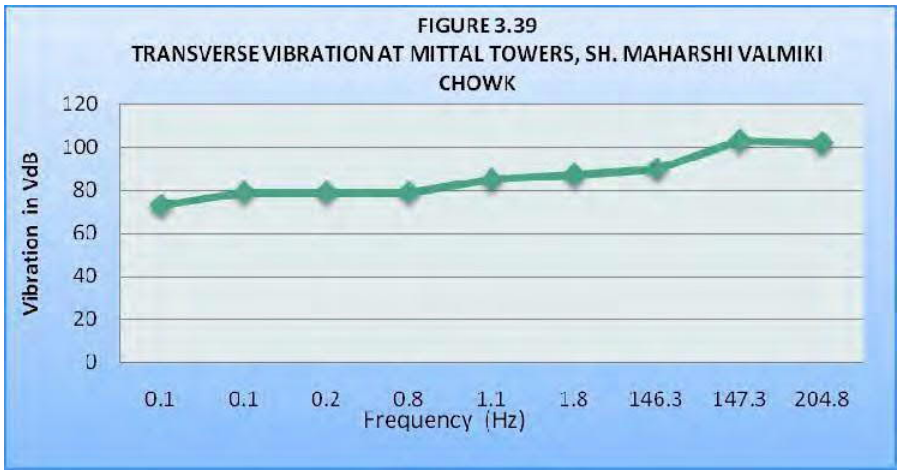


FIGURE 3.39
TRANSVERSE VIBRATION AT MITTAL TOWERS, SH. MAHARSHI VALMIKI CHOWK
Vibration in VdB
120
100
80
60
40
20
0
0.1
0.1
0.2
0.8
1.1
1.8
146.3
147.3
204.8
Frequency (Hz)

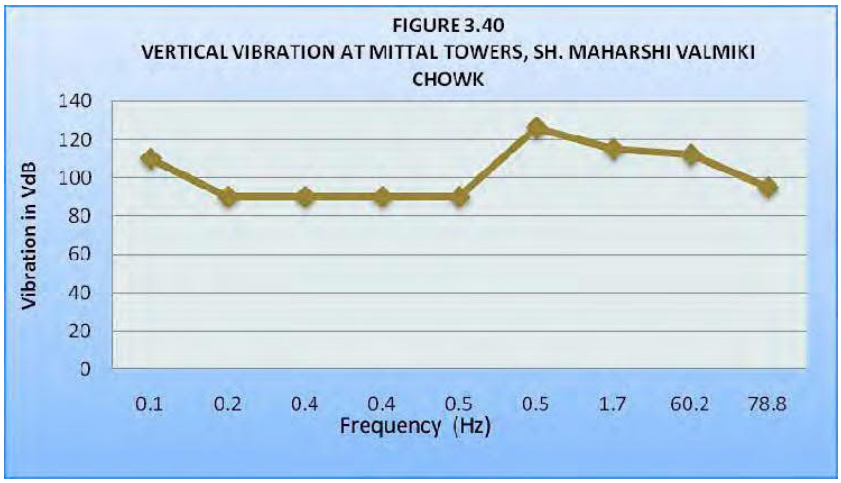


FIGURE 3.40
VERTICAL VIBRATION AT MITTAL TOWERS, SH. MAHARSHI VALMIKI CHOWK
Vibration in VdB
140
120
100
80
60
40
20
0
0.1
0.2
0.4
0.4
0.5
0.5
1.7
60.2
78.8
Frequency (Hz)

3.6.4 Vibration Monitoring at Location 4: Central Assurance Building, opp to Commissariat Building, Dr. Dadabhai Naoroji Road

The Central Assurance Building is one of the oldest building and is also in the list of Heritage structures. The vibration monitoring was carried out in front of the building. The location of the monitoring is shown in Figure 3.55. The monitoring location falls at chainage no. 3280.00 of proposed metro alignment. As per the field observation about 4500 vehicles per hour pass by this road which includes two and four wheelers.

FIGURE 3.55
VIBRATION MONITORING AT LOCATION AT CENTRAL LIC BUILDING, DN ROAD

The graph has been plotted for radial, transverse and vertical vibration and shown in old Figure 3.42, old Figure 3.43 & old Figure 3.44 respectively. The result of the monitoring shows that, the average radial vibration is 85 VdB which is quite normal vibration due to road traffic and the peak radial vibration is 93 VdB. The average transverse vibration is found to be between 86 VdB and the peak transverse vibration is 94 VdB. The average vertical vibration is 112 VdB and the peak vertical vibration of the study location is found to be 124 VdB.

FIGURE 3.42
RADIAL VIBRATION AT LIC BUILDING, DR. DADABHAI NAOROJI ROAD

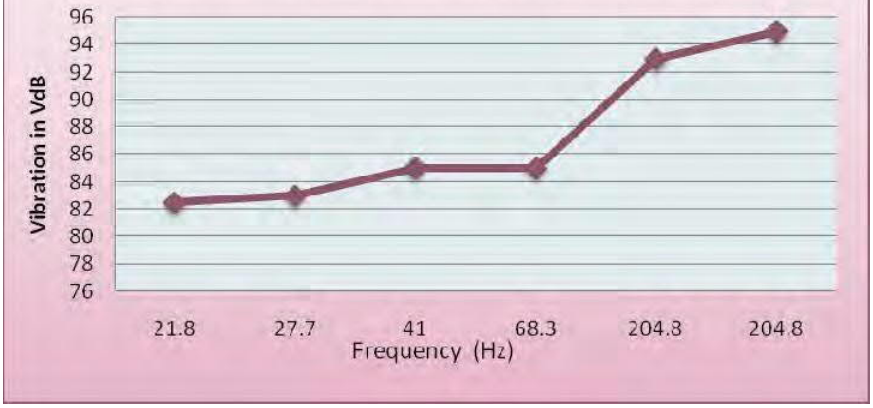


FIGURE 3.43
TANSVERSE VIBRATION AT LIC BUILDING, DR. DADABHAI NAOROJI ROAD

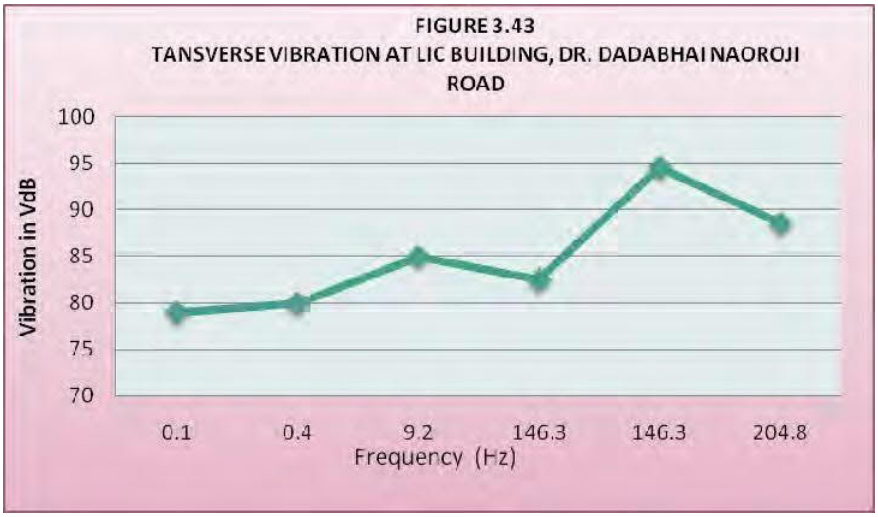
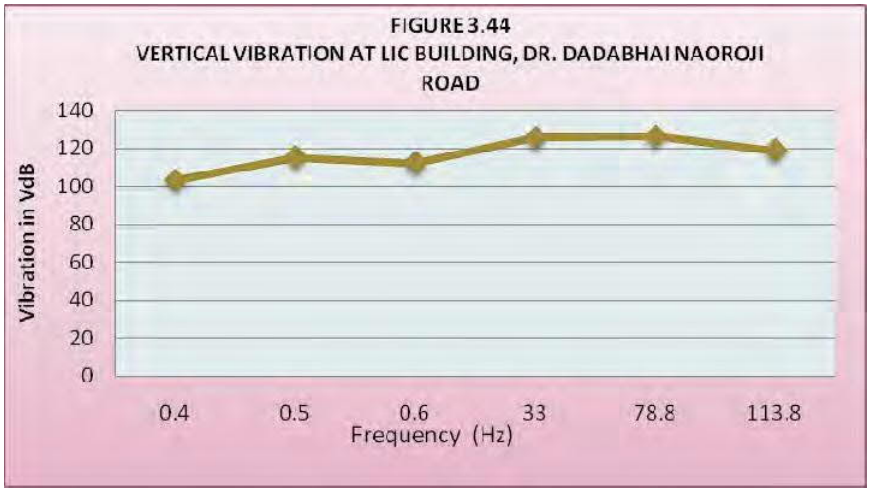


FIGURE 3.44
VERTICAL VIBRATION AT LIC BUILDING, DR. DADABHAI NAOROJI ROAD



3.6.5 Vibration Monitoring at Location 5: Bhikha, Behram, Parsees Well, Hutatma Chowk.

Bhika Behram Well is a freshwater well dug in 1725 by a Parsi named Bhikaji who had come from Bharuch to Mumbai. The well has a perennial source of sweet water, which is remarkable as most of the water in the area is brackish owing to the proximity to the Arabian Sea. The vibration monitoring was carried out in front of Parsees well. The location of the monitoring is shown in Figure 3.56. The monitoring location falls at chainage no. 2700.00 of proposed metro alignment. As per the field observation about 4700 vehicles per hour pass by this chowk.

FIGURE 3.56
VIBRATION MONITORING AT LOCATION AT PARSEES WELL, HUTATMA CHOWK

The graph has been plotted for radial, transverse and vertical vibration and shown in old Figure 3.46, old Figure 3.47 & old Figure 3.48 respectively. The result of the monitoring shows that, the average radial vibration is about 86 VdB and the peak radial vibration is 88 VdB.

The average transverse vibration is found to be 81 VdB and the peak transverse vibration is 83 VdB. The average vertical vibration is 107 VdB and the peak vertical vibration is found to be 113.9 VdB.

FIGURE 3.46
RADIAL VIBRATION AT PARSEES WELL, HUTATMA CHOWK

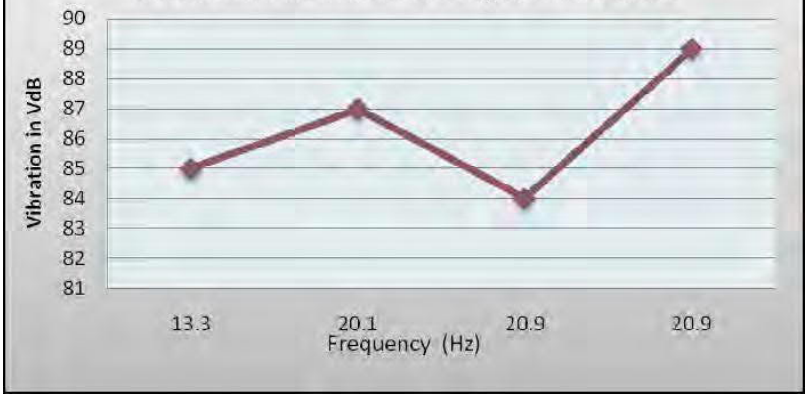


FIGURE 3.47
TRANSVERSE VIBRATION AT PARSEES WELL, HUTATMA CHOWK

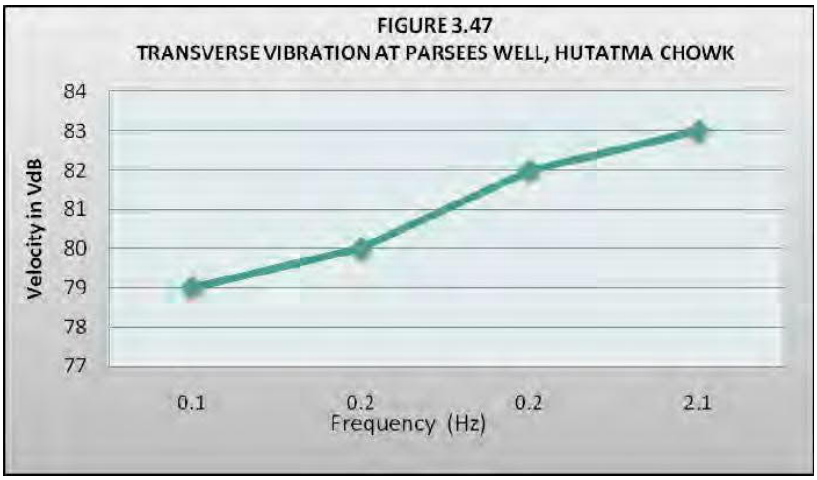
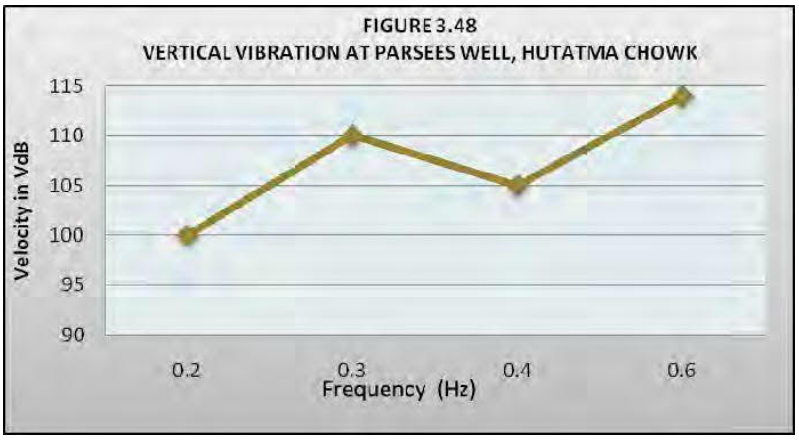


FIGURE 3.48
VERTICAL VIBRATION AT PARSEES WELL, HUTATMA CHOWK



3.6.6 Vibration Impact Assessment at Location 6: Chhatrapati Shivaji Terminus, Mumbai.

Chhatrapati Shivaji Terminus (Victoria Terminal) is one of the very renowned World Heritage structure in India which serves as the headquarters of the Central Railway. Chatrapati Shivaji Terminus building is more than 125 year old located at the heart of South Mumbai. Based on the measured vibration at 5 locations along the corridor, the verticle vibration level for this location would be in the range of 110-126 VdB. The photograph of CST is given in the Figure 3.57. Ambient vibration at this location will be measured prior to the start of construction work, as per the vibration monitoring program given in Table 3.15.

FIGUR
E 3.57
PHOTOGRAPHS SHOWING CHHATRAPATI SHIVAJI TERMINUS BUILDING

The impact of vibration due to TBM operation and train traffic has been predicted using GIS software on the satellite image of study location and using the Pipe-in-Pipe (PiP) model. The vibration analysis is presented in Chapter-4.

(Baseline Vibration) : Updated (EIA Feb, 2020)

Fresh baseline vibration monitoring have been carried out along the alignment `Colaba-Bandra-SEEPZ' during the period March'19 to April '19 at 32 Comparable sites/locations... This involved taking measurements at selected representative locations in the vicinity of anticipated vibration generating activities for MML-3

Total thirty two (32) representative location were finalised along the alignment having comparable developmental activities. These representative locations were selected for baseline vibration monitoring owing to their proximity to the existing road traffic, with the potential to result in ground borne vibration from the passing vehicles etc. . The representative monitoring locations are provided in Table 3-16

. monitoring.

Table 3-16: Selected Sites for Baseline Vibration Monitoring

Sr.No.	Stations	Representative sites	Distance from the station
1	Cuffe Parade NATM station	Parsi Dharamsala	25 m
2.	Vidhan Bhawan Station	Sarang Building	15 m
3.	Churchgate Station	Ground floor, Orbit Export House	30 m
4.	Hutatma Chowk Station	Behind Siddhartha College	25 m
5.	CST Azad Maidan	World Heritage site UNESCO (CST)	30 m
6.	CST Azad Maidan	Launching Shaft (Near Kama Hospital)	25 m
7.	Kalbadevi Station	Kalbadevi NATM inside Gujarati Dharamshala	20 m
8.	Girgaon Station	Mahadev Shankar Bhagwan temple	20 m
9.	Grant road Station	In front of RK silk house MA road	20 m
10.	Mumbai Central Station	Mumbai Central Station Main Entrance Gate	55 m
11.	Mahalaxmi Station	Existing Western Railway crossing / RG Land batching plant backside of Western Railway Yard	35 m
12.	Mahalaxmi Station	In front of Belevodoure Court building	10 m
13.	Science Museum Station	Science Museum Launching Shaft back side	40 m
14.	Achrya Atre Chowk station	Achrya Atre Chowk front of four season hotel	25 m
15.	Worli Station	Worli,front side of sasmira institude	15 m
16.	Siddhivinayak Station	Siddhivinayak launching shaft near national book trust	20 m
17.	Dadar Station	Dadar front of shivsena bhawan	25 m
18.	Shitladevi NATM Station	Shitladevi, near paradise e square	20 m
19.	Naya Nagar Launching shaft	Naya Nagar front of RAHEJA HOSPITAL	40 m
20.	Dharavi Station	Existing Dharavi western railway crossing	25 m
21.	BKC station	BKC _front of income tax office	15 m
22.	Vidyanagari launching shaft	Vidyanagari front of santa Tukaram building.	25 m
23.	Santacruz NATM Station	Santacruz, right side of air force quarters.	18 m
24.	CSIA Domestic Airport	Near ATC Tower	13 m
25.	Sahar Road Station	Sahar Road	18 m
26.	CSIA International Airport	CSIA International Airport Launching shaft	15 m
27.	Marol Station	Cross Over point of existing Metro Line 1 near Marol opposite Medicare hospital	20 m
28.	Pali Ground	Pali Ground Launching shaft in the basement of Cresent tower	28 m

29.	MIDC station	MIDC in front side of ESIC OFFICE	20 m
30.	SEEPZ Metro Station	Near National Scientific Laboratory	20 m
31.	Ramp area	Near Existing western expressway flyover	22 m
32.	AAREY Depot	Depot	15 m

The details of the baseline vibration levels recorded for each representative locations are given in Table 3-17.

Table 3-17: Details of ground born vibration in PPV at Representative Locations

S. No	Representative Location	Recorded Time	Vibration in PPV (in mm/sec)	Dominant Frequency (in Hz)	Recorded Time	Dominant Frequency (in Hz)
1	Parsi Dharamsala	16:16:34	2.858	204.80	16:16:34	27.68
2.	Sarang Building	19:17:33	1.270	68.27	13:07:30	3.04
3.	Orbit Export House	20:39:49	0.254	10.56	19:00:31	20.90
4.	Behind Siddhartha College	20:01:16	0.381	06.36	19:00:53	27.68
5.	World Heritage site UNESCO	19:32:11	1.016	8.46	18:00:54	93.09
6.	Launching Shaft (Monitoring will scheduled & done near Kama Hospital)	08:48:44	0.635	20.08	20:48:17	146.29
7.	Kalbadevi NATM inside Gujarati Dharamshala	19:56:11	0.508	11.77	15:04:18	2.05
8.	Mahadev Shankar Bhagwan temple	11:44:26	1.397	113.78	13:06:46	2.05
9.	In front of RK silk house MA road	14:29:18	3.429	40.96	15:16:25	78.77
10.	Mumbai Central Station Main Entrance Gate	11:00:34	0.889	78.77	09:47:09	1.95
11.	Existing Western Railway crossing / RG Land batching plant backside of Western Railway Yard	10:29:56	1.524	146.29	11:17:46	2.33
12.	In front of Belevodoure Court building	16:34:58	1.905	44.52	15:52:04	5.09
13.	Science Museum Launching Shaft back side	10:40:52	1.143	21.79	14:26:24	4.08
14.	Achrya Atre Chowk front of season hotel	09:18:58	1.276	204.80	09:50:16	78.77
15.	Worli,front side of sasmira institude	11:06:14	2.667	26.26	13:23:19	6.28
16.	Siddhivinayak launching shaft near national book trust	21:21:01	1.143	68.27	17:12:10	78.77
17.	Dadar front of shivsena bhawan	12:41:43	0.762	10.56	08:16:59	68.27
18.	Shitladevi, near paradise e square	16:08:21	1.016	93.09	16:50:06	44.52
19.	Naya Nagar front of RAHEJA HOSPITAL	12:37:34	1.397	9.57	12:37:16	37.93

20.	Existing Dharavi western railway crossing	19:03:57	1.778	40.96	14:14:23	1.97
21.	BKC _front of income tax office	10:21:04	0.889	6.36	12:59:10	2.75
22.	Vidyanagari front of santa Tukaram building.	20:24:37	1.270	341.33	20:57:19	146.29
23.	Santacruz, right side of air force quarters.	07:41:31	0.889	11.01	07:46:23	8.06
24.	Near ATC Tower	17:33:03	0.508	27.68	17:05:41	3.13
25.	Sahar Road	13:02:46	1.397	204.80	10:18:01	146.29
26.	CSIA International Airport Launching shaft	15:24:01	0.635	8.75	15:37:55	2.95
27.	Cross Over point of existing Metro Line 1 near Marol opposite Medicare hospital	10:37:19	1.143	21.79	09:34:10	37.93
28.	Pali Ground Launching shaft in the basement of Cresent tower	20.:10:26	0.381	204.80	19:10:15	146.29
29.	MIDC front side of ESIC OFFICE	21:06:10	0.826	204.80	15:08:19	113.78
30.	Near National Scientific Laboratory	11:37:30	0.889	146.29	13:24:30	113.78
31.	Near Existing western expressway flyover	18:59:20	3.048	15.28	16:07:29	78.77
32.	Depot	13:36:01	0.254	113.78	13:18:26	2.4

The maximum vector sum value of 3.51 mm/s observed at Grant road representative location is less than allowable ppv of 5 mm/second.

System Packages (Baseline Environmental Monitoring): Updated (EIA Feb, 2020)

, Temporary storage and fabrication activities of system equipment are proposed at CTS No. ¾ plot and CTS No. 5 plots at Wadala infront of Anik Depot, Mumbai suburban. The Scope of work for the various contractors includes designing, manufacturing, supply, installation, testing, commissioning and maintaining the Signaling, Rolling stock, automated fare collection system Train Control System, Communication systems, Tunnel ventilation and Environment etc.

Baseline environmental monitoring was carried out during the period, April 2019 to May, 2019.

Ambient Air Quality

The ambient air quality monitoring was undertaken twice a weeks at every locations (2 nos) in the month of May,2019. One set of 24 hour average samples were collected continuously for PM10, PM2.5, SO2, NO2 and 8 hourly samples were collected for CO and HC. Analytical results of the air monitoring are presented in Table 3-18.

The PM10 concentration is found within the prescribed CPCB limits of 100µg/m3 at both the locations. The minimum value recorded was 66.2 µg/m3 at ALSTOM Site office and the maximum value of 87.1µg/m3 recorded at ALSTOM Site office.

The PM2.5 concentration recorded at both the monitoring locations found within the prescribed CPCB limits of 60 µg/m3 .The PM2.5 varied from a minimum of 23.9 µg/m3 to maximum 44.3 µg/m3 at ALSTOM Site office.

The concentrations of sulphur dioxide (SO2) at both the locations observed within the CPCB limits of 80

µg/m3.
The concentrations of nitrogen dioxide (NO2) observed within the prescribed CPCB norms of 80 µg/m3 at both the locations.
The CO concentration observed at two locations varied from less than 0.18 mg/m3 to 0.62 mg/m3. All the values observed for CO do not exceed the permissible standard of not to exceed 2 mg/m3 (monitoring on 8hourly basis) .
.

Table 3-18: Ambient Air Quality Results

Alstom Site Office										
Sr. No.	Date of Monitoring	Week	PM_{10} (µg/m³)	$PM_{2.5}$ (µg/m³)	SO_2 (µg/m³)	NO_X (µg/m³)	CO (mg/m³)			HC (µg/m³)
							06 - 14	14 - 22	22 - 06	
1	06.05.2019	1	70.1	33.0	14.9	25.8	0.37	0.32	0.25	70.3
2	07.05.2019		79.7	29.5	14.0	21.0	0.28	0.28	0.20	45.7
3	16.05.2019	2	77.6	29.5	10.0	14.4	0.44	0.47	0.20	46.6
4	17.05.2019		78.4	42.5	10.8	16.2	0.37	0.30	0.28	17.9
5	20.05.2019	3	73.2	33.9	15.3	21.4	0.56	0.63	0.18	32.7
6	21.05.2019		83.9	29.5	14.6	22.5	0.28	0.43	0.24	28.2
7	30.05.2019	4	66.2	23.9	14.6	20.4	0.28	0.61	0.20	43.2
8	31.05.2019		87.1	44.3	14.8	22.2	0.48	0.48	0.25	24.9
CPCB Limits			100	60	80	80	2			---
Minimum			66.2	23.9	10.0	14.4	0.18			17.9
Maximum			87.1	44.3	15.3	25.8	0.63			70.3

Open Plot near Alstom Office										
Sr. No.	Date of Monitoring	Week	PM_{10} (µg/m³)	$PM_{2.5}$ (µg/m³)	SO_2 (µg/m³)	NO_X (µg/m³)	CO (mg/m³)			Pb (µg/m³)
							06 - 14	14 - 22	22 - 06	
1	08.05.2019	1	66.2	27.8	11.1	17.4	0.57	0.52	0.20	56.0
2	09.05.2019		78.7	32.1	9.8	14.5	0.28	0.50	0.27	65.5
3	13.05.2019	2	74.3	29.1	8.9	13.3	0.56	0.52	0.20	38.6
4	14.05.2019		66.5	33.4	10.2	15.6	0.54	0.37	0.30	48.6
5	23.05.2019	3	71.9	25.2	12.5	21.6	0.62	0.48	0.25	55.0
6	24.05.2019		71.8	26.0	11.8	19.5	0.51	0.35	0.25	63.5
7	27.05.2019	4	64.5	25.6	9.1	13.7	0.62	0.34	0.27	23.5
8	28.05.2019		68.7	37.8	10.2	17.9	0.40	0.62	0.20	34.2
CPCB Limits			100	60	80	80	2			---
Minimum			64.5	25.2	8.9	13.3	0.20			23.5
Maximum			78.7	37.8	12.5	21.6	0.62			65.5

Ambient Noise Quality

Ambient Noise level was monitored at three (03) locations. The noise was measured on hourly basis in dB (A)by class I noise meter IEC -61672-1 (2002-05). The noise levels were analyzed as per CPCB / IS: 4954 –1968 manual. The noise level for each site are processed and calculations were done for L10, L50, L90, and Leq for day and night time period.

The baseline noise levels at all the locations were found generally higher than prescribed CPCB standards for Leq day and night time measured in dB (A).. The results are presented in the Table 3-19.

Table 3-19: Ambient Noise Quality

Week 1			
Location	Alstom Site Office	Open Plot near Alstom Office	Temple near CNG Pump

Date	06.05.19	07.05.19	08.05.19	09.05.19	10.05.19	11.05.19
L_{90}	70.8	69.2	71.5	62.6	63.9	56.9
L_{min}	66.6	63.9	54.7	54.9	59.7	52.7
L_{max}	71.3	70.1	77.3	70.3	67.1	58.4
L_{eq} Day dB(A)	69.7	68.0	69.9	62.4	62.9	56.0
L_{eq} Night dB(A)	69.1	65.5	55.9	56.2	61.3	54.2
Week 2						
Date	16.05.19	17.05.19	13.05.19	14.05.19	13.05.19	15.05.19
L_{90}	53.8	54.3	74.5	64.1	56.2	57.9
L_{min}	50.0	48.9	54.5	53.8	51.2	53.4
L_{max}	54.9	55.8	75.0	67.0	57.1	58.8
L_{eq} Day dB(A)	53.0	53.1	70.4	61.8	55.1	56.8
L_{eq} Night dB(A)	50.9	51.0	65.1	57.1	53.3	55.0
Week 3						
Date	20.05.19	21.05.19	23.05.19	24.05.19	20.05.19	21.05.19
L_{90}	60.9	59.2	74.4	65.7	55.3	54.0
L_{min}	57.0	55.3	53.3	53.8	50.0	49.8
L_{max}	61.9	59.7	76.2	68.2	55.8	55.0
L_{eq} Day dB(A)	60.4	58.6	71.7	63.4	53.6	52.7
L_{eq} Night dB(A)	58.4	56.8	56.6	57.6	51.1	52.0
Week 4						
Date	30.05.19	31.05.19	27.05.19	28.05.19	27.05.2019	28.05.2019
L_{90}	54.0	56.0	66.6	63.7	58.5	55.7
L_{min}	50.7	52.4	55.1	52.6	53.5	51.5
L_{max}	54.4	56.3	70.3	66.0	59.7	56.3
L_{eq} Day dB(A)	53.1	55.1	64.7	61.5	57.3	54.6
L_{eq} Night dB(A)	52.7	54.7	58.5	56.1	55.4	53.0

Surface Water Quality

The surface water sample was from one (01) location and analyzed as per the designated best use classification of Central Pollution Control Board.

The surface water sample was analyzed for parameters as per IS: 10500 standards and the analysis was undertaken as per IS 3025. The surface water quality presented in Table 3-20.

Table 3-20: Surface Water Quality Results

Sr. No.	Parameter	Method of Analysis	Unit	Results (Nallah near open plot area)
1	pH	IS 3025 (Part 11)	--	7.45
2	Turbidity	IS 3025 (Part 10)	NTU	17.9
3	Total Dissolved Solids	IS 3025 (Part 16)	mg/lit	1929
4	COD	IS 3025 (Part 58)	mg/lit	85
5	BOD 3 days 27^{0}C	IS 3025 (Part 44)	mg/lit	20
6	Chloride	APHA 4500-Cl	mg/lit	809.7
7	Salinity	IS 3025 (Part 32)	ppt	1.50
8	Sulphate	APHA 4500-SO4-E	mg/lit	156.3
9	Nitrate	IS 3025 (Part 34)	mg/lit	1.10
10	Total Nitrogen	IS 3025 (Part 34)	mg/lit	48.7
11	Total Phosphate	APHA 4500-P-C	mg/lit	16.8
12	Iron	APHA 3111-B	mg/lit	0.12
13	Calcium	IS 3025 (Part 40)	mg/lit	57.6
14	Lead	APHA 3111-B	mg/lit	<0.01
15	Oil & Grease	APHA 5520-B	mg/lit	1

Soil Quality:

Sample for soil quality analysis was collected from Open Plot near Alstom Office location. Details of Soil Sampling location and results are presented in Table 3-21.

Table 3-21: Soil Analysis Results

Sr. No.	Parameter	Method of Analysis	Unit	Open Plot near Alstom Office
	Date of Sampling			09.05.2019
	Sample Code			NIL/SO/05/19/001
1	pH	IS-2720 (Part-26)		6.75
2	Sodium	**Lab SOP No. NIL/SOP/09	mg/l	260.19
3	Potassium	**Lab SOP No. NIL/SOP/09	mg/l	55.24
4	Chloride	**Lab SOP No. NIL/SOP/03	mg/l	1943.8
5	Nitrogen	APHA 4500-N-C	mg/l	1116
6	Phosphorous	**Lab SOP No. NIL/SOP/13	mg/l	<0.05
7	Organic Matter	**Lab SOP No. NIL/SOP/03	%	19.7
8	Iron	**Lab SOP No. NIL/SOP/10	mg/l	459.96
9	Lead	**Lab SOP No. NIL/SOP/10	mg/l	1.24
10	Manganese	**Lab SOP No. NIL/SOP/10	mg/l	6.20
11	Nickel	**Lab SOP No. NIL/SOP/10	mg/l	1.60
12	Barium	**Lab SOP No. NIL/SOP/10	mg/l	13.16
13	Zinc	**Lab SOP No. NIL/SOP/10	mg/l	3.02
14	Copper	**Lab SOP No. NIL/SOP/10	mg/l	2.03
15	Cadmium	**Lab SOP No. NIL/SOP/10	mg/l	0.04
16	Chromium	**Lab SOP No. NIL/SOP/10	mg/l	2.63
17	Aluminium	**Lab SOP No. NIL/SOP/10	mg/l	240.42
18	Arsenic	**Lab SOP No. NIL/SOP/10	mg/l	0.10
19	Mercury	**Lab SOP No. NIL/SOP/10	mg/l	<0.01
20	Oil & Grease	Soxhlet extraction method	%	0.18

3.7 ECOLOGY

An ecological study 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 no wildlife is envisaged. To have a general understanding of the ecology within project area, brief information about flora and fauna of Mumbai is given below.

3.7.1 Forests/Flora

The forests cover in Mumbai city is 0.45 sq.km and Mumbai Suburban district 33.0 sq. km. which are entirely under the management of the Forest Department. The important species found in the Mumbai forests are Teak, Khair (Acacia Catechu), Sisav (Dalbergia latifolia), Hed (Adina or Nauclea Cordifolid), Kalamb (Stephegyne or Nauclea arvifolia) and Bamboo.

Trees survey has been conducted along the proposed alignment, at station locations

and at depot area. The type of species observed is Gulmohar, Peepal, Coconut Palms, Sirus, Pilkhanand Neem. Approximately 589 trees have been observed along the project alignment at proposed station locations which are depicted in Appendix-3.1. About 1652 trees are observed at depot location at Aarey Milk Colony, which is given in Appendix-3.2. Tree species are Gulmohar, Mango, Ber etc. No rare or endangered species of trees have been noticed during field studies.

The proposed alignment is passing underground at a depth of about 20 m below ground level, hence no mangrove area are getting affected and no issue of CRZ are anticipated for the project.

Update (EIA Feb, 2020)

Stations and allied activities- As part of updation of EIA in the year, 2015 (EIA jan, 2016) the survey of trees along the alignment for stations was carried out in July-Aug, 2015 which identified 4255. Thereafter, detailed engineering of the station plans and allied activities such as entry /exit, ventilation shaft etc was carried out by appointed civil contractors. Total number of trees identified at stations and allied activities and at pylon, casting yards, ramp, traffic diversions, launching shafts etc are 5203. The species of trees observed are Coconut, Neem, Desibadam, Bhend, Asupalav, Sonmohar, Gulmohar, Rain tree, Umber, Pimple, Banyan tree etc.

Car shed depot- Fresh tree survey for car shed depot at Aarey colony area was conducted in the year May, 2017. Total number of trees observed are 3691. The species of trees observed are Rain tree, Kala umber, Banyan tree, Gulmohar, Dhaman, Kate saver, Pimple, Atrun, Subabul, Wawla, Australian babhul etc.

Inventry of the Trees is given in Part-II of the Updated EIA report Feb, 2020.

3.7.2 Coastal Regulation Zone (CRZ) Updated (EIA Jan 2016 & Feb, 2020)

CRZ Notification published by MOEF, GOI on 6th Jan, 2011 under Environment Protection Act, 1986 by superseding the earlier CRZ notification, 1991 has made it mandatory to obtain prior CRZ clearance for the activities proposed in various CRZ categories namely CRZ I,II,III and CRZ IV with the objective to regulate the activities in CRZ areas and to conserve and protect the coastal areas, its unique environment, its marine area and to promote development through sustainable manner.

Mumbai Metro line -3 is an underground project with 26 underground stations and 1 station at grade. The length of alignment is 33.5 km. The underground stations namely Cuffe Parade, Vidhan bhavan, Churchgate, Girgaon, Worli, Sidhivinayak (Partly), Shitladevi, Dharavi and BKC, and its allied activities are falling in various categories of CRZ as per approved Coastal Zone Management plan (CZMP) prepared as per CRZ notification 1991 . Portion of alignment of about 11.676 kms is also falling in various categories of CRZ as per approved CZMP prepared as per CRZ notification 1991.

As per approved Coastal Zone Management Plan (CZMP-1991) the Cuffe Parade station

and allied activities are categorised as CRZ II as the station is proposed within the width of DP road of Prakash Pethe Marg. The Vidhan Bhavan Station and Sidhhivinayak stations and its allied activities are categorised as partly CRZII and Partly CRZIII.BKC and Dharavi stations and its allied activities are categorised as CRZ I and CRZ II. Remaining Stations namely Churchgate, Girgaon,Worli, Shitla devi are falling in CRZ II area. Some area of these stations is also falling in non-CRZ area.The alignment (11.676 kms) is falling in CRZ I,II and water area. Casting yard at BKC is falling in CRZ II area.

In addition to above nine temporary sites mentioned below are also falling in CRZ area.

Sr. No.	Plot No. ref./Ownership	CRZ Status
1	Helipad land; Adj. Backbay BEST Depot Plot No. 97 D BBRS Scheme, Block 6	CRZ II
2	Plot No. 105, BBRS Scheme, Block 4, Colaba,	CRZ II
3	Plot No. 109 , Open land of BMC park, near Badhwar Park on Prakash Pethe Marg,	CRZ II
4	Plot No. 151 B/1 & 151 B/2, Fort, CTS No. 1975 & 1/1975 , BBRS Scheme, Block 5, Land behind Fire Brigade,	CRZ II
5	Road end of Senapati Bapat Marg, Nr. Police Colony and Raheja Hospital Mahim.	CRZ II
6	CTS 343, Land Adjacent to Sion Mahim Road (T Junction)	CRZ II
7	CTS 629 (part), 629/1269, Bandra, 629/1276 BKC, TATA Plot and Court land plot	Partly CRZ-II
8	Land behind World Trade Centre CTS 1/639 and 1A/639 BBRS, Block 5, Plot no. 97/B of Colaba Division	Land is falling in CRZ II area as per the approved CZMP. However, the land is reserved as PG/stadium- MCGM and PG/Gymkhana-MMRDA as per DP of MMRDA (1990). Hence, the

		site is CRZ III area as per the para 8 (v)(e) of the CRZ Notification 2011.
9	Land behind Manora Plot No. 150A, BBRS Scheme, Block 3	Land falls in CRZ II area as per approved CZMP. However, DP of MMRDA indicates the land as No Development Zone. Hence, the site is CRZ III area as per para 8(v)(e) of the CRZ Notification, 2011

Following sites are observed in Non CRZ though application was submitted to the CRZ Authority.

Desai Maidan Part of F.P. No. 484 A TPS-III, Mahim and Naya Nagar Slum Area, Nr. Xaviers Engg. Institute, Mahim.

Land parcel at Wadala for storage and fabrication activities of the equipment of system packages falls in CRZ II and non CRZ as per approved CZMP -1991. Casting yard at BKC falls in CRZ II and CRZ III area as per approved CZMP -1991

In compliance to the provisions of CRZ notification, 2011, MMRC submitted CRZ proposals of various stations,, various land parcels for construction of storage depot and Traction substation and part of the alignment of Colaba –Bandra- SEEPZ Corridor falling in CRZ area to MCZMA for CRZ clearance along with necessary documents.

Maharashtra Coastal Zone Management Authority (MCZMA) has recommended these proposals to concerned planning authorities/SEIAA from CRZ point of view under CRZ notification 2011.

CRZ clearances Obtained Under CRZ Notification 2011:-

- MCZMA recommended the proposals of Cuffe Parade, Churchgate, Girgaon and Shitladevi and allied activities to concerned planning authority from CRZ point of view in CRZ II area. This is a final CRZ clearance.
- MCZMA recommended the proposals of 09 sites for temporary activities (except TSS at Badhwar Park which is permanent activity) and construction of storage depot from CRZ point of view to concerned planning authority in CRZ II and CRZ III area. This is a final CRZ clearance.

- On recommendations of MCZMA, State Level Environmental Impact Assessment Authority (SEIAA) have granted CRZ clearance to Vidhan Bhavan, Worli, Siddhivinayak, Dharavi andBKC stations and allied activities.

- On recommendations of MCZMA, SEIAA have granted CRZ clearance for alignment proposal (11.676 km out of 33.5 km- Colaba – Bandra – SEEPZ) for laying of underground tracks and construction of underground tunnels.

- On recommendation of MCZMA CRZ clearance is granted to BKC casting yard by SEIAA under CRZ notification 2011.
  MOEFCC, Government of India have approved new CZMP prepared as per CRZ notification 2011 and accordingly Vidhan Bhavan station and its allied activities fronting to back bay are falling in non CRZ area as per IRS, Chennai report.

3.7.3 Forest Clearance under Forest (Conservation) Act, 1980: Updated (EIA Jan 2016 & Feb, 2020)

BKC and Dharavi metro station sites along the Mumbai metro line 3 alignments are declared forest area. There are mangroves at BKC site. Though there are no mangroves at Dharavi site it is designated forest area. Under the Forest (Conservation) Act, 1980, final Forest clearance (stage -II) for two under ground Metro stations have been obtained for Dharavi Metro station (0.34 ha) andBKC Metro Station (0.91 ha)from MOEFCC, Government of India.

High Court of Judicature at Bombay have granted leave for removal of mangroves. State forest department has given permission for felling of trees (mangroves) and execution of work at BKC and Dharavi Station sites being a linear project

3.7.4 Mangroves: Updated (EIA Jan 2016 & Feb, 2020)

Mangroves are not only important but crucial for the coastal areas. Mangroves are a salt tolerant species and absorb salinity thereby preventing ingress of saline water into sweet water zone protecting drinking water source. Mangroves are buffers between the land and the sea and also help in controlling hazards at sea. Mangroves not only help in preventing soil erosion but also act as a catalyst in reclaiming land from seas. Mangrove forests and estuaries are the breeding and nursery grounds for a number of marine organisms including the commercially important shrimp, crab and fish species. While there are various benefits of mangroves as forests, their value as "protector of shore-line" is enough to convince for conserving them.

Mangrove patches are observed on the bank of Mithi River which is a tidally influenced water body. Metro underground stations at BKC (0.91 ha) and Dharavi (0.34 ha)sites of Mumbai metro line 3 project are planned partly in mangroves forest area near to Mithi River bank. While 108 No. of mangrove trees (0.91 Ha area) of Avicennia marina species are cleared for construction of BKC metro station, there are no mangroves (0.34 Ha area) in existence at Dharavi metro station site.

Mangroves area at BKC and Dharavi metro station sites is a declared forest and also falls

in Coastal Regulation Zone and thereby attracts the provisions of Forest conservation Act 1980 and CRZ regulations 2011 for diversion of forest land for construction of underground metro stations.. MMRC has obtained all requisite permissions for removal of mangroves. Though, clearance of mangroves for BKC metro station is essential, adequate steps have been taken in consultation with mangroves cell, State Forest Department for Compensatory Afforestation of mangroves vegetation at Koparkhairne Village Dist. Thane in 1 Ha area each in lieu of diversion of forest land for BKC and Dharavi Metro Stations at a standard spacing of 1.5 m x 1.5 m In addition to the compensatory afforestation of mangroves, in Situ mangrove plantation will also be done in consultation with Mangrove Cell, State Forest Department at BKC and Dharavi sites to restore the mangrove vegetation in 0.7 Ha and 0.28 Ha area respectively after the completion of station work. Plans for in-situ plantation have been approved by Mangrove Cell, State forest department.

3.7.5 Fauna

Mumbai is now so populous and overcrowded that it is no more a congenial home for wild animals. Greater Mumbai at present comprises mainly of residential and industrial areas. At present there is no forest in the true sense except the national Park at Borivli, extending over an area of about 19.18 sq. km. Hence, wild life as such is almost extinct from Mumbai. The fauna mainly consists of the common varieties of domesticated animals, such as, cows, oxen, buffaloes, sheeps, goats, pigs, donkeys, and mules. Wild life is now seen only within the National Park. The Tulsi and Vihar lakes are reported to provide a habitat to crocodiles and alligators. The varieties of birds occur in Mumbai city and suburbs and particularly in the National Park are listed in Appendix 3.3. Mumbai is known as a fishing centre from the earliest days and fishing was one of the chief industries during the pre-British epoch. The Kolis (Fisherman) are fishing as their hereditary occupation and
operating from Colaba, Chaupati, Mazagaon, Worli, Sion, Mahim, Bandra, Trombay, Madh, Danda, Vesava, etc. The common species of fishes are Bombil (Harpodon nehereus), Mandeli (Coilia dussumieri), Kolambi (Penacus sp. Actes sp), Rawas (Eleutheronema) etc.

Biodiversity :Flora and Fauna of Sanjay Gandhi National Park

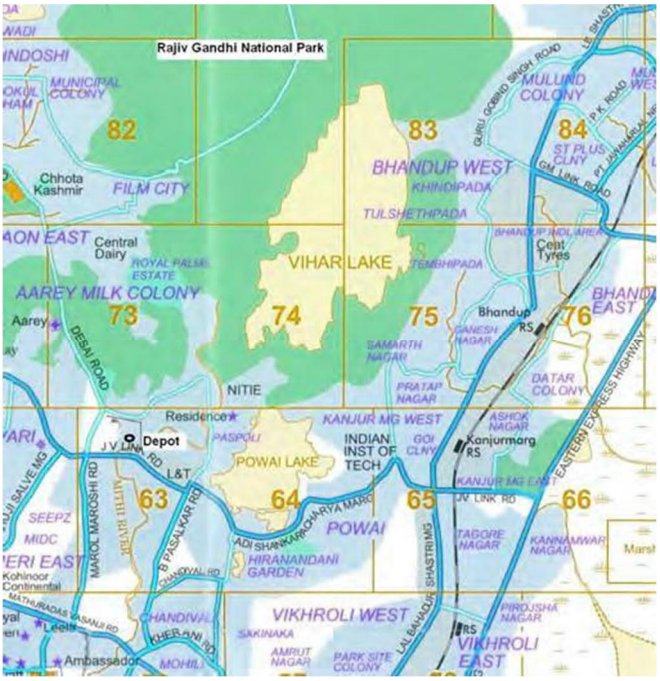
Sanjay Gandhi National Park is the house of 40 species of mammals, 251 of birds, land and water birds, 38 species of reptiles, 9 species of amphibians besides a large variety of fishes. The spectacular flowering of Butea monosperma (Flame of Forests) is a real feast to eye inthe dry month of February to May. The national Park is a bird watcher paradise having Tickell's flower pecker (small bird in India), sun bird (humming birds), majestic white bellied sea eagle, the elusive Trogon and many species of Kingfishers, Woodpeckers, and Drongos.
The varieties of insects found in the park are Silk cotton bugs, Beetles and Mantis.

Sanjay Gandhi National Park, Borivalli is coming within the 10 km radius and at a

distance of 1.65 km from centre of proposed depot having higher contour level than depot area. No wildlife has been observed at the project site. The location of Depot is shown in Figure 3.58.

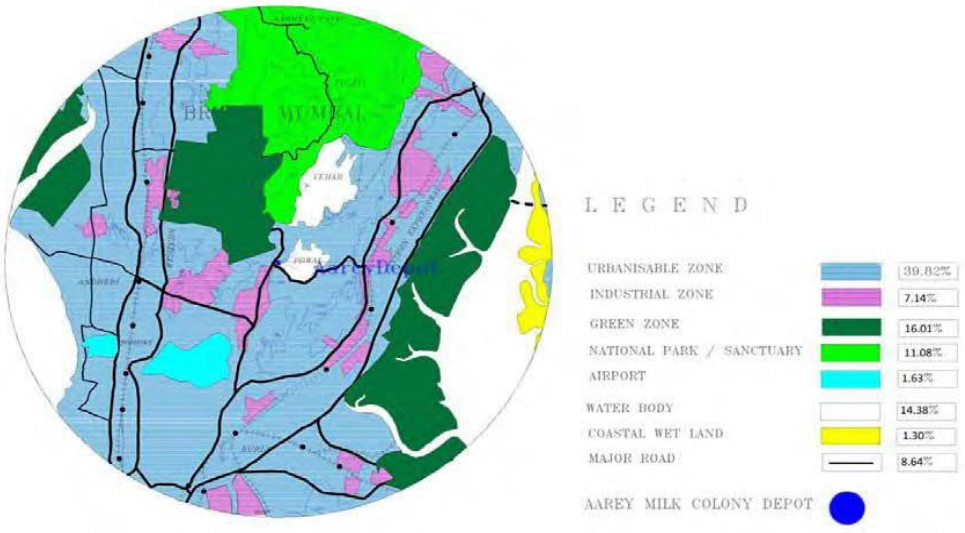
The depot has been planned at Aarey Milk Colony covering an area of 26.407 Ha. A landuse map has been prepared for study area of 10 km radius keeping depot site at centre is given in Figure 3.59.

FIGURE 3.58
LOCATION OF NATIONAL PARK



Depot

FIGURE 3.59
LANDUSE PATTERN OF DEPOT



Mahim Nature Park: Located on the southern bank of Mithi River, and at Bandra-Sion Link Road close to Mahim Nature Park at Mahim. Here the proposed Metro alignment is passing underground. Earlier being the garbage dump, the place was conceived by WWF-India to be a nature park in 1976. MMRC undertook the project to restore and develop the place as sophisticated nature park. The nature park is having the rich greenery.

Updated (EIA Jan, 2016):

The Maharashtra Nature Park (MNP), popularly known as Mahim Nature Park, is one of the larger green areas of Mumbai city. It is situated on the southern bank of the Mithi River in the Dharavi area of Mumbai (approximate location: 19 03 09.38 N, 72 51 42.33 E).

The MNP is spread across an area of approximately 35 acres. Used as a garbage dump till the 1970s, the area was restored to a large woodland through the 1980s.

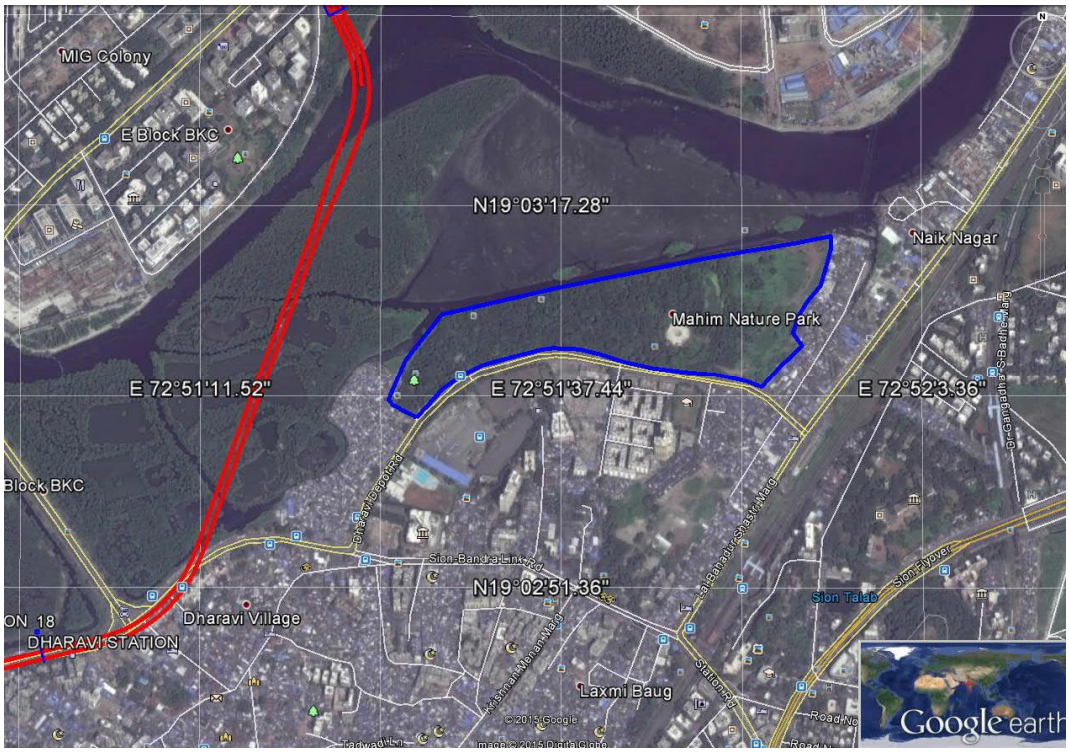
Besides providing habitats to nearly 300 species of plants and over a 100 species of birds, as per recent records, the densely vegetated area is also considered to be one of the green lungs of Mumbai.

The proposed underground alignment of the MML3, between its Dharavi and BKC stations, passes within a distance of 0.5 km of the MNP. The proposed Dharavi station box is located at a distance of less than 1 km to the west of the MNP, while the proposed BKC station box is located less than 1 km to the northwest of the MNP.

. The location of Mahim Nature Park and the alignment of proposed metro are shown in the Google map as Figure 3.60.

Figure 3.60.

LOCATION OF MAHIM NATURE PARK



3.7.6 Updated Section on Ecology: Updated (EIA Jan, 2016)

For the purposes of this section of the report, the area screened for ecological impacts of the proposed project comprises that encompassed within a belt extending 500m either side of the proposed metro-corridor.

From the ecological point of view, the greater part of this largely subterranean metro project is located beyond the realm of the project area's ecosystems. The permanent interface between the proposed project-works and the project-area's ecology occurs mainly at the locations of the metro station-boxes, with their over-ground facilities, and the proposed metro-depot(s)..

This ecological assessment focusses on these aforementioned parts of the defined project area that are likely to be directly impacted, either temporarily or permanently, by the project's construction activities.

The following sections provide an overview of the ecology of the project area, highlight any ecologically sensitive features within, or in close proximity to, the project area and

predict the potential impacts of the project on these ecological receptors.

3.7.6.1 Ecology of the Project Area

Much of the project area is situated within a highly urbanized landscape, and thus, represents an extensively modified habitat. Most of the land-surface is occupied by anthropogenic structures and features, such as residential, commercial and industrial establishments, paved or concretized open spaces, and ground-level or elevated roads, rails and walkways. The natural water channels flowing through the project area have been forded using bridges and culverts, and contained using concrete embankments. The natural ponds and marshes of the project area stand partially or completely reclaimed.

Scattered amidst this vast urban expanse are a few remnant pockets of native vegetation, offering sanctuary to the remaining wild flora and fauna of the project area. Many of these are represented by mere individuals or small groups of native species, surviving on public land or in private premises. The mixed native and alien vegetation, either conserved or planted, in the occasional garden or public-park, or along avenues, serves to provide supplemental near- natural habitats to the project-area's surviving wild flora and fauna.

The sole significantly large natural habitat within the project area is a part of the estuary of the Mithi River, together with its mangrove forests, while the forest of the Sanjay Gandhi National Park is the natural habitat, which is about from the nearest project area.

Species of Conservation Concern

The following species, either designated as globally threatened or near-threatened by the IUCN, or protected under Schedules I or II of the Wildlife (Protection) Act of India - 1972 (WPA), have recorded ranges that coincide with the Mumbai region.

Table3.16: Globally Threatened & Legally Protected Species of Mumbai Region

Sr. No.	Scientific Name	Zoological Group	IUCN Status*	WPA Schedu
1	Loris lyddekerianus	Mammalia	LC	I
2	Macaca radiata	Mammalia	LC	II
3	Semnopithecus entellus	Mammalia	LC	II
4	Moschiola meminna	Mammalia	LC	I
5	Canis aureus	Mammalia	LC	II
7	Panthera pardus	Mammalia	LC	I
8	Felis chaus	Mammalia	LC	II
9	Prionailurus bengalensis	Mammalia	LC	I
10	Prionailurus rubiginosus	Mammalia	VU	I
11	Prionailurus viverrinus	Mammalia	EN	I
12	Viverricula indica	Mammalia	LC	II

13	Paradoxurus hermaphroditus	Mammalia	LC	II
14	Herpestes edwardsii	Mammalia	LC	II
15	Herpestes smithii	Mammalia	LC	II
16	Manis crassicaudata	Mammalia	EN	I
17	Pavo cristatus	Aves	LC	I
18	Dendrocygna bicolor	Aves	LC	I
19	Aythya nyroca	Aves	NT	-
20	Mycteria leucocephala	Aves	NT	-
21	Threskiornis leucocephala	Aves	NT	-
22	Platalea leucorodia	Aves	LC	I
23	Falco chicquera	Aves	NT	I
24	Falco jugger	Aves	NT	I
25	Falco peregrinus	Aves	LC	I
26	Pandion haliaetus	Aves	LC	I
27	Haliaeetus leucogaster	Aves	LC	I
28	Neophron percnopterus	Aves	EN	I
29	Gyps bengalensis	Aves	CR	I
30	Gyps indicus	Aves	CR	I
31	Sarcogyps calvus	Aves	CR	IV
32	Accipiter badius	Aves	LC	I
33	Limosa limosa	Aves	NT	-
34	Python molurus	Reptilia	VU	I
35	Atretium schistosum	Reptilia	LC	II
36	Ptyas mucosa	Reptilia	NA	II
37	Xenochrophis piscator	Reptilia	NA	II
38	Naja naja	Reptilia	NA	II
39	Daboia russelii	Reptilia	LC	II
40	Chamaeleo zeylanicus	Reptilia	LC	II
41	Varanus bengalensis	Reptilia	LC	I

*Conservation status assigned to the species by the International Union for Conservation of Nature and Natural Resources, where CR – Critically Endangered, EN – Endangered, LC – Least Concern, NA – Not Assessed, NT – Near Threatened and VU – Vulnerable

Sources: Vivek Menon, A Field Guide to Indian Mammals; R. Grimmett, C. Inskipp & T. Inskipp, Birds of the Indian Subcontinent; Salim Ali, Book of Indian Birds; Indraneil Das, Snakes & other Reptiles of India; Romulus Whitaker & Ashok Captain, Snakes of India; www.iucn.org

While a considerable part of the project area is far too urbanized to support most of the species listed, individuals or small populations of any of these species could occur at all such places within or around the project area where a remnant natural habitat preferred by the species is available. Significantly large natural or near-natural habitats present within, or in close proximity to, the project area are described in the following section.

These species merit special attention on account of their globally threatened or nationally protected status which highlights their vulnerability as well as their ecological importance. The potential environmental impacts of the project could directly or indirectly affect the individuals or even the local populations of these species.

Habitats of Conservation

Concern Natural Habitats

3.7.6.2 Mangroves of the Mithi Estuary: Updated (EIA Jan, 2016)

A part of the basin of the Mithi River falls within the project area.

This natural drainage-basin is important to the ecology of the Mumbai region. It is an important ecosystem, providing habitats to a diverse range of aquatic life, nurturing other habitats around its channel with the moisture it secures within its hyporrheic zone and transporting nutrients from its higher reaches to the downstream habitats. The river-channel also acts as an important natural corridor for the movement of wild fauna.

The estuary of the Mithi River, also referred to as the Mahim Creek, forms an important interface between some of the freshwater ecosystems associated with the Mithi River and the saline-water ecosystems of the Arabian Sea. Such interface-areas, termed as ecotones, are typically associated with high genetic and species biodiversity.

The mangrove forest surviving on the Mithi's estuarine mudflats performs crucial ecological roles, providing habitats for diverse freshwater and marine flora and fauna, serving as a breeding-ground and nursery for a number of faunal species, many of which are of economic significance to the fisheries of the Indian West Coast, and acting as a physical buffer, shielding the area from the onslaught of tides and storm-waves.

Available secondary data suggests the presence of at least six characteristic mangrove plant species in this forest, many of its original constituent plant species having already been lost, mainly to pollution-related habitat degradation. Other data indicates that Avicennia marina is the most common species of this mangrove forest, followed by Sonneratia apetala and Acanthus ilicifolius. Other mangrove species reported from the Mumbai region include Aegiceras corniculatum, Bruigera cylindrical, Ceriops tagal and Rhizophora mucronata. The average density of mangrove plants in the Mahim-Bandra area is reported to be 27.5 individuals per 25 square metres.

Mangrove forests also contain non-mangrove species, technically termed 'mangrove associates', which are usually to be found growing on their landward fringe.

Mangrove associate species reported from the Mumbai region include Acrostichum aureum, Barringtonia racemosa, Caesalpinia crista, Calophyllum inophyllum, Cerbera odollam, Clerodendrum inerme, Derris heterophylla, Dolichandrone spathacea, Pongamia pinnata, Salvadora persica and Thespesia populnea.

Conservative valuation of the non-quantifiable ecosystem-services provided by Mumbai's surviving mangrove forests has emphasized their cumulative value to the built environment, people and future security of Mumbai. In the light of climatic change, sea-level rise andrelated emerging sustainability challenges, the need for conserving and restoring these mangrove forests gets reinforced. Currently, this mangrove forest, as are all mangrove forests on public land throughout the state of Maharashtra, is a legally protected area designated as a Protected Forest, and likely to be re-designated as a Reserve Forest.

The ecological integrity of this river and its estuarine mangrove forest, already under considerable anthropogenic pressure, could be further disturbed by project-related activities.

Sources: V. Vijay et al, "Mangrove Mapping and Change Detection around Mumbai", Indian Journal of Marine Sciences, Vol. 34(3)310-315(2005); Leela J. Bhosale, Mangroves of Maharashtra (2005); Mark Everard et al, "The Benefits of Mangrove Systems to Mumbai", Aquatic Conservation: Marine and Freshwater Ecosystems, Vol. 24(2)256-274(2014); www.mangrovecell.org

3.7.6.3 Sanjay Gandhi National Park

The Sanjay Gandhi National Park, a legally protected area designated as a National Park, and, therefore, possessing the highest protection status granted under Indian Law, is situated at a distance of less than 2 km of the northern part of the project area. This protected area, covering 104 square kilometres, is a recorded habitat of several faunal species accorded special protection under Schedules I and II of the Wildlife (Protection) Act of India (1972). It also possesses the distinction of being the largest protected area in the world contained within the limits of a city.

Classified, as per the Champion and Seth System for classification of Indian Forest Types, as a Southern Moist Mixed Deciduous Forest, this forest is reported to contain over 1300 species of plants. Some of the typical species of trees, shrubs, climbers, forbs and grasses that constitute this forest, and consequently, may be deemed more or less native to the Mumbai region, are listed in the table that follows.

Table 3.17 : Common Plant Species of Sanjay Gandhi National Park

Sr. No.	Species	Habit	Family
1	Alangium salvifolium	Tree	Alangiaceae
2	Ampelocissus latifolia	Climber	Vitaceae

3	Anogeissus latifolia	Tree	Combretaceae
4	Apluda mutica	Grass	Poaceae
5	Argyreia nervosa	Climber	Convolvulaceae
6	Argyreia sericea	Climber	Convolvulaceae
7	Arundinella pumila	Grass	Poaceae
8	Baliospermum montanus	Forb	Euphorbiaceae
9	Bauhinia foveolata	Tree	Caesalpiniaceae
10	Bauhinia racemosa	Tree	Caesalpiniaceae
11	Blumea sp.	Forb	Asteraceae
12	Bombax ceiba	Tree	Bombacaceae
13	Borassus flabellifer	Tree	Arecaceae
14	Bridelia retusa	Tree	Euphorbiaceae
15	Butea monosperma	Tree	Fabaceae
16	Butea parviflora	Climber	Fabaceae
17	Butea superba	Climber	Fabaceae
18	Callicarpa tomentosa	Tree	Verbenaceae
19	Calophyllum inophyllum	Tree	Clusiaceae
20	Calycopteris floribunda	Climber	Combretaceae
21	Canavalia gladiata	Climber	Fabaceae
22	Capparis sepiaria	Shrub	Capparaceae
23	Careya arborea	Tree	Myrtaceae
24	Carissa congesta	Shrub	Apocynaceae
25	Cassia fistula	Tree	Caesalpiniaceae
26	Catunaregam spinosum	Tree	Rubiaceae
27	Clerodendrum inerme	Shrub	Verbenaceae
28	Coix lachryma-jobi	Grass	Poaceae
29	Combretum albidum	Climber	Combretaceae
30	Cordia dichotoma	Tree	Boraginaceae
31	Curcuma pseudomontana	Forb	Zingiberaceae
32	Cynodon dactylon	Grass	Poaceae
33	Cyperus exaltatus	Forb	Cyperaceae
34	Cyperus nutans	Forb	Cyperaceae
35	Dalbergia lanceolata	Tree	Fabaceae
36	Dalbergia latifolia	Tree	Fabaceae
37	Dendrocalamus strictus	Tree	Poaceae
38	Derris trifoliata	Climber	Fabaceae
39	Dicanthium annulatum	Grass	Poaceae
40	Digitaria ciliaris	Grass	Poaceae
41	Dillenia pentagyna	Tree	Dilleniaceae
42	Diospyros montana	Tree	Ebenaceae
43	Entada rheedi	Climber	Fabaceae
44	Eragrostis pilosa	Grass	Poaceae
45	Eranthemum roseum	Forb	Acanthaceae
46	Erythrina stricta	Tree	Fabaceae
47	Ficus hispida	Tree	Moraceae
48	Ficus racemosa	Tree	Moraceae
49	Firmiana colorata	Tree	Sterculiaceae

50	Flacourtia indica	Shrub	Flacourtiaceae
51	Garuga pinnata	Tree	Burseraceae
52	Glochidion sinicum	Shrub	Euphorbiaceae
53	Gmelina arborea	Tree	Verbenaceae
54	Grewia nervosa	Shrub	Tiliaceae
55	Grewia tiliaefolia	Tree	Tiliaceae
56	Haldinia cordifolia	Tree	Rubiaceae
57	Haplanthodes verticillatus	Forb	Acanthaceae
58	Helicteres isora	Shrub	Sterculiaceae
59	Heterophragma quadriloculare	Tree	Bignoniaceae
60	Heteropogon contortus	Grass	Poaceae
61	Holarrhena pubescens	Tree	Apocynaceae
62	Holoptelea integrifolia	Tree	Ulmaceae
63	Ipomoea pes-caprae	Climber	Convolvulaceae
64	Ipomoea pes-tigridis	Climber	Convolvulaceae
65	Ischaemum semisagittatum	Grass	Poaceae
66	Ixora arborea	Tree	Rubiaceae
67	Kydia calycina	Tree	Malvaceae
68	Lagerstroemia parviflora	Tree	Lythraceae
69	Lawsonia inermis	Shrub	Lythraceae
70	Leea macrophyla	Forb	Vitaceae
71	Malachra capitata	Shrub	Malvaceae
72	Mallotus philippensis	Tree	Euphorbiaceae
73	Mammea suriga	Tree	Clusiaceae
74	Mangifera indica	Tree	Anacardiaceae
75	Manilkara hexandra	Tree	Sapotaceae
76	Memecylon umbellatum	Tree	Melastomaceae
77	Mimusops elengi	Tree	Sapotaceae
78	Mitragyna parvifolia	Tree	Rubiaceae
79	Morinda pubescens	Tree	Rubiaceae
80	Mukia maderaspatana	Climber	Cucurbitaceae
81	Murraya koenigii	Shrub	Rutaceae
82	Neuracanthus sphaerostachys	Forb	Acanthaceae
83	Oroxylum indicum	Tree	Bignoniaceae
84	Pandanus furcatus	Tree	Pandanaceae
85	Phoenix sylvestris	Tree	Arecaceae
86	Phyllanthus reticulatus	Shrub	Euphorbiaceae
87	Pogostemon benghalensis	Shrub	Lamiaceae
88	Pongamia pinnata	Tree	Fabaceae
89	Pterocarpus marsupium	Tree	Fabaceae
90	Radermachera xylocarpa	Tree	Bignoniaceae
91	Rungia pectinata	Forb	Acanthaceae
92	Salvadora persica	Tree	Salvadoraceae
93	Schleichera oleosa	Tree	Sapindaceae
94	Securinega virosa	Shrub	Euphorbiaceae
95	Semecarpus anacardium	Tree	Anacardiaceae
96	Setaria pumila	Grass	Poaceae

97	Sida retusa	Forb	Malvaceae
98	Solanum violaceum	Forb	Solanaceae
99	Spondias pinnata	Tree	Anacardiaceae
100	Sterculia guttata	Tree	Sterculiaceae
101	Sterculia urens	Tree	Sterculiaceae
102	Streblus asper	Tree	Urticaceae
103	Strobilanthes sp.	Shrub	Acanthaceae
104	Syzigium cumini	Tree	Myrtaceae
105	Tamarix ericoides	Shrub	Tamaricaceae
106	Tectona grandis	Tree	Verbenaceae
107	Terminalia bellerica	Tree	Combretaceae
108	Terminalia crenulata	Tree	Combretaceae
109	Themeda quadrivalvis	Grass	Poaceae
110	Thespesia populnea	Tree	Malvaceae
111	Tinospora cordifolia	Climber	Menispermaceae
112	Trema orientalis	Tree	Ulmaceae
113	Trichosanthes cucumerina	Climber	Cucurbitaceae

114	Trichosanthes cuspidata	Climber	Cucurbitaceae
115	Typha angustifolia	Forb	Typhaceae
116	Ventilago maderaspatana	Climber	Rhamnaceae
117	Woodfordia fruticosa	Shrub	Lythraceae
118	Wrightia tinctoria	Tree	Apocynaceae
119	Ziziphus mauritiana	Tree	Rhamnaceae

This forest is reported to contain the natural habitats of at least 40 species of mammals, 251 species of birds, 38 species of reptiles and 9 species of amphibians, critical species amongst which are listed in the section on Species of Conservation Concern earlier in this report.

Sources: Botanical Survey of India, Flora of the Sanjay Gandhi National Park; H. G. Champion & S. K. Seth, A Revised Survey of the Forest Types of India; www.bnhsenvis.nic.in; www.mahaforest.nic.in

Modified Habitats

3.7.6.4 Mahim Nature Park, Dharavi

The Maharashtra Nature Park (MNP), popularly known as Mahim Nature Park (approximate location: 19° 03' 09" N, 72° 51' 42" E), situated on the southern bank of the Mithi River in the Dharavi area, is a planted woodland covering approximately 35 acres of land and serving as one of the larger green spaces of Mumbai city.

The proposed underground alignment of the MML3 between the Dharavi and BKC stations, spanning a length of approximately 1 km, passes within a distance of 0.5 km to the west and northwest of the MNP. The proposed Dharavi station box is located at a distance of less than 1 km to the west of the MNP, while the proposed BKC station box is located less than 1 km to the northwest of the MNP.

BPT Garden, Colaba

Sagar Upavan, also known as BPT Garden or Mumbai Port Trust Garden (approximate location: 18° 54' 37" N, 72° 49' 25" E), situated in the Sassoon Docks area of Colaba, is a botanical garden covering approximately 50,000 square metres and serving as one of the green spaces of the area. The proposed Cuffe Parade station of MML3 is situated less than 350 metres to the west of the garden.

3.7.6.5 Colaba Woods Garden, Colaba

Colaba Woods, (approximate location: 18° 54' 45" N, 72° 49' 08" E), situated in the Cuffe Parade area of Colaba, is a garden covering approximately 30,000 square metres and serving as one of the green spaces of the area. Some of the accessory areas associated with the garden, comprising mainly a tennis court, a basket-ball court, a children's playground, a plant- nursery and public walkways, fall within the proposed project-area of the Cuffe Parade station of MML3, while the main garden area is situated within 50

metres of it.

There are few more gardens which are within 500 m of the proposed alignment. The names of these gardens are as given below in Table 3.18 :

Location	Sensitive Receptor	Distance	Side
Cuffe parade Station	Colaba Woods Garden	Crossing	
Inter Station alignment Cuffe pared -Vidhan Bhawan	Badhwar park (Heritage Building Western Railways Officer Flat)	19m	RHS
Inter Station Alignment Churchgate -Hutatma Chowk	Park	25m	LHS
Inter Station Alignment Churchgate -Hutatma Chowk	Oval Park	Crossing	
CST Metro Station	Azad maidan	Crossing	
Siddhi Vinayak Temple Metro Station	Prabha Devi Garden	Crossing	
Siddhi Vinayak Temple Metro Station	sane Guru Ji garden	Crossing	
Dadar metro Station	Verma garden	25m	LHS

3.7.4 Potential Ecological Impacts of the Project: Updated (EIA Jan, 2016)

Removal of Trees

The chief ecological aspect of the project area to be directly and unavoidably impacted by this project is the trees that will need to be removed to clear the twenty-six proposed station-box sites for construction activities.

As per the primary data obtained through a detailed tree survey, a total of 4255 trees exist collectively at these twenty-six sites. While all of these trees are unlikely to require removal, the actual number of trees affected is expected to be confirmed only once construction contractors assess the concerned sites for their construction space requirements. This ecological assessment assumes the worst-case scenario of all the trees surveyed requiring removal.

The tree-survey data indicates that the species and individuals involved are a near equal mix of native and alien species.

While the loss of any tree, whether native or alien, shall lead to the loss of the basic regulating services that any tree provides, such as carbon sequestration, temperature regulation, water regulation and primary production, the loss of the native trees among them shall lead to loss of additional ecological services that only native species provide,

such as provisioning services in terms of food, roosts, tools, nesting materials and nest-sites for native flora and fauna, supporting services such as soil-replenishment, pollinator-services and primary production, as also, cultural services such as aesthetic or religious value to the local communities.

The trees include large numbers of keystone species such as Ficus benghalensis, Ficus glomerata and Ficus religiosa. Such trees are recognized as miniature ecosystems in themselves, with a single tree capable of supporting a rich biodiversity and providing an array of ecosystem services. Many of these Ficus trees, as also, some of the other native species, such as Mangifera indica, Pongamia pinnata, Syzygium cumini and Tamarindus indica, are old- growth trees that are fully developed and support well-established communities of dependant organisms.

Many of the trees concerned are likely to be the sole surviving relics of erstwhile natural forests and are likely to be providing crucial habitat-needs to surviving populations of wild fauna in the concerned areas. They are also likely to be acting as vital wildlife corridors connecting remnant patches of natural vegetation in the surrounding areas.

The tree survey also records a few dead trees. Standing dead-wood serves as a preferred perch for birds of prey, and also as a nesting-site for certain groups of birds, such as Barbets and Woodpeckers.

Construction Activities

The various activities that are part of the construction-phase of the project are likely to affect the ecology and biodiversity of the project-area through one or more of the following impacts:

Loss and/or Degradation of Biodiversity

Any construction-phase activity that involves clearing, digging or mining of land results in loss of plant numbers/species growing on that land, leading to loss/degradation of the natural vegetation of the area.

Such loss/degradation of natural vegetation entails:

i) Loss of the over-ground plant-systems (canopy and stems) protecting the underlying soil from the impact of rain, wind and sunlight
ii) Loss of the under-ground root-system holding the soil-particles together and protecting it from erosion by water-flows and wind
iii) Loss of habitats created by different features of the natural vegetation, such as trunk-buttresses, stem-hollows, bark-crevices, branches, foliage, root-network, leaf-litter, shrubbery, grass-mats, etc., which act as camouflage, roosts or nest- sites for local wild fauna
iv) Loss of resources provided by different features of the natural vegetation, such as bark, stem-fibres, leaves, flower-nectar, fruits, seed-floss, etc., which

act as food or nesting materials for local fauna

v) Loss/fragmentation of microhabitats/habitats, leading to loss of access to habitat- features previously available to the local population of any given local faunal species

vi) Isolation of parts of a previously integrated population of any given local faunal species, leading to an unviable number of individuals required to sustain a healthy

population of the concerned species, as well as, inbreeding within the isolated populations of the concerned species, leading to its genetic weakening

vii) Loss of numbers of individuals, species and/or ecosystems, leading to overall loss/degradation of genetic/species/ecosystem biodiversity of the area

viii) Loss of provisioning, regulatory, supportive and cultural ecosystem- services provided by the natural vegetation to all the organisms of the area (including humans), such as water, primary production, temperature-regulation, soil-formation, nutrient-recycling, pollinator-services, aesthetic services, etc.

Loss and/or Degradation of Soil

Any construction-phase activity that involves digging or mining of land, or paving/concretization of the land-surface, results in loss and/or degradation of the natural soil-structure, as well as, disturbance to the natural soil-profile.

Such loss or degradation of soil leads to:

i) Loss of the nutrient-rich top-soil layer – an especially valuable natural resource, in view of both, the primary-productivity it supports and the exceptionally long time required for its formation – resulting either from erosion or from mixing with underlying nutrient-poor soil-layers

ii) Loss of habitats previously available to soil flora and fauna

iii) Alteration of ecologically significant soil-features of the area, such as, drainage- rate, water-percolation rate, water-holding capacity, etc. resulting from alteration of the physical properties of soil, such as permeability, porosity, slope-angle, etc.

Pollution of Natural Resources

Any construction-phase activity that involves wilful or inadvertent release of polluting materials into the natural environment results in pollution of various ecosystem resources such as air, water and soil, as also, contamination of the organisms inhabiting that environment. The disposal of debris generated during construction phase of the project would have minimum impact on soil or water quality as the chemicals/materials used during drilling work are stable compounds and will not react to the natural soil and water.

The chemicals and fuels which shall be stored on construction sites shall be stored in proper manner and any accidental spill if occurs shall be controlled by providing Spill control kits on all the sites.

Contaminated organisms can, in turn, contaminate all or part of the food-webs which they are a component of.

Pollution of natural resources leads to either unnatural presence or unnatural quantities of the concerned pollutants in an ecosystem, leading to:

i) Disruption of the natural physical and chemical reactions involved in the functioning of the ecosystem

ii) Death or degradation in the quality of life of the organisms inhabiting the ecosystem, thereby disrupting the natural biogeochemical cycles and flow of energy in the ecosystem

Both processes hinder the optimal functioning of the concerned ecosystems and compromise their ability to deliver various ecosystem-services to the community inhabiting the area.

3.8 SOCIO- ECONOMIC CONDITIONS (EIA 2012 & Update EIA Feb, 2020)

Development of proposed Mumbai Metro (Coloba-Bandra-SEEPZ) involves acquisition of land for stations, running sections, TSS, Depot and for other facilities. For different components of this corridor, out of total 37 hectare requirement of land, 1.39 hectare private land and 35.61 hectare government land shall be acquired. The detailed socio-economic assessment and resettlement action plan for the proposed project is being presented in separate report i.e., Social Impact Assessment for Mumbai Metro Corridor (Coloba-Bandra-SEEPZ).

3.9 Socio Economic Survey Update (EIA Feb, 2020)

The Socio economic survey was carried out during September 2013 to 5 October, 2015 to assess the impact of proposed metro rail project. Some corrections in the name of PAPs and minimization of impact on structures have incorporated during updating SIA in the month of October 2017. A structured and pre-tested questionnaire was used to collect detailed information about households who are going to be affected by the proposed project and to document the project impact on their assets, incomes and livelihood. The objective of the Socio economic survey was generate an inventory of social and economic impacts on the people affected by the project; type of impact, type of ownership, social profile of the affected people, poverty status, the presence of the non – titleholders in the project area, also views of the affected PAPs about the project an on various options for rehabilitation and resettlement. The major findings and magnitude of impacts are discussed in the following sections. List of PAPs of each affected area is given in Field Data Report (Volume-II).

OVERALL PROJECT IMPACT

Following table indicates overall project impacts 107.36 ha of land shall be acquired for the purpose of temporary and permanent usages. Total 2888 structures of residential, commercial, residential cum commercial and others were identified in the area to be

affected by the project. Based on the property identification, the number of PAFs has been determined. Total number of PAFs identified is about 2766. This number may change as the data for Girgaon and Kalbadevi is not fully incorporated till even. Since number of cases are pending with competent authority for redressal of grievances. Out of total identified 2766 affected families, 778 PAFs are titleholders and 2110 PAFs are non-titleholders. About 1959 PAFs and 807 PAFs (766 commercial and 41residential cum commercial) will loss their residential and business respectively. About 187 vulnerable families will be affected.

OVERALL PROJECT IMPACTS

Sr. No.	IMPACT	MAGNITUDE
1	Acquisition of Land (in Ha)	107.36
2	Impact on Structures (No.)	2888
2.1	Impact on PAPs	7273
2.2	Total PAFs (No.)	2766
2.3	Surveyed PAFs	2766
2.4	Surveyed PAPs	7273
3	Titleholder (No.)	778
4	Non-Titleholder (No.) (including others)	2110
5	Loss of Residence	1959
6	Loss of Business	807
7	Vulnerable PAPs	187
8	Impact on Community Resources	122

A details of structures, huts, families and persons likely to be affected are presented in Table-3.11. Out of total 152 buildings, about 30 buildings (734 families) would be affected permanently due to Girgaon and Kalbadevi Station work and 122 buildings (government and private offices and other structures like public toilets, religious structures) are also getting affected. Approximately 1988 jhugies/ huts, including commercial structures are also getting affected due to metro rail - 3 project.

Table 3.11 : Details of Structures, Jugies and Families

Sr. No.	Description	No	Details
1.	No of Building Structures	152	Commercial, Residential, office buildings
2.	No of Jugies/huts	1988	Residential, Commercial and R+C Structures on government land excluding other structures
3.	No of Families	2766	
4.	No of persons	7273	

The figures of total PAFs/No. of persons is subject to change in respect of affected families of Girgaon and Kalbadevi Stations ## ## some grievances are yet to be finalized by competent authorities however benefit of temporary shifting is provided to all affected families/persons.

Approach & Methodology

A Socio-Economic Survey (SES) was undertaken for the proposed corridor to assess the socio-economic conditions of project-affected families/people and to examine the impacts of the proposed corridor on these conditions. On the basis of alignment drawings and field visits it was noted that approximately 2766 families would be affected as the plots of these families are touching the proposed metro rail corridor. During the social survey, it was observed that approximately 73% families are squatters which needed relocation/compensation. The social survey in these affected areas was conducted by using random sampling method. About more than 10 % (152 families) of total affected families from major locations along the alignment which represent the whole stretch of proposed corridor were randomly selected for analysing their socio- economic conditions. The primary data for the study was collected through interviews with the project-affected people by using structured household questionnaire.

Demographic and Social Profile of the PAFs

Demographic & Social Profile

Demographic and social profile of project affected families and persons is presented in Table 3.12. Sex Ratio is a very helpful indicator to know the participatory share of males and females in a region, which is also an important indicator for human development index. Among the surveyed population, it is observed that there are 3206(52.90%) males and 2854(47.10%) are females. There are 893 females against 1000 males. This shows that male are slightly preponderate in the sample.

It is evident from the table that majority (31.53%) of family members belong to the age group of 18-34 years; 16.68% belong to the age group to 35-44 years and 16.19 % belong to 45-59 years. Remaining 28.15% are below 18 years and 7.45%of family members are above 60 years respectively. The majority of the population are Hindus (55%), followed by those belonging to Muslims (28%), Buddhist (10%), Christian (1%) and others like Sikh (1%) and Jain(5%). A look at the data regarding the caste heritage reveals that the majority of the people (71%) come from General Category But the second largest group of the people in project-affected areas belong to Other Backward Castes (12 %), followed by those coming from Scheduled Caste (10%). It is observed that 19.23% persons has studied up to primary, 50.75% studied up to High School, 12.90 studied up to Higher Secondary and 13.42% are graduates. It is important to be noted that 19.15% of project affected people are illiterate. Illiteracy was found more in Jhugies/Jhupdi areas.

TABLE 3.12 : SOCIO-DEMOGRAPHIC PROFILE

SR. NO	DESCRIPTION		VALUE
1	Sex Ratio (females per 1000 males)		893
	Male		3206 (52.90%)
	Female		2854 (47.10%)
2	Religious Group		
	HINDU		55%
	MUSLIM		28%
	BUDDHIST		10%

	CHRISTIAN		1%
	SIKH		1%
	JAIN		5%
3	Social Group		
	General		71%
	SC		10%
	OBC		12%
	ST		5%
	NT		1%
	VJ		1%
	ADIVASI (1 No.)		0.06%
4	Language		
	MARATHI / KONKANI		47%
	HINDI / BHOJPURI		32%
	URDU		1%
	TAMIL / TELUGU / MALAYALAM		4%
	TULU / KANNADA		7%
	GUJARATI / MARWADI / RAJASTHANI		5%
	ENGLISH / GOAN		1%
	BANGALI		1%
	TRIPURI / NEPALI / UDIYA /		1%
	PUNJABI / SINDHI		1%
	WARLI (1 No.)		0.06%
5	Age Group		
	< 18 Years		28.15%
	18-34		31.53%
	35-44		16.68%
	45-59		16.19%
	>60		7.45%
6	Marital Status		
	Married		53.86%
	Unmarried		42.83%
	Others		3.31%
7	Family Size		
	Small (Less than 2)		29.19%
	Medium (3-5)		53.81%
	Large (> 5)		17%
8	Type of Family		
	Nuclear		61.88%
	Joint		23.57%
	Single		14.55 %

Educational Attainment

Sr. No.	DESCRIPTION	VALUE
1	Literacy Level	
	Literate	80.85%
	Illiterate	19.15%
2	Education Level	
	Primary	19.23%
	High School	50.75%
	Higher Secondary	12.90%
	Graduate	13.42%
	Technical	3.7%

Economic Conditions of PAFs

The economic condition of PAFs describes occupational pattern, family income, and number of earning and dependent members. The occupational pattern includes work in which the head of the project affected families are involved. The family income includes income of all the earning members. The earning members include the people who work and earn to contribute to the family; however, dependents include housewife, children, elderly people and others who cannot work and earn. About 30% of families reported less than ₹ 2500/- monthly income. About 9% of families' monthly income is between ₹ 2501 to 5000/-. About 29% of families' monthly income is between ₹ 5001 to 10000/-, 32% of families' income is more than ₹ 10001/-. The average income of a family is ₹4720/- per month. (Table 3.2).

An attempt was made to collect the information about loan taken by the family for various purposes. Our keen interest was to see the housing loan, or the loan taken for either purchase of new house or renovation of the house. If the family has equal income and expenditure or less income and more expenditure, to manage the daily expenses, the family has to avail the loan and it is another aspect to measure the economic status of the family. It is important to mention here that most of the respondents did not want to give the information on the issue of indebtedness. Only eight surveyed families have availed loan for one or the other purpose.

TABLE 3.2: ECONOMIC CONDITIONS OF PAF

Sr. No.	DESCRIPTION	VALUE
1	Avg. Monthly Income	4720.00
2	Monthly Household Income (in ₹)	
	UPTO Rs. 2,500/-	30%
	Rs. 2,501/- to Rs. 5,000/-	9%
	Rs. 5,001/- to Rs. 10,000/-	29%
	Above Rs. 10,001/-	32%

Details of Structures

The project affects government, private and community property resource structures. These structures are mainly of three uses - residential, commercial, and residential cum commercial and

others. The study identified three types of structures, based on construction material of the wall and floor/roof, which are: kaccha (temporary) structures, which largely consist of mud/straw walls with tile roof; semi-pucca made of wooden walls with tin/roof, and pucca (permanent)- these are made of brick or concrete walls with concrete and/corrugated tin roof.

Table 3.4 indicates that of total affected structures 66.94% are residential, 27.11% are commercial, 1.49%are residential cum commercial and 4.46%is of other types. The structures are classified in to two categories. 3.68%of the structures are kaccha, 96.32% pucca. Further the age of the structures is also collected for valuation of the structures. 13.64% of the building structures are constructed before 1960, 2.88% of the building structures are constructed during 1961-1970, 15.03% during 1971-1980, 21.72% during 1981-1990, 37.56% during 1991-2000, 4.38% during 2001-2010 and only 4.79% are constructed after 2010. 97.41% have electric connections, 76.39% have water connections of BMC, and 99.13% have phone/mobile connections in their house

TABLE 3.4 INFORMATION ON STRUCTURE

Sr. No.	DESCRIPTION	VALUE
1	Use of Structure	
	Residential	66.94%
	Commercial	27.11%
	Residential-cum- Commercial	1.49%
	Others	4.46%
2	Type of Construction	
	Kaccha	3.68%
	Pucca	96.32%
3	Age of Structure (Year of Construction)	
	<1960	13.64%
	1961-1970	2.88%
	1971-1980	15.03%
	1981-1990	21.72%
	1991-2000	37.56%
	2001-2010	4.38%
	2011 and after	4.79%
4	Utility Connection	
	Electricity	97.41%
	Water	76.39%
	Phone/ Mobile	99.13%

Update Land Acquisition: (EIA Feb, 2020)

Development of proposed Mumbai Metro Line III (Coloba-Bandra-SEEPZ) involve acquisition of land for stations, running sections, TSS, Depot and for other facilities. For different components of this corridor. Out of the total 107.36 hectare requirement of land, 2.55 hectare of private land and 104.81 hectare of government land shall be acquired. The details of land requirement for different components of the project is given in below Table. Acquisition of this private land may cause social disruption and economic loss for the project affected families/people. While implementing the project, there is a need to take into account these disturbances and losses due to the project, their impact on socio-economic condition of the people and plan for their mitigation measures to minimize any negative impacts. Considering the above, a sample Socio-Economic Survey (SES) was undertaken in order to assess the socio-economic condition of Project Affected Families/People and to examine the impacts of the proposed metro rail system on these conditions.

Land Requirement in sq. mtr

Sr. No.	Particulars	Permanent Land Requirement		Permanent Below Ground		Temporary Land Requirement	
		Govt.	Private	Govt.	Private	Govt.	Private
1	Depot	29.79	0.00	0.00	0.00	0.00	0.00
2	Stations	1.50	1.24	0.61	0.14	29.03	0.99
3	TSS	0.58	0.15	0.04	0.00	0.00	0.03
4	Ventilation Shaft	0.02	0.00	0.00	0.00	0.10	0.00
5	Pylon Shifting	0.72	0.00	0.00	0.00	0.00	0.00
6	Property Development	3.00	0.00	0.00	0.00	0.00	0.00
7	Construction Depot	0.00	0.00	0.00	0.00	7.30	0.00
8	Casting Yard	0.00	0.00	0.00	0.00	28.01	0.00
9	TBM Launching Shaft	0.00	0.00	0.00	0.00	0.39	0.00
10	Track	0.00	0.00	0.00	0.00	3.72	0.00
	Total	35.61	1.39	0.65	0.14	68.55	1.02

Total Govt.	104.81 ha
Total Private	2.55 ha
Abandon Quaries (Temporary Land) in sq.mtr	
Dapode	22.93 ha
Mahape	10.00 ha
Kalwar/ Bhiwandi	19.32 ha
Ambernath (Plot no. 12(A))	6.11 ha
Ambernath (Plot no. 8 & 9)	1.68 ha
Total	60.04 ha
The above land is not included in above chart.	

3.10 HISTORICAL SITES

In 1972, the General Conference of UNESCO adopted a resolution with overwhelming enthusiasm creating thereby a 'Convention concerning the protection of the World Cultural and Natural Heritage'. The main objectives were to define the World Heritage in both cultural and natural aspects; to enlist Sites and Monuments from the member countries which are of exceptional interest and universal value, the protection of which is the concern of all mankind; and to promote co-operation among all Nations and people to contribute for the protection of these universal treasures intact for future generations.

The proposed alignment is passing closer to three historical monuments and given in the Table 3.20. Chhatrapati Shivaji Terminus (formerly Victoria Terminus) is the World Heritage Cultural Properties located at 40 m from the centre of the proposed metro alignment. Brihanmumbai Municipal Corporation Building located on Mahapalika Marg is declared as Historical Monuments and is 22 meter from the centre of the proposed metro alignment. The location of historical monuments and its distance from the centre of proposed alignment are shown in Google map as Figure 3.61, Figure 3.62 respectively.

TABLE 3.20

HISTORICAL MONUMENTS WITHIN VICINITY OF MML3 ALIGNMENT

Sr. No.	HISTORICAL MONUMENTS	DISTANCE FROM CENTRE OF METRO ALIGNMENT
1	CST Railway Station	40 metre
2	BMC Building	22 metre
3	Western Railway Head Quarter	45 metre

FIGURE 3.61

CST RAILWAY STATION & BMC BUILDING AT DN ROAD

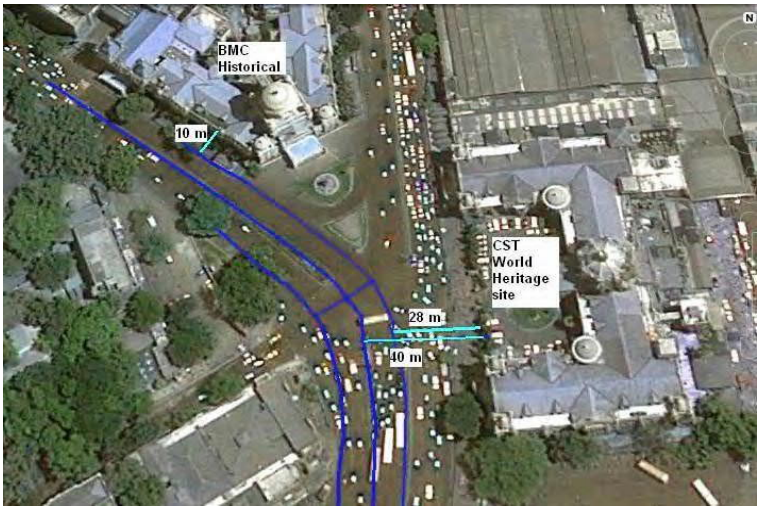


FIGURE 3.62
WESTERN RAILWAY HEAD QUARTER ON JAMSHETJI TATA ROAD

3.11 SENSITIVE RECEPTOR

A drawing showing sensitive receptor like school, colleges, hospitals, place of worship, monuments/Statue structures etc. within 100 m on either side of metro is prepared and enclosed at last of the report in plastic pouch. The list of sensitive receptor is tabulated in Table 3.21.

TABLE 3.21
LIST OF SENSITIVE RECEPTOR

Sr. No.	Description	Within 100 m on Either side
1	Education Institutions(Schools and Colleges)	13
2	Hospital	22
3	Temple	21
4	Mosque	05
5	Church	06
6	Monuments/Statue	08
7	Nature Park	01
	Total	76

3.9 Tree Inventory: Updated (EIA Feb, 2020)

The tree inventory of stations, allied activities and car shed depot, for which the permissions are received from Tree authority, MCGM is covered in updated EIA- Feb, 2020 Part-II along with Tree summary.

CHAPTER–4 NEGATIVE ENVIRONMENTAL IMPACTS

4.1 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. The process begins by identifying the development and operational activities resulting from the proposed project as contained in Chapter-2 and Chapter-3 is dedicated for providing information on the baseline environmental conditions for various parameters.

Attempts have been made to predict the impacts due to proposed project. The pollutants generated due to the proposed project premises during construction and operation phases are solid, liquid and gaseous in nature. This section identifies and appraises the negative impacts on various aspects of the environment likely to result from the proposed development.

- Land Environment,
- Water Environment,
- Air Environment,
- Noise Environment,
- Biological Environment and
- Socio-Economic Environment

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

Update (EIA Feb, 2020)

Based on project particulars and existing environmental conditions, potential negative impacts likely to result from the proposed development have been identified. Negative impacts have been listed under the following headings:

- Impacts due to project location
- Impacts due to construction works, and
- Impacts due to project operation.

4.2 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,
- Impact on Historical and Cultural Monuments, and
- Impact on Local Transport Facilities

4.2.1 Project Affected People (PAPs)

The proposed Mumbai metro rail project shall cause involuntary displacement of people along the alignment, which shall include both title holder and non-titled holder land owners. The issue of Rehabilitation and Resettlement (R&R) is addressed in a separate SIA report.

4.2.2 Change of Land Use

Development of proposed Mumbai Metro Line III (Coloba-Bandra-SEEPZ) involves acquisition of land for stations, Depot, TSS, Cut & Cover station and for other facilities. For different components of this corridor, out of total 45.81 hectare requirement of land,
4.72 hectare private land and 41.08 hectare government land shall be acquired. The details of land requirement for different components of the project are given in Table 4.1. Acquisition of the private land may cause social disruption and economic loss for the project affected families/people. While implementing the project, there is a need to take intoaccount these disturbances and losses due to the project, their impact on socio-economic condition of the people and plan for their mitigation measures to minimise any negative impacts.

TABLE 4.1LAND REQUIREMENT (Ha)

S.NO	PARTICULARS	PERMANENT LAND REQUIREMENT		TEMPORARY LAND REQUIREMENT	
		GOVERNMENT	PRIVATE	GOVERNMENT	PRIVATE
1	Depot	26.407	--	-	-
2	Stations	1.49	3.23	-	-
3	TSS	0.4	0.2	-	-
4	Cut & Cover Station	-	-	1.84	0.067
5	Construction Depot	-	-	10.95	1.23
Total		28.297	3.43	12.79	1.29

Source: DPR

From the data it could be concluded that out of total permanent land requirement about 89.58 % land to be acquired is from Government and 10.42% from private sector. The compensation for land is included in Social Impact Assessment Study Report.

4.2.3 Loss of Trees/Forests

The proposed alignment of metro rail is in urban/ city area and not passing through any forest. Hence no loss of forest is anticipated. The trees are getting affected only at stations and at depot location since proposed alignment is underground. There are 589

trees observed along the alignment at station locations and 1652 trees are at depot (Refer Section3.7.1).
Hence the total number of trees observed on project site area is 2241. It is observed from the tree survey that, out of total 70% (i.e 1568) of the tree has girth below 1 metre which will be transplanted and remaining 30% (i.e 673) of the trees needs to be cut. With removal of these trees the process of CO2 absorption and O2 production will get affected and the losses are reported in TABLE 4.2. The loss of tree will have short term Heat-Island Phenomenon and would be mitigated after construction due to afforestation. The loss of tree will have short term heat-island phenomenon and would be mitigated after construction due to afforestation.

TABLE 4.2
OXYGEN DEFICIT DUE TO TREE LOSS

SI	DESCRIPTION	QUANTITY
1.	Total no. of Trees to be cut	673
2.	Increase in CO_2 @ 21.8 Kg/year/ tree	14672 kg
3.	Decrease in Oxygen production @ 49 Kg/year/ tree	32977 kg

According to Clean Development Mechanism one tonne of CO increase will yield one Carbon credit and 6 Euros (1Euro = Rs.69.00) is earned by one carbon credit. Total loss of carbon credit is 14.67 ton per year due to cutting of 673 trees. About 32,977 kg of Oxygen production will get reduced because of tree loss and loss of Rs. 18.32 lakh (32977 (kg of O_2) X 55.55 (Rs./Kg of O_2) is anticipated.

4.2.4 Utility/Drainage Problems

There will have no impact on utility and drainage on the running section area as the proposed metro rail alignment is underground. But construction of metro station by cut and cover method will affect utilities and drainage of the area. The sub-surface, surface and overhead utility services may be sewer, water mains, storm water drains, telephone cables, electric lines, 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.

4.2.5 Impact on Historical and Cultural Monuments

The proposed metro rail project will affect residential and commercial structures at some of the metro stations where construction be made by cut and cover method whereas no Archeological Monuments are likely to be affected. Some of the historical structures are close to the proposed metro alignment as depicted in Table 3.13. Chhatrapati Shivaji Terminus (formerly Victoria Terminus) is the World Heritage Cultural Properties located at 40 m from the centre of the proposed metro alignment.

Brihanmumbai Municipal Corporation Building located on Mahapalika Marg is declared as Historical Monuments and is 22 metre from the centre of the proposed metro alignment. Utmost care needs be taken so that no significant impact is anticipated on the historical structures due to project activities during construction and operation.

4.2.6 Impact on Local Transport Facilities

The metro rail has been proposed to cater the additional demand of present and future traffic requirement. Hence, no loss of job to the existing transport facilities is anticipated. The drivers of local transport facilities like buses, taxis, autos and rickshaws may be utilized to cater the requirement of transport from metro stations to work place and vice- versa. Additional employment opportunities are also anticipated due to the proposed metro.

4.2.7 Impact on Mangroves: Updated (EIA Jan 2016 & Feb, 2020)

The proposed location of the BKC station of MML3 coincides with a patch of mangrove vegetation that is part of the natural mangrove forest growing on the Mithi River's estuarine mudflats. It represents an eco-tone, an interface between two ecosystem-types, in this case, between the freshwater ecosystem of the Mithi River and the marine ecosystem of the Arabian Sea.

This mangrove forest is an important ecosystem of the Mumbai region. It performs crucial ecological roles. It provides habitats for unique and diverse flora and fauna associatedwith brackish water ecosystems. It serves as a marine breeding-ground and nursery for a number of faunal species, many of which are of economic significance to the fisheries of the Indian West Coast. It also acts as a physical storm-buffer, shielding the area from the onslaught of tides and storm-waves.

The construction of the BKC station will inevitably involve the clearing of several mangrove plants.About 108 no of mangrove plants are removed at BKC station sites

Ecological Impacts

- Loss, degradation and fragmentation of natural mangrove forest habitats
- Loss and/or degradation of ecosystem-services (erosion-control, storm-buffer and marine nursery)
- Loss of genetic and specific biodiversity

Management Measures

- Compensatory afforestation at Koparkhairane, Dist. Thane
- Plantation of five times as many plants as the number removed
- In-situ plantation of mangroves at BKC and Dharavi station sites.
- Plantation of native mangrove species

Updation on Impact due to Project Location (EIA Feb, 2020)

i. Acquisition of Land

About 107.36 ha of land (Government land-104.81 ha & Private land-2.55 ha) will be required for the proposed metro rail project. The details of land required for the project is given in Table-4.3.

Table 4.3: Acquisition of Land

S.No.	Land Requirement	Area (in ha.)	
1	Govt. land	104.81	97.62%
2	Private land	2.55	2.38 %
	Total	107.36	100

ii. Displacement of People

Rehabilitation and Resettlement (R&R) of displaced families is most important social issue addressed in this section. About 2888 families constitute 7273 persons are affected.

iii. Loss of Trees Update (EIA Feb, 2020)

Stations and allied activities -

As per Tree authority permissions granted under Maharashtra (Urban area) protection and preservation of trees act, 1975, out of 5203 number of trees observed, 1618 number trees are to be cut, 2098 number of trees are to be transplanted and 1487 number of trees would be retained. In addition to this, the proposals for 122 number of removal of trees are in process with MCGM tree authority and few more proposals are anticipated.

Car shed depot –

As per the permission granted by tree authority, total number of trees permitted for removal are 2646 (cut – 2185; transplant – 461 and retained- 1045).

iv. Loss of Historical and Cultural Monuments: (EIA Jan 2016)

The proposed metro rail project may have impact on residential and commercial structures at some of the metro stations where construction be made by cut and cover method. No cultural and monuments are likely to be affected.

4.3 IMPACTS DUE TO PROJECT DESIGN

Considered impacts, due to project designs are:

- Platform inlets and outlets,
- Ventilation and lighting,
- Metro station refuse, and
- Risk due to earthquake.

4.3.1 Platforms Inlets and Outlets

The platform level is about 13 m below for underground stations. The rail level of the corridor is about at a depth minimum of 15 m below the ground level/road level at station location and 18-20 m for mid sections. Wherever, the station proposed by NATM, the rail level is proposed minimum 20 m below the ground/ road level. With the increase in ridership, 8 coach trains are envisaged in future. To accommodate an increase in ridership, 27 m wide and 290 m long stations are proposed. Station design is planned for considering the growth in traffic demand beyond 2031. Hence the station layout accommodates the worst case scenario at each station. Also the station design is in compliance to the “Guidelines and space standards for barrier free built environment for disabled and elderly persons” published by the Ministry of Urban and Employment India in 1998.

The typical underground station is a two level station with platforms at the lower level and concourse on the upper level. Concourses are provided at the ends in such a manner that the total depth of the underground station and cost is kept to the minimum. Two emergency staircases are also being planned in the traffic islands.

Provision has been made for escalators to connect concourse to platforms. The escalators will be heavy duty “Public” service escalators capable of operating safely, smoothly and continuously in either direction, for a period of not less than 20 hours per day, seven days per week within the environmental conditions. The

escalators will be equipped with energy saving system with protection barriers. Also the design of the escalators will be such that they can be used as fixed staircases under a condition of power failure or activation by safety/protection devices. When the escalators are stationed, no slipping, jerking, sliding and vibration should occur. One lift has been provided on platform to provide access for elderly and disabled.

Additional staircases have been provided for the fire escape at the two ends of platform. For emergency evacuation purposes, the maximum distance to an exit

route on the platform shall be 50 metre.

Hence, it can be concluded that all stations have necessary provision for space at inlet, outlet, elevators and platforms to accommodate people in normal as well as in emergency situation. Hence no hazard is anticipated due to the proposed sizes of inlets and outlets.

4.3.2 Ventilation and Lighting

The underground stations of the corridors are built in a confined space. A large number of passengers occupy concourse halls and the platforms, especially at the peak hours. The platform and concourse areas have a limited access from outside and do not have natural ventilation. It is therefore, essential to provide forced ventilation in the stations and inside the tunnel for the purpose of supply of fresh air, preventing concentration of moisture, removing heat from battery, light fittings and air conditioning plant.

With the hot and humid ambient conditions of Mumbai during the summer and monsoon months, it is essential to maintain appropriate conditions in the underground stations in order to provide a “comfort-like” and pollution free environment. An overview of VAC systems in other metros like Jubilee line extension, Bangkok etc. have similar climatic conditions and provide valuable information in deciding VAC concept.

The purpose of ventilation system is to provide pollution free comfort environment inside the tunnel (Underground station). Provision of ventilation system leads to air exhaust into the outside environment which has no significant impact on the environment.

In emergency situation, the tunnel ventilation system would be set to operate to control the movement of smoke and provide a smoke free path for evacuation of the passengers and for the firefighting purposes. The proposed VAC system design has been guided by codes and standards like Subway Environment Design Handbook (SEDH), ASHRAE Handbook and NFPA-130, 2003 edition.

The platforms, concourse, staircase and escalator areas for underground stations will have adequate and uniform fluorescent lighting to provide pleasant and cheerful environment. The lighting system adopted in other metro system in India will guide the design of this system. An Illumination adopted at different locations such as Entrance
to stations, Booking/Concourse, Platforms, Passenger staircase and escalator areas, Offices and Tunnels should be in the range of 100 to 250 LUX.

4.3.3 Metro 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, the solid waste generation is about 0.5-1.0 cum/day at underground stations. Thus about 20 cum of solid waste will be generated from all metro stations per day. The maintenance of adequate sanitary facilities for temporarily storing refuse on the premises is considered a responsibility of the MMRC 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.

4.3.4 Risk Due to Earthquake

The project area lies in Zone III of Bureau of Indian Standards (BIS) Seismic Zoning Map. Seismic factor proposed by India Meteorological Department (IMD) for the purpose of design of Civil Engineering structures shall be incorporated suitably while designing the structures.

4.4 ENVIRONMENTAL IMPACT DUE TO PROJECT CONSTRUCTION

The environmental hazards related to construction works are mostly of temporary nature. 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,
- Traffic diversion and risk of existing building,
- Impact of proposed road improvement works,
- Muck disposal,
- Dust Generation
- Increased water demand,
- Impact due to construction of Tunnel,
- Impact due to Land subsidence/Landslides,
- Impact due to Supply of Construction Material,
- Loss of Historical and Cultural Monuments,
- Impact due to Construction near Archeological Structures,

- Impact on Ground and Surface Water
- Air Pollution,
- Noise Pollution,
- Impact due to Vibration,
- Health risk at construction site,
- Impact on Sensitive Receptors, and
- Impact due to Labour Camp, Impact due to blasting.

4.4.1 Soil Erosion,

Though the project may not have significant impact on soil erosion, however, minor impact on soil erosion due to runoff from unprotected excavated areas may result in soil erosion, especially when erodibility of soil is high. Problems could arise from dumping of construction soils (concrete, bricks), waste materials (from contractor's camp) etc. causing surface and ground water pollution. Mitigation measures include careful planning, timing of cut-and-fill operations and re-vegetation. It is also proposed to have Ready Mix Concrete (RMC) directly from batching plant for use at site. The construction material such as steel, bricks, etc. will be housed in a fenced stored yard. The balance material from store yards will be removed for use/disposal at the end of work.

4.4.2 Traffic Diversions and Risk to Existing Buildings

During construction period, partial traffic diversions on road will be required, as most of the construction activities are for the entry and exit blocks on the edges of road. Most of the roads where alignment is passing are double lane. It will be advisable to make these roads as one way to allow for operation of traffic together with construction activities. Advance traffic updates/information on communication systems will be an advantage to users of affected roads. The rail corridor does not pose any serious risk to existing buildings as the alignment is passing underground. Still it will be appropriate to carry out stability and ground settlement analysis for proceeding further during construction.

4.4.3 Impact on proposed road improvement works

The proposed metro rail alignment passes through areas where some projects are already under construction and some projects have been proposed for construction in future.
During construction of the proposed metro rail project it is required for proper integration with other on-going and future projects. Area wise details of project under construction and future projects are given in Table 4.3.

TABLE 4.3
ON-GOING AND FUTURE PROJECTS

AREA	PROJECT UNDER CONSTRUCTION	FUTURE PROJECTS
Dharavi	--	Redevelopment plan
BKC-ITO	--	Metro Line-II

Kalina	Widening of Sharada devi Raod	
Domestic Airport	--	Construction of terminals/facilities as per
Sahar Road	IA Project Raod	Construction of terminals/facilities as per
International Terminal	IA Project Raod	Construction of terminals/facilities as per
Marol Naka	Metro Line-I	--

Aarey Milk Colony	--	Monorail Alignment on JVLR with integration station at Aarey Milk Colony(only if present metro gets terminated and mono rail comes)

Schedule of construction of other road improvement works may be carefully seen prior to taking up of the construction of proposed metro corridor. EIA reports of the ongoing and future road improvement works should be collected by the developer for review to integrate the project activities of the proposed metro rail project. On the basis of review of impacts due to various activities of ongoing and future projects on the environment, suitable changes in the project schedule may be suggested during construction of the project. The above points will be taken care of by environmental engineer/Environmental expert of project developer.

4.4.4 Muck Disposal

The proposed metro route is completely underground. The underground portion is 33.508 km. The construction activity involves tunnelling, cut and cover, foundation, fill and embankment. All these activities will generate about 5.40 Mm3 of muck. On land disposal, 130 Ha of area will be required taking an average depth of filling as 4 metre.
Owing to paucity of space in busy cities and for safety reasons, elaborate measures need to be adopted for collection, storage, transfer and disposal of soil. To avoid impact on land due to muck disposal, project proponent has identified five options for disposal of muck by utilizing the muck for various purposes as described in chapter-6.

4.4.5 Dust Generation

Protective measures shall be undertaken during construction phase for transportation of earth and establishment of the material due to 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. The total 5.40 Mm3 of muck has to be transported through trucks. The muck will be transported by trucks up to nearest proposed Jetty.

The truck movement required for transporting the muck/ earth will be about 591 truck trips per day for the entire length. On an average a truck is anticipated to move about 50 km per trip. Hence total distance travelled would be 29,550 km per day. Being the good road condition in Mumbai, the dust generation due to transportation of muck will be insignificant.

4.4.6 Increased Water Demand

The water demand will increase during construction phase. Sufficient water for construction purpose is made available by digging borehole / bore 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.

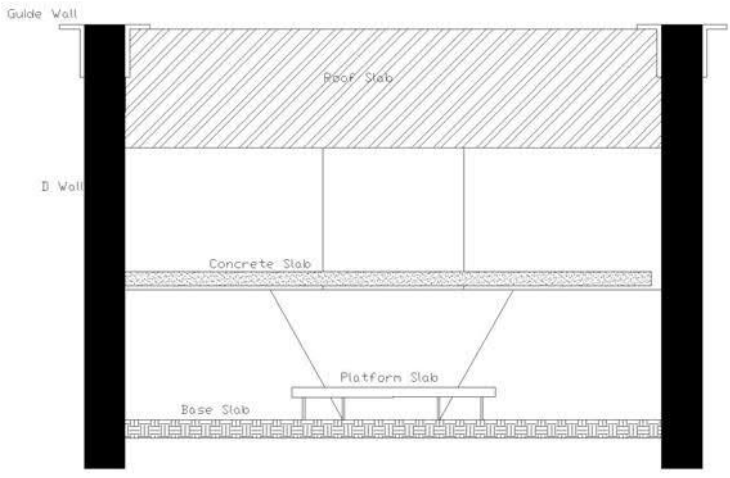
4.4.7 Impact due to Construction of Tunnel

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. The tunneling is to be done in hard rock by Tunnel Boring Machine (TBM), which is widely used throughout the world. The proposed project alignment is underground and tunneling will be done through hard rock hence no major impact on flow of water, surface and ground water quality is anticipated. However, care shall be taken that construction activities are not carried out during the monsoon period.

4.4.8 Impact due to Land Subsidence/Landslides

Land subsidence during construction of tunneling will not be anticipated as the whole alignment is passing through the hard rock base. It may be anticipated at the station locations where cut and cover method would be adopted. 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. Typical section of D-wall is shown below.

The tunnel is passing through Basaltic Granite strata hence no land slide is anticipated. However, state of the art technology like Tunnel Boring Machine (TBM), NATM etc will be adopted during construction to prevent the possible landslides.



4.4.9 Impact due to Supply of Construction Material

Metro construction is a material intensive activity. A summary of approximate construction material required for Line III corridors is given in Table 4.4. 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 haphazard manner may cause surface and ground water pollution near the construction sites.

TABLE 4.4

CONSTRUCTION MATERIAL REQUIREMENT

MATERIAL	UNIT	TOTAL QTY
Tunnel		
Cement	MT	51698
Fly Ash	MT	8363
Sand	MT	92818
Aggregate 20mm	MT	67504
Aggregate 10mm	MT	82513
Silica	MT	647
Reinforcement	MT	14735
Underground station		
Cement	MT	304846
Fly Ash	MT	110450
Sand	MT	669473
Aggregate 20mm	MT	651652
MATERIAL	UNIT	TOTAL
Aggregate 10mm	MT	485130
Reinforcement	MT	175876
Stone Work	m2	255360
MS Structure	Kg	645120
Stainless Steel	Kg	926016
Paint	Ltr	161280
Tiles Work	m2	45696

4.4.10 Loss of Historical and Cultural Monuments

No historical/cultural monuments will be lost as a result of the proposed development.

4.4.11 Impact due to Construction near Archaeological Structures

As per section 4.2.5 of the report, there is no Archeological Monuments near to proposed metro corridor; hence no impact is anticipated during construction. However 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.
Stations/entry/exit area will be constructed by Cut and Cover method which is widely accepted and the safest technique being adopted by metro in India and abroad.

4.4.12 Impact on Ground and Surface Water

Insignificant impact will be anticipated on surface water as whole alignment is passing underground while ground water may get affected at the location where tunnel crosses the ground water flow. The availability of ground water aquifer in basaltic rock strata seems to be very rare and hence, breaking of water bearing strata is not anticipated. 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. This will prevent generation of turbid water during construction in the tunnel. No ground water is used by inhabitants staying near at proposed alignment since adequate water supply is available. No ground water is used by inhabitants staying nearby proposed tunnel since adequate water supply is available.

Update (EIA Feb, 2020)

Update Impact on surface water bodies due to release of waste water generated from station construction, tunneling activities and RMC/casting yard plants is not anticipated. Waste water is being treated by appropriate sedimentation/ETP facilities to a conforming standard before its release. Part of the treated wastewater is also recycled to minimize the quantum of release of wastewater into the water body.

4.4.13 Air Pollution

Impact Construction work of the metro rail has impact on the air quality at station and at depot only since metro alignment is constructed at an average depth of 18-20 metres. Potential sources of air emission are: (i) dust from earth works during site preparation, (ii) emissions from the operation of construction equipment and machines, (iii) fugitive emissions from vehicles plying on the road, (iv) fugitive emissions during the transport of construction materials, (v) air emissions other than dust arise from combustion of hydrocarbons particularly from the RMC plant and casting yard, and (vi) localised increased traffic congestion in construction areas. Most

of the emissions will be in the form of coarse and fine particulate matter that will settle down in close vicinity of construction site. RMC plant and casting yard activity will emit particulate matters, NOx and SOx. This may affect the air quality of nearby areas especially due to emission, discharge from low stack height.

.

However, the air pollution during construction is localized and only around the station construction sites only.

4.4.14 Noise Pollution

The major sources of noise pollution during construction are movement of vehicles for transportation of construction material and the construction machinery/equipment at the construction site. No major impacts are anticipated due to noise pollution as the major construction works are underground only. Noise levels at source have been forecasted at various distances as reproduced in Table 4.5. As seen from the table, construction activities are expected to produce noise levels in the range of 104- 109 dB (A) at source which decreases with increase in distance.

TABLE 4.5
FORECASTED NOISE LEVELS

S No	Machine	Noise Levels in dB(A) without Noise Controls		
		At Source**	At 50 feet*	At 150 feet**
1	1.5 cum capacity Excavator / Loader	109	85	65
2	8.33 cum capacity rear end dumper	108	84	64
3	Crawler Dozer	109	85	65
4	Heavy Duty jack Hammer	109	85	65
5	Compressor	104	80	60
6	Crane	107	83	63
7	Generator	105	81	61
8	Rock Drill	122	98	78

* Data taken from "construction equipment noise levels and ranges report" of Federal Highway Administration, ** Calculated using logarithmic equation.

Exposure to noise may lead to complete hearing loss, tension, fatigue, fast pulse/ respiration rates, dizziness & loss of balance, anger, and irritation & in extreme case nervousness. Construction of noise barriers, such as temporary walls between noisy activities and receivers reduces noise by up to 15 dB(A). Vegetation cover also reduces the noise level.

Careful planning of machinery operation and scheduling of operations can however reduce the noise levels. The overall noise during construction will be for short-term (for day time only) and can be mitigated as mentioned in Chapter - 6.

4.4.15 Vibration Impact

The whole alignment of the Mumbai metro is underground and will be carried out by Tunnel Boring Machine (TBM). TBM is the worldwide accepted machine having less impact of vibration. Human response to ground-borne vibration is influenced by amplitude, duration and frequency and are subjective in nature. According to the U.S. Department of Transportation, (1998) the perception threshold of humans for particle velocity is about
0.04 mm/s (65 VdB with reference 1e-6 inch/sec). For a person in their residence, the lower threshold for annoyance is 72 VdB (FTA 2006). The vibration affects human health by causing fatigue, increased pulse & respiration rates, dizziness & loss of balance, anger and irritation.

4.4.15.1 Vibration due to Tunnel Boring Machine (TBM)

TBM typically consist of a large rotating cutting wheel in front of large metal cylinder(s) known as shields as well as trailing control and ancillary mechanisms. Behind the cutting wheel is a chamber where the spoil is removed using conveyors to the rear of

the machine. The cutting wheel is moved forward by hydraulic jacks supported off the finished tunnel walls. When the cutting wheel has reached maximum extension the TBM head is braced against the tunnel walls and the rear section of the TBM is dragged forward.

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. Therefore, it is more important to study the effect of vibration on the historic buildings especially the structures that comes under heritage category.

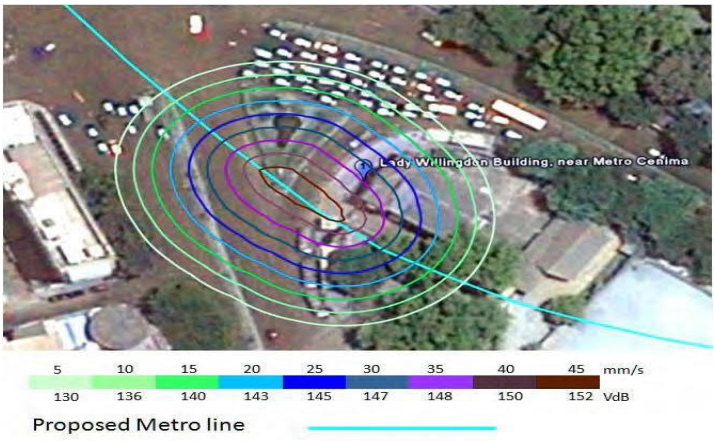
The vibration that could be generated due to TBM has been calculated at each monitoring location as presented in Chapter-3 using the standard equation. The diameter of the TBM blades is assumed as 10 m with the operating speed of 1 m/ Hr. The TBM operation is considered at a depth of 18 m below ground level. The soil of the site is considered soft soil from 0 to 8m and beyond 8m, it is hard bed rock. The vibration contours has been drawn using GIS software on the satellite image of study location.
Vibration is generated at source from 18 m below the ground level and dissipates in all direction.

4.4.15.2 At the Lady Willingdon Building

The Figure 4.1 shows the predicted vibration contours that could cause due to operation of TBM. The contour in the figure shows the vibration level on the ground surface. The predicted ground borne vibration due to TBM operation at this building is about 144 VdB. Geotechnical investigations is recommended at this location before going for TBM operation.

FIGURE 4.1

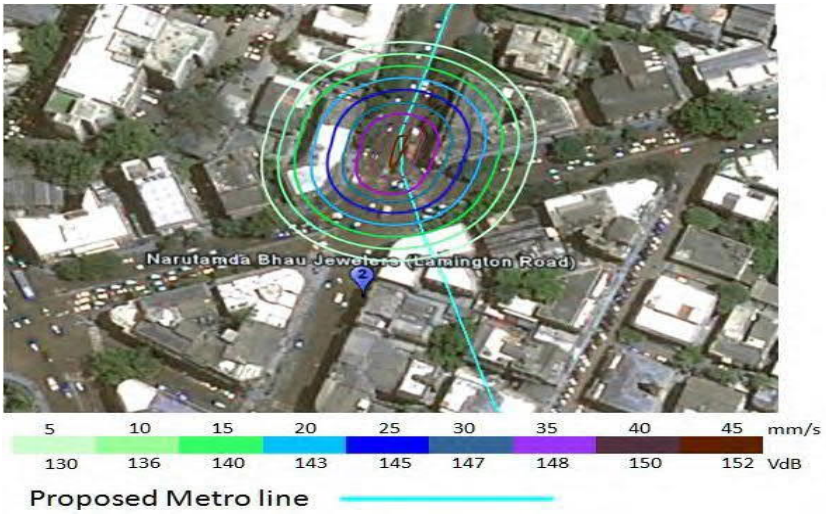
VIBRATION CONTOURS DUE TO TBM AT LADY WILLINGDON BUILDING



4.4.15.3 At the Narutamdas Bhau Jewelers, K.Gajanan Vertak Chowk, Lamington Road

The predicted vibration contours that could cause from TBM at this location are shown in the Figure 4.2. The predicted ground borne vibration due to TBM operation at closest building to road is about 147.8 VdB. Care should be taken during the TBM operation at this location. Geotechnical investigation is recommended before going for TBM operation.

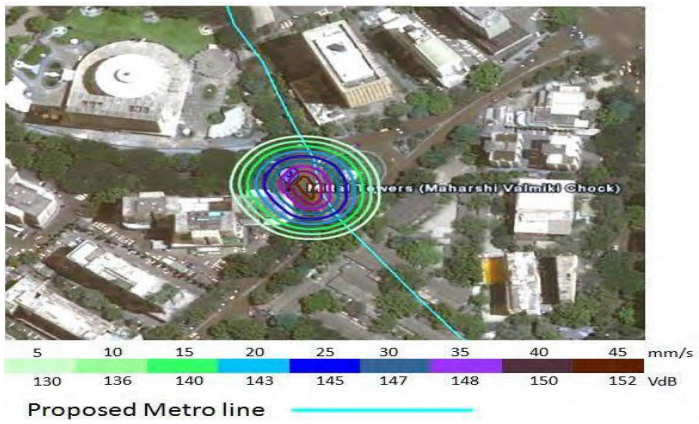
FIGURE 4.2
VIBRATION CONTOURS DUE TO TBM AT LAMINGTON ROAD MUMBAI



4.4.15.4 At Mittal Towers, Maharshi Valmiki Chowk

The Figure 4.3 shows the predicted vibration contours that could cause from TBM. The predicted ground borne vibration due to TBM operation at closest building to road is about 143 VdB. Geotechnical investigations is recommended before going for TBM operation.

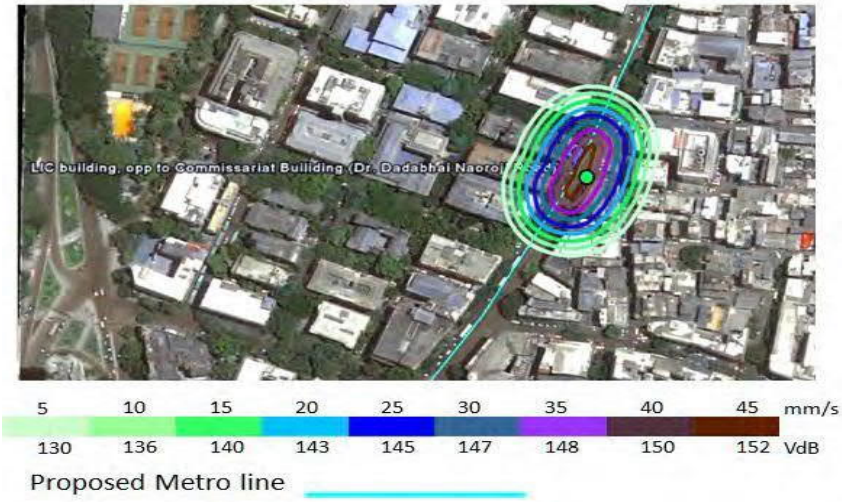
FIGURE 4.3
VIBRATION CONTOURS DUE TO TBM AT MAHARSHI VALMIKI CHOWK



4.4.15.5 At Central Assurance Building, opp. to Commissariat Building

The Figure 4.4 shows the predicted vibration contours that could cause from TBM operation. The predicted ground borne vibration due to TBM operation at closest building to road is about 147.8 VdB. Special care should be taken during the TBM operation at this location. Geotechnical investigation is recommended at this location before going for TBM operation.

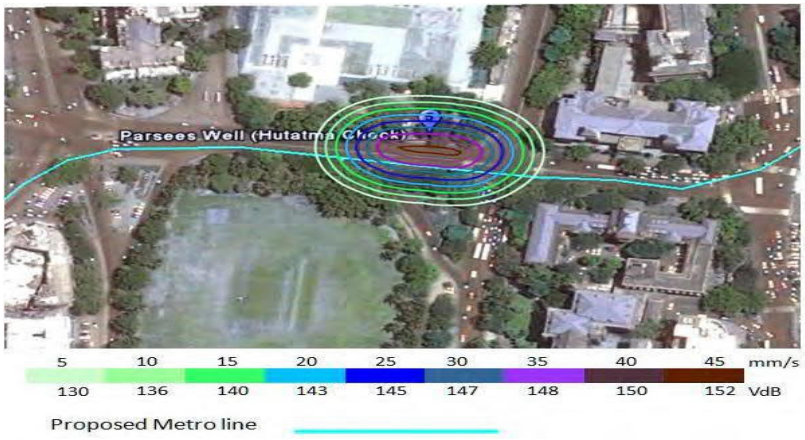
FIGURE 4.4
VIBRATION CONTOURS DUE TO TBM AT CENTRAL ASSURANCE BUILDING



4.4.15.6 At Bhikha, Behram, Parsees Well, Hutatma Chowk

The Figure 4.5 shows the predicted vibration contours that could cause from TBM operation at this location. The contours show the vibration is high with 152 VdB at the center of road and at the Parsees well is around 145 VdB. The predicted ground borne vibration due to TBM operation at closest building to road is about 143 VdB. Special care should be taken during the TBM operation at this location. Geotechnical investigation is recommended at this location before going for TBM operation.

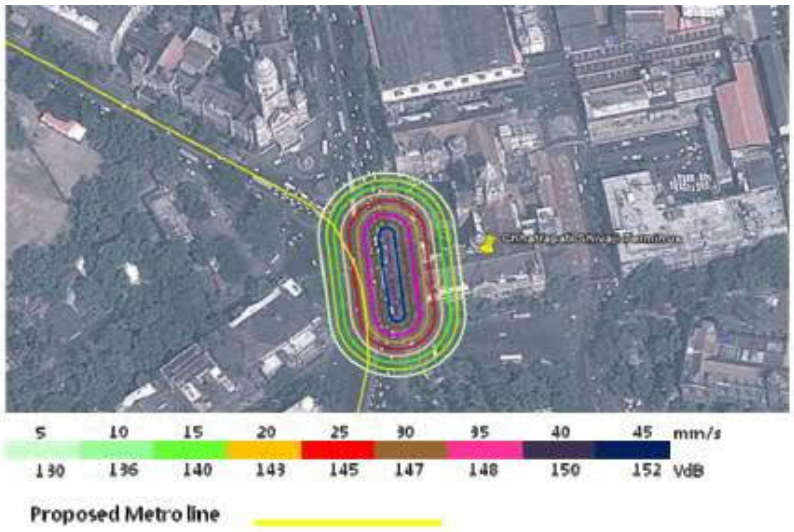
FIGURE 4.5
VIBRATION CONTOURS AT HUTATMA CHOWK



4.4.15.7 At Chhatrapati Shivaji Terminus

The Figure 4.6 shows the predicted vibration contours that could cause from TBM. The contours show the vibration is about 147.3 VdB at closest building. Care should be taken during the TBM operation at this location. Geotechnical investigation is recommended at this location before going for TBM operation.

FIGURE 4.6
VIBRATION CONTOURS AT CHHATRAPATI SHIVAJI TERMINUS



4.4.16 Health risk at construction site

Health risks include accidents due to improper construction practice and hazard diseases due to lack of sanitation facilities (i.e., water supply and human waste disposal). Implementation of good construction practice may reduce the chance of accident at work place. Mitigation measures should include proper water supply, sanitation, drainage, health care and human waste disposal facilities at construction site. In addition to these, efforts need to be made to avoid water spills, adopting disease control measures, awareness programmes etc.

4.4.17 Impact on Sensitive Receptors

As discussed in section 3.9, there are 76 numbers of sensitive receptors identified within 100 m on either side of the alignment. The nearest receptor is 40 metre away from the centre line of metro alignment. No disturbance to facilities such as School, Hospital and Park (Mahim nature Park) are anticipated as proposed alignment passing underground. No station location is exists in the park area. The major impacts to the sensitive receptors are due to noise and vibration.

The major sources of noise pollution during construction activities would be during excavation, loading, transportation of materials and operation of construction equipment and DG sets etc. Expected noise levels due to use of construction machineries at site are forecasted w.r.t distances are given in Table 4.5.

Construction activities have the potential to produce vibration levels that may be annoying or disturbing to humans living nearby. Federal Transit Administration (FTA) has recommended the typical levels of vibration for construction equipment which are summarized in Table 4.6. In the table the values at 25 feet are based on the FTA 1995. On the basis of reference values of vibration at 25 feet, an impact at 75 feet, 100 feet and 150 feet are calculated. The ground borne vibration impacts may be somewhat perceptible to people who are outdoors, it is almost never annoying and does not cause a strong adverse human reaction. According to the California Department of Transportation, (2004), the threshold of perception, or roughly 0.25 mm/s (108 VdB) may be considered annoying to people and the architectural damage criterion for continuous vibrations is 5 mm/s (134 VdB).

TABLE 4.6

TYPICAL LEVELS OF VIBRATION FOR CONSTRUCTION EQUIPMENT

Sl	Construction Activity	VdB at 25 Feet	VdB at 75 Feet	VdB at 100 Feet	VdB PPV at 150 Feet
1	Rock drilling	115.9	101.6	97.9	94.3
2	Dump trucks	122.7	108.3	104.6	99.3
3	Bulldozer	124.0	109.7	106.0	100.7
4	Excavator 0.089, 106	124.0	109.7	106.0	100.7
5	Crane 0.808, 87	143.2	128.9	125.1	119.8

Source: *Transit Noise and Vibration Impact Assessment, Federal Transit Administration (FTA).*

4.4.18 Impact due to Labour Camp

About 5,000 persons are likely to work during peak construction activity. The skilled workers associated with tunneling and fabrication work are supposed to stay at labour camp while the local workers will be employed for other associated work like earthwork and concreting. About 500 skilled workers will stay at labour camp. Three labour camps will be proposed at appropriate and suitable locations. Considering that 80% of labourers are married, in 80% of married families both husband and wife will be working and taking average family size as 4, total workforce in the labour camps will be about 900. The water requirement at camp will be 63 KLD, waste water generation 50.4 KLD & Municipal solid waste generation 315 Kg per day.

Construction workers are more prone to infectious diseases like HIV/AIDS due to migration and lack of education. The three main transmission routes of HIV are sexual contact, exposure to infected body fluids or tissues and from mother to foetus or child during prenatal period. Training and awareness programme will be conducted during construction to avoid the spread of infected diseases and maintain good sanitation in labour camp. After construction, operation of metro does not give significant impact on spreading of infectious diseases.

Updated (EIA Feb, 2020)

Approximately 196 KLD of domestic sewage and 2.19 tonnes per day of Municipal Solid Waste would be generated from 4860 no. of labours in total at 14 labour camp sites. Septic tanks and soak pits have been provided at certain sites. Sewage is connected to sewer line after septic tank. Municipal Solid Waste is segregated and handed over to local body.

4.4.19 Impact due to blasting

Controlled blasting will be required during construction of stations to remove hard rock. Blasting will generate ground vibration and noise of which intensity is depends upon the quantity of explosive charge.

Ground Vibration: The intensity of ground vibrations depends on several factors. The most important are how close the person or house is to a blast and how many kilogram of explosives are detonated per delay period. The magnitude of ground vibrations decreases as the distance from the blast increases. The most commonly accepted blast vibration prediction in use was developed by Lewis L. Oriard, a noted seismologist from Huntington Beach, California. The derived equation is:

$$V = K (R/Q^{½})^{B}$$

Where, V: Peak Particle Velocity (mm per second), K = Site and Rock Factor Constant, Q = maximum instantaneous charge per delay (Kg), B = Constant related to the rock and site (usually-1.6), R = Distance from charge (m)

Typical K Factors in Metric System are 500 for Under Confined hard or highly structured rock, 1140 for Free face average rock (Normal Confinement) and 5000 for heavily (Over) Confined rock.

Putting the value of R = 15 m, Q = 1 Kg (The quantum of explosive should be strictly restricted to 1 Kg per delay), K = 1140, in above equation, we get peak particle
velocity of 14.96 mm per second. Table 4.7, indicates the average human response that may be anticipated when the person is at rest, situated in a quiet surrounding.

Comparing Peak Particle Velocity of 14.96 mm/second, it is observed from the Table, that the vibration will be strongly perceptible to mildly unpleasant and it will have no damage to the structure.

TABLE 4.7
HUMAN RESPONSE TO BLASTING GROUND VIBRATION

SI	Average Human Response	PPV (mm/sec)	Air Blast (dB)
1	Barely to distinctly perceptible	0.508–2.54	50-70
2	Distinctly to strongly perceptible	2.54–12.7	70-90
3	Strongly perceptible to mildly unpleasant	12.7–25.4	90-120
4	Mildly to distinctly unpleasant	25.4–50.8	120-140
5	Distinctly unpleasant to intolerable	50.8–254	140-170

Source: Transportation- and Construction-Induced Vibration Guidance Manual, June 2004

The safe ground vibration level for structures for low–frequency blast vibration is 19.05 mm/sec and 50.8 mm/sec for frequencies above 40 Hz. (United State Bureau of Mines, 656, RI 8507).

Noise and Air Blast

A simple estimate of air blast overpressure levels is given using the following cube root scaling formula from AS2187.2 for the estimated Maximum Instantaneous Charge (MIC) of 1 kg of explosive.

$P = K \{R/(Q)^{0.33}\}^B$

Where, P= Pressure (KPa)

K= Site constant (State of confinement, Typical K factors are 185 for unconfined, 3.3 for fully confined)

R=Distant from charge (m)

Q=Explosive charge mass per delay (kg)

B= Constant related to Rock & Site (usually K=-1.2)

Now, Take K = 5 (blasting inside and may be assumed as confined), R = 15 m,

Q = 1 Kg and B= -1.2

P=0.127 kPa=196 Pa

Equivalent Noise Level would be 136 dB, which will be impacts mildly to distinctly unpleasant.

4.5 IMPACTS DUE TO PROJECT OPERATION

The negative impacts may cause during operation of the project due to increase in the number of passengers and trains at the stations:

- Noise pollution,
- Vibration Impact due to train,
- Water supply and sanitation at Stations,
- Refuse disposal and sanitation, and
- Electromagnetic Interference

4.5.1 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. The main sources of noise from the operation of trains include: engine noise, cooling fan noise, wheel-rail interaction, electric generator and miscellaneous noise like passenger's chatting.

US data shows that the noise levels inside the rail transit cars ranges between 65 to 105 dB(A) during normal operation but it will depend on various factors like Train speed, type of way structure, sound insulations of car body, type & design of mechanical equipment, wheel and rail conditions. A study was conducted by National Physical Laboratory for Delhi metro for noise levels in elevated and underground metro stations. The Noise Level at 15 m from track Centre Line and at 25 km/h is 75.0± 10.0 while interior noise level is about 78.0±8.0. The noise generated due to metro is limited within the tunnel area and station and hence users only have impact of noise during operation.

4.5.2 Vibration Impact due to train

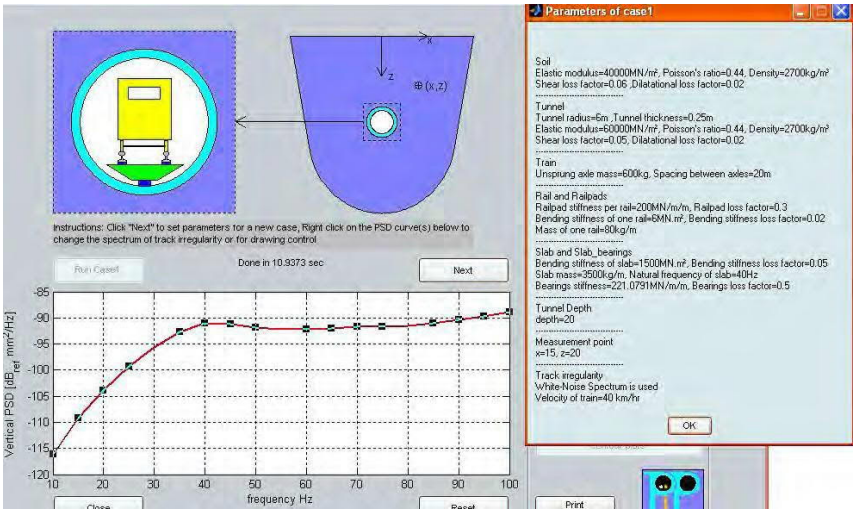
The prediction of vibration is computed using the Pipe-in-Pipe (PiP) model using train traffic. PiP model has been developed by the team of experts and scientist from Nottingham University, UK. It is commonly used to simulate the vibration that is generated in the tunnel due to train passage. The vibration is calculated in Power Spectral Density. The prediction of vibration due to train passing is simulated and the results are shown in Power Spectral Density (PSD). The figures plotted shows the assumptions made for the prediction of vibrations. The velocity of the train is considered as 40 km/hr at all locations. Due to limitation in the available modeling tools, the vibration simulation was carried out with single train passby, however there would be increase in vibration when two trains are in tunnel. The increase would be up to 3 VdB. The Power Spectral Density graph plotted in Figure 4.7, 4.8, 4.9, 4.10, 4.11 & 4.12 are used to calculate the vibration at 6 locations during operation. The calculations are based on the input data as per site condition and operation of metro train. In Mumbai, the cultural heritage structures were constructed as per British Standards.

4.5.2.1 At Lady Willingdon Building.

The result of the vibration prediction using PiP model is shown in Figure 4.7. The graph shows that the vertical Power Spectral Density (PSD) is rising with the frequency and has become constant between 85-90 PSD (VdB).

FIGURE 4.7

VIBRATION DUETO TRAIN AT LADY WILLINGDON BUILDING USING PiP

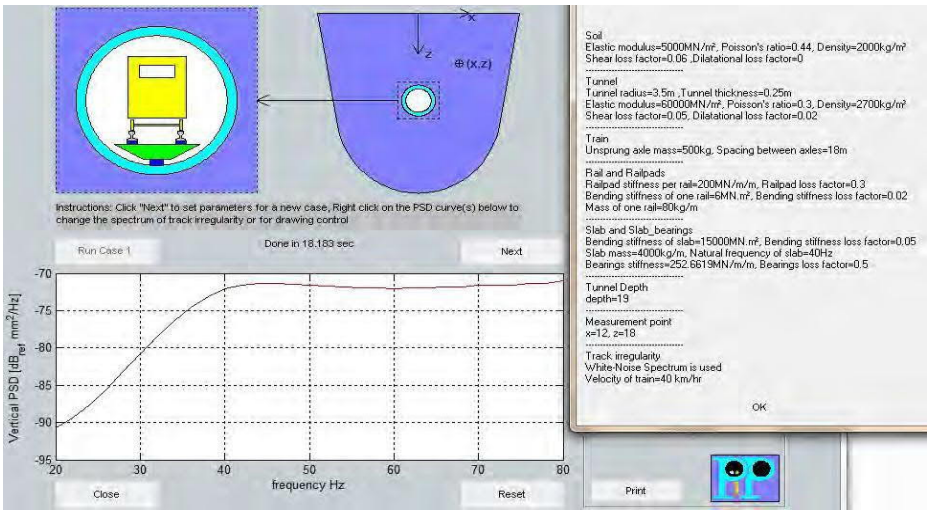


4.5.2.2 At K.Gajanan Vertak Chowk, Lamington Road Mumbai.

The result of the vibration prediction using PiP model is shown in Figure 4.8. The graph shows that the vertical Power Spectral Density (PSD) is low from 10 to 20 Hz frequency after that is found rising. The predicted vertical vibration at this location shows between 70 to 75 VdB

FIGURE 4.8

VIBRATION DUETO TRAIN AT K.GAJANAN VERTAK CHOWK, LAMINGTON ROAD USING PiP

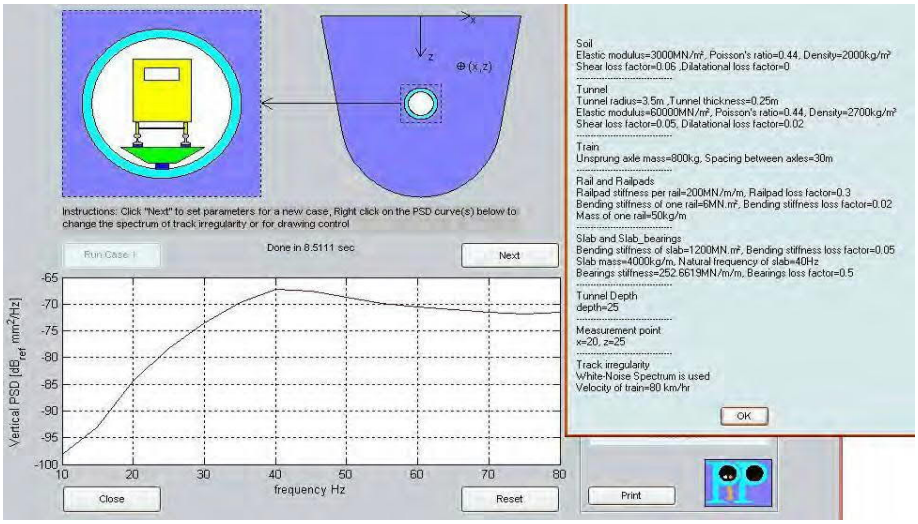


4.5.2.3 At Mittal Towers, Maharshi Valmiki Chowk.

The result of the vibration prediction using PiP model is shown in Figure 4.9. The graph shows that the vertical Power Spectral Density (PSD) is high at the frequency 40 Hz and is constant between 65 to 75 PSD (VdB).

FIGURE 4.9

VIBRATION DUE TO TRAIN AT MITTAL TOWERS, MAHARSHI VALMIKI CHOWK USING PiP.

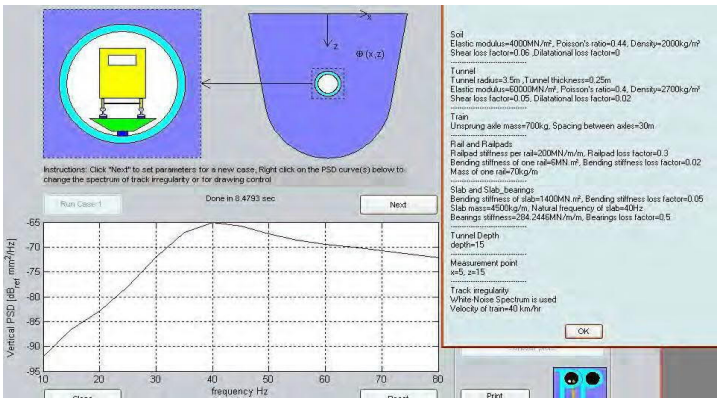


4.5.2.4 At Central Assurance Building, Opp. to Commissariat Building

The result of the vibration prediction using PiP model is shown in Figure 4.10. The graph shows that the vertical Power Spectral Density (PSD) is more at the frequency 40 Hz and is constant between 65 to 75 PSD (VdB). Many building at the road comes under heritage category. Special care should be taken at the time of construction of tunnel and also during metro rail operation.

FIGURE 4.10

VIBRATION DUE TO TRAIN AT CENTRAL ASSURANCE BUILDING, USING PiP

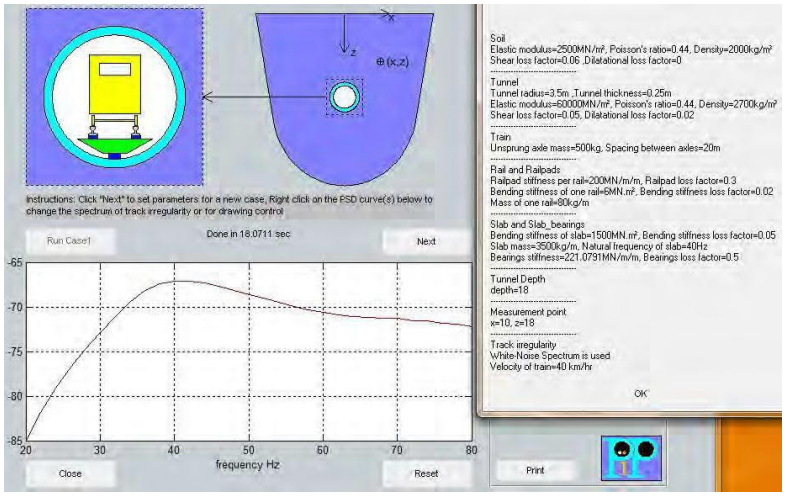


4.5.2.5 At Bhikha, Behram, Parsees Well, Hutatma Chowk

The result of the vibration prediction using PiP model is shown in Figure 4.11. The graph shows that the vertical Power Spectral Density (PSD) is rising at the beginning with the frequency; it is maximum at frequency 40 Hz. The predicted vertical vibration due to metro rail passby at this location shows between 65 to 70 VdB.

FIGURE 4.11

VIBRATION DUE TO TRAIN AT PARSEES WELL, HUTATMA CHOWK USING PiP

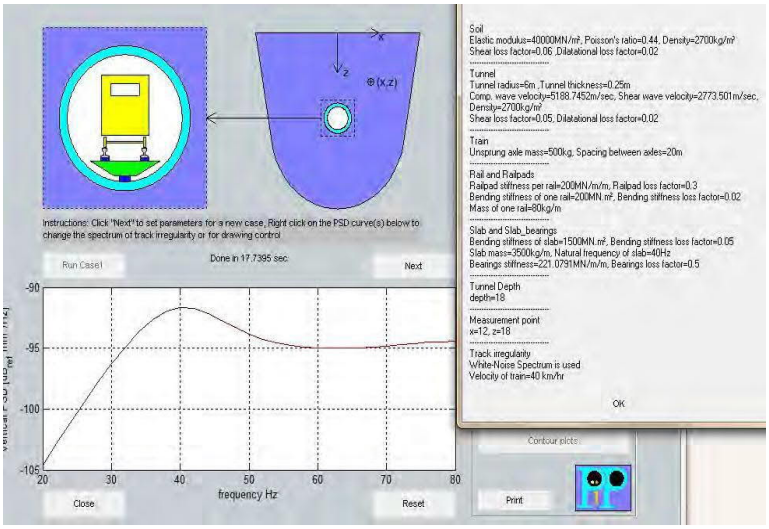


4.5.2.6 At Chhatrapati Shivaji Terminus

The result of the vibration prediction using PiP model is shown in Figure 4.12. The graph shows that the vertical Power Spectral Density (PSD) is low from 10 to 20 Hz frequency after that is found rising. The predicted vertical vibration due to metro rail pass by at this location shows between 90 to 95 dB.

FIGURE 4.12

VIBRATION DUE TO TRAIN AT CHHATRAPATI SHIVAJI TERMINUS



The result of the vibration impact on the surrounding due to TBM and underground train traffic has been tabulated in Table 4.8. The limits for vibration is 65 VdB as per Federal Transit Administration (FTA) whereas 83 VdB is the maximum limit as per ISO -2361-2.
The predicted vibration level during construction and operations seems to be higher than the standard limits. This is due to consideration of worst case scenario of having the subsoil condition as rocky structure and may be expected actually less than the predicted value.

TABLE 4.8
OVERALL RESULT OF VIBRATION IMPACT

Sl	Location	Field Measured vertical vibration (VdB)	Vibration due to TBM Operation(VdB)	Vibration due to Metro Train Operation (VdB)	Standards of Vibration in (VdB)
1	Lady Willingdon Building.	113.9	144	85 to 90	65- 83
2	Narutamdas Bhau Jewelers, Lamington Road.	123.5	147.8	70 to 75	65- 83
3	Mittal Towers, Maharshi Valmiki Chowk	126	143	65 to 70	65- 83
4	Central Assurance Building, Dr. Dadabhai Naoroji Road.	124	147.8	65 to 70	65- 83
5	Bhikha, Behram, Parsees Well, Hutatma Chowk	113.9	143	68 to 70	65- 83
6	Chhatrapati Shivaji Terminus	110-126	147.3	90-95	65- 83

4.5.3 Water Supply and Sanitation

Public Health facilities such as water supply and sanitation are very much needed at the stations. The water demands will be for drinking, toilet, cleaning and also for other purpose like AC, chiller etc. The demand is presented in Table 4.9. It is assumed that there would be similar water requirements in Mumbai Metro corridors also. The Water Demand of existing Delhi Metro corridors is considered for requirement of Mumbai metro. Water should be treated before use upto WHO drinking water standards.
Municipal supply/Ground water shall be used for this purpose.

S.No.	Particular	Water Demand at Each Station (KLD)	Total Water Demand (KLD)
1	At Stations for Drinking Purpose	6	162
2	For AC, cleaning, chiller and other purposes	240-250	6750
		Total	**6912**

Update (EIA Feb, 2020)

Central Public Health Environmental Engineering Organization (CPHEEO) has recommended 45-litres/day, water supply to persons working at railway stations. Water requirement at all stations has various components, viz. Personal use of Staff, Fire demand, Make up water for air conditioning and ventilation, and wastage. The water demand at each station would be about 50 m^3 per day. Platform cleaning requirement

has been worked out at the rate of 0.250 lit per sqm.

4.5.4 Electromagnetic Interference

Transmission lines do not usually interfere with normal television and radio reception. In some cases, interference is possible at a location close to the ROW due to weak broadcast signals or poor receiving equipment. An impact due to electromagnetic interference is insignificant as the proposed alignment is passing underground.

This interference may arise either from the electric field or from the magnetic field. 25 KV traction currents produce alternating magnetic fields that cause induced voltages to any conductor running along the track.

4.5.5 Solid and Liquid Waste

International consultative committee on telecommunications and Telegraphy (CCITT) gives the following formula to arrive at the minimum separation between contact wire and the communication line to limit the induced voltage to 300 Volts. The minimum spacing is given by a = 1/3 under-root E. Where, E is the contact wire voltage. For 25 kV systems this works out to 53 m.

4.5.6 Refuse from stations:Update (EIA Feb, 2020)

According to CPHEEO guidelines about 200gm per person per day of municipal solid waste would be generated as a station. The total refuse, generated will be insignificant since it is due to staff working at station only. Passengers will not be allowed for littering of the area.

4.6 IMPACTS DUE TO DEPOT

The depot at Araey colony is planned for metro corridor Line III. The area of depot is about 26.407 hectares. The area at depot is vegetated with no habitation. The depot will have following facilities:

- Washing Lines,
- Operation and Maintenance Lines,
- Workshop, and
- Offices.

These facilities could generate water and noise issues. The area will be levelled through cut and fill method within the depot and additional earth will be taken from tunnelling to raise the ground level. Problems anticipated at depot sites are:

- Water supply,
- Effluent Treatment,
- Oil Pollution
- Noise Pollution,
- Surface drainage,
- Solid Waste,
- Cutting of trees.

4.6.1 Water Supply

Water supply will be required for different purposes in the depot. The water requirement for train washing purpose will be 500 litres per day. About 159 KLD of fresh water will be required at Depot for different uses. Projected water demands are summarised in Table 4.10. Other water requirement for horticulture, flushing urinals/closet will be met from recycled water.

TABLE 4.10
WATER DEMAND AT AAREY MILK COLONY DEPOTS

S.NO	DEPOT	PROJECTED NUMBER OF CARS	PROJECTED WATER REQUIREMENT PER DAY (LITRES)
1	Car Washing	280	140000

2	Floor Washing @ 0.5 lit/sqm	--	17,500

2	Drinking Purpose: 300 persons @ 5 lit per person per day	--	1500
	Total		**1,59,000**

The water after conventional treatment can be processed through Reverse Osmosis (RO) technology for specific use such as washing of equipment/ trains. This will reduce the fresh water requirement.

4.6.2 Effluent Treatment

About 130 KLD of waste is to be generated at depot, which will be treated at 160 KLD effluent treatment plant. The treated waste water will be tested for Inland Water Discharge Standard before release in to Mithi River, is required. The part of the water will be recycled to use at depot horticulture purpose.

Update (EIA Feb, 2020)

About 38 KLD of domestic sewage and 48 KLD of trade effluent would be generated from activities at depot. Treated sewage and trade effluent would be recycled/utilized on land for irrigation and would not be discharged into nearby Mithi river water body.

It is estimated that about 0.6 Ton/day of MSW likely to be generated from the Depot.

4.6.3 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.

4.6.4 Noise Pollution

The main source of noise from depot is during operation of workshop. The roughness of the contact surfaces of rail, wheel and train speed is the factors, which influence the magnitude of rail - wheel noise. The vibration of concrete structures also radiates noise. No impact on the ambient noise is anticipated due to mild activities.

4.6.5 Surface Drainage

Due to the filling of the low-lying area for the construction of depots, the surface drainage pattern will change. Suitable drainage measures will be adopted to drain off the area suitably in the nearby Mithi River.

4.6.6 Solid Waste

At per available data, it is estimated that about 1.8 Ton per month of solid waste will be generated from the Depot.

4.6.7 Cutting of Trees

About 1652 numbers of trees are observed at Depot at Aarey milk area. The details of tree cut are mentioned in the section 3.7.1. The details of tree likely to be cut and transplanted are given in the Environmental Management Plan.

Update EIA Feb, 2020-

The details of trees for removal is mentioned in tree summary and tree inventory of updated EIA – Feb, 2020 Part II.

4.7 EPILOGUE

Based on above negative impacts, a checklist of impacts has been prepared along with positive impacts in Chapter-5. The net resultant impacts without management plans are also summarised. The management plans to mitigate the negative impacts are reported in Chapter-6.

CHAPTER-5 POSITIVE ENVIRONMENTAL IMPACTS

5.1 POSITIVE ENVIRONMENTAL IMPACTS

This chapter deals with the positive impacts of the project. The introduction of Metro Rail 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 pollutiom 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 problemsdue to reduction in pollution, etc have not been quantified.

Various positive impacts have been listed under the following headings:

- Employment Opportunities,
- Benefit to Economy,
- Mobility,
- Safety,
- Traffic Congestion Reduction,
- Reduction in the number of Vehicle Trips on the road,
- Less Fuel Consumption,
- Reduced Air Pollution,
- Carbon Dioxide Reduction,
- Reduction in Number of Buses,
- Saving in Road Infrastructure, and
- Traffic Noise Reduction.

5.1.1 Employment Opportunities

The project is likely to be completed in a period of about 5 years. During this period manpower will be needed to take part in various activities. About 5,000 persons are likely to work during peak period of construction activities. In operation phase of the project about 45 persons per kilometre length of the corridor, ie (approx. 1,510 persons) will be employed for operation and maintenance of the proposed system. Thus the project would provide substantial direct employment; besides, more people would be indirectly employed in allied activities and trades.

5.1.2 Benefit to Economy

In the present context, the project will streamline and facilitate easy movement of public in Mumbai city. The metro rail will yield tangible and non-tangible saving due to equivalent reduction in road traffic and certain socio-economic benefits. Introduction of this metro rail project, in Mumbai city will result in the reduction in number of buses and private vehicles. This, in turn will result in significant social and economic benefits due to reduction in fuel consumption, vehicle operating cost and travel time of passengers. This will facilitate the movement of people fast. With the development of this corridor, it is likely that more people will be involved in trade, commerce and allied services

5.1.3 Mobility

The proposed Mumbai Metro Colaba – Bandra – SEEPZ network are estimated to carry 16.99 lakh passengers per day, in the year 2031. The maximum PHPDT on any section will be more than 24,800 by 2031.Passenger average time saved will be about 60 minutes by year 2031. The proposed development will reduce journey time to an extent as indicated in the Table 5.1.

TABLE 5.1 JOURNEY TIME

S. No	Section	Length in km	Journey Time (Min)	Type of Corridor Proposed
1.	Colaba-Bandra-SEEPZ	33.508	60	Underground

5.1.4 Safety

According to the National Crime Record Bureau's report, Mumbai city tops in the list of accidents in India. It accounts for one out of every five fatal accidents in the country. The latest compiled data with the home ministry shows that Mumbai accounts for 18.5% of total accidents in the country. Kolkata, with a record of 1.8%, comes at the bottom of the list. Substantial decrease in road accident has been noticed after 2007 with the implementation of Delhi Metro Phase I & II in Delhi. Hence, operation of Mumbai Metro Rail will also provide improved safety and lower the number of accidental deaths.

5.1.5 Traffic Congestion Reduction

To meet the forecast transport demand in the year 2031, it is estimated that the number of buses will have to be more. During this period personalised vehicles may also been grow.
Together, they will compound the existing problems of congestion and delay. The proposed development will reduce journey time and hence congestion and delay.

5.1.6 Reduction in the number of Vehicle Trips on the road

The number of vehicle trips in the years 2016, 2021, 2031 and 2041 with and without metro rail is projected in Table 5.2. After the introduction of metro rail system the reduction of vehicles for the years 2016, 2021, 2031 and 2041 is as indicated in Table 5.3. Similarly vehicle trip KMs and reduction in vehicle trip KMs are summarized in Table 5.4 and Table 5.5 respectively.

The basis of reduction of vehicle is shift of ridership from road vehicle to the proposed system. The reduction in number of vehicles gives benefits to economy by reduction in Vehicle Operating Cost (VOC), Fuel Consumption, Pollution Load, Accidents and Travel Time etc.

TABLE 5.2
NUMBER OF VEHICLES TRIPS WITH AND WITHOUT METRO CORRIDOR (Avg. Daily)

MODE	No of Vehicle Trips without C-B-S Metro				No of Vehicles Trips with C-B-S Metro			
	2016	2021	2031	2041	2016	2021	2031	2041
Car + Taxi	4628346	5365521	6540541	7972882	4552876	5273172	6428421	7838339
2W	7239698	8392794	10230769	12471251	7060698	8173760	9964844	12152141
Bus	160988	186629	227500	277321	151680	175239	213672	260728
Auto	1510263	1750809	2352941	2868222	1400758	1616812	2190258	2673002
Total	13539295	15695754	19351751	23589676	13166012	15238983	18797195	22924209

TABLE 5.3

REDUCTION IN VEHICLE TRIPS (Avg. Daily)

S.NO.	MODE	Reduction of Vehicle Trips with C-B-S Metro			
		2016	2021	2031	2041
1.	Car + Taxi	75470	92350	112120	134544
2.	2W	179000	219034	265925	319110
3.	Bus	9308	11390	13828	16594
4.	Auto	109506	133998	162684	195220
	Total	373283	456771	554556	665468

TABLE 5.4

NUMBER OF VEHICLES TRIP KMs WITH AND WITHOUT METRO CORRIDOR (Avg. Daily)

MODE	No of Vehicle Trip KMs without C-B-S Metro				No of Vehicles Trip KMs with C-B-S Metro			
	2016	2021	2031	2041	2016	2021	2031	2041
Car + Taxi	55540150	64386256	78486486	95674589	54634509	63278060	77141050	94060065
2W	108595469	125891912	153461538	187068759	105910475	122606396	149472663	182282109
Bus	1609880	1866292	2275000	2773212	1516800	1752394	2136719	2607275
Auto	12082107	14006474	18823529	22945777	11206062	12934493	17522061	21384015
Total	177827607	206150934	253046554	308462338	173267846	200571344	246272493	300333465

TABLE 5.5

REDUCTION IN VEHICLE TRIP KMs WITH METRO CORRIDOR (Avg. Daily)

S.NO.	MODE	Reduction of Vehicle Trip KMs with C-B-S Metro			
		2016	2021	2031	2041
1.	Car + Taxi	905641	1108196	1345437	1614524
2.	2W	2684994	3285516	3988875	4786650
3.	Bus	93080	113898	138281	165937
4.	Auto	876045	1071980	1301468	1561762
	Total	4559761	5579590	6774061	8128873

5.1.7 Less fuel Consumption Due to reduction in Vehicle

There will be a reduction in number of vehicle trips on implementation of this project. Therefore, it is estimated that both petrol and diesel consumption will also get reduced. There is an inter- fuel substitution of petrol and diesel to electricity that could result in savings of foreign exchange and a reduction of air pollution. Fuel saved due to traffic diverted to the metro rail is estimated by the diverted traffic described above and the annual run and fuel consumption norms of different vehicles. Table 5.6 provides information about the savings in fuel consumption due to reduction of vehicles in Mumbai for the years 2016, 2021, 2031 and 2041. These fuel savings are valued at 2011 prices (Rs.67.00/L for petrol and Rs.41.00/L for diesel) the corresponding fuel

savings for buses, car + taxi and 2/3 wheelers are as shown in Table 5.7.

TABLE 5.6
SAVINGS IN FUEL CONSUMPTION DUE TO REDUCTION OF VEHICLES (Avg. Daily)

MODE	Reduction in Vehicle Trips KMs with CBS Metro				Fuel Consumption Norm (Km/L)	Reduction in Fuel Consumption (litres)			
	2016	2021	2031	2041		2016	2021	2031	2041
Bus (Diesel)	93080	113898	138281	165937	6	15513	18983	23047	27656
Car +Taxi(Petrol)	905641	1108196	1345437	1614524	14	64689	79157	96103	115323
2-3Wheeler (Petrol)	3561039	4357496	5290343	6348412	30	118701	145250	176345	211614

TABLE 5.7
MONEY SAVING DUE TO REDUCTION OF VEHICLES (Avg. Daily)

MODE	MONETARY VALUE(RS LAKH)			
	2016	2021	2031	2041
Bus (Diesel)	6.36	7.78	9.45	11.34
Car (Petrol)	43.34	53.04	64.39	77.27
2-3Wheeler (Petrol)	79.53	97.32	118.15	141.78

5.1.8 Reduced Air Pollution

Reduction in traffic on Mumbai roads due to proposed metro rail could lead to reduce air pollution. Reduction in number of vehicles and the Emission factor of vehicles as per Euro-II norms given in Table 5.8 and the reduction level of different pollutants like PM, NOx, HC, CO and CO2 for the years 2016, 2021 and 2031 and 2041 is given in Table 5.9.

TABLE 5.8
EMISSION FACTOR OF VEHICLES AS PER EURO-II NORMS (G/KM)

MODE	PM	NOX	HC	CO
Bus	0.05	0.87	2.75	0.66
Car	0.03	0.2	0.25	1.98
2- Wheeler	0.075	0.3	0.7	2.2

TABLE 5.9
REDUCTION IN POLLUTION EMISSION DUE TO REDUCTION OF VEHICLES (TONNES/YEAR)

MODE	Year			
	2016	2021	2031	2041
Emission reduction of Particulate Matter (PM)				
Bus	1.70	2.08	2.52	3.03
Car	9.92	12.13	14.73	17.68
2/3 Wheelers	97.48	119.29	144.82	173.79
Total	109.10	133.50	162.08	194.50
Emission reduction of Oxides of Nitrogen NOx				
Bus	29.56	36.17	43.91	52.69
Car	66.11	80.90	98.22	117.86
2/3 Wheelers	389.93	477.15	579.29	695.15

Total	485.60	594.21	721.42	865.70

Emission of reduction of Hydrocarbons HC				
Bus	93.43	114.33	138.80	166.56
Car	82.64	101.12	122.77	147.33
2/3 Wheelers	909.85	1113.34	1351.68	1622.02
Total	1085.91	1328.79	1613.25	1935.90
Emission reduction of Carbon Monoxide CO				
Bus	22.42	27.44	33.31	39.97
Car	654.51	800.89	972.35	1166.82
2/3 Wheelers	2859.51	3499.07	4248.15	5097.77
Total	3536.44	4327.40	5253.80	6304.57
Emission reduction of Carbon Dioxide CO_2				
Bus	35.24	43.12	52.35	62.82
Car	1028.51	1258.55	1527.97	1833.57
2/3 Wheelers	4493.52	5498.54	6675.66	8010.79
Total	5557.27	6800.20	8255.98	9907.17

5.1.9 Carbon Dioxide Reduction

Carbon dioxide is one of the major greenhouse gases, which directly deplete the ozone layer. To reduce the overall greenhouse gas emissions International Emission Trading (IET) Mechanism has been followed under Kyoto Protocol. Under IET mechanism, countries can trade in the international carbon credit market. Countries with surplus credits can sell the same to countries with quantified emission limitation and reduction commitments under the Kyoto Protocol. Caron credits are measured in units of certified emission reductions (CERs). Each CER is equivalent to one ton of carbon dioxide reduction. Therefore, 5557.27, 6800.20, 8255.98 and 9907.17 Carbon credits per year will be achieved through this project in the 2016, 2021, 2031 and 2041 respectively. In economic terms it will valued as Rs. 23.01 lakh (5557.27 (Caron Credit) X 6 (Amount in Euro) X 69 (Amount in Rs.), Rs. 28.15 lakh (6800.20 (Caron Credit) X 6 (Amount in Euro) X 69 (Amount in Rs.), Rs. 34.18 lakh (8255.98 (Caron Credit) X 6 (Amount in Euro) X 69 (Amount in Rs.) and Rs. 41.02 lakh (9907.17 (Caron Credit) X 6 (Amount in Euro) X 69 (Amount in Rs.) for year 2016, 2021, 2031 and 2041 respectively.

Clean Development Mechanism: –Update (EIA Feb, 2020)

The Clean Development Mechanism (CDM) was recognized in the Kyoto Protocol to operationalize the United Nations Framework Convention on Climate Change (UNFCCC) by committing reduction in CO_2 emissions . CDM projects such as Metro rail projects are an alternative to Existing modes of transport viz buses, taxis, passenger cars, automatize three & two wheelers which has serious effects on urban eco system due to congestion and emission of greenhouse gases / other air pollutants. The metro rail projects result in passenger ridership shift from road-based transport to metro rail and provides alternate mode of public transportation. Metro Rail is a more efficient, faster, safer and more reliable mode of green transport and complements as well as substantially replaces other modes of transport. It improves the resource efficiency of transport passengers as emissions per passenger kilometer are reduced compared to a transport situation without a metro.

The Metro Line-3 project is entitled as CDM Project under MRTS-POA-9863 and successfully registered with UNFCCC as a CDM project in December 2017. The MRTS PoA in India is being coordinated by DMRC as a coordinating and managing entity, which acts as an umbrella organization for all MRTS CDM projects in India. The ex-ante estimate of reductions of Carbon dioxide in crediting period of Ten years since the year 2021 is 26, 19,680tonne of CO2e. The annual average emission reduction estimated over the crediting period is 2, 61,968tonne CO2e. The Metro Line -3 Project would contribute in a global initiative of reducing the global warming effect by ensuring reduction in emissions of CO2 and other greenhouse gases.

5.1.10 Reduction in Number of Buses

The requirement of buses is estimated to be 450 numbers to cater the additional ridership due to increase in traffic on road in absence of Mumbai metro. This will save an amount equal to Rs. 2203 million towards capital cost of bus system.

5.1.11 Saving in Road Infrastructure

The total road network in the Mumbai city is 1889 km and additional 182 km road infrastructure will be required to cater the additional load. About 10% of road infrastructure will be saved.

5.1.12 Traffic Noise Reduction

Reduction in traffic volume affects the noise levels. A 50% reduction of the traffic volume may results in a 3 dB reduction in noise levels, regardless of the absolute number of vehicles.
Reduction in traffic volume of 10% & 50% reduces noise at the tune of 0.5 dB & 3.0 dB respectively. An introduction of Mumbai Metro Rail Line III substantially reduces the vehicular traffic which ultimately reduces noise level.

5.2 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 or projects is the final step in impact assessment. There are about numerous methods for carrying out impact assessment, which 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. A typical checklist identifying anticipated environmental impacts is shown in Table 5.10.

TABLE 5.10 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	*		
iii.	Loss of Trees	*		
iv.	Loss of Cultural and Historical Structures		*	
v.	Drainage & Utilities Problems	*		
vi.	Impact on Local Transport Utilities			*
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	*		
ii.	Traffic Diversions and Risk to Existing Buildings	*		
iii.	Air Pollution	*		
iv.	Noise Pollution	*		
v.	Impact due to Vibration		*	
vi.	Health risk at construction site	*		
vii.	Impact on Sensitive Receptors		*	
viii.	Problem of excavated soil disposal	*		
ix.	Dust Generation	*		
x.	Problems of Soil Disposal	*		
xi.	Labour Camp	*		
D.	Impact due to Project Operation			
i.	Noise & Vibration	*		

ii.	Water Demands	*		
iii.	Refuse disposal and sanitation	*		
iv.	Electromagnetic Interference		*	
v.	Employment Opportunities			*
vi.	Benefit to Economy			*
S. No.	Parameter	Negative	No Impact	Positive
vii.	Mobility			*
viii.	Safety			*
ix.	Traffic Congestion Reduction			*
x.	Less fuel Consumption			*
xi.	Reduced Air Pollution			*
xii.	Carbon dioxide Reduction			*
xiii.	Traffic Noise Reduction			*
xiv.	Reduction in Buses			*
xv.	Reduction in Infrastructure			*

CHAPTER – 6 ENVIRONMENTAL MANAGEMENT PLAN

6.1 APPROVALS/CLEARANCES REQUIREMENT

On the basis of baseline study and identified negative impacts, issues like tree cutting, development near World Heritage Structures and muck disposal etc needs necessary approvals/clearance from the relevant concerned authorities. PMU will ensure that all necessary approvals/clearances are in place before implementation. Before commencement of the construction the necessary permission required for the project is given in Table 6.1.

Issues	**Provision of Laws & Regulations**	**Due Date**	**Required Documentation**	**Approval Authority**
Permission for Tree Cutting	Maharashtra Protection & Preservation of Trees Act, 1975, as modified up to 3rd Nov 2006.	67 days before the construction	Application Format enclosing Detailed Address of Site, Plans & drawings of the proposed construction approved by competent authority, Plan showing indication of trees required to be felled.	The Tree Authority MCGM, Mumbai
Development permission near World Heritage Structures.	Development Control Regulations, 1991, Under MCGM Act, 1988.	Before Construction	Format of submission for MHCC NOC. Detailed Address of Site, Location of Heritage structure w.r.t Metro Alignment. Plans& drawings of the proposed construction activities.	Mumbai Heritage committee, MCGM. (MCGM Act, 1988)
Muck disposal permission	Environment Protection Act	Before Construction	Location of Muck Dumping Site	State Pollution Control Board/ MoEF(Govt. Of India)
Resettlement Permission	Resettlement & Rehabilitation Policy for Mumbai Urban Transport Project (MUTP), 1997 Amended in Dec 2007.	Before Construction	Social Impact Assessment & RAP Report	State Government, Maharashtra.
Consent for Establishment	Environment Protection Act	Before Construction	Site plan, sources of effluent discharge/emissions, Details of Water Pollution Control/Air Pollution Control, Ambient Air Quality Report, Consent	State Pollution Control Board (Maharashtra Pollution Control Board)
Consent to Operate	Environment Protection Act	After Construction	Site plan, Latest analysis report of effluent Discharge/emissions, Details of Water Pollution Control/Air Pollution Control, Ambient Air Quality Report, Consent fees.	State Pollution Control Board (Maharashtra Pollution Control Board)

6.2 MANAGEMENT PLANS

The Mumbai Metro Rail Project will provide employment opportunity, quick mobility service and safety, traffic de-congestion, less fuel consumption and reduced air pollution on one hand and problems of muck disposal, traffic diversion, utility dislocation etc. on the other hand during construction and operation of the project.

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 threesections:

- 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 channelled through the project authority.

The Environmental Management Plans have been prepared and discussed in subsequent

sections.

6.3 MITIGATION MEASURES Updated (EIA Feb 2020)

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

- Compensatory and in-situ Afforestation for loss of trees,
- Compensatory and in-situ afforestation for Loss of Mangroves
- Construction Material Management,
- Safety Management Measures during the construction period
- Labour Camp,
- Energy Management,
- Hazardous Waste Management,
- Environmental Sanitation,
- Utility Plan,
- Archaeological and Historical Preservation,
- Air Pollution Control Measures,
- Noise Control Measures,
- Vibration Control Measures,
- Traffic Diversion/Management,
- Soil Erosion Control,
- Muck Disposal,
- Draining of Water from Tunnel,
- Water Supply, Sanitation and Solid Waste Management,
- Sensitive Receptors
- Electromagnetic Interference
- Management Plans for Depot,
- Training and Extension, and
- Environmental Enhancement Measures.
- Waste water management

6.3.1 Compensatory Afforestation

A) Afforestation

The objective of the afforestation programme should be to develop natural areas in which ecological functions could be maintained on a sustainable basis. The Tree Authority of Mumbai is responsible for the tree cutting in the project area under Maharashtra (Urban Areas) Protection and Preservation of Trees Act 1975, as modified up to 3rd Nov 2006. According to the Tree Authority an application with site map should be submitted to authority for inspection and permission for cutting of tree. The Permission letter for removal of trees is enclosed as Appendix 6.1 .As mentioned in section 3.7.1 about 2241 trees are observed at station and Depot locations. The detail of tree likely to be removed or transplanted is given in the Table 6.2.

TABLE 6.2

DETAILS OF TREES CUT AND TRANSPLANTATION

Sr. No	Particulars	Number of Trees observed	Number of trees to be cut	Number of trees to be Transplanted	Remarks
1	Along Alignment	589	177 (30%)	412 (70%)	(Stations, Entry & Exit)
2	Depot	1652	496 (30%)	660 (40%)	30% (i.e 496) trees in depot area will remain as where it is.
	Total	**2241**	**673**	**1072**	

The number of trees to be transplanted depends on the site condition and root condition & health of tree. More stress should have been given for transplantation of the tree rather than removal. The trees which are not possible to transplant will only be cut. The trees which are cut will be compensated by planting two times the number of trees. As per estimation, 673 trees are likely to be cut for which 1346 trees are required to be planted. The compensation for loss of these trees works out to Rs. 10.095 million @ Rs. 15000 per tree.The total area required for afforestation of these trees comes out to about 1.5 ha. It is presumed that Government land will be provided for afforestation; hence no land cost will be involved. Land for plantation of trees will be identified by the project proponent in consultation with Forest Department of State Government. Compensatory afforestation cost (excluding fencing) for 1.5 ha will be about Rs. 0.3 million @ about Rs.200000 per ha. Fencing shall be provided in order to save the saplings from the animals. The cost towards fencing is estimated to be about Rs. 0.2 million. Thus, the total cost of compensatory afforstation and fencing works out to Rs. 10.595 million. The Maharashtra Felling of Trees (Regulation) Act, 1964 has recommended native plant species for afforstations. The native plant specie [1] recommended for afforestation includes gulmohar, neem, Pilkhan, Ashoka, Jamun, Desi Badam etc. The botanical names of the species to be planted are indicated in the Table 6.3.

TABLE 6.3

SCIENTIFIC NAMES OF TREE FOR PLANTATION

S. No	Local Name	Botanical Name
1	Gulmohar	*Delonix regia*
2	Neem	*Azadirachta indica*
3	Ashoka	*Saraca asoca*
4	Jamun	*Syzygium cumini*
5	Desi Badam	*Terminalia catappa*
6	Coconut Tree	*Cocos nucifera*
7	Jackfruit	*Artocarpus integra*
8	Karanj	*Pongamia pinnata*
9	Rubber Tree	*Ficus elastica*
10	Sheesham	*Dalbergia sissoo*

Updation on Compensatory Afforestation (EIA Feb, 2020)

As per the permissions granted by the Tree authority/MCGM under Maharashtra (Urban Areas) Preservation and Protection of trees Act, 1975 3716 number of trees are permitted for removal (2098-transplant; 1618-cut) for 26 stations, allied activities and Launching shaft, Traffic diversions, casting yard, pylon, Ramp etc, . For car shed maintenance depot at village Parjapur in Aarey colony area, 2646 trees (trees for cut-2185 ; trees for transplant 461) are permitted for removal .

Compensatory afforestation in lieu of the trees cut has been started in Aarey colony, NSG area JVLR, Navy colony Kanjurmarg, Defense land at Vidyanagari etc. About 3090 tree are planted at these locations. Tree planation program has also been completed on degraded forest through SGNP in Aug, 2018 by planting about 20,900 number of trees under compensatory afforestation and corporate social responsibility program. Total plantation done is 23,990. Plantation of native species includes such as Banyan tree, Neem, Pilkhan, Pipal, Bahava, Bakul, Kadamb, Jamun, Desi Badam, Karanj, Saptparni, Akashneem, Kanchan, Taman, Bael, Jungali Badam, Sonchapha, Undi, Spathodia etc..

In situ tree plantation at 26 station sites has been planned as per undertaking given to Hon'ble High Court after completion of station work to restore the green cover. Tenders are floated and two agencies are finalised. The process of retendering for finalizing third agency is in progress.

Plantation of more than 9000 trees has been planned at Goregaon site in Mumbai by Miyawaki concept/method. The process of tendering is in progress.

Project neighbourhood has been implemented by distributing more than 25,000 number of tree saplings to the educational institutes, residential societies and government offices etc. located near the stations along the alignment in the year 2017.

The maintenance schedule followed for the trees planted includes creation of tree basin followed by regular irrigation, application of fertilizers, pesticides/ nutrients and regular interval of weeding activities etc.

B) Transplantation

The trees at station location will be transplanted in the nearby open area while transplantation of trees from the depot area will be done in the nearby available area within the Aarey milk colony itself in consultation with MCGM. The structural component of depot should be planned in such a way that about 30% of the trees will get saved. The management plan for transplantation of trees is summarized below:

- Preliminary root investigation should be carried out,
- Health diagnosis of the tree should be carried out for treating infected trees,
- Soil condition where the tree has to be transplanted is thoroughly checked & necessary treatments are applied to the soil after digging a pit,
- The pit size has to be kept in accordance with the root ball of the tree,
- Packing material should be strong enough to hold the soil around the root zone,

- Crane should be used to lift the packed tree and a trolley or truck should be used to transport the tree,
- Timely feeding of the plant should be done with soluble fertilizers and watering,
- JCB should be used for digging pits,
- There should be regular monitoring for fertilizer schedules and the chemicals like insecticides and pesticides.
- Scaffolding should be used wherever required to support the trees,
- Any broken stems during transplantation should be removed cautiously.

After transplantation, there are chances of external infections to the tree which needs maintenance for at least 2-3 months.

The cost towards transplantation of trees varies with its girth. An average girth of 0.75 metre has been taken for the cost estimation. The cost for transplanting 1072 number of trees is about Rs. 53.60 million @ Rs. 50,000/- per tree. The cost i.e Rs. 50,000/- for one tree transplantation is including lead of 1.5 km with all tools, testing, man & machinery, necessary preparation and maintenance.

EIA Update Feb, 2020

The permitted trees at station locations and allied activities are being transplanted in the nearby open area at stations , at available sites in MCGM area viz. Chhatrapati Shivaji Maharaj terminus premises, Oval Maidan at Churchgate, Lokmanya Tilak Terminus, Juhu Circle, Sport Authority of india at Kandivali, Marol fire Brigade, ESIC premises at MIDC, Sandip Patil Cricket Academy at Vidyanagari, BKC steel yard etc as well as land available at Aarey colony. Few permitted trees of Aarey Depot have also been transplanted at Aarey Colony area.

Tree transplantation activities are being carried out as per guidelines issued by General Consultant (GC).

The tree transplantation phases includes Preparatory Phase in which categorising trees into small, medium and large depending upon the site condition is done.

Calculation of approximate root ball weight to be done in order to estimate the lifting arrangement of tree. Tree protection and rooting treatments with fungicides is carried out.

Excavation phase incudes the excavation around the trees as per calculated root ball diameter. Application of rooting hormones to be done on fresh cuts, then root ball packing in which the packing of root ball is done firmly to minimise damage to roots and its structural integrity during the transportation. Further lifting and transportation of the trees is done after working out the centre of gravity of tree. Depending upon the tree size and root ball weight, appropriate lifting and transport arrangements have been done at site. The tree canopy is to be covered during transportation.

The final stage of planting at receiving site includes planting of trees in pits followed by application of good quality mixture of organic compost and rooting hormones. Stacking of the trees as required has to be done.

According to the present scenario some trees were situated in the garden areas and open grounds where root ball preparation has been possibly done.However,most of the trees permitted are located on footpath, road median, strom water drainage, trees having entangled underground and above ground utilities,etc have difficulties to transplant due to inadequate root ball development and damage to the roots during excavation of the root ball . In addition to above as many tree species viz. Mango, Guava, Nilgiri, Bismarkhiya Palm, Jamun, Jack fruit, Asupalav etc observed at the sites have poor survival ratio. Also, other factors like tree size, age, health, tree structure are also major aspects impacting the survival. The post transplantation maintenance schedule followed for the trees transplanted includes creation of tree basin followed by regular irrigation, application of fertilizers, pesticides/ nutrients and regular interval of weeding activities etc.

6.3.2 Compensatory and in-situ afforestation for loss of Mangroves: Updated (EIA Feb 2020)

Around 108 no of mangroves at BKC metro station are cleared with the permission of Competent Authorities. Adequate steps have been taken in consultation with mangroves cell for compensatory afforestation and in-situ plantation of mangroves for BKC & Dharavi metro stations. Compensatory Afforestation of mangroves vegetation would be carried out at village- Koparkhairne Dist. Thane in 1 Ha area each at a standard spacing of 1.5 m x 1.5 m in lieu of diversion of forest land at BKC and Dharavi Metro Stations. In Situ mangroves plantation will also be done in consultation with mangrove cell of State Forest Department at BKC and Dharavi sites in 0.7 Ha and 0.28 Ha area respectively to restore the mangrove vegetation after the completion of station work.

6.3.2 Construction Material Management

The construction material to be used are 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 MMRC Officer 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.

6.3.3 Safety Management Measures

Prior to the construction, identification of safety hazard would be made by Project Authority to establish the safety programmes following rules, regulations and guidelines These would help to avoid and reduce the accidents. The comprehensive safety programmes will include deployment of a full time safety engineer who will prepare safety plan/schedule for their implementation during construction and operation. The emergency measures include tunnel evacuation plan and procedures independent of the tunnel power supply. The tunnel personnel would wear protective headgear, footwear and other special garments that applicable code requires. The specific working areas in underground construction can have their own unique hazards that personnel requires to be made aware of by providing training and displaying the instruction wherever it requires. The weatherproof first aid boxes will be made available at appropriate locations. The tunnel will be provided with mechanically induced reversible flow primary ventilation for all work areas. Detailed instructions will be followed for handling and storage of explosives to be used in controlled blasting if any.

6.3.4 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 MMRC. 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 be 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. The labour camps cleanliness and worker's hygiene will be monitored as a part of Labour Laws of the Country during construction of proposed project. Deployment of labour at the construction site will be made by following the fairer process as mentioned in civil contract agreement.

Shelter at Workplace: At every workplace, shelter shall be provided free of cost, separately for use of men and women labourers. 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 0.5m^2 per head.

Occupational health hazards and control: Updated (EIA Feb. 2020)

Housekeeping and cleanliness are maintained especially in labor camps to avoid any epidemics along workers working in sites. Mosquito control fogging is being carried out in all sites as well as in labor camps for Malaria and Dengue control. Rest shed are provided to workers working on sites to avoid humidity effects and rest during lunch hours. Provision of conditions in contract and good construction practices will take care of any occupational health hazard issues and provide environmentally safe work areas. However, a provision of Rs. 100.00 Lakhs have been proposed for health-related issues and its control for this project.

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 will be provided. Suitable transport will be provided to facilitate taking injured and ill persons to the nearest hospital. Construction contractor will provide health check-up camps for construction workers at least once in a month.

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 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. 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) to the satisfaction of local medical, health, municipal or cantonment authorities.

Prevention of Infectious Diseases: Construction workers are more prone to Infectious diseases such as HIV/AIDS. It should be prevented by following actions as depicted

below:

- One-one interactions – helps to build confidence,
- Counselling- addressing the myths and misconceptions,
- Community events-street theatre, puppetry, cultural programs are proven communication tools to the illiterate community to message dissemination,
- STD clinic - early identification through testing,
- Condom promotion- encouraging condom usage, an accessible place, made available at all times and free distribution.
- Advertisement board at appropriate location will be put to make aware

about the infectious diseases.

- Co-ordination with State Aids Control Society and Health Department

Sanitation Facilities: Construction camps shall be provided with sanitary latrines and urinals. Drains for waste water 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. 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.

Water Supply and Waste water Treatment Facility for Workers Camps: It is estimated that about 63 KLD water will be required daily for the camps, which will be taken from borewell/Municipal Water Supply. Borewell water will be chlorinated for use as drinking water. About 80% of the water supply will be generated as sewage/waste water, which needs.

Water Supply and Sanitation: Updated (EIA Feb. 2020)

During construction phase of the project the workers facilities such as water supply and sanitation arrangement has been provided at labour site accommodation and temporary site office staffs.

Swachhata Action Plan is released and to be implemented on all labour camp and construction site sites. It is estimated that approximate 730 KLD water is likely to be required for workers in labour camp and construction site office which will be taken from tanker and Municipal supply. Potable water will be provided for all construction staff. Drinking water shall be tested before use up to WHO/ Indian drinking water standards.

All labour camps and construction site have provided with septic tank and soak pit arrangement for waste water treatment. All septic tank/soak pit facilities are regularly serviced and emptied to reduce the risk of surface or groundwater pollution.

to be treated before disposal or may be connected to nearby sewerage network.

As per the Contract Labour (Regulation & Abolition) Act, 1970, there shall be at least one latrine for every 25 male. The sewage from the community water closet would be treated through septic tank and disposed off through soak pits. The drinking water facilities and sewage disposal sites should be located away from each other. A provision of Rs. 1.205 million would be made for these facilities as reported in Table 6.4.

TABLE 6.4
COST OF WATER SUPPLY AND SANITATION FACILITIES

Sr. No	Description	Rate (Rs/Unit)	Numbers	Cost (million)
1	Water Treatment & Supply Facilities	1,50,000	3	0.45
2	Community water closet	25,000	20	0.50
3	Septic Tank & Soak pit including connection	85,000	3	0.255
			Total	**1.205**

Solid Waste Management

It is estimated that about 315 Kg per day municipal solid waste will be generated from the labour camp. The collection, conveyance and disposal facilities shall be made available by providing 20 litres capacity bin with handle and cover for 8 workers. In addition, one community bins would be provided for effective collection of the waste. The disposal of the waste will be at municipal corporation landfill site. The cost of these facilities including maintenance for 5 years works out to be about Rs. 1.207 million as summarized in Table 6.5.

TABLE 6.5
COST OF DOMESTIC SOLID WASTE MANAGEMENT FACILITIES

Sl	Description	Numbers	Rate (Rs/Unit)	Cost (million)
1	Solid waste collection bins @ Rs. 200/bin Community bin 3 no. @ Rs. 15,000/bin	60 3	12,000 45,000	0.057
2	Transportation	-	Lump sum	0.250
3	Manpower cost of 3 persons @ 5000 per person per year for 5 years	3	3x60x6,000	0.90
			Total	**1.207**

Update (EIA Feb 2020)

Solid waste generated from labour camps is about 2.19 tons per day (TPD) is segregated and collected in separate bins for non-biodegradable and biodegradable waste. Non-biodegradable waste will be disposed by selling to scrap dealers (recyclable) and to existing authorized agency (inert and non-recyclables). Biodegradable waste is collected by local Mumbai Municipal Corporation

6.3.5 Construction Labour Management Plan: Updated (EIA Jan 2016 & Feb, 2020)

6.3.5.1 Introduction

Construction of proposed Mumbai Metro Line 3 (MML3) is likely to start after the rehabilitation and resettlement of affected communities is undertaken. The construction period is envisaged to continue for a period of 60 months (five years) after which the operational phase of the project will commence.

The entire length of the proposed metro line is 33.54 km which has been divided into seven (7) packages with 23 Tunnel Boring Machine (TBM) work sites and 9 construction depots. During the construction phase, it is anticipated that the labour requirement for the proposed work will range from approximately 1000 labours during normal operations and extend to approximately 2500 labour during peak operations. These seven packages of the proposed project are expected to be developed simultaneously, thus taking up the entire total workforce during the peak period of the construction phase to approximately 15,000. As shortlisting of Contractors is yet to be undertaken for the proposed project, it is expected that there would be a significant influx of migrant labour (unskilled and semi-skilled) during the construction phase required for performing mostly civil and systems work. It is assumed that about 50% of the labour would be migrant for which accommodation facilities will be required. The migrant labour and other semi-skilled and skilled personnel are anticipated to be accommodated in labour accommodations near their place of work (at each of the seven packages). It is also expected that local employment, one of the principal socio-economic benefits of the proposed project, will be enhanced through effective procedures for recruitment, employment and training of personnel during all phases of the Project.

The Construction Labour Management Plan has been designed to demonstrate that the regulatory applicability of national and local laws and international requirements are consistently complied with throughout the constructional phase of the proposed project.

6.3.5.2 Objectives

The Construction Labour Management Plan is being developed for the Project Proponent (MMRC) so that it can be used to achieve the following elements:

- To achieve compliance with the national and local labour requirements of the country;
- To achieve compliance with international standards on labour requirements;

- To ensure generation of local and national employment opportunities;
- To ensure that the recruitment, employment and training is undertaken in a fair and transparent manner, consistent with good international industry practice.

The Project Management Unit (PMU) is responsible for implementation of the Construction Labour Management Plan. The specific objectives of the Labour Management Plan are to:

- Outline the applicable standards for hiring, employment, training and labour management;
- Outline the procedures for recruitment, hiring employment, working conditions and training;
- Assignment of roles and responsibilities;
- Establishment of monitoring and reporting procedures; and
- Determine training requirements.

6.3.5.3 Scope

This plan shall be applicable to the construction labourers directly or indirectly employed by MMRC, if any, all construction contractors engaged, and any other third parties associated with the proposed Project. The plan will address labour-related aspects, including hiring and

training of personnel. Worker's accommodation and transportation policies and measures are also detailed out in this plan.

6.3.5.4 Applicable Standards and Legislations

National and Local Legal Requirements

Details of the national and local legal requirements that will be applicable to the proposed project in the construction phase are provided below,

- The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996: According to Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 – A "building worker" is defined as any person who is employed to do any skilled, semi-skilled or unskilled, manual, supervisory, technical or clerical work for hire or reward, whether the terms of employment to be expressed or implied, in connection with any building or other construction work.

  The Act also covers the areas of conditions of service of building workers, working hours, weekly paid rest days, wages for overtime, provision of basic welfare amenities like drinking water, latrines and urinals, crèches, canteens, first aid, temporary living accommodations, welfare measures and safety and health

measure etc.

- Maharashtra Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Rules, 2007: The Rules covers aspects relating to responsibilities and duties of employers, architects, project engineers and designers, building workers etc.; registration of establishments; registration of workers as beneficiaries, child labour, working hours, intervals of rest, maintenance of records, overtime work, night shifts, wage period, returns welfare benefits like latrine and urinal accommodation, canteens, health and safety provisions in various scenarios, medical facilities etc.

- Contract Labour (Regulation and Abolition) Act, 1970: The Act covers aspects related to registration of establishments employing contract labour, licensing of contractors, welfare and health of contract labour, penalties and procedures etc.

- The Inter-State Migrant Workmen (Regulation of Employment and Conditions of Service) Act, 1979 and Rules made thereunder: The Act encompasses aspects relating to registration of establishments employing inter-state migrant workmen, licensing of contractors, wages welfare and other facilities etc.

- The Child Labour (Prohibition and Regulation) Act, 1986: The Act covers aspects pertaining to prohibition of engagement of children in certain employments and to regulate the conditions of work of children in certain other employments. In this act, 'child' is referred to as a person who has not completed his fourteenth year of age.

- The Bonded Labour System (Abolition) Act, 1976: The Act provides 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.

- The Workmen's Compensation Act, 1923: This Act covers aspects related to employees receiving compensation for injury by accident during employment with theemployers.

- The Employee's Provident Funds and Miscellaneous Act, 1952: The Act provides for the institution of provident funds for employees in factories and other establishments. The Qualifying Period Of employment for applicability of the scheme to Employee is 90 days continuous service or 60 days random employment, within a period of 30 days. Was 240 Days. This act will be applicable if any contractor engages a minimum strength of 20 employees.

- The Employee's State Insurance Act, 1948: The Act provides for certain benefits to employees in case of sickness, maternity and employment injury and makes provisions for certain other matters in relation thereto.

- The Equal Remuneration Act, 1976: The Act covers aspects pertaining to payment of equal remuneration to men and women workers and for the prevention of discrimination, on the ground of sex, against women in matter of employment and for matters connected therewith or incidental thereto.

- The Minimum Wages Act, 1948: The Act provides for fixing minimum rates of wages in certain employments including skilled or unskilled work, manual or clerical.

- The Payment of Wages Act, 1936: The Act regulates the payment of wages of workers undertaking work related to construction, development or maintenance of buildings, roads etc.

- The Trade Union Act, 1926, as amended till date: The Act provides procedures for formation and registration of Trade Unions and lists their rights and liabilities. It encompasses any combination, permanent or temporary, that gets formed to regulate relationship between workmen and their employers.

- The Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013: The Act provides protection against sexual harassment of women at workplace and for the prevention and redressal of complaints of sexual harassment and for matters connected therewith or incidental thereto.

International Conventions and Standards

- International Labour Organisation (ILO) Conventions: India has been a permanent body of the Governing Body of ILO since 1922. On the International Labour Organization (ILO)

  core conventions, India has ratified the following four 'core' International Labour Conventions (ILCs),

S. No.	ILO Convention Number, Title and Year	Ratification Status
1	Forced labour Convention (No. 29), 1930	30th November 1954
2	Abolition of Forced Labour Convention (No. 105), 1957	18th May 2000
3	Equal Remuneration Convention (No. 100), 1951	25th September 1958
4	Discrimination (Employment Occupation) Convention (No. 111), 1958	3rd June 1960

- International Finance Corporation's (IFC) Performance Standards:

  IFC Performance Standard (PS) 2 on Labour and Working Conditions[1] is specific to labour and working conditions. This Standard focuses on the protection of the basic rights of workers, fostering constructive worker-management relationships, as well as promoting fair treatment and the provision of a safe and healthy workplace. The basic provisions for migrant workers under PS 2 are enumerated below:

  - As per the provisions of PS 2, MMRC is required to identify migrant workers and ensure that they are engaged on substantially equivalent terms and conditions to non-migrant workers carrying out similar work;
  - MMRC shall provide accommodation, transportation, and basic services including water, sanitation, and medical care for the workers working on that project;
  - The compensation paid to the migrant workers should be non-discriminatory and the principle of equal opportunity and fair treatment to be followed; and
  - Wastewater, sewage, food and any other waste materials are to be adequately discharged, in compliance with local or World Bank standards – whichever is more stringent – and without causing any significant impacts to the biophysical environment or surrounding communities.

  IFC Performance Standard (PS) on Community Health, Safety and Security carries health and safety through to the community environment. The objectives of the PS are to minimise and manage health and safety risks to local communities and to ensure that the project does not harm community health and safety. The

basic provisions for management of migrant labour and labour camps under this PS have been detailed out below:

- MMRC is required to prevent or minimise the potential for community exposure to water borne, water based, water related or vector borne disease that could result from project activities. They shall be responsible to avoid transmission of communicable diseases that may be associated with the influx of temporary or permanent project labour.

[1] International Finance Corporation's Performance Standards on Social & Environmental Sustainability, 2007. Performance Standard 2: Labour and Working Conditions

- When the client retains direct or contracted workers to provide security to safeguard its personnel and property, it will assess risks posed by its security arrangements to those within and outside the project site. In making such arrangements, the client will be guided by the principles of proportionality and good international practice in relation to hiring, rules of conduct, training, equipping, and monitoring of such workers.

6.3.5.5 Management Controls

MMRC is committed to ensure compliance of its own operations and those of any contractors or sub-contractors that would be engaged in the proposed project with the provisions of the following:

- The National and Local Labour Regulatory Requirements;
- ILO Conventions No. 29, 105, 100 and 111; and
- IFC Performance Standard 2 and 4.

Details of the measures that are to be adopted by the MMRC pertaining to the construction phase are provided in the following thematic areas,

6.3.5.6 Hiring

Identifying Labour Needs

It is essential to forecast the requirement of workforce in a systematic and timely manner for the Project so that identification of available resources and suitable local/regional individuals for all unskilled, semi-skilled and skilled positions can be ensured. The Hiring Policy and Procedure of MMRC should be adhered to while identifying labour needs.

The various departments and Contract Managers are responsible for drafting job descriptions, identifying whether the vacancies are categorised as skilled, semi-skilled or unskilled, and specifying the number of individuals required and expected duration of employment.

A detailed Project Workforce Database is required to be maintained by the Human

Resource Department of PMU to assist in forecasting the labour requirement and to undertake appropriate planning for the relevant recruitment and employment activities.

Recruitment and Hiring Procedure

Policies and procedures to ensure that recruitment and hiring practices are fair and transparent is required to be developed.

Discrimination in relation to recruitment and employment on grounds of race, gender, age, disability, sexual orientation, or religious or political beliefs should be prohibited under all circumstances.

A comprehensive Hiring Policy and Procedure should be developed by MMRC's Human Resource Department and should contain the following key recruitment processes,

- Identifying project recruitment needs and staffing requirements;
- Developing and reviewing job descriptions in a standard MMRC template. All job descriptions are to be composed by the responsible managers in competency based terms and will provide an appropriate level of detail in terms of job specification and requisite qualifications;
- Posting internal and external advertisements for available job vacancies;
- Initial screening by the Human Resources Department of the to develop[a short-list of suitable contractors;
- Skills, and pre-employment medical checks;
- Valid documents highlighting date of birth and proof of address;
- Undertaking reference checks; and
- Processing Employment Agreements for job placements.

The Contractors are required to implement equivalent recruitment procedures and have all associated documentation in place. An internal audit process shall be conducted once every six (6) months to monitor the recruitment and hiring practices conducted by the contractors and sub-contractors.

Preferential Local Employment

In the process of engagement of workers, preference should be given to local workers from the Project Affected and Influenced Areas.

Recruitment Staff and Offices

Project related recruitment should be conducted in designated offices of the PMU. Dedicated recruitment officers should conduct regular visits and recruitment events in the communities within the Project Affected and Influenced Areas. These events are to be managed centrally by the PMU.

The procedures and requirements for recruitment offices are to be reviewed prior to the

operational phase.

Skills Database

The Human Resource Department of MMRC should work closely with the PMU in carrying out the local recruitment effort. The PMU is required to maintain a local database of people interested in employment with the Project. Quarterly reports on recruitment activities and performance are to be prepared and submitted to MMRC.

Prohibition of Informal Hiring

Informal approaches of recruitment shall not be permitted. Recruitment should be conducted formally and not via informal requests, approaches or solicitations from community members, relatives of the currently employed personnel and other job seekers.

Information Provision as part of Recruitment Process

Dissemination of all recruitment advertisements for the Project is controlled by MMRC or PMU. Recruitment procedures in relation to information provision is to include the following,

- Vacancy announcements and advertisements must have appropriate approval from MMRC
- Means of information dissemination include advertising of employment opportunities in the local newspapers, online resources (MMRC website), local TV Channels, advertisements in community notice boards, local places etc.

6.3.5.7 Terms of Employment

All recruitment information and employment contracts of the Contractors shall specify an employee category and duration of the employment term. Special effort shall be made to ensure that proper understanding of the written provisions in contracts, with specific verbal explanations delivered individually in a simple and understandable manner to avoid any confusion with respect to the duration and terms of employment. Basic eligibility requirements that are to be adhered to by the Contractors for employment process are as follows:

- All applicants must be at least 16 years of age on the date of hire for all positions;
- All applicants are to possess valid documents showcasing their date of birth and proof of address;
- Citizens convicted of a criminal act by a legal court and currently serving their sentences are not eligible for appointment;
- Preference of employment are to be given to residents from Project Affected and Influenced Areas whenever required;
- Medical Clearance to be fit for work;
- Women labour shall be given equal employment preferences during hiring process;
- No child labour or bonded labour will be permitted.

Besides these criteria's, the Contractor is to abide to the following conditions,

- The contractor to ensure that work hours are set at eight hours a day, 48 hours a week, with a weekly rest day for all engaged labours.
- Every labour is entitled for maximum of only two hours a day as Overtime (OT) work. OT pay is twice the hourly remuneration.
- The Contractors are mandated to observe equal wages for male and female workers for work of equal nature or value.
- A grievance redressal mechanism for workers shall be put in place by the contractor to raise workplace concerns. The workers will be informed about the grievance mechanism at the time of recruitment.
- MMRC shall ensure that the primary contractors develop and implement a procedure to review the performance of their sub-contractors.

Work Contracts, Working Hours and Vacation

MMRC shall ensure that the contractor provide awareness to the construction labour hired for the Project regarding their rights under national labour and employment law, terms of employment and other benefits at the time of appointment, through induction training.

Contracts of employment shall be in writing and all employees are to receive a copy of their employment agreement which will include information pertaining to job title, job duties, basic salary, work hours, compensation for overtime work hours, rest days, leaves, benefits, termination and labour conditions.

All appointed labour shall be provided with valid identity cards giving details of the person, such as photograph, name, age and address. The identity cards will need to be carried by the labour at all times.

All appointed labour shall be covered under the Employee State Insurance (ESI) Scheme and provided medical benefits there under.

It is likely that the local communities who may not have had any previous experience with waged or temporary employment may assume that all jobs will be permanent. All local and migrant labour shall therefore be prior informed about the duration of the construction works and their employment by the contractors during the induction training.

The contractors shall maintain following documentation pertaining to labour engagement as per forms provided in Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Central Rules, 1998 (BOCWR 1998):

a. Register of construction workers employed (Form XV)
b. Muster Roll (Form XVI)
c. Register of Wages (Form XVII)
d. Register of advances (Form XXI);
e. Register of over-time (Form XXII);
f. Wage Book (Form XXIII)

MMRC shall ensure that daily wage rates as per the Minimum Wages Act are displayed at the construction site in English, Hindi and local language (Marathi). In addition, a notice showing the period for which wages are to be paid, place and time of disbursement of wages shall also be displayed at conspicuous places within the construction site in English, Hindi and local language (Marathi).

Labour Remuneration

All Contractors and Sub Contractors of the Project must be provided an employment contract that clearly sets out their salary conditions and other allowances. All contract workers are to be covered under welfare benefits as prescribed by the laws of the country.

All worker terminations will be performed strictly according to MMRC policies. The procedures to guide the retrenchment of employees should encompass,

- All Contractors while hiring should be clearly explain the period of employment and conditions of hiring and layoff to new recruits and recorded in the individual employment contracts;
- During regular meetings with worker's, the Contractor is to disseminate information relating to the Project's schedule and potential layoffs, whenever applicable;
- The Contractor and Sub Contractor is responsible for returning workers to the place from where they were recruited (the place of hire will be specified and transport service or cost of transportation will be covered by the Employer).

6.3.5.8 Anti-Discrimination and Grievance Management

All Contractors' are to abide by to the regulatory requirements of anti-discrimination and are responsible in ensuring that all workers engaged by them are treated fairly, with dignity and respect and have equal employment opportunities. A Grievance Mechanism is also required to be developed and communicated to all employees. The IFC Performance Standard 2 requires the client to ensure that contracted workers have access to Grievance Redressal Mechanism (GRM) in order to raise workplace concerns. Effective and timely response to complaints is essential for maintaining good working relations with the labours that can be addressed only through an efficient grievance redressal. This mechanism provides the employees with an authorised process for raising concerns to senior management, covering any issues that are work related and that are deemed by the employee as unfair. Such concerns may relate (but not limited) to the following,

- The decision of the supervisor;
- The behaviour of another employee, supervisor, or contractor; and
- The application of the Company's policy

MMRC shall ensure that the contractor has a documented GRM with the following elements:

- Proper system for lodging grievances;
- Provisions for raising anonymous complaints;
- Appropriate level of management for addressing concerns;
- Provision for timely action and feedback;
- Monitoring and review of grievances raised and action taken; and
- Scope of continual improvement of the system.

In case, any of the contractors do not have a formal system of grievance redressal, MMRC shall formulate a GRM and share the same with the contractors.

Implementation of the GRM shall lie with the contractors while MMRC shall be responsible for monitoring and review.

The Grievance Redressal Mechanism outlines the process for lodging grievances, steps to be taken for subsequent action and the time limit within which the issue would be resolved to the satisfaction of the complainant. All complaints shall be recorded and addressed in a uniform and consistent manner.

6.3.5.9 Workers Accommodation and Transportation

The Contract labour will be provided accommodation during their period of employment at a labour camp near their place of work. The labour camps are to be set up and managed by the Contractors in accordance with the applicable legal requirements and guidance contained in the IFC/EBRD Guidance Note "Workers Accommodation: Processes and Standards". The key elements of the standards are as follow:

Climatic Aspects: The accommodation facilities are to be provided with ventilation so that the inside temperature is constantly kept around 25^0C. The labour will be provided with accommodation made of insulated material and locally available building material etc.

Drinking Water: Drinking water shall be provided in sufficient quantities at all times, either from regular taps if drinking water quality can be ensured or in bottles. MMRC shall regularly monitor the quality of drinking water available. In case of non-compliance with the Drinking Water Specifications[2], additional treatment shall be provided or alternative sources of water supply shall be arranged. All tanks used for the storage of drinking water are constructed and covered as to prevent water stored therein from becoming polluted or contaminated. The water quality from water storage tanks (indirect source of drinking water) shall be regularly monitored. Water samples will be sent to recognized laboratories and testing reports will be well documented. The water storage tanks shall be cleaned every fifteen days to ensure safe drinking water.

General Hygiene: Pest extermination, vector control and disinfection shall be carried out throughout the living facilities as required and pests and vectors are to be monitored on a regular basis. Dustbins shall be provided for collection of garbage around the camp and will be removed on a daily basis.

Accommodation Facilities:

- Not more than eight workers accommodated in the same room with separate beds for each worker;
- Partitions to ensure privacy and a minimum distance of one metre between beds;
- Not more than one worker per five square metre (surface) and one worker per ten cubic metre (volume); and
- The migrant workers with families shall be provided with individual accommodation comprising bedroom, sanitary and cooking facilities.

Dining Facilities:

- The contractor shall provide a canteen facility for the construction workers and the food will be of appropriate nutritional value and will take into account religious/cultural backgrounds.
- Places for food preparation shall be designed to permit good food hygiene practices, including protection against contamination between and during food preparation;
- Adequate personal hygiene including a sufficient number of washbasins designated for cleaning hands with clean, running water;
- All kitchen floors, ceiling and wall surfaces adjacent to or above food preparation and cooking areas are built using durable, non-absorbent, easily cleanable, non-toxic materials; and
- Fuel need of labourers in the project area shall be ensured so that it does not interfere with the local requirements; necessary arrangements for supply of fuel to the labourers shall be done by the Contractor. Fuel requirement for cooking purposes are only to be met by fuel that is to be purchased from authorized vendors only.

Sanitary Facilities:

- A total of 100 litres of water per worker per day shall be available in average for personal hygiene purposes;
- One hand wash sink per ten persons shall be provided;
- One toilet per ten persons shall be provided;
- One urinal per fifteen persons shall be provided;
- One shower per ten persons shall be provided;
- Regular cleaning of soil and sanitary facilities and regular washing of bed linen shall be ensured; and
- Separate storage space shall be provided for boots and PPE.

Gender: Separate sleeping areas and separate sanitary facilities are to be provided for men and women.

Comfort, culture and recreation: Facilities for the storage of workers' personal belongings are to be provided. Effort shall be made to provide facilities for observance of religion as defined in consultation with workers' representatives; and a television shall be provided in a common area.

Safety: Both natural and artificial lighting are provided and maintained in living facilities. Emergency lighting shall also be provided. Fire Extinguishers are to be provided and fire emergency procedures shall be in place, with trained fire wardens in each accommodation block. Provision for first aid boxes in adequate number and ties up with

hospital adjacent to the project site shall also be complied with.

Complaints and incident reporting: A formal Complaints Procedure will be implemented to ensure timely and transparent response to complaints as received from labour.

Labour education: The workforce will be sensitized to local social and cultural practices through provision of an induction course for all employees that stipulates expected behaviour.

Security: The contractor shall be responsible for deploying adequate number of guards in the accommodation area. The security personnel shall be provided with training to respect the community traditions and in dealing with, use of force etc.

Inspection of Accommodation Facilities

Accommodations provided shall be inspected at frequent intervals to ensure that the facilities are well organized and maintained to acceptable and appropriate standards. The key areas are:

- Daily sweeping of rooms and houses shall be undertaken;
- Regular cleaning of sanitary facilities shall be undertaken;
- The kitchen and canteen premises shall be established under good hygiene conditions;
- Daily meal times shall be fixed for the labour;
- Smoking and alcohol consumption shall be prohibited in the workplace;
- Water logging shall be prevented at areas near the accommodation facilities and adequate drainage is to be provided;
- Checklists pertaining to the daily housekeeping schedule shall be maintained and displayed at houses, toilets and kitchen.

Camp Policy and Code of Behaviour

MMRC is required to establish a Camp Policy and Code of Behaviour for all employees to main good employee and camp relations and to guide all staff with expectations of professional behaviour at the Project. All employees and contractors at the labour camps are to be provided a copy of this Policy (in local and national language) and code prior to residing at the camp. The Contractors are required to sign an 'Acknowledgement and Agreement' Form stating that they have understood and will abide by the Policy and Code. The Policy shall contain clauses which will relate to on-site behaviour and interaction with the local communities. The Policy and Code should be developed based on the following outline,

- Application of the Camp Policy and Code of Behaviour
- Code of behaviour
    - Acceptable Behavioural Standards;
    - Unacceptable behaviour resulting in immediate termination of employment and removal from site; and
    - Unacceptable behaviour resulting in disciplinary action.
- Alcohol Consumption
    - Alcohol use at workplace;
    - Alcohol consumption at designated areas; and
    - Alcohol search at camp entrances.
- Accommodation

  - Check in and check out;
  - Residential Supplies and Services;
  - Safety and security of residents; and
  - Complaints and suggestions.
- Catering and Dining;
- Health and Hygiene;
- Fire Fighting Equipment

Transportation

All workers employed by the Contractor and residing in the labour accommodations provided shall be ensured free and adequate transport facilities from the living facilities to the worksite.

Wastewater Generation

There will of generation of wastewater from these labour accommodation. About 80% of water supply shall be generated as sewage/wastewater. The Contractors shall ensure that all the accommodation blocks are equipped with septic tank and soak pit for disposal of sewage. It is also recommended that the storm water and sewage system should be separate. The surface water drainage shall include all necessary gutters, down pipes, gullies, traps, catch pits, manholes etc.

Solid Waste Management

The municipal solid waste generated from these labour camps will mostly comprises of compostable wastes like vegetable matters and combustible waste like paper, cans, plastic and some non-degradable waste like glass/glass bottles. Improper disposal of solid waste will lead to environmental degradation and health hazards to labour as well as nearby community.

The following measures shall be adopted by the Contractors for ensuring effective management of solid waste:

- The solid wastes of domestic nature generated shall be collected and stored separately in appropriate containers with proper sealing on them;
- Separate bins with proper markings in terms of recyclable or non-recyclable waste shall be provided in the houses and kitchen premises in sufficient numbers for collection of garbage.
- Food waste and other refuse are to be adequately deposited in sealable containers and removed from the kitchen frequently to avoid accumulation.
- The Contractors shall identify the nearest municipal solid waste storage facility and tie up with the concerned urban local body for disposal of waste at frequent intervals.

6.3.5.10 Management of Contractors and Supply Chain

Contractors and Sub Contractors Management

Contractors and Sub-Contractors that would be engaged at the Project Site shall comply with all requirements as provided above. MMRC shall ensure that the contractual provisions reflect these requirements. Compliance by Contractors and Sub-Contractors will be undertaken either by adopting the policies and procedures of MMRC or by implementing the Contractors own procedures provided it is approved by MMRC. The PMU shall be the interface between the Project proponent, MMRC and the Construction Team. In addition, to having a contractual obligation to implement the measures set out in the Contract Agreement, Project Contractors are also responsible for implementing any additional measures relevant to the contractor's scope of work that have been identified through the ESIA process.

Compliance verification shall be used to assess contractors' performance against MMRC procedures, applicable national and local Laws, and international standards (particularly those of the IFC and ILO). Audits may be conducted directly by the MMRC Human Resources Department or by authorised government inspection agencies every three months.

The focus of Contractor monitoring will be on ensuring that employment arrangements do not contravene applicable national and local Law or international standards and on monitoring the working and living conditions at Project work sites and in the worker accommodation camps.

Supply Chain Management

All suppliers to the Project shall be expected to comply with the national and local labour laws along with the applicable standards of ILO and IFC Performance Standard.

Selected supplier standards include the following:

Supplier Standards for Employment: As a minimum, the MMRC suppliers are required to maintain and implement policies to comply with Indian laws and regulations, and prohibit the employment of forced, bonded or child labour, with a process for assuring compliance.

Supplier Standards for Human Rights: As a minimum, the MMRC suppliers are required to maintain and implement policies that respect basic human rights and dignity, without distinction on any basis, including the rights to life, liberty, and security of person, freedom from slavery and cruelty, and equal protection under applicable Indian and International laws and constitutions and a process to assure compliance.

Supplier Standards for Health and Safety: As a minimum, the MMRC suppliers are

required to maintain compliance with all Health, Safety and Environment (HSE) requirements of MMRC and to demonstrate strong organisational commitment to responsible HSE management and the elimination of workplace injuries and illnesses, with a process for obtaining assurance on compliance with those policies, both internally and externally, by regular audits, reviews and reports.

Supplier Standards for Community Relations: As a minimum, the MMRC suppliers are required to demonstrate organisational commitment to responsible and productive community relationships. Suppliers will commit to this standard by maintaining business relationships that will have a positive and enduring effect on the local communities and neighbours affected by MMRC's operations.

MMRC requires that all suppliers pay specific attention to the management of their subcontractors. All subcontractors must be approved in writing by the Procurement team, and must meet the strict HSE and quality requirements of the contract. Subcontractors failing to comply with MMRC safety requirements will be prevented from future works on the Project and its associated businesses if they cannot meet the requirements set out above after being requested to bring their procedures into compliance.

6.3.5.11 Contractor Verification Process

Labour and working conditions for contractors and their adherence to the applicable policies and requirements will be monitored by the Procurements Department. Compliance verification covers recruitment, hiring and employment practices, as well as working conditions and training within MMRC Departments and for all key Contractors. The Procurement Department is subject to internal audit by the MMRC Audit Department. Compliance verification will assess MMRC and Contractors performance against MMRC procedures, Indian Law, and international standards (particularly those of the IFC and ILO). Compliance verification may be conducted directly by the MMRC Audit Department or externally by third parties hired by MMRC for this function. MMRC will conduct at least yearly audits of its own Departments. Written reports will be prepared describing the findings of the audits undertaken and a mechanism developed for implementing any corrective actions required.

6.3.5.12 Training

All project employees (direct and indirect) shall be provided with trainings pertaining to human resource policies, employment conditions, camp behaviour, code of conduct, tool box training, fire safety, first aid, security training, grievance mechanism and associated requirements. MMRC will require a commitment by all contractors and key suppliers to conduct their businesses according to these principles. A clearly defined training curriculum shall be developed and implemented for job specific health and safety training.

6.3.5.13 Roles and Responsibilities

The overall implementation of the Plan will be undertaken by the contractor under supervision of PMU. Every contractor engaged by MMRC for construction shall appoint a representative (preferably Site Supervisor) who will be responsible for supervising the implementation of measures as suggested in the Plan. The Site Supervisor will be stationed at the project site office. He will report be supported by HR Officer and Safety officer at the site. The key responsibilities of the contractor team will be;

- Issuing the PPE to workers and keeping records of all the protection equipment;
- Maintaining the registers of wages, overtime and advances;
- Keeping the daily in/out records of workers working at site;
- Taking action on the workers without PPE and indiscipline;
- Inspecting the site/workshop/tools/machinery for safety;
- Keeping the records of accidents/incidents/injuries;
- Inspecting the hygiene and housekeeping at work place;
- Recording grievances of workers and addressing them; and
- Ensuring compliance to requirements of the Plan

MMRC will play an essential role in ensuring implementation of the influx and labour camp management actions as set out in this Plan. Overall responsibility for the implementation of the Plan shall rest with the Project Manager (PMU) stationed at site. He will be supported by the following site staff on daily basis:

- Site Environment, Health & Safety (EHS) Head
- Safety Officer
- Site Human Resources (HR) Head/ Officer

These persons shall be responsible for ensuring that the policies and procedures of MMRC are integrated into the overall operations, plans and programmes in relation with management of labour camp. The EHS Head at site, along with Safety Officer will handle EHS issues while the HR Head/Officer will be instrumental in interacting with labours and addressing their day to day concerns. The contractors will be controlled by the Project Manager at site. A Pharmacist shall be employed for effective health management of labours, and will report to the HR Head/Officer at site. This team shall work in close coordination with the Site Supervisor of contractor for labour issues encountered during construction phase.

6.3.5.14 Monitoring

MMRC shall regularly monitor effective implementation of the above requirements of the Plan by contractors and labour. Periodic audits shall be conducted by MMRC for ensuring compliance. The principle objectives of monitoring and audits shall be to check whether:

- The contractor in adhering to the requirements of Construction

Labour Management Plan;

- The performance of contractor is in compliance with the documented labour management measures;
- There is need for implementation of corrective action in the event that the described management measures do not meet the desired level of performance;
- The existing practices need to be altered thus facilitating continual improvement.

Migrant Labour Monitoring

MMRC shall regularly undertake monitoring of migrant labour numbers throughout the construction phase. The HR Officer of contractor shall report to the Site HR Head/ Officer of PMU on a monthly basis on:

(i) The occurrence of monthly migrant labour during construction phase;
(ii) Employment composition of labour (local or outsiders);

(i) Maintenance of proper records of labours with age, district, state and other details;

The following parameters will be taken into consideration while monitoring the impacts arising due to migrant labour and necessary actions will be taken by MMRC/PMU accordingly:

- Evidence of conflict or tensions within host communities;
- Evidence of social ills – problems with alcohol, drugs, gambling, prostitution;
- Crimes, incidents, convictions and evictions recorded by the local police against the labour;
- Any grievances related to migrant labour.

Labour Camp Monitoring

Assessment of accommodation needs of construction labour engaged at site shall be undertaken by MMRC/PMU. Construction workers living in labour camps provided by contractor may encounter discomfort due to poor living conditions at the site. Hence, the workplace shall be inspected for general hygiene and living conditions as per IFC standards which include, but not limited to the following:

- General living conditions;
- Accommodation Requirements;
- Sanitation and toilet facilities;
- Food and canteen facilities;
- Drinking water facilities;
- First aid facilities and services;
- Entertainment and recreational facilities; and
- Grievance reported by workers

6.3.5.15 HR Audits

An internal audit shall be conducted by Site HR Officer once every six (6) months to monitor the recruitment and hiring practices conducted by the contractors and sub-contractors.

6.3.5.16 Health and Safety Audits

The Safety Officer of MMRC/PMU shall conduct internal health and safety audits once in a quarter to assess the compliance of health and safety aspects at labour camps. The

findings of the audit shall be discussed between the Site EHS Head and Safety Officer of PMU, and representative from contractor. Corrective actions which will be time bound shall be formulated and implemented. The EHS Head shall supervise and monitor the implementation of the corrective actions.

Incident Reporting

The labour shall be trained on incident reporting system of MMRC. Any incident, near miss or activity irrespective of its severity occurred inside the labour camp shall be reported and recorded. The Safety Officer of MMRC/PMU shall thoroughly investigate the actual cause of the injury and identify potential corrective actions to prevent future incidents. Proper documentation shall be maintained in timely and accurate manner to mitigate against similar situations in future.

Weekly Safety Meetings

Safety Officer of MMRC/PMU present at the site shall organize weekly meetings on safety in coordination with representative from contractor. The objective of meeting will be to discuss the efficacy of the safety measures incorporated during construction phase for labours. Any other health and safety concerns and safety measures can also be incorporated in further course of work. Monthly meetings shall also be organized with the EHS Head at site to update him on the health and safety aspects in labour camps and to seek his guidance in developing safety measures.

Internal HR Meetings

The site HR Head/officer of PMU shall organise monthly meetings with MMRC HR head and Project Manager to assess the issues raised by labours. The purpose of the meeting will be to evaluate the frequency of grievance being reported by the labours and the effectiveness of corrective actions taken for its closure by both contractor and MMRC. Concerns regarding the entitlement of benefits by contractors to the labours, wages paid to them and leaves granted will also be discussed.

The monitoring program to be followed by MMRC has been summarised below;

Monitoring	Description	Frequency	Responsibility
Migrant Labour Monitoring	• Occurrence of monthly labourinflux during construction phase; • Employment composition of labour (local or outsiders); Maintenance of proper records of labours with age, district, state and other details	Monthly	Site HR Officer
Labour Camp Monitoring	• General living conditions; • Accommodation Requirements; • Sanitation and	Monthly	Site HR Officer and EHS Head
Monitoring	Description	Frequency	Responsibility
	contractor and MMRC		

6.3.5.17 Documentation

Proper documentation shall be maintained in the project office of the Contractors and PMU and shall be accessible to only the Safety Officer and HR Officer. The following records shall be maintained,

i. Training Records
ii. Safety Meetings and Logs
iii. Incident Reports
iv. Labour Camp Monitoring Reports
v. First Aid Register
vi. Regulatory documents or forms (such as Wage Register, Muster Rolls, Benefits like PF, ESI, Overtime, etc. as applicable to the project)

6.3.5 Energy Management

Energy conservation measures are often the easiest, quickest and cheapest way to reduce costs and implement environmentally pro-active Energy conservation program both on energy demand and supply. The contractor shall use and maintain equipment so as to conserve energy and shall be able to produce demonstrable evidence of the same upon MMRC request.

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

- Use of energy efficient motors and pumps,

- Use of energy efficient lighting,
- Adequate and uniform illumination level at construction sites suitable for the task,
- Proper size and length of cables/ wires to match the rating of equipment, and
- Use of energy efficient air conditioner.

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.

6.3.6 Hazardous Waste Management

Hazardous Waste needs to be stored at a secured 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 contractor shall identify the nature and quantity of hazardous waste generated as a result of his activities. Hazardous Waste will be handled and disposed as per the Hazardous waste (M& H) Rules, 2008 and shall be authorized with Maharashtra Pollution Control Board. Outside the storage area, the contractor shall place a 'display board', which will display quantity and nature of hazardous waste. The labeling and packaging is required to be easily visible and be able to withstand physical conditions and climatic factors. The contractor shall approach only Authorized Recyclers with MPCB for disposal of Hazardous Waste, under intimation to the MMRC.

6.3.7 Environmental Safeguard

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 at 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 to ensure for good environmental sanitation at Work Site, Construction Depot, Batching Plant, Labour Camp, 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 MMRC.

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 and endanger to 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 structural dimension of the barricade, material and composition, its colour scheme, MMRC logo and other details.
- All stairways, passageways and gangways shall be maintained without any blockages or obstructions. All emergency exits passageways, exit 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 are removed/disposed off from the working areas to officially designated dump sites. Trucks carrying sand, earth and any pulverized materials etc. in order to avoid dust or odour impact shall be covered while moving.
- 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. shall not be allowed on the roads to obstruct free movement of road traffic.
- Water logging on roads shall not be allowed.
- Turbid water from construction area shall be treated by sedimentation tank as required.
- 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 identified locations(s).
- All wooden scrap, empty wooden cable drums and other combustible packing materials, shall be removed from work place to identified location(s).
- 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 (housekeeping).

6.3.8 Utility

The proposed Metro alignment is passing through underground, hence utilities like sewers, water mains, storm water drains, telephone cables, electrical transmission lines, electric poles, traffic signals etc. would not get affected except at locations where construction of stations is proposed through cut and cover method. These utility services 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 6.6. While planning for diversion of underground utility services e.g. sewer lines, water pipe lines, cables etc., during construction of Metro rail, 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.

TABLE 6.6
ORGANIZATIONS RESPONSIBLE FOR UTILITIES AND SERVICES

S. NO.	ORGANIZATION/ DEPARTMENT	UTILITY/SERVICES
1.	Brihan Mumbai Municipal Corporation	Sewerage and drainage lines.W ater mains and their service lines, including hydrants and fountains etc, water treatment plants, pumping stations, Roads, surface water drains, nallahs, sewer lines, street lights, high mast lights etc.
2.	Public Works Department	Roads, surface water drains, nallahs etc.
3.	NHAI	Roads, surface water drains, nallahs etc.
4.	Brihanmumbai Electric Supply and Transport (BEST) for island city, and Reliance Energy, Tata Power and Mahavitaran (Maharashtra State Electricity Distribut. Area	Power cables and their appurtenances, pole mounted transformers.
5.	Mahanagar Telephone Nigam ltd. (MTNL)	Telecommunication cables, junction boxes, telephone posts, O.H. lines etc.
6.	Office of Commissioner of Police, Mumbai	Traffic signal posts, junction boxes and cable connection etc.

7.	Reliance Mobile India Limited, Idea, Airtel and Tata Tele service India Limited	Telecommunication cables, junction boxes etc.
8.	Mahanagar Gas Limited	Gas Pipelines

6.3.9 Archaeological and Historical Structure Preservation

No damage to Archeological Monuments is anticipated. However, during construction, archaeological or historical structures may get affected by direct or indirect construction activity. Chhatrapati Shivaji Terminus (formerly Victoria Terminus) is the World Heritage Cultural Property located at close vicinity to the alignment, for which necessary procedure will be followed to obtain the necessary construction permit from MCGM. No Objection Certificate (NOC) will be taken from the Mumbai Heritage Conservation Committee, MCGM under MCGM Act, 1988. The tentative application format is enclosed at Appendix 6.2. Prior to the initiation of construction, MMRC will conduct condition survey of all historical important structures in the vicinity of alignment. This survey will help to identify the impact on the structures during construction and operation of the project. Any impact would be compensated by adequate management plan to preserve the structures. The management plan will include ground vibration monitoring during construction and operation of project.

The tunnel will be constructed by using the state of the art technology i.e. Tunnel Boring Machine which gives negligible vibration and does not affect the surrounding structure. 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 and successfully implemented by DMRC in the Delhi while carrying out works in the regulated/prohibited areas (ASI protected monuments) as well as close to public and private buildings and there is no damage to these structures due to the construction activities of Delhi Metro.

6.3.10 Air Pollution Control Measures

During the construction period, the impact on air quality will be mainly due to increase in Suspended Particulate Matter (SPM) along haul roads and emission from vehicles and construction machinery. Though an air quality during construction shows insignificant impact, nevertheless certain mitigation measures which shall be adopted to reduce the air pollution are presented below:

- The Contractor shall take all necessary precautions to minimise 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 during handling of materials, construction or storage activity. The emission should not remain visible in atmosphere beyond the property line of emission source for any prolonged period of time without notification to the Employer.
- The Contractor shall use construction equipment to minimise or control of air pollution. He shall maintain evidence of design and equipment to make these available for inspection by 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 use cover for materials of dust generating 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
- Contractor shall install barriers around the open construction sites before

commencing the work.

- The temporary dumping areas shall be maintained by the Contractor at all times until excavate is re-utilised for backfilling wherever necessary 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 wetted each day, to minimize dust production. During dry weather, dust control measures must be used daily especially on windy, dry days to prevent any dust from blowing across the site perimeter.
- The Contractor shall sprinkle water at construction sites 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 especially 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.

6.3.11 Noise Control Measures

There will be an increase in noise level in the tunnel due to construction and operation of the Metro corridors. However, noise levels in the core city are expected to go down. The increases in levels are 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 to the extent possible,
- Automation,
- Construction of permanent and temporary noise barriers,
- Re-route and regulate the traffic, a main source of noise,
- Use electric instead of diesel powered equipment,
- Use hydraulic tools instead of pneumatic tools,
- Acoustic enclosures should be provided for individual noise generating construction equipment,
- Scheduling of truck loading, unloading and hauling operation,
- Proper operation and maintenance of the construction vehicles and equipment would keep them within noise limit,
- Schedule work to avoid simultaneous activities,
- Anti drumming floor and noise absorption material,
- Low speed compressor, blower and air conditioner,
- Mounting of under frame equipment 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.

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 equipment, 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. 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. Noise proof barriers will be provided on the construction boundary near the residential area.

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 is supported on two layers of rubber pads to reduce track noise and ground vibrations. In addition, baffle walls as parapets will be constructed at up to the rail level so as to reduce sound levels.

6.3.12 Vibration Control Measures

The vibration impact analysis has been conducted considering the worst case scenario. An actual vibration impact shall be carried out prior to the start of construction and during the construction on the basis of detailed soil investigation and TBM activities involved. Detailed geotechnical investigation is required prior to the tunnel construction. By adopting good construction practices, generation of vibration will be controlled during construction and operation.

Following measures to be taken during construction of tunnel, the contractor shall prepare a monitoring scheme prior to construction at such locations.

- Detailed vibration investigation should be carried out prior to construction at locations where the alignment is close to historical / heritage structures.
- Continuous vibration monitoring equipment shall be installed during construction.
- Vibration monitoring shall also be conducted inside as well as on the top of the building mainly for old structures and heritage buildings.
- Proper vibration mitigation measures to be taken during construction of tunnels and also during operation of metro rail.
- Pre-construction structural integrity inspections of historic and sensitive structures.
- The local residence staying in the buildings close to the proposed metro rail alignment shall be informed about the vibrations and to vacate the location if needed.

- Install supporting wall piles to reduce vibration and settlement impact,
- Information dissemination about the construction method, probable effects, quality control measures and precautions to be used.
- Inform the public about the project and potential vibration-related consequences, monitor and record vibration from the activities for sensitive receptors.

Vibration emanates from rail - wheel interaction and the same 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 been 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 will be achieved by providing of bolster less type bogies having secondary air spring.

6.3.13 Traffic Diversion/ Management

Traffic is most likely to be affected during construction of metro rail project. 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. As the whole alignment of proposed metro is underground little disturbance will took place at the station locations only. Any reduction of road space during Metro construction results 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 at the minimum. They are:

- In 'Cut-and-Cover' method, 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 if possible.
- 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. At the onset, all encroachments from road ROW for stations and entry/exit 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 due to non-availability of reasonably good alternate road network.

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 similar traffic diversion plans shall be formulated and followed during the execution of project.

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. 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 will hire a transportation consultant that carryout the traffic survey and suggest alternative routes for smooth flow of traffic.

6.3.14 Soil Erosion Control

Soil Erosion during construction of proposed Metro rail will cause very little impact as whole alignment is passing underground. The surface facilities and related transport will cause soil erosion. Prior to the start of the construction, the Contractor shall submit his schedules to the MMRC 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, pavement courses and shoulders. He shall also submit his proposed method of erosion/sedimentation control and his plan for disposal of waste materials. Visual monitoring will be carried out during construction which includes photographic records and site description data. The visual inspection should be conducted on quarterly basis by the contractor in presence and consultation with PMC. Monitoring may be undertaken by staff with good observational skills, the ability to reliably record and report site conditions. Work shall not be started until the erosion/sedimentation control schedules and methods of operations for the applicable construction have been approved by the MMRC

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, dikes, 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 MMRC.

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 MMRC, and these shall be carried out at the Contractor's own expense. Temporary erosion, sedimentation and pollution control work, which is not attributed to the Contrac-tor's negligence, carelessness or failure to install permanent controls, will be performed as ordered by the MMRC.

6.3.15 Muck Disposal

Construction of underground tunnel for metro projects is a specialised and complex task. 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 collection, transportation, disposal and its treatment need to be carried out in a systematic manner. Muck collection should be in containers from the dredging sites / places. These containers should be such that muck should not spill during movement to disposal site.

As discussed in Chapter-4, 5.40 Mm^3 muck will be disposed by adopting five options as described below.

i. Use as fill material for JNPT Terminal 4: It is informed that JNPT is proposing to build a new terminal (Terminal 4) over 200 ha is size. A large quantity of soil and graded material is required as fill material. Muck generated from Metro Line 3 works can be used as fill material for JNPT Terminal 4 construction; however the timing for the construction of the terminal and metro will have to be synchronised. Further temporary jetties will have to be constructed along the metro alignment to transport the muck to JNPT Terminal 4 site.

ii. Use as fill material for minor ports in Maharashtra: Several minor ports being developed within 300 km from Mumbai including one at Srivardhan by DAS Offshore who have indicated their willingness to use muck generated from Metro Line 3 for their construction. Apart from this MMB has informed of 5 other minor ports being developed close to Mumbai. This alternative also requires synchronisation of construction activities and temporary jetties will have to be constructed along the metro alignment to transport the muck to the ports.

iii. Filling of abandoned quarries in Raigad and Thane districts: Raigad and Thane districts have several abandoned quarries of varying sizes; muck generated could be used to fill these quarries. These quarries are located far from the metro alignment (over 100 km) and require road transportation of the muck. There are
36 os of abandoned quarry sites in Raigad district and 59 Nos in Thane district. The details of abandoned quarry sites located in Raigad and Thane district is depicted in Appendix 6.3. The total area of abandoned quarry sites is worked out as 498 Ha and 1115 Ha located in Raigad and Thane district respectively.

iv. Recycle and Reuse: Muck generated can be reused as aggregate material for road beds, ballast for railways, construction material and graded material can be used in concrete. The use can be decided only after thorough geotechnical investigation, testing of the muck and choice of TBM. This alternative will require land for setting up a plant to convert the muck to a useful form. It is proposed to appoint IIT – Bombay to study this alternative. A separate proposal in this regards is being moved.

v. Deep Sea Dumping: There are a couple of deep sea dumping sites within 100 km from the Mumbai coast. Necessary clearances for use of these sites will be ensured before actually resorting to this. The Coordinates of deep sea dumping location is as indicated below.

1. 18°52'33.00"N, 72°45'6.60"E
2. 18°52'32.75"N, 72°45'38.99"E
3. 18°52'43.76"N, 72°45'39.02"E
4. 18°52'43.74"N, 72°45'6.60"E

Capacity of all the five options described above is approximately assessed for the disposal of muck as depicted in Table 6.7. Any one or more of the options will be selected on the basis of detailed investigation and getting the necessary clearances/permission from the concerned authority. Out of five options discussed above Recycle and Reuse and Filling of Abandoned Quarries in Raigad & Thane district seems to be most feasible options. Accordingly cost estimate for muck disposal has been prepared and given in Table 6.8. Muck will be monitored/ analyzed for heavy metals prior to their disposal at dumping site and monitoring programme is given in the Environmental

Monitoring Plan.

TABLE 6.7
CAPACITY OF MUCK DUMPING OPTIONS

Sl.	Options	Capacity of dumping site in Mm^3	Remarks
1.	JNPT Terminal 4	4.0	Average depth of fill taken as 2.0 m
2.	Ports/Jetties : at Rajauri Creek, Vill – Rohini, Dist. : Raigad	7.8	As Communicated by project proponent M/s Das Offshore Engg Pvt Limited
3.	Abandoned Quarries (Raigad and Thane)	16.13	Average of fill taken as 1.0 m
4	Recycle and Reuse	-	Appointment of IIT – Bombay to study this alternative is in process
5	Deep Sea Dumping	-	Detailed investigation requires to be taken up

TABLE 6.8 COST OF MUCK DISPOSAL

SI	PARTICULARS	COST (Million)
1	Environmental Study/Clearances (Lump sum)	10.00
2	Detailed Investigation (Lump Sum)	30.00
3	Transportation Cost @ 591 trips per day	3471.8
4	Transportation cost by sea route @ 300/cum for 25	16.20
5	Plantation & Beautification works (Rs.	20.20
6	Miscellaneous (5%)	177.40
	Total	**3725.60**

6.3.16 Draining of Water from Tunnel

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. 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 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.
- During operation phase, seepage water will 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.

6.3.17 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 safe sewage disposal systems would be provided.

Requirements of drinking water supply at station are about 6 KL/day. Raw water requirement for station is about 240-250 KL/Day. The water requirement at Depot will be 159 KLD. This shall be provided from municipal/ground water source.

Solid waste generated at underground station is about 0.5–1.0 m^3/day. The maintenance of adequate sanitary facilities for temporarily storing refuse on the premises is considered a responsibility of the MMRC 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. This should be collected and transported to local municipal bins for onward disposal to disposal site by municipality. Waste generated during and after construction will be disposed in accordance with relevant National and State laws and Regulations.

6.3.18 Sensitive Receptors

As discussed in section 4.4.17, the impact on sensitive receptors is anticipated due to noise and vibration during construction work of stations. The management plan for noise & vibration control mentioned at section 6.2.10 & 6.2.11 will reduce the noise & vibration level substantially. Furthermore information will be communicated to the land owner of sensitive receptors about the project and potential noise & vibration generation due construction activities. The noise & vibration due to construction activities will be monitored and recorded at sensitive receptors. Construction contractor must provide a mechanism for receiving and responding to complaints arising due to impacts on sensitive receptors.
Avoid nighttime construction activities near sensitive receptors if possible. Precautionary measures will also be taken to safeguard the Nature Park during construction.

6.3.19 Blasting Control

The predicted ground vibration and noise due to air blast by blasting is 14.96 mm/sec and 136 dB respectively for 15 meter distance from charge. Explosive charge mass per delay should be strictly restricted to 1 kg for each blast event. Controlled blasting is required at station location to be constructed by NATM and Cut & Cover method. Good planning is essential to mitigate noise, vibration and air blast impacts which might otherwise lead to unacceptable effects on the community or the natural environment. There are a number of factors that can either increase or decrease the intensity of ground vibrations and noise due to air blast.
Measures which are commonly adopted include:

- Identify potential problem areas surrounding the project site,
- Prior to start of construction, condition survey of building is required to be done. If any existing cracks are measured initially and it is again measured after blasting to see the impact and mitigation measures to be adopted to safeguard the building,
- Determine the conditions that exist prior to commencement of construction,
- Inform the public about the project and potential blasting-related consequences,
- Schedule the work to reduce adverse effects,
- The blast should be well designed for the geological conditions, rock type and availability of the explosive,
- Design the blast to reduce vibration and air over pressure,
- All blasting operations shall be conducted under the direct supervision of a

blaster holding a current license issued under the state or local laws.

- Blasting should generally be carried out during the hours of 0900 hrs to 1700 hrs Monday to Saturday. Blasting should not take place on Sundays and public holidays,
- Blasting mats or back fill material must be utilized to control fly-rock damage to surrounding structures,
- Use blast signals to notify nearby residents that blasting is imminent,
- Monitor and record the vibration and air overpressure effects of the blast,
- Respond to and investigate complaints,
- Information from manufacturer should be collected for the physical properties, performance characteristics and sensitivity of the explosive which will help in correct choice of explosive.

6.3.20 Electromagnetic Interference

Concrete structures are not good electrical earths and therefore, Earthing & Bonding of the power supply & traction system shall be designed in accordance with the latest standards EN50122-1, IEEE80, IS3043 etc. Two earth conductors-Overhead Protection cable (OPC) and Buried Earth Conductors are proposed to be laid along with underground tunnel and all the metallic structures, structural reinforcement, running rails etc will be connected to these conductors to form an equiv-potential surface & a least resistance path to the fault currents. The overhead protection cable will also provide protection against lightning to the 25 KV Rigid OHE on the underground and 25 KV OHE on the elevated viaduct.
Detailed specification of equipment e.g. power cables, transformer, switchgear, E&M equipment etc shall be framed to reduce conducted or radiated emissions as per appropriate international standards. The metro system as a whole (trains, signalling & telecomm, traction power supply, E & M system etc) shall comply with the EMC requirements of international standards viz. EN50121, EN50123, IEC61000 series etc. As precautionary measures, the location of sub-station should be away from the dumping yards and sub-station should not be less than 3 km from the airport.

6.3.21 Management Plans for Depot

The depot is planned at Aarey Milk Colony (26.407 hectares) for the proposed metro project. The management plans for depot site includes:

- Water Supply,
- Oil Pollution Control,
- Sewage/Effluent Pollution Control,
- Solid Waste
- Surface Drainage,
- Green belt development,
- Rain water harvesting, and
- Recycling of treated waste water.

Water supply: About 159 KLD of water will be required for operation and functioning of depot. This could be either collected from Municipal Corporation or through boring tube well into the ground. The ground water will need treatment depending upon its use.

Domestic and some of the industrial application, a Reverse Osmosis (RO) plant of 8 liter/ minute capacity will be appropriate. The water treatment plant flow chart is given in Figure 6.1. The estimated cost of water supply plant is about Rs.5.0 million.

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 has to be installed at initial stage of effluent treatments. 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. The tank may be designed for a detention period of 5 to 15 minutes.

This accumulated oil and grease will be disposed off through approved re-cyclers.
Sewage/Effluent Pollution Control: About 130 KLD of sewage/effluent is likely to be generated at depot. The sewage could be treated up to the level so that it could be used for horticulture purpose in the campus and can also be discharged into the stream a process flow chart is presented in Figure 6.2. The estimated cost of sewage/effluent treatment plant is about Rs.6.0 million. This has to be treated as per the requirement of regulatory pollution control agency of the state (MPCB).

Solid Waste Disposal: About 1.8 Ton per month of solid waste will be generated from the Depot which will be taken by the cleaning contractor weekly and disposed to the Mumbai Municipal Corporation waste disposal sites in accordance with relevant National and State laws and regulations.

Solid and Liquid Waste of Depot: Update (EIA Feb, 2020)

The sewage and trade effluent generated from maintenance depot will be treated in well-designed sewage treatment plant and effluent treatment plant with advance treatment respectively to meet the stipulated standards prescribed by the competent authority. Treated trade effluent will be completely reused for washing activities and will not be discharged into any surface water body. Similarly, treated sewage will be utilized on land for irrigation within the depot area. As the planned mode of disposal of the sewage and the effluent is satisfactory, there will be no impact on the water quality of nearby surface water bodies.
About 0.6 Ton/day MSW likely is estimated to be generated from the Depot. MSW after segregation at the site will be handed over to agencies appointed by Municipal Corporation of greater Mumbai for further scientific disposal.

Surface Drainage: The Storm water of the depot will be collected through the drain. Rain water harvesting pits are provided at different locations in the drains and for surplus storm water, the drainage system is connected to a nearby disposal site. The drainage costs have been included in project cost.

Green belt development: The greenbelt development / plantation in the depot area not only functions as landscape features resulting in harmonizing and amalgamating the physical features with surrounding environment but also acts as pollution sink / noise barrier. In addition to augmenting present vegetation, it will also check soil erosion, make the ecosystem more diversified and functionally more stable, make the climate more conducive and restore balance. It is recommended to have a provision of Rs 4 million in the cost estimate for the green belt development. Treated sewage and effluent in the best combination should be used for green belt development.

Rain water harvesting: To conserve and augment the storage of groundwater, it has been proposed to construct roof top rainwater harvesting structure at the constructed depot site. Depot cum workshop area of 36,938 sq.m is available at Aarey Milk colony depot for roof top rain water harvesting. An annual average rainfall is 2000 mm, 202 KLD rain water will be harvested. The total recharge pit area of 8.5x8.5x3 will be required. A provision of Rs. 1.5 million has been kept in the cost estimate.

Recycling of treated waste water: Waste water generated at depot is proposed to be collected at ETP for treatment and recycled for horticulture work of the depot. About 105 KLD of treated waste water will be available for horticulture. The rest of treated water will be release to the Mithi River.

6.3.22 Training Programmes

The training programmes need to be conducted by the experts, for MRTS officers. 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.

Two international training programme per year for 10 numbers of MMRC officers are proposed to acquire the latest know how about the construction, operation and maintenance of Metro rail. During the project construction period 100 numbers of MMRC staff will get the International training for which estimated cost will be Rs. 172.10 Lakhs. The overall cost involved for National and International training programmes will be Rs. 21.61 million which is presented in Table 6.9.

TABLE 6.9
COST FOR TRAINING PROGRAMME

S. NO	ITEM	COST (Million)
1.	Curriculum Development and course preparation 2 months Rs.50000/month	0.10
2.	10 Extension Officer (1year) Rs.35, 000/month	3.50
3.	Instructor 20 sessions of 10 days each	0.50
4.	Demonstration/Presentation Aids	0.10
5.	Material etc	0.20
6.	International Training for 100 MMRC staff	17.21
	Total	**21.61**

6.3.23 Environmental Enhancement Measures

In addition to mitigation measures adopted for negative impacts during construction and operation of the project, some of the measures for improvement of environment have

been undertaken as described below:

- Landscaping & beautification
- Solar energy
- Renovation of Heritage structures & religious places
- Environmental awareness programmes
- Utility facilities to unprivileged people

The cost for environmental enhancement measures has been kept as Rs. 8.50 million (Lump sum).

6.4 EMP Reporting Arrangement and Institutional Strengthening

Supervision involves periodic checking to ascertain whether activities are going according to the plans. It provides necessary feedback for project management team to keep the program

on schedule. The supervision and reporting process with respect to implementation status of mitigation measures during construction will initiate from the contractor at the lowest rung who will report to the Project Implementation Agency (PIA) through the project management consultant.

During construction phase of the project, the EMP implementation comprises of

the following key activities:

- Implementing various mitigation and enhancement measures within the time frame recommended
- Overseeing the implementing various mitigation and enhancement measures and fine tuning/advocating more measures, if needed, depending on site conditions;
- Project level monitoring of key performance indicators to evaluate the implementation of EMP measures at the recommended intervals.
- Periodical reporting of status of EMP implementation and monitoring results and key performance indicators and
- Constant evaluation of EMP measures implemented based on the data available from project level monitoring and status reports and providing directions accordingly.

These activities to be carried out by various agencies that will be involved in the implementation of Metro project. It is also to be noted that all these activities will be carried out concurrently or at regular intervals and at different duration and location. This makes it pertinent that all agencies involved work within a predefine setup. The coordination model proposed during construction and operation phases is presented in Figure 6.3 and Figure 6.4 respectively. The identified agencies and their sphere of work are presented in following section.

Project Implementation Agency (PIA)

The responsibility of implementing environmental mitigation measures lies with the PIA. PIA in this project will be Mumbai Metropolitan Regional Development Authority (MMRC). The responsibility also includes various tasks such as notifying various affected parties such as the resident and commercial establishment, facilitate the relocation of people, notify other utility departments such as telephone, water supply, sewerage etc. which used the road for providing public utility services.

Project Management Consultant (PMC)

The PIA will get the EMP implanted through the Project Management Consultant (PMC) appointed for managing engineering and construction related activity. The PIA will delivered the responsibility of overseen the implementation of as per the contract agreement. In order to effectively discharge the duties PMC will have an environmental officer/expert in the project management unit. The environmental

officer will work for a full time basis at the site office. The officer must possess experience in the environmental

management of metro projects.

Project Contractor

Project contractor will implement the EMP measures, enhancement measures and measures as directed by PIA and PMC. The responsibility to implement the EMP measures will be built in to the contractual agreement. The contractor shall submit a report on compliance of environmental mitigation measures periodically to the PMC. The PMC will review and approve the environmental compliance report (ECR) submitted by the contractor and forward the ECR to PIA after approval. The PIA will then submit the ECR to Joint Project Director (JPD), environment which after review and monitoring will submit to Independent Monitoring Panels through the Project Director, MMRC. The Project Director accordingly submits report to the JICA.

MMRC

MMRC as an apex organization shall initiate coordinate process among the concern organization for EMP implementation. MMRC shall take lead in

- Reviewing the progress of the project for the subsequent year- institution wise
- Reviewing and discussing the salient features of the report in the year on environmental aspects and their violations
- Organizing and coordinating training programs for all member organization

Independent Monitoring Panel (IMP)

This has been constituted by MMRC with the objective to ensure that the Banks policies: related to social and environmental issues are followed. The Chairman of IMP is Ex- Chief Secretary to Government of Maharashtra. The other members are eminent environmental engineers, a senior Journalist and a leading Advocate. The IMP will meet periodically to review the periodical reports, environmental compliance report etc. In addition to above JICA will monitored implementation of environmental management during and post construction.

6.5 Environmental management and Monitoring plan: Updated (EIA Jan 2016 & Feb. 2020)

MMRC is required to incorporate a process of management and monitoring of all activities during the construction and operation phase of the proposed Project. The Environmental Management and Monitoring Plan (EMMP) intends to delineate management measures to minimise adverse impacts by allocating management responsibility for implementation of these measures during the construction and operational phase of the project.

The EMMP is formulated to mitigate the adverse environmental impacts that have been mentioned in the Environmental Impact Assessment (EIA) studies undertaken by RITES Limited (September 2012) and have been updated in this EIA report. The EMMP is aimed at managing and monitoring the environmental parameters in a sustainable manner. The EMMP section is organised as follows,

- Organisational Structure – This section describes the role and responsibilities of personnel engaged by MMRC who will be responsible for implementing this EMMP.
- Environmental Management Plan – This Plan consists of a detailed description of the positive and negative environmental impacts anticipated from the proposed project, mitigation measures and the persons/committees responsible for ensuring implementation of the mitigation measures. Additional plans such as Muck disposal plan, solid waste plan, labour camp management plan, traffic management plan have also been provided.
- Environmental Monitoring Plan – The Environmental Monitoring Plan details the parameters and frequency of monitoring parameters, detailing the minimum requirements for periodic review and updation of the EMMP to address any new impacts due to change or modification of the project.
- Documentation and record-keeping – Specifies the requirements for documents to be maintained covering the social aspect.

6.5.1 Organization structure and Responsibility

The implementation of this EMMP requires the involvement of several stakeholders each performing a vital role to ensure sound environmental management during the construction phase. During construction phase of the project, the EMP implementation comprises of the following key activities:

- Implementing various mitigation and enhancement of measures within the time frame recommended;
- Overseeing the implementation of various mitigation and enhancement measures and fine tuning/advocating more measures, if needed, depending on site conditions;
- Project level monitoring of key performance indicators to evaluate the implementation of EMP measures at the recommended intervals;

- Periodical reporting of status of EMP implementation and monitoring results and key performance indicators and
- Constant evaluation of EMP measures implemented based on the data available from project level monitoring and status reports and providing directions accordingly.

These activities have to be carried out by various agencies that will be involved in the implementation of the MML3 project. It is also to be noted that all these activities will be carried out concurrently or at regular intervals and at different duration and location. This makes it pertinent that all agencies involved work within a predefine setup.

Project Implementing Agency (PIA): The responsibility of implementing environmental mitigation measures lies with Mumbai Metro Rail Corporation (MMRC), which is Project Implementing Agency for the MML3 project.

Project Management Consultant (PMC): The PIA will get the EMMP implanted through the Project Management Consultant (PMC) appointed for managing engineering and construction related activity. The PIA will deliver the responsibility to oversee the implementation of management plans as per the contract agreement. In order to effectively discharge the duties PMC will have a Chief Project Manager- environmental in the project management unit. He will work for a full time at the site office. The officer must possess experience in the environmental management of similar metro projects. He will be followed by HSE manager, environmental engineers and junior engineers. Roles and Responsibilities of PMC team will be as discussed below. The role of PMC will be undertaken by GC.

Chief Project Manager (CPM)

1. Provide impetus to metro project Environmental Team for effective management of onsite environmental issues.
2. Ensure resource allocations and expedite commissioning of onsite facilities required to resolve and improve the onsite environmental issues.
3. Preside over SHE meetings to discuss the onsite environmental issues and establish a management action plan to address such issues.

SHE Manager

1. Provide necessary advice and support in effective implementation of the project environmental management plan.
2. Provide environmental Engineer required support for effective implementation of the environmental training programs.

Environmental Engineer

1. Preparation of daily environmental report through site investigation and information obtained from Site In-charges and Jr. Engineers.
2. Coordinate training of target groups to improve their awareness on onsite environmental issues and management.
   Maintain and update the records pertaining to water consumption, Hazardous and non- hazardous waste generation and disposal, energy consumption detail, waste water generation detail, water sourcing details, water/waste recycling detail, chemical storage and handling, dust suppression, etc. prepared as part of the standard operating procedures.

3. Auditing and identifying subcontractors' activities having potential environmental impacts and advising subcontractors of any potential risks and issues of non-compliance notices where necessary.

Jr. Engineer

1. Ground level environmental compliance along with the execution team.
2. Environment observation to be reported to Environmental Engineer.

Project Contractor (PC): Project contractor will implement the EMP measures, enhancement measures and measures as directed by PIA and PMC. The responsibility to implement the EMP measures will be built in to the contractual agreement. The contractor shall submit a report on compliance of environmental mitigation measures periodically to the PMC.

MMRC: MMRC as an apex organization shall initiate coordinate process among the concern organization for EMP implementation. MMRC shall take lead in

- Reviewing the progress of the project for the subsequent year- institution wise
- Reviewing and discussing the salient features of the report in the year on environmental aspects and their violations
- Organizing and coordinating training programs for all member organization

6.5.2 Environmental Management Plan update (EIA Jan 2016 & Feb, 2020)

i. Air Environment

Management Anticipated Sources

The major sources of air pollution are Construction activities like excavation, grading and clearing of land, muck handling / disposal and handling & storage of construction material.

Impacts

Construction work of the metro rail has impacts on the air quality at stations and at depot only since metro alignment is constructed at an average depth of 18-20 metres. Hence, dust could be the problem when the project is under construction.

Mitigation Measures

- Take all necessary precautions to minimise fugitive dust emissions from operations involving excavation, grading, and clearing of land and disposal of waste. Also prevent emissions of fugitive dust from any transport during handling of materials, construction or storage activity.
- Transportation vehicles and other equipment to conform to emission standards fixed by Government of India or the State Government from

time to time. Periodical checks of the vehicles to be carried out and remedial measures including replacement, if required, to be undertaken so as to operate within permissible norms.

- Provision of cover for dust generating material like debris and soil being transported from construction sites. All trucks carrying loose material to be covered and loaded with sufficient free- board to avoid spills through the tailboard or sideboards.
- Install barriers around the open construction sites before commencing the work.
- The temporary dumping areas to be maintained by the Contractor at all times until excavate is re-utilised for backfilling wherever necessary.
- Dust control activities to be continued even during any work stoppage.
- The Contractor shall place material in a manner that will minimize dust production. Material shall be wetted each day, to minimize dust production.
- During dry weather, dust control measures must be used daily especially on windy, dry days to prevent any dust from blowing across the site perimeter.
- Sprinkle water at construction sites to suppress dust, during handling of excavation soil or debris or during demolition. Dust screens to be used, as feasible when additional dust control measures are needed especially where the work is near sensitive receptors.
- 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.
- Vehicles and machinery are to be regularly maintained so that emissions conform to National and State AAQ Standards.
- Construction plants and equipment will meet recognized international standards for emissions and will be maintained and operated in a manner that ensures relevant air regulations are met.
- Undertake monitoring of ambient air quality in the vicinity of construction sites in areas representative of the receiving environment and sensitive receptors for the duration of surface works, and in response to complaints.

For each construction worksite required for tunnelling works involving extensive spoil handling and haulage, except for sites involving 'cut and cover' works following mitigation measures are suggested:

- Erect an enclosed acoustic-lined shed equipped with ventilation and dust filtration equipment over the tunnel entrance (decline or shaft);
- Maintain the ventilation and dust filtration equipment for the enclosed sheds to achieve acceptable performance
- Undertake the loading of construction spoil into haulage vehicles within enclosures or the enclosed shed, with the shed doors being closed when meteorological conditions would cause dust from within the shed to

impact on adjacent locations.

- Ensure any conveyor system for spoil transport that continues out of the enclosed shed is appropriately designed (eg: may be enclosed, may use idlers designed for quiet operation, may include water spray system if not enclosed etc.) to ensure compliance with the standards and minimize dust all along the route.

- The construction activities of stations, tunnels, allied activities and maintenance depot etc. will have localized impact due to fugitive emissions of dust particles. The impact would be of temporary nature during construction period. Appropriate air pollution control measures are being taken such as dust suppression system, water sprinkling through tankers/manual water sprinkling etc. and wheel washing facilities to control secondary dust emission.
- RMC plants are also a source of air pollution. Appropriate measures such as dust collector, dust suppression system with fixed water sprinklers and water sprinkling through tankers, closed shed for raw material storage and closed tin sheets for material transfer points are provided for control of air pollution.
- Regular maintenance of the vehicles is ensured and also the emission parameters are observed regularly through certification of PUC.
- Regular maintenance of stationary construction equipment/facilities such as compressor, pilling rig machine is ensured.
- Adequate stack height to DG sets is provided corresponding to its capacity for control of air pollution.

ii. Noise Management

Anticipated Sources

The major sources of noise pollution during construction activities would be during excavation, loading, transportation of materials and operation of construction equipments and DG sets etc. other sources include movement of vehicles for transportation of construction material and the construction machinery /equipment at the construction site.

Impact

No major impacts are anticipated due to noise pollution as the major construction works are underground. Noise levels at a distance of 50 feet from source have been presented in Table below. As seen from the table, construction activities are expected to produce noise levels in the range of 80 - 98 dB (A) at 50 feet which will again decrease with increase in distance.

Table 6.1 : Noise Levels at 50 feet from source for various construction equipment

S. No	Machine	Noise level in dB(A) without noise control at 50 feet
1	Excavator	85
2	Dumper	84
3	Crawler Dozer	85
4	Heavy Duty Jack Hammer	85
5	Compressor	80
6	Crane	83
7	Generator	81
8	Rock Drill	98

Source: "construction equipment noise levels and ranges report" of Federal Highway Administration

Mitigation Measures

There will be an increase in noise level in the tunnel due to construction activity. 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 to the extent possible,
- Construction of permanent and temporary noise barriers,
- Re-route and regulate the traffic, a main source of noise,
- Use electric instead of diesel powered equipment,
- Use hydraulic tools instead of pneumatic tools,
- Acoustic enclosures should be provided for individual noise generating construction equipment,
- Scheduling of truck loading, unloading and hauling operation,
- Proper operation and maintenance of the construction vehicles and equipments would keep them within noise limit,
- Schedule work to avoid simultaneous activities,
- Use of noise absorption material,
- Minimising the volume of reverse horn
- Use of low speed compressor, blower etc.,

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 equipment, 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.
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. Noise proof barriers will be provided on the construction boundary near the residential area.

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.

Reasonable and practicable measures to achieve the construction noise limits also include the following:

- Commence advanced notification of works and undertake on-going consultation with potentially affected property owners and occupants;
- Establishing temporary/ fixed noise barriers between construction worksites and sensitive activities (e.g. residential, schools, community facilities) wherever feasible ;
- Fitting noise-reduction measures to all plant and equipment engaged in above-ground construction works;
- Designing worksites to minimise potential noise impacts on nearby sensitive places;
- With the consent of owners and occupants of potentially-affected premises, undertake mitigation actions such as temporary modifications to nearby buildings, temporary relocation during construction or other measures to achieve reasonable environmental conditions.

Where surface construction noise impacts are predicted due to specific construction activities, reasonable and practicable mitigation and management measures must be adopted and notified in advance to potentially affected owners and occupants of adjacent properties. If such activities are to occur often during the construction works, a program for a regular, scheduled occurrence should be devised and implemented in consultation with the owners and occupants of nearby properties.

Potentially affected property owners and occupants are to be notified well in advance (7 days or more) as to the scale, extent and duration of construction works, as required by the consultation and communications program.

Table 6.2: Ambient Noise Limit

Area code	Category of area	Unit in dB(A) Leq	
		Day time (06:00 to 22:00 Hrs)	Night time (22:00 to 06:00 Hrs)
A	Industrial area	75	70

B	Commercial area	65	55
C	Residential area	55	45
D	Silence Zone	50	40

Source: CPCB

Where there are no ambient noise measurements, the construction activities shall be limited to levels measured at a distance of 200 feet from the construction limits or at the nearest affected building, whichever is closer, as given in Table below.

Table 6.3 : Allowable Construction Noise

LAND USE	MAXIMUM NOISE LEVELS – L_{max} dB (A)	
Residential	Day Time	Night Time
	75	65
	At all Times	
Commercial	85	
Industrial	90	

The ground borne noise levels within building structures due to tunnel boring machine and any other underground and tunneling construction activities shall not cause interior noise levels to exceed the levels given below as measured in the inside of the affected noise sensitive structure:

Residential: L_{max} 55dB(A)
Commercial: L_{max} 60dB(A)

At the surface of the construction site during nighttime hours, the Contractor shall use only equipment that operating under full load meets the noise limits specified in Table below, if a sensitive receptor would be affected.

Table 6.4 : Noise emission limits for construction equipment measured at 50 feet from construction equipment

Equipment Category	L_{max} Level dB(A)
Backhoe	80
Bar Bender	75
Chain Saw	81
Compactor	80
Compressor	80
Concrete Mixer	85
Concrete Pump	82
Crane	85

Dozer	85
Front End Loader	80
Generator	82

Gradall	85
Grader	85
Paver	85
Pneumatic Tools	85
Scraper	85
Tractor	84

Source: Federal Highway Administration

The adjustments for close in equipment noise measurement shall be made in accordance with Table below.

Table 6.5 : Adjustments for close-in equipment noise measurements (Measurement Values to be subtracted from Measured Sound)

Distance (Feet)	Level to Estimate Sound Level at 50 Feet dB (A)
19-21	8
22-23	7
24-26	6
27-29	5
30-33	4
34-37	3
38-42	2
43-47	1
48-50	0

If such controls fail to reduce sound levels within the levels of the table, personal protective equipment shall be provide and used to reduce sound levels within the levels of the table.

Table 6.6 : Permissible Noise Exposures

Duration per day, Hours	Sound level (slow Response)
8	90
6	92
4	95
3	97
2	100
1 ½	102
1	105
½	110
¼ or less	115

Source: Schedule I, Building and Other Construction Workers Rule, 200

iii. Vibration

Management Anticipated

Sources

The most significant sources of the vibration during construction of tunnel will be operation of Tunnel Boring Machine (TBM) and equipment/blasting used for station and NATM tunnel excavation.

Impacts due to TBM

The whole alignment of the Mumbai metro line-3 is underground and will be carried out by Tunnel Boring Machine (TBM). TBM is the worldwide accepted machine having less impact of vibration. Human response to ground-borne vibration is influenced by amplitude, duration and frequency and is subjective in nature. According to the U.S. Department of Transportation, (1998) the perception threshold of humans for particle velocity is about 0.04 mm/s (65 VdB with reference 1e-6 inch/sec). For a person in their residence, the lower threshold for annoyance is 72 VdB (FTA 2006). The vibration affects human health by causing fatigue, increased pulse & respiration rates, dizziness & loss of balance, anger and irritation.

Continuous effect of vibration on the buildings can cause damage to buildings. Building subjected to the vibration effect with more than 50 mm/s (154 VdB) 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 are also subjected to impacts of vibration especially those come under heritage category.

Federal Transit Administration (FTA) has recommended the typical levels of vibration for construction equipment which are summarized in Table below.

Table 6.7 : Typical levels of Vibration for Construction equipment

S. No	Construction Activity	VdB at 25 feet
1	Rock drilling	115.9
2	Dump trucks	122.7
3	Bulldozer	124.0
4	Excavator 0.089, 106	124.0
5	Crane 0.808, 87	143.2

Source: Transit Noise and Vibration Impact Assessment, Federal Transit Administration (FTA).

Impacts due to blasting

- Potential environmental impacts of blasting are in terms of noise, dust and vibrations
- Blasting would significantly reduce the duration of vibration, though the vibration level would be higher compared with bored tunnelling (with proper blast design & techniques vibration can be reduced);

Mitigation Measures

An actual vibration impact shall be carried out prior to the start of construction and during the construction on the basis of detailed soil investigation and TBM activities involved. Detailed geotechnical investigation is required prior to the tunnel construction.

Following measures to be taken during construction of tunnel, the contractor shall prepare a monitoring scheme prior to construction at such locations.

- Detailed vibration investigation should be carried out prior to construction at locations where the alignment is close to historical / heritage structures.
- Continuous vibration monitoring equipment shall be installed during construction.
- Vibration monitoring shall also be conducted inside as well as on the top of the building mainly for old structures and heritage buildings.
- Proper vibration mitigation measures to be taken during construction of tunnels.
- Pre-construction structural integrity inspections of historic and sensitive structures.
- The local residence staying in the buildings close to the proposed metro rail alignment shall be informed about the vibrations and to vacate the location if needed.
- Install supporting wall piles to reduce vibration and settlement impact,
- Information dissemination about the construction method, probable effects, quality control measures and precautions to be used.
- Inform the public about the project and potential vibration-related consequences, monitor and record vibration from the activities for sensitive receptors.
- Restriction of heavy duty vehicles during construction of metro rail work.

Minimizing Impacts from Drilling and Blasting

- Pre-blast condition survey
- Reasonable Blast Vibration Limits
- Pre-Qualification of Blasting Contractor
- Good blasting plan
- Use of blasting mats,
- Monitoring of Vibrations, Airblast, Crack Gages in the nearby buildings, Heave

iv. Traffic

Management Plan Anticipated

Sources

Traffic Management for the project includes public roadways and sidewalks and the maintenance of access to residence, business and public services throughout the construction area. Traffic delays and reduction in roadways capacity are anticipated during aspects of the construction of the metro rail.

Impacts

Even though vehicular, pedestrian and surface transit traffic will be impacted at a few locations, the contractor should minimize such impacts through the development of Traffic Management Plans, which will be submitted in advance to the GC for his notice of no objection. These plans will provide specific guidance on traffic management for various portions of construction zones and staging.

Mitigation measures

The types of mitigation measures to be implemented by the Contractors will be on a site- specific basis and will include

- Signage and barriers for protecting and guiding pedestrians
- Detour signs placed at strategic locations
- Relocation of bus stops at construction sites
- Provision of sidewalks of least 2m where feasible
- Physical separation between construction zone and sidewalks of concrete barriers or wood fencing or mesh fencing

Wherever heavy equipment like cranes or dozers have to be moved on public roads and the normal moving dimensions are infringed, these shall be moved under advice to traffic police, and with adequate precautions and at low speed.

Traffic Management Plan as given in Tender document

The Contractor shall develop a detailed Traffic Management Plan for the Work under the Contract. The purpose is to develop a Traffic Management Plan to cope with the traffic disruption as a result of construction activities by identifying strategies for traffic management on the roads and neighbourhoods impacted by the construction activities, which shall be submitted to the Mumbai Traffic Police for their approval and to the Engineer for his Notice of No Objection. The Contractor shall implement the Traffic Management Plan throughout the whole period of the Contract and shall comply strictly with the approved plan during the construction of his works.

Principles for Traffic Management

The basis for the Plan shall take into consideration eight principles:

- To minimise the inconvenience of road users and the interruption to surface traffic through the area impacted by the construction activities;
- To ensure the safety of road users in the impacted area;
- To facilitate access to the construction site, and to maintain reasonable construction progress.
- To ensure traffic safety at each construction site.
- To make the most efficient use of the restricted area available, whilst minimising disturbance to the general public.
- The design shall provide for a minimum of two lanes of traffic in each direction or as approved by the relevant authorities and the Engineer, which may require temporary road decking where necessary, which must be maintained at all times, shall be approved by Mumbai Police Traffic Department.
- The traffic management plan shall provide for a minimum of 2m of footpath (or as agreed with the relevant authorities and the Engineer) adjacent to buildings or thorough fares for all road diversion schemes.
- The Contractor should take into account that the construction of the stations may have to be done in phases to ensure that the traffic management plan provides the minimum number of two traffic lanes (or as approved by the relevant authorities and the Engineer) in each direction.

Integrated Traffic Management Plan

The Contractor shall prepare an integrated plan showing the arrangements to be made for accommodating road and pedestrian traffic, at individual construction sites and continuously along the alignment, including arrangements being implemented by other Contractors, to smooth traffic operations and for the safety of both construction workers and road users. The Plan shall consider different measures such as:

The use of suitable construction sequences and methods at station sites to reduce the period of disruption to road users; proper phasing and timing of traffic signals; modifications to intersection geometry; changes in lane usage; parking prohibitions; re-location of bus stops; maintenance of existing roads within the vicinity of the Works areas; reducing width of footpaths and median; right-turn prohibition; work site access management; minimising the duration of any road closure; reversible lane operations; modification of roadway alignment affected by the construction, which shall be in conformance with the requirements and regulations defined by the relevant

authorities; other engineering traffic measures as may be applicable.

Mitigation of Traffic Disturbances

The Contractor shall manage the vehicular and pedestrian right of way during the period of construction. The Contractor shall take account of the need to maintain essential traffic requirements, as these may influence the construction process.

The Contractor shall include local traffic diversion routes and assess traffic impacts caused by the construction in the affected areas. Signage layout shall be included to ensure that adequate motorist information will be provided for traffic diversions.

Where it becomes necessary to close a road or intersection, or supplementary lanes are required to satisfy the traffic demands, traffic diversion schemes to adjacent roadways shall be developed with quantitative justifications. The Contractor shall co-ordinate with all relevant authorities.

Other considerations include:

- The minimum lane widths for fast traffic and mixed traffic shall follow the regulations of the different authorities.
- The design shall provide for a minimum number of two traffic lanes in each direction (or as agreed with the relevant authorities and the Engineer), with a minimum of 2m of footpath (or as agreed with the relevant authorities and the Engineer) adjacent to buildings or thoroughfares.
- Any roads or intersections that have no alternative access shall not be fully closed for construction.
- Emergency access to all properties shall be maintained at all times.
- The type, size, lighting, painting, etc.. requirements for barricades, hoardings and fencing shall be as detailed in Section VIII or as required by the Engineer.
- Access to business premises and property shall be maintained to the extent that normal activities are not seriously disrupted.
- Minimum footpath width shall be 2m (or as agreed with the relevant authorities and the Engineer), unless otherwise indicated. The footpath shall be separated from vehicle traffic and not necessarily immediately adjacent to vehicle traffic;
- Where existing footbridges and underpasses are demolished or closed, provisions shall be made for pedestrian crossing to minimise the conflicts

between a traffic lane.

- Construction traffic shall be separated from other traffic wherever possible;

Any traffic related facilities (bus stops, parking, etc.) which are affected by the construction works shall be maintained or relocated to appropriate locations;

Motorists, pedestrians, workmen, plant and equipment shall be protected from accident at all times;

The Contractor's temporary traffic management plan shall be coordinated with the Works and traffic arrangements of other Contractors where these interface with this Contract.

Roadway designs, traffic management schemes, and installation of traffic control devices shall be in conformance with the requirements and regulations defined by the relevant authorities; and Where applicable, utility diversions shall be incorporated in the traffic management plan.

Approval for Temporary Traffic Arrangements and Control

The Contractor shall make all arrangements with and obtain the necessary approval from the transport authorities and the Mumbai Police Traffic Department for temporary traffic arrangements and control on public roads. In the event that the Contractor, having used its best endeavours, fails to secure the necessary approval from the transport authorities and the Mumbai Traffic Police Department for temporary traffic arrangements and control on public roads, then the will use its best endeavours to assist the Contractor to secure such approval but without responsibility on the part of the Employer to do so.

Temporary Traffic Arrangements and Control

Temporary traffic diversions and pedestrian routes shall be surfaced and shall be provided where work on roads or footpaths obstruct the existing vehicular or pedestrian access. The relevant work shall not be commenced until the approved temporary traffic arrangements and control have been implemented.

Temporary traffic arrangements and control for work on public roads and footpaths shall comply with the requirements of the Mumbai Traffic Police. Copies of documents containing such requirements shall be kept on the Site at all times. Contractor has to effect the necessary changes suggested by Mumbai Traffic Police from time to time for management of traffic.

Temporary traffic signs, including road marking, posts, backing plates and faces, shall comply with the requirements of the Mumbai Traffic Police and should be in accordance with the requirements of Ministry of Surface Transport.

All overhead traffic management signs that are fixed to bridges and gantries shall be

illuminated at night. Pedestrian routes shall be illuminated at night to a lighting level of not less than 50 lux.

Adequate number of traffic marshals shall be deployed for smooth regulation of traffic.

Temporary traffic arrangements and control shall be inspected and maintained regularly, both by day and night. Lights and signs shall be kept clean and legible. Equipment which are damaged, dirty, incorrectly positioned or not in working order shall be repaired or replaced promptly.

Particulars of Temporary Traffic Arrangements and Control

The following particulars of the proposed temporary traffic arrangements and control on public roads shall be submitted to the Engineer for his Notice of No Objection, at least 28 days before the traffic arrangements and control are implemented:

(a) details of traffic diversions and pedestrian routes;

(b) details of lighting, signage, guarding and traffic control arrangements and equipment;

(c) any conditions or restrictions imposed by Mumbai Traffic Police or any other relevant authorities, including copies of applications, correspondence and approval

Where concrete barriers are used to separate flows of traffic, the barriers shall be in a continuous unbroken line. No gaps shall be left between any section of the barrier.
Contractor has to liaise with and agree with the adjacent business proprietors and residents regarding the access to the property and the traffic arrangements.

Site perimeter fencing and barriers along the roadway, shall have flashing amber lights positioned on the top of them every 50 metres apart and at every abrupt change in location. Directly below the flashing light shall be fixed, in the vertical position, a white fluorescent light with a waterproof cover.

Use of Roads and Footpaths

Public roads and footpaths on the Site in which the Work is not being carried out shall be maintained in a clean and passable condition.

Measures shall be taken to prevent the excavated materials, silt or debris from entering gullies on roads and footpaths; entry of water to the gullies shall not be obstructed.

Surfaced roads on the Site and leading to the Site shall not be used by tracked vehicles unless protection against damage is provided.

Contractor's Equipment and other vehicles leaving the Site shall be loaded in such a manner that the excavated material, mud or debris will not be deposited on roads. All such loads shall be covered or protected to prevent dust being emitted. The wheels of all vehicles shall
be washed when necessary before leaving the Site to avoid the deposition of mud and debris on the roads.

v. Water

Management Anticipated

Sources

- Dumping of construction waste/spoil in haphazard manner may cause surface and ground water pollution near the construction sites.
- Ground water contamination can take place if chemical substances get leached by precipitation of water and percolate to the ground water table.

Impacts

Insignificant impact will be anticipated on surface water as whole alignment is passing underground while ground water may get affected at the location where tunnel crosses the

ground water flow. The availability of ground water aquifer in basaltic rock strata seems to be very rare and hence, breaking of water bearing strata is not anticipated.

In the proposed project none of the activity uses any harmful ingredients, which could leach down to water table. The tunneling is proposed to be carried out in hard rock by Tunnel Boring Machine (TBM), which is widely used throughout the world. The proposed project alignment is underground and tunneling will be done through hard rock hence no major impact on flow of water, surface and ground water quality is anticipated.

The water demand will increase during construction phase. About 159 KLD of fresh water will be required at Depot for different uses which will be taken from bore well/Municipal Water Supply. Also water will be required for labour camps and other construction activities.

Mitigation Measures

- A detailed hydrological investigation to 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. This will prevent generation of turbid water during construction in the tunnel.
- Turbid water from the construction site to be treated.
- Sewage generated from labour camps to be treated as per the requirements of MPCB and to a level so that it can be used for horticulture purpose.
- Storm water of the depot to be collected through the well-designed storm water drain.
- Rain water harvesting pits will be provided at different locations in the drains and for surplus storm water, the drainage system to be connected to a nearby disposal site.
- Optimum water will be used for all the activities onsite. Workers will be trained regarding the importance of water conservation through optimal use.
- Daily drinking water records to be maintained in drinking water record sheet and to be submitted to MMRC engineer.
- Water meter to be installed on all the bore wells planned to be digged for construction purpose. Use of water from bore well will also be maintained in water consumption record sheet.
- The proposed project will use water resource and will also discharge polluted water (sewage) and thus will have to pay Cess on water consumed with a view to generate resources for prevention and control of water pollution.
- Monitoring shall be carried out at 10 locations as per decision of Engineer in Charge for the parameters pH, Dissolved Oxygen, BOD, COD, TDS, Chlorides, Nitrates, Sulphates, Total Nitrogen, Total Phosphates, oils and grease etc.

Dewatering of water from Tunnel

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. 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 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 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.
- During operation phase, seepage water will be drained along the side of walls (retaining). Proper drainage system needs to be incorporated in design and implemented during construction phase.

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vi. Soil

Management Anticipated

Sources

The Mumbai Metro Line 3 is entirely an underground rail project. Hence, a large volume of muck will get generated during the construction of this project. The composition of muck would majorly comprise of soil and rock spoil. During excavation of stations and shafts, the muck generated would comprise of soil and rock spoil, whereas during excavation of tunnels, the muck would comprise of rock spoil.

Impacts

Loss of topsoil is a long term impact due to (i) site clearance for construction depot and TBM launching points (ii) temporary construction activities such as construction camps, material storage locations, diversion routes etc.

Mitigation measures

The procedures with respect to soil conservation have been provided below:

- Silt fencing to be provided to protect the soil erosion.
- Topsoil will be removed and preserved for reinstated and soft landscaping of construction areas.
- Proper routing and adequate capacity of the storm water run-offs drains to be provided.
- A retention wall or bund will be provided around the storage areas.
- Excavated soil will be used/ transported for filling low lying areas at the site.
- All storage facilities to be designed with paved surface, provided with covered shed and adequate containment facility at the construction site to prevent contamination of soil due to accidental spills of lubricating oil, fuel oil, paints, thinner, varnishes etc.
- Proper storage for machine oil, used oil and grease will be undertaken to avoid any soil contamination.
- A portable spill containment and clean up equipment will be available at site.
- Activities such as refuelling of DG sets, heavy machinery, maintenance, handling of waste oil etc. shall be undertaken on paved surfaces, with secondary containment and oil traps.
- Restoration of area used for parking of heavy machinery and other storage will be undertaken immediately after completion of project activity.
- Construction works should be programmed to minimize soil excavation works in rainy season. If excavation in soil could not be avoided in these months or at any time of year when rains are likely, for the purpose of preventing soil erosion, temporarily exposed slope surfaces should be covered e.g. by tarpaulin, and temporary access roads should be protected by crushed stone or gravel, as excavation proceeds. Arrangement should always be in place to ensure that adequate surface protection measures can be safely carried out well before the arrival of rains.

vii. Waste Management

Sources Anticipated

Construction activities are expected to generate a variety of waste such as:

- General refuse
- Construction Waste including waste from excavated material
- Chemical waste and
- Hazardous waste

Impacts

Handling and disposal of such waste may cause environmental degradation and nuisance

Mitigation measures

General Refuse

- Each worksite would generate general refuse including paper and food waste. There is likely to be a concentration of such waste at batching plants on major worksite. The storage of general refuse has the potential to give rise to negative environmental impacts.
- Handling and disposal of general refuse should cope with the peak construction workforce during the construction period. The refuse should be stored and transported in accordance with good practice and disposed at licensed landfills
- General refuse should be stored in enclosed bins or units and has to be separated from construction and chemical wastes. An authorised waste collector should be employed by the Contractor to remove general refuse from the site, on a daily basis to minimise odour, pest and litter impacts.

Construction Waste

- Construction Waste would mainly arise from the project construction activities and from the demolition of existing structures where necessitated. It includes unwanted materials generated during construction, rejected structures and materials, materials that have been over-ordered and materials, which have been used and discarded such as:
  - Material and equipment wrapping packaging material
  - Unusable/surplus concrete/grouting mixes
  - Damaged/contaminated/surplus construction materials; and

- Wood from formwork and false work.

- Also, demolition of buildings and houses to accommodate station buildings and construction depots will generate concrete rubble, plastics, metal, glass, asphalt from surfaces, wood and refuse.
- Waste from excavation would comprise soil, rubble, sand, rock, brick etc.
- It is estimated that construction activities used generate 2.5million m3 of soil, majority of which will be used for filling purpose.

Chemical Waste

Chemical waste is likely to be generated by construction and maintenance activities. For those processes, which generate chemical waste, it may be possible to find alternatives, which generate reduced quantities or even no chemical waste, or less dangerous types of chemical waste.

- The contractor should explore the possibilities given in (i) above and produce evidence of acceptable disposal methods (e.g., waste transfer) to the Employer's Representative.
- Containers used for the storage of chemical waste should:
  - Be suitable for the substances they are holding, resistant to corrosion, maintained in good condition, and securely closed.
  - Be of adequate capacity and
  - Display a label in English and local language as to the contents, quantity and safe method of disposal in accordance with instructions contained in MSDS.
- The storage area for chemical waste should:
  - Be clearly labelled and used solely for the storage of chemical waste;
  - Be enclosed on at least three sides;
  - Have an impermeable floor and bunding, of capacity to accommodate 110% of the volume of the largest container or 20% by volume of the chemical waste stored in that area, whichever is higher
  - Have adequate ventilation;
  - Be covered to prevent rainfall entering and
  - Be arranged so that incompatible materials are adequately separated.
- Disposal of chemical waste should be through a licensed waste collector, duly authorized by MoEF or Tamil Nadu Pollution Control Board as the case may be. License of the waste collector shall be shown to the Employer's Representative on demand.
- The Contractor should maintain an inventory of chemicals, solvents and adhesives.

He should minimise disposal of excess material, reuse when applicable and dispose of chemical waste properly. He should prepare a plan that identifies proper ventilation, protected clothing and personal protective equipment.

- The Contractor should have a point of contact, who will maintain the above information and also conducts periodic inspections.

Hazardous Waste

- Classification of waste as Hazardous shall be in accordance with Hazards Waste (Management & Handing) Rules 1989, and 2003 or its latest amendment.
- The Contractor shall identify all the hazardous waste generated as a result of his activities. If such waste is generated then the Contractor shall apply to State Pollution Control Board for 'authorisation' according to Form 1 of the Hazardous Waste (Management & Handling) Rules and dispose the same only to currently authorised recyclers(a list of which can be obtained from State Pollution Control Board) under intimation to the Employer's Representative.
- The Rules given in (i) above shall govern the Classification, Handling, Storage and disposal of such Hazardous Waste.

Hazardous waste would mainly arise from the maintenance of equipment. These may include, but not be limited to, the following:

- Used engine oils, hydraulic fluids and waste fuel;
- Spent mineral oils/cleaning fluids from mechanical machinery;
- Scrap batteries or spent acid/alkali; and
- Spent solvents/solutions, some of which may be derived, from equipment cleaning activities.

- For disposal of waste requiring special attention and hazardous waste the contractor shall enter into agreement with authorised agencies dealing with the same.
- The hazardous waste shall be stored on an impermeable surface with containment bunding to retain leaks, spills and ruptures.
- Waste oil and chemical containers shall be delivered to the Contractor's Storage yard. The Contractor is responsible for the correct storage and handling of waste oil/waste chemical containers for such a time until they are transported to the chosen disposal area or waste oil containers.
- All waste collection containers shall be of appropriate size with a closed lid. Each container will be clearly labelled both with a colour code system and labelled in local language and English. Original labels of empty containers should be completely covered and the contents of the type of waste stored in the used containers clearly indicated.

Storage and Segregation of Waste

i. Disposal and collection points should be established around all construction work sites. The waste containers should be of at least 50L/100L

ii. Burning of refuse at construction sites is not permitted.

iii. The contractor shall enter into a contract with a licensed organisation to collect waste from Construction depots, Labour Colony etc. and dispose it at their landfill as per existing norms.

iv. The Contractor is responsible for the separation of construction and demolition material into re-usable and non-reusable materials, and transfer of these materials to low lying areas or landfills, depending on the type of material and the percentage of inert material.

v. Segregation of Waste should be done on site. All construction waste including debris should be sorted on site into inert and non-inert components as given in Table below. Different areas of the worksites should be designated for such segregation and storage wherever site conditions permit.

Table 6.8 : Storage of Waste

Waste Container	Colour Code	Sign
Landfill / Biodegradable	Green	Waste
Recyclable	Blue	Paper & Plastic
Burning / Combustible	Red	Burning
Scrap Metal	Brown	Metal

vi. On-site measures promoting proper segregation and disposal of construction waste should be implemented e.g. provide separate containers for inert (rubber, sand, stone etc.) and non-inert (wood, organics etc.) wastes. The inert waste should be used on site before disposed of at filling area and the non-inert waste should be sorted for re-use or recycling before being transported to landfills.

vii. Non-inert materials such as wood, glass and plastic are acceptable for disposal to a landfill as a last resort if these can no longer be reused or recycled.

viii. Inert materials such as excavated materials comprising soil, rubble, sand, rock, brick and concrete should be separated and broken down to size suitable for subsequent filling in low lying areas, if it is determined that such material can no longer be reused at the site itself.

Reuse and Recycle

i. If some good quality reusable topsoil is expected from site clearance works it shall be locally stockpiled and used later in final landscaping works, thus saving on costs for such works and transportation and environmental impacts of disposal.

ii. The design of framework should maximise use of wooden panels so that high reuse levels can be achieved. Alternatives such as steel framework should be considered to increase the potential for reuse.

iii. The Contractor should recycle as much of the construction waste as possible on-site.

iv. Excavated materials are usually inert such as soil and rock, and can normally be reused on site or in public filling areas. The excavated material may have to be temporarily stockpiled on-site for subsequent re-use.

v. Steel and other metals should be recovered from the construction waste and recycled as far as practical. If possible, scrap steel mills can use steel bars.

Transportation of Waste

i. The transportation of construction spoil shall be allowed only to officially designated dumpsites after obtaining necessary permission from appropriate authority.

ii. A procedure to facilitate tracking of loads should be developed to prevent illegal disposal of waste. This procedure should include, inter alia, the name of driver, vehicle registration number, type and quantity of waste, place and time of origin, place of disposal and route of haulage.

iii. In orders to avoid dust or odour impacts, vehicles leaving a site carrying excavate should have their load covered. Vehicles should be routed as far as possible to avoid sensitive receivers in the area.

iv. Contractors who produce significant quantities of scrap are obliged to enter into agreement with authorised dealers of scrap for its disposal. Copies of such agreements shall be shown to the Employer's Representative on request.

Training

i. The Contractor's Environmental Department is responsible for training of

workers and personnel involved in generation of waste.

ii. The Contractor shall provide training for workers about the concepts of site cleanliness and appropriate waste management procedure, including waste separation, reduction, reuse and recycling. Failure to do so would result in poorly separated waste, resulting in difficulties in treating the waste correctly and/or a bad market for reuse /recycling.

iii. The awareness will be created through briefings and toolbox talks. The personnel/workers should be trained in waste classification and separation. The training should include:

- Organic waste
- Combustible waste
- Hazardous waste
- Minimisation of waste

iv. Separation awareness training shall be given to employees responsible for the separation of the waste and information regarding waste separation shall be posted at appropriate locations around the site.

Solid Waste and Liquid Waste Management (Stations, tunnel and allied activities) Updated (EIA Feb. 2020)

Construction phase:-

Waste water generated during construction of the stations is treated in an intermittent type sedimentation tanks.

Waste water generated at standalone launching shafts at Pali and Nayanagar is also treated in treatment plants comprising of primary and tertiary treatment arrangement.

At RMC/casting yard at Wadala, JVLR and MIDC plot at Cuffe Parade effluent treatment plant have been provided.

The treated waste water from stations and launching shafts is partly recycled for wheel washing, dust suppression, TBM cooling etc. At RMC plants complete recycle of treated waste water is ensured.

Biomedical waste generated at the first aid Centre's at the work sites is segregated at the site and handed over to authorized agencies appointed by Maharashtra Pollution Control Board in accordance with biomedical waste management rules 2016 .

Hazardous waste generated in the form of used oil and oil filters etc. at the work sites is handed over to the authorized agencies of Maharashtra Pollution Control Board in accordance with the provisions harzardous and other waste (management and trans boundary movement) rules 2016,

C&D waste generated at the work sites is utilized for making recyclable products such as concrete tables, flower pots, tree basins and for construction of internal roads. Remaining C&D waste is disposed at authorized locations of local body as per construction and demolition waste (C&D) management rules,2016.

Municipal solid waste generated at the work sites is handed over to the agencies appointed by local body

after segregation at the source as per Soild waste management rules, 2016 .

Operational Phase:- (stations and allied activities)

Sewage generated from stations would be connected to MCGM sewer lines after treatment in septic tank.

Municipal solid waste generated from the stations will be handed over to the agencies appointed by local body after segregation at the source.

Hazardous waste generated in the form of used oil and oil filters etc. at the station sites will be handed over to the authorize agencies.

Environmental management system at maintenance car shed depot will be maintained efficiently and operated in a scientific manner.

viii. Muck Disposal: Update (EIA Feb, 2020)

Anticipated Sources

The Mumbai Metro line 3 is entirely an underground rail project. Hence, a large volume of muck will get generated during the construction of this project. The major sources of muck generation are construction of:

- Stations(Cut & Cover and NATM),
- Tunneling by TBM
- NATM Tunnels and
- Various shafts

The composition of muck would majorly comprise of soil and rock spoil. During excavation of stations and shafts, the muck generated would comprise of soil and rock spoil, whereas during excavation of tunnels, the muck would comprise of rock spoil. With reference to the DPR of this project, the volume of muck generation expected from the entire stretch ofmetro line is 5.4 Mm3. IC performed a quick check on this aspect. Taking into consideration the revised station configurations, and applying a swell factor of 1.2 on excavated soil/rock (to account for increase in volume of muck spoil as compared to in-situ soil/rock) the total muck volume from all seven packages will be approximately 6.92 Mm3.

The estimated muck generations quantities have been re-estimated periodically and as per the latest re -assesment done in the year 2017, the estimated muck generation stands to 9.527693 Mm3. Package wise details are presented in the Table 6. 11

Table 6.11: Detailed Muck Generation from Proposed Station and Tunnel

		Station and Tunnel	Total Muck (m3)
UGC-01	1	Cuffe Parade	14,77,026.13
	2	Vidhan Bhavan	
	3	Churchgate	
	4	Hutatma Chowk	
UGC-02	5	CST Metro	12,78,747.97
	6	Kalbadevi Metro	
	7	Girgaon Metro	
	8	Grant Road Metro	
UGC-03	9	Mumbai Central Metro	15,46,235.31
	10	Mahalaxmi Metro	
	11	Science Museum	
	12	Acharya Atrey Chowk	
	13	Worli	
UGC-04	14	Siddhi Vinayak	13,80,948.88
	15	Dadar Metro	
	16	Sheetla Devi Temple	
UGC-05	17	Dharavi Metro	16,70,782.11
	18	Bandra Metro	
	19	Vidya Nagari	
	20	Santacruz Metro	
UGC-06	21	Domestic Airport	11,86,424.09
	22	Sahar Road	
	23	International Airport	
UGC-07	24	Marol Naka	9,87,528.76

	25	MIDC	
	26	SEEPZ	
		TOTAL Muck	95,27,693.26

Note – The above quantities of estimated muck generation also includes the muck from tunneling/NATM activities at Station site as well as standalone tunneling sites at Churchgate , Nayanagar and pali ground.

Management of Muck Disposal

The Mumbai region is a thriving mega polis with every inch of available space either occupied or in the process of being inhabited. Underground Metro systems have their unique set of challenges and with the enormous quantum of muck being generated; a realistic strategy needs to be formulated for its disposal. Muck is a heterogeneous product unlike natural soils and is most likely to be having a composition of soil, rock spoil, moisture and other biotic and abiotic elements. Ecological receptors like soil, water and air quality along with local communities (if present nearby) are likely to be impacted.

The construction of MML-3 will involve tunneling (both by TBM and NATM), station construction (both by cut & cover and NATM), shaft construction, fill and embankment (depot). Owing to paucity of space in this busy city and for safety reasons, elaborate measures need to be adopted for collection, storage, transfer and disposal of spoil. About 9.527 Mm^3 of muck will get generated. To avoid impact on land due to disposal of this large volume of muck, five alternate options for disposal of muck was suggested in the RITES EIA report 2011, which are as following

Table 6.13: Capacities of the Muck dumping option

Sl. No	Alternate option	Capacity of dumping site Mm^3	Remarks
1	JNPT Terminal 4	4	Avg. depth of fill taken as 2.0m
2	Ports/ Jetties At Rajauri Creek, Vill Rohini, Dist. Raigad	7.8	As communicated by project proponent M/s Das Offshore Engg. Pvt Ltd
3	Abandoned Quarries Raigad and Thane	16.13	Avg. depth of fill taken as 1.0 m
4	Recycle and reuse	-	
5	Deep Sea Dumping	-	Detailed investigations

.

Selection of dumping sites

There are several factors to be considered while selecting the dumping sites. Hence during the selection of dumping sites following criteria must be fulfilled at the sites.

1. The dumping sites to be close to the Project worksites to minimize the lead in transporting the muck to be disposed.
2. The sites that are located downwind of any habitation are preferable.
3. The sites to be free from active landslides or creeps and should not have a possibility of toe erosion related slope failure.
4. Sites should not be pristine habitats containing threatened species.

- The dumping sites should not be an ecologically sensitive area and free of pristine habitats.
- There shall not be any channel of small streams flowing through the dumping sites.

Muck Disposal Sites

There are six quarry sites identified in the IC report for muck disposal-2013, namely

1. Dhapode :- Quarry Capacity - 1.45Mm^3
2. Kalwar :- Quarry Capacity - 0.9 Mm^3
3. Talavile-Pise:- Quarry Capacity - 1.07Mm^3
4. Waliv :- Quarry Capacity - 1.08 Mm^3
5. Barwai :- Quarry Capacity - 1.81 Mm^3
6. Kalyan :- Quarry Capacity - 1.43 Mm^3

The total capacity of all the above sites provides 7.75 million m3.

There are two sites Barwai and Kalyan which are privately owned and MMRC's discussion with the owners has concluded with their unwillingness to accept . Thus, reduces the available disposal capacity to 4.51 Mm3 only.

Due to the failure in securing the two sites Barwai and Kalyan, additional sites were identified and mentioned in the bid documents. These sites are landfill at Mhape and Ambernath, quarries at Mankoli, Wehle, and Ovale..
. Package wise muck disposal location, and their capacity is presented in Table below

Table: Contract Package wise location of muck disposal site

Contract	Average Distance (km)	Travel time (in min.)	Muck Disposal	Capacity in m3	Haulage rout Highway No
UGC-01	58.9	112	Kalwar	0.9	NH-3
UGC-02	42.9	87	Land at Mhape & Ambernath	0.25+	NH-3

UGC-03	48.1	91	Dhapode	0.73	NH-3
UGC-04	42.5	68	Dhapode, Mankoli, Wehle, Ovale	0.73+	NH-3
UGC-05	52.2	79	Waliv	0.54	NH-8
UGC-06	57.8	91	Waliv, Wehle, Ovale	0.54+	NH-8
UGC-07	53.6	82	Talavali-Pise	1.07	NH-3

Muck is property of civil contractors as per the contractual provisions. In addition to above sites. contractors have identified additional sites for the disposal of the muck at various locations such as Navi Mumbai, Raigad district etc, where muck disposal is practiced.

Impacts

Ecological receptors like soil, water and air quality along with local communities (if present nearby) are likely to be impacted if the muck which is generated is not handled appropriately.

Measures to be adopted

- Any diversion required for traffic during disposal of debris shall be provided with traffic control signals and barriers after the discussion with local people and with the permission of Engineer-in-Charge of works.
- Materials having the potential to produce dust will not be loaded to a level higher than the side and tail boards and will be covered with a tarpaulin in good condition.
- During the debris disposal, contractor will take care of surrounding features and avoid any damage to it.
- The dumping of muck on these sites should not lead to flooding being caused in the surroundings.
- No channel of small streams to be flowing through the dumping sites (If it is unavoidable, adequate care and measures to be taken to eliminate the possibility of muck getting washed away by the stream).
- The slopes of the dumping sites should not be susceptible to landslides and moreover slopes do not have a possibility of toe-erosion related slope failure.
- The foundations of the dumping sites must be at a higher elevation than the maximum flood level.

5. Alternate uses may be explored for
    - Road aggregate
    - Aggregate for concrete
    - Fill material

Site Rehabilitation Measures

A muck disposal site when utilized to its optimum capability has to be ecologically restored to the maximum extent possible. Dumping of muck and its rehabilitation is a real challenge in the underground metro projects as a huge quantity of muck is generated. All ancillary activities of muck dumping like excavation, transportation, relocation and rehabilitation have some form of adverse impacts on the life support system and landscapes. The nature of excavated muck varies significantly from the natural soils. The unsound disposal of muck will not only contaminate the water quality, air quality but also the soils and vegetation of surrounding areas.

Considering the elevation setting and geography of dumping sites, the possibility of soil erosion and other impacts of loose soils on the local water bodies are relatively low with the correct precautionary measures. However, other adverse impacts on ambient air quality, surrounding vegetation and human health cannot be overlooked. Taking into consideration all the environmental consequences of dumping area, the rehabilitation measures that can be taken are described below.

a) Compaction

The dumped muck should be mechanically compacted and properly levelled with suitable safe slopes. .Compaction will help in reducing the volume and also reduce erosion by wind. The

compaction and leveling also makes it suitable for the plantations which will further stabilize its top surface/slopes and improve aesthetic value of the area. .

b) Fencing

Fencing is a primary line of action. After rehabilitation of muck, the dumping areas need protection for some time from disturbing by human and domestic animals. Establishing temporary wind barrier around the dump areas is suggested, especially if the site is near a settlement area.

c) Biological Measures

After compaction, the total available surface area including tops and slopes of muck may be left to be administered to other measures of restoration. This area may be used for the plantation so that vegetation cover could control the mechanical and hydrological effects on the slopes and top surface and would give permanent stability to the muck.

The biological measures include the following:

- Soil Treatment

Generally the excavated soils/rock spoil are not fertile, if not treated vegetation cannot be grown properly on such surfaces. In order to make it nutrient rich, an Integrated Life Sciences Based Approach' may be adopted.

- Selection of Species

To stabilize the muck and restore the disposal sites, fast growing plant species may be planted on the finished soil surface. The grasses are suited to bind loose soil and the shrubs and trees hold soil up to deeper level. Taking into account, the climate, soil and drainage conditions of the sites, selection of local plant species is generally preferred. Important tree species which can be used to rehabilitate the loose soil are Alnus nepalensis, Altingia excelsa, Brassiopsis aculeata, Castanopsis indica, Erythrina arborescens, Gymnema arborea, Saurauia punduana and Schima wallichii. Shrubs that can be useful as soil binders are Bambusa tulda, Boehmeria macrophylla, Debregeasia longifolia, Hydrangea robusta and Oxyspora paniculata. Among tuft forming and fast growing grasses useful in soil binding are Chrysopogon gryllus, Digitaria setigera, Eleusine coracana, Eragrostis nigra, Eulaliopsis binata, Saccharum longisetosum and Thysanolaena latifolia. These species are conventional industry standards usually implemented in such projects.

- Use of Geo-textile

After treatment of soils, mats of coir jute may be spread over the dumping slopes and wetted suitably. These mats increase the water holding capacity and retain the water. After decomposition, they increase the fertility of soils.

d) Other Precautionary Measures

- All dumpers and trucks must be well maintained and equipped with tarpaulin sheets and hooks for covering of the loose spoil during transportation.
- The vehicle speeds on unpaved roads may be restricted to 25 kmph
- Contractors should maintain valid PUC – Pollution under Control certificates and maintain proper maintenance records for their fleet ;
- To control fugitive dust emissions arising during material handling, the heights from which materials are dropped should be reduced to a practical minimum height.
- Windbreaks and shelterbelts along with other vegetation methods are found to be most effective methods to arrest wind where the ground is virtually bare and devoid of vegetation.
- Upwind fencing of the site to control soil movement by wind and water.
- Dumping would be avoided during the high speed wind, so that Respirable suspended particulate matters (RSPM) level could be maintained.
- Care should be taken so that the loose soil will not be leached out

in the nearby water body, if any.

6.5.3 Environmental Monitoring Plan (Updated EIA, Jan. 2016, & Feb. 2020)

An environmental monitoring plan provides a delivery mechanism to identify any potential environmental impacts of a project during its construction and execution, to enhance project benefits, and to introduce standards of good practice to be adopted for all project works. An environmental monitoring program is important as it provides useful information and helps to:

- Assist in detecting the development of any unwanted environmental situation, and thus, provides opportunities for adopting appropriate control measures, and
- Define the responsibilities of the project proponents, contractors and environmental management team members and provide means of effectively communicating any environmental issues if any during the progress of the project.
- Define monitoring mechanism and identify monitoring parameters.
- Evaluate the performance and effectiveness of mitigation measures proposed in the Environment Management Plan (EMP) and suggest improvements in management plan, if required,

An environmental monitoring plan is suggested to monitor environmental parameters during preconstruction, construction and during operation phase.

The environmental monitoring framework for the proposed MML3 is given in this report. Since the construction and the operation phases of the project shall be overlapping, a common monitoring plan for both the phases has been proposed and shall be extended beyond the design year. The monitoring shall be carried out by the Environment Management Cell.

Table 6.9 Environment Monitoring Plan

S. No	Attribute	Parameter	Period and Frequency
1	Ambient Air Quality	PM_{10}, $PM_{2.5}$, SO_2, NO_x, CO and HC	Twice in a week for each season for three season in a year
2	Noise	Leq, L90, L50, L10, Lday, Lnight, Lday-night	Twice in a week

3	Vibration	Peak Particle velocity in mm/sec	Continuous monitoring during tunnelling and underground station construction at work stations and 4 years during operation
4	Water Quality – Ground water and Surface Water	pH, Biochemical Oxygen Demand (BOD 3 days 27^{O}c), Chemical Oxygen Demand (COD), Suspended Solid,Total Dissolved Solids, Chlorides, Nitrates, Sulphates, Iron, Calcium, Total Nitrogen, Lead, Total Phosphates, oils and grease.Heavy metals (optional)	Once in a season for three season in a year
5	Wastewater (Inlet & Outlet) Sedimentation tank at stations / tunneling	pH, Biochemical Oxygen Demand (BOD 3 days 27^{0}c), Chemical Oxygen Demand (COD), Suspended Solid,Total Dissolved Solids, Chlorides, Nitrates, Sulphates, Iron, Calcium, Total Nitrogen, Lead, Total Phosphates, oils and grease.Heavy metals	Quarterly
	Wastewater (Inlet & outlet)at Car shed Depot	ETP-pH, Biochemical Oxygen Demand (BOD 3 days 27^{0}c), Chemical Oxygen Demand (COD), Suspended Solid,Total Dissolved Solids, oils and grease. Total metals, Iron as Fe STP- Suspended Solid, Biochemical Oxygen Demand (BOD 3 days 27^{0}c), Chemical Oxygen Demand (COD), oil & grease	Monthly (Operational phase)

6	Soil	pH, Sodium, Potassium, Chloride, Nitrogen, Phosphorous, Organic Matter, Heavy Metal, oil and Grease	3 samples in a season and 3 times in a year
	Muck	pH, Sodium, Potassium, Chloride, Nitrogen, Phosphorous, Organic Matter, Heavy Metal, oil and Grease	Random sampling @ three sample in one km

6.5.4 EMMP Implementation Review Process

The EMMP is required to be reviewed periodically to address any changes in the organization, process or regulatory requirements.

Following a review, the Project Director of the Project Management Unit (GC) , after discussion with the Site Supervisors and EHS Manager will be responsible for making the amendments in the EMMP and thereafter, seek approval from MMRC. The amended EMMP would be communicated to all relevant staff who would be responsible for its implementation.

6.5.5 Documentation and Record Keeping

Documentation and record keeping system has to be established to ensure updating and recording of requirements specified in the EMMP. Responsibilities have to be assigned to relevant personnel for ensuring that the EMMP documentation system is maintained and that document control is ensured through access by and distribution to identified personnel in the form of the following:

Record keeping and reporting of performance is an important management tool for ensuring sustainable operation of the proposed MML3. Records should be maintained for regulatory and monitoring of construction issues.

Environmental Engineer should carry out assessment of the Projects Environmental performance based upon the reports from the Environmental Supervisors. The findings/observations should be rectified on daily basis.

The contractor's Environmental should send the following reports to the MMRC periodically:

- Monthly Environment Report
- Environmental Committee Meeting Minutes
- Environmental Audit Reports
- Air, Noise, water and Vibration monitoring reports
- Environmental compliance reports

6.6 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 due to construction. The potential causes are excessive load, cracks, failure and malfunctioning of sensing instruments, accident, etc. These need to be looked into with care.

6.6.1 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 be aware of availability of repair equipment, materials, labour and expertise for use during emergency.

6.6.2 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, and
- Nearest medical facilities.

6.6.3 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.

6.6.4 Emergency Action Committee

To ensure coordinated action, an Emergency Action Committee should be constituted. MD MMRC will be the Chairman of this Committee. The committee may comprise of:

- Head of operations,
- Head of technical services,
- Head of security,
- Fire brigade,
- Police representatives, and
- NGO

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 mock 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.

6.7 EMERGENCY MEASURE

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 of 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.

6.7.1 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.

6.7.2 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 overhead 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 firefighting.

Accumulations of refuse of 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:

- Down stand 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, and
- In underground stations the ventilation system will be designed to extract smoke in the event of fire

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. Firefighting 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 earthen. For electrical fires, non-aqueous extinguishers like chemical dry powder or CO2 gas are utilized for firefighting. 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 needs to be transported away from the site of the fire. In order to achieve this, 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 art 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,
- 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 Mumbai 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. Heat detector shall be installed at roof level, ceiling and floor cavity.

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/ installed in the station controllers room, for the control, indication and monitoring of the whole detection and fire fighting systems.

W

hile designing the fire fighting system, the zone of Mumbai 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 1500m 2

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 when the need arises. 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.

6.7.3 Ventilation Shafts

The Environmental Control system for underground stations requires ventilation openings between various plants, plant rooms and the atmosphere. Shafts are required for exhaust air, fresh air intake and draft relief. Ventilation shafts will be provided at each station.

6.7.4 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.

6.8 SUMMARY OF ENVIRONMENTAL MANAGEMENT PLAN (EMP)

The negative 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 6.10, 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 practise 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 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 MMRC, should prepare and establish Environmental and Health Policy and Procedures 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. 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 and follow on timetable of actions.

TABLE 6.10 :ENVIRONMENTAL MANAGEMENT ACTION PLAN (EMP): EIA 2012 & update EIA , Feb 2020

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 minimise the land disturbance to avoid archaeological sites, temples and other environmentally sensitive areas.	During Design	DPR and design consultant	PIU
Cultural Heritage	Avoided by adjustment of alignment.	During Design	DPR and design consultant	PIU

Inadequate design provision for safety against seismological 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 for construction purpose etc., shall be planned and arranged from Municipal water supply/Ground water.	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, wherever it is required to avoid dust. Vehicles delivering materials should be covered to reduce spills and dust blowing off the load.	During construction	Contractor	PIU/EMP implementing agency
Air Pollution	Vehicles and machinery are to be regularly maintained so that emissions conform to National and State AAQ Standards.	Beginning with and continuing throughout construction	Contractor	PIU/EMP implementing agency
Environmental Impact	Mitigation Measures Taken or To Be Taken	Time Frame	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	During construction	Contractor	PIU/EMP implementing agency
Noise	Workers in vicinity of strong noise will wear earplugs and their working time should be limited as a safety measure. Noise barriers (Stone walls or plantation) for silence zones	Beginning and through construction	Contractor	PIU/EMP implementing agency

Vibration	The detailed vibration investigation will be required prior to construction. Awareness about vibration impact to the public residing near to the alignment, if required.	Beginning and 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 other water bodies.	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 purpose.	Beginning with and continuing throughout construction	Contractor	PIU/EMP implementing agency
Sewage disposal during construction at Service Centres	A minimum distance of any sewage or toilet facility from water sources should be 200 metres	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. 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	During	Contractor	PIU/EMP
Environmental	Mitigation Measures Taken or To Be Taken	Time Frame	Implementing	Responsible
	licensed quarries only.	construction		implementing
FLORA AND FAUNA				
Loss of trees and Plantation	Two times trees will be planted against every tree cut as per norms. Plantation of trees as per Maharashtra (Urban Areas) Protection and Preservation of Trees Act 1975. More importance should be given for transplantation of tree rather than cut.	During construction and after completion of construction activities.	PIU through Contractor	PIU /EMP Implementation Agency
SOCIAL				
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	During construction At start-up Throughout construction	Contractor	PIU/EMP implementing agency
Location of camp and storage areas	Location of camps and storage areas shall be as per the contract specifications.	Throughout construction	Contractor	PIU/EMP implementing agency
OPERATION PHASE				
Noise and Vibration	Suitable measures should be considered where warranted. The public shall be educated about the regulations of noise and vibration pollution and its implications.	After completion of construction	PIU/EMP implementing agency	PIU/EMP implementing agency
Environmental Impact	Mitigation Measures Taken or To Be Taken	Time Frame	Implementing Organization	Responsible Organization
WATER				
Oil pollution/Wastewater treatment/Sewage treatment	Suitable treatment shall be taken for treatment of oil/Wastewater/sewage treatment in depot areas before discharging the wastewater.	During operation of the treatment plant	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. Updated- (EIA Feb. 2020) Treated wastewater- Recycle to maximum extent for secondary purposes and remaining for utilization on land for green belt for treated wastewater Treated Sewage- Recycle to maximum extent for secondary purposes and remaining for utilization on land for green belt/sewer for treated sewage	During operation of the treatment plant	PIU/EMP implementing agency	PIU/EMP implementing agency

CHAPTER-7 PUBLIC CONSULTATION

7.1 INTRODUCTION

"Public Consultation" refers to the process by which the concerns of local affected persons and others who have plausible stake in the environmental impacts of the project or activity are ascertained with a view to taking into account all the material concerns in the project or activity design as appropriate. Consultation is used as a tool to inform stakeholders about the proposed action both before and after the development decisions are made. It assists in identification of the problems associated with the project. Initial Public consultation has been carried out in the project areas with the objectives of minimizing probable adverse impacts of the project and to achieve speedy implementation of the project through bringing in awareness among the community about the benefits of the project.

7.2 METHODS & APPROACH FOR CONSULTATION

Public consultation was accomplished to collect the opinion/views of the stakeholders for the construction of the project. Open discussion was held by conducting one to one meeting at project level and district level by disseminating the information by circulating the project summary/ discussing the issue on the desk. At pre-scheduled date and venue, people were communicated to gather for stakeholder consultation. Gathering was explained about the project activities and their consequences in brief. Copy of project summary was also distributed among the stakeholders. Queries of the stakeholder were replied by the environmental expert and at the same time their suggestions were also endorsed. It was held at the doorstep of the people or at a common place of people's gathering. In one to one meeting, people expressed open view and asked openly to understand the project while in gathering combined opinion of the people was collected.

7.3 CONSULTATION AT PROJECT LEVEL

The consultations were conducted during the reconnaissance/ field visit during second and third week of January 2012 and based on informal unstructured interviews and focus group discussion. The objective of the consultation was to disseminate the project information and ascertain stakeholder's views on probable environmental and social impacts that may arise due to the implementation of the proposed project. Public were intimated about the consultation venue, date and time. The venues, date and time of the public consultations are presented in Table 7.1. RITES experts with MMRC officials explained about need of the project describing social and environmental issues like land acquisition, anticipated positive & negative impacts and use of techniques during construction and time frame of construction period during public consultation. About 93 people from different community participated for public consultation at project level. Of the total participants, 5 persons at Girgaon, 9 at Dharavi and 12 persons at Santacruz had raised the questions related to environmental issues.

The following issues were discussed during the consultations.

- Overall need of the project;

- Project location;
- Environmental concerns; and
- Social concerns

TABLE 7.1
PROJECT LEVEL PUBLIC CONSULTATION VENUE

S.No.	Venue of the Public Consultation	No. Of Participant	Time and Venue
1	Girgaon	14	14:30 PM, 13th Jan 2012
2	Dharavi	34	13:30 PM, 16th Jan 2012
3	Dori Nagar, Santacruze	45	14:00 PM, 17th Jan 2012
4	Dori Nagar, Santacruze		16:00 PM, 17th Jan 2012

The photographs showing stakeholders participation at public consultation held at various places are shown in Figure 7.1.

7.4 ISSUES, SUGGESTIONS AND MITIGATION MEASURES

Issues raised by the stakeholders with their valuable suggestions were noted down for consideration into the report which is depicted at Appendix 7.1. Table 7.2 depicts the stakeholders' consultation at project level in which some of the important issues raised by stakeholders and their suggestions have been incorporated. The suggestive mitigation measures are taken in detail in the last column of the table.

ISSUES RAISED	SUGGESTIONS OF STAKEHOLDERS	MITIGATION MEASURES

Muck Transportation	Compact engineering solution through traffic management, monitoring of air, noise and vibration and safety precautions.	Traffic regulatory measures would be developed during construction. Contractor in consultation with local government will prepare traffic management plan for the construction period. Water, air, noise monitoring will be conducted as per schedule. Vibration Monitoring during construction & Operation.
Air & Noise pollution	Pollution due to air and noise during the construction and insisted for regular air monitoring.	Latest technology will be adopted to minimize pollution during construction. Air & noise monitoring will be conducted regularly as per schedule.
Tree removal	Transplantation and some new trees should be afforested.	Cutting of trees will be minimized wherever possible. Compensatory afforestation will be done by transplanting & planting trees.
Work Schedule	Work should be carried out in systematic manner and working hours should be up to 6 pm.	Work will be carried out in systematic manner and the working hours would be up to 6 pm.
Employment	Job preference should be given to the local people.	As per policy contractors will give preference to affected PAFs.
Muck Disposal	Muck should be disposed at safer site.	Muck will be disposed at identified site & systematic manner. It will be reclaimed immediately after the project completion
Construction Depot	It should be kept away from the habitation zone.	Depot has been planned at Aarey Milk colony area which is well away from the habitation. All necessary pollution measures will be adopted at depot.
Labour Camp	Provide adequate sanitation facilities and safe drinking water at labour camps	Adequate sanitation facilities and safe drinking water will be provided at labour camps.

7.5 CONSULTATION AT CITY LEVEL

Consultation meeting was organized with officers of concerned government department and non-government organizations (NGO) of district vide newspaper Notification dated 5th April 2012. The public hearing notification is enclosed at Appendix 7.2. A public hearing for concerned stakeholders of the project were organized on 11th April 2012 the details given in Table 7.3.

TABLE 7.3
PUBLIC HEARING

NOTICE

Date	Time	Venue
11th April, 2012	10.00 am - 1.00 pm	Insurance Institute of India (college of Insurance), 'G'block, Plot no.C-46, Bandra-Kurla Complex, Bandra(E) Mumbai-400051

Suggestions / objections from concerned stakeholders were invited for Environmental Impact and Social Impact due to proposed project. Public hearing was attended by 200 stakeholders and about 27 stakeholders raised their objection with suggestions. Details of some objection/ suggestions raised by stakeholders relevant to environment are summarized in Table 7.4. The photographs of the City level public consultation are given in Figure 7.2.

ISSUES RAISED	SUGGESTION/OBJECTION OF STAKEHOLDERS	MMRC REMARK
Metro Rail Alignment	Metro line 3 to be combined with Metro line 2 and One depot location can be saved. A letter addressed to the then C.S., GoM, Shri Johnny Joseph by Mr/ Shrideran, MD, DMRC was also discussed regarding Charkop- Bandra-Colaba corridor and MMRC later changed as Charkop-Bandra-Mankhurd corridor.	PPP contract has been awarded for Metro Line 2 (Charkop – Bandra – Mankhurd). Merging with Line 3 is not possible at this stage. Area required for a combined depot will be much greater than the space available at any one site. Combined depot will not be feasible for Metro Train operation of Line-2 and Line-3.
Muck Disposal	Aarey Milk Colony should be taken up very strongly. MMRC has a responsibility for mass public transport; it has also responsibility towards environment. How to dispose of the muck coming out of excavation? Where will it be dumped? Mumbai affected by seismic fault line and how you will evacuate passengers?	MMRC is working on several options for muck disposal. Due care will be taken with regards to environmental impact. Designs will account for Mumbai's seismic zone. Disaster and evacuation plans will be as per Indian standards.

Safety Measures	Expressed doubt regarding completion year 2019 in light of VAG corridor Line 1 experience. How much will be the fare? What are the minimum and the maximum? The area from where the line 3 will go through is a very highly congested area. We have to take great caution because of the underground cables, pipelines, etc.	Based on experience of Line 1 and other underground metros in India MMRC will device a construction plan including comprehensive utility diversion to complete project within given time frame. MMRC is in the process for fare fixation for line 3.
Undergroun d Utilities & DMP	MMRC to take utmost care for underground utilities Disaster Plan and Evacuation Plan etc. to be prepared.	MMRC will device a comprehensive utility diversion plan. Disaster and evacuation plans will be as per Indian standards
Duplication of Metro Line 2 & 3	Difficult to understand the logic of having 2 parallel lines. (Metro Line 2 & 3).	Line 2 and 3 are serving different areas and there is no duplication.

Cost/Km	Enquired about cost per k.m. of underground metro.	Approximate cost of u/g metro is Rs 600 cr / km
Connectivity	Enquired about people living in Ballard Estate, Colaba, Gateway of India to access metro station. How will you connect this metro line with the main line?	CST station, Churchgate, Cuffe Parade Station and Hutatma Chowk stations serve these areas. Metro stations will be integrated with suburban stations at interchange points with main lines.
DMP, evacuation plan, seismic zone	1. High cost of underground metro 2. Suburban train overcrowded , 44% walk trips and 3.1% cars 3. Enquired about technical details of metro line 3	Technical details and DPR is available for review at MMRC office. Tunnelling by TBM, station s by either cut and cover or

	4. DPR not available 5. Method of construction 6. Disaster Management Plan, Evacuation Plan etc. 7. Mumbai affected by seismic zone 8. Commuter dispersal at stations 9. Encouraged BRTS due to less cost and less time for construction. 10. Metro projects are very costly & time consuming	NATM. MMRC will device a comprehensive utility diversion plan. Disaster and evacuation plans will be as per Indian standards MMRC will take due care during detailed design stage Since ridership is in excess of BRTS capacity metro is required to satisfy demand.
Fire Safety	Indian Institute of Shipping are involved in fire safety and can guide MMRC, if associated. How to minimise construction cost?	MMRC will consider the proposal.
Station Location	There are 2 stations. It is going through Marol slum. Why these stations are so close? Why it should go through the slum?	Marol naka station is an interchange station with Line 1. 3 stations have been proposed in Airport as per their requirement.

Metro Corridor	Whether Metro alignment is underground or elevated.	Proposed Metro line-3 is fully U/G

FIGURE 7.2
PHOTOGRAPHS OF STAKEHOLDERS' CONSULTATION AT CITY LEVEL

DETAILS OF PUBLIC CONSULTATION HELD WITH PROJECT AFFECTED PEOPLE & VARIOUS OTHER ORGANISATIONS / INSTITUTIONS HELD AFTER 2012.

Sr.No.	Division	Date	Place
1	Gyaneshwar Nagar–BKC	28-11-2014	Namtree G- Block Bandra Kurla Complex, Bandra (East).
2	Agripada (Santacruz) & Dharavi	02-12-2014	Namtree G - Block Bandra Kurla Complex, Bandra (East).
3	Sariput Nagar (Aarey Colony)	11-12-2014	Community Hall Durga Nagar Rehabilitation Colony Jogeshwari-Vikhroli Link Road.
4	M.I.D.C	26-12-2014	Labour/Worker Welfare Centre Andheri – (East).
5	Maheshwari Nagar Police (Resi) Colony - Discussion Session	13-02-2015	Police Colony Maheshwari Nagar Rd.No.16, M.I.D.C. Andheri (East).
6	Kalbadevi & Girgaon	02-03-2015 To 04-03-2015	CR-2 Building, 1st Floor Nariman Point, Mumbai.
7	Cuff Parade & Churchgate Local Residents Association - Discussion Session	05-03-2015	CR-2 Building, 1st Floor Nariman Point, Mumbai.
8	Sahar (Shanti Nagar)	12-03-2015	Namtree G - Block Bandra Kurla Complex, Bandra (East).
9	Kalbadevi & Girgaon Action Committee	16-03-2015	CR-2 Building, 1st Floor Nariman Point, Mumbai.
10	Indian Merchant Chambers - Discussion Session With Them & Presentation	26-03-2015	CR-2 Building, 1st Floor Nariman Point Mumbai
11	Mumbai 1st Press Club. - Discussion Session With Them & Presentation	27-03-2015	CR-2 Building, 1st Floor Nariman Point Mumbai
12	M.I.D.C. Officers & M.I.D.C. Plot Owners	08-06-2015	Territorial / Regional office M.I.D.C., Thane Div. Office Complex Bldg. 1st Floor, Thane
13	M.I.D.C. Officers & M.I.D.C Plot Owners	22-06-2015	Association Office PL. No. 15; Street No.14, M.I.D.C Marol, Andheri – East. Mumbai.
14	Cricket Club Of India - Discussion Session With Them & Presentation	24-07-2015	CR-2 Building, Floor Nariman Point Mumbai.
15	Janata/Naya Nagar Mahim	29-07-2015	Namtree G- Block Bandra Kurla Complex, Bandra (East).
16	Oval Ground Association. Mumbai Discussion Session With Them.	24-08-2015	CR-2 Building, Floor Nariman Point Mumbai.
17	Girgaon Kalbadevi Residents Association - Discussion Session With Them.	28-08-2015	CR-2 Building, Floor Nariman Point Mumbai.

THE MINUTES OF THE PUBLIC CONSULTATION WITH PROJECT AFFECTED PEOPLE OF GNYANESHWAR NAGAR, BKC AREA ON 28-11-2014.

Metro-3 work has been under taken by Metro Rail Corporation Limited (M.M.R.C.L) which is jointly owned by Govt. of India & Govt. of Maharashtra state. State has given the approval COLABA - BANDRA - SEEPZ - Metro 3 Project. This Project will be implemented, Monitored and financed by Japan International Co- Operative Associations (JICA) and as per their guidelines. Maharashtra State Government has declared Metro-3 project as "an important public project" & "Important City transport project" on 3rd March 2014. The approval is given for the Rehabilitation of the people who are affected by this project, as per Maharashtra Urban Transport Project (MUTP) Resettlement & Rehabilitation policy. As per the JICA Guidelines open public consultation were held and brochures were distributed, specially prepared with full details of the project and resettlement policy; in Marathi, Hindi & English languages to inform them about their rehabilitation from the place that is affected by this public project.

In response to various quarries raised by Project affected persons all information was given to them and their suggestion have been noted down.

Date	Time	Place
26/11/2014	11.00 am to 1.00 pm	NAMTREE, G-BLOCK BANDRA KURLA COMPLEX, BANDRA.

In the public consultation the following officers from the MMRCL had guided the slum dwellers / shop owners (PAP's).

1) Mr. Ramana – Executive director.

2) Mr. Vishram Patil - General Manager (SOCIAL development) M.M.R.C.

3) Mr. G. C. Mangle – Add. Collector (PU & PU)

4) Mr. Charuhas Jadhav – Dy. General Manager (Tunnel)

5) Mr. Vikas Tondvalkar – Joint Project Director (Environment)

6) Mr. Dani – Asst. Manager (Safety)

In the beginning a video film of the Metro-3 Project highlighting the importance of this Project, station location and alignment etc., was shown to the projects affected people; following officers guided the PAP's.

- Mr. Charuhas Jadhav: - He had given the detail information of project alignment station locations of Metro-3 to the people affected by this project.

- Mr. Vishram Patil: - He had given the detail information about the (MUTP and R&R policy) for those people who are affected by this project. He also had given guidance about the persons those who can take the advantages / benefits of this project. Apart from this he had given very clear idea about survey, FLGRC, SLGRC, Information centers, the distribution of tenements and Rooms for the common usage of co-operative housing society & its maintenance fund etc.

- Mr. G. C. Mangle: - He had given the detail information about the details list of survey of the people affected by this project The name of the person affected, area affected, usage & ownership right etc. he had also given an information about how to give a complaint / Request in writing and also, which officer to be contacted.

In this public consultation 205 people were present who were affected by this project. The list of the persons present is attached as appendix – 1. The details about point raised by the project affected persons and reply to their quarries have been tabulated below:-

Sr. No.	The points that were raised by the PAP's.	The information provided by the officers
1	We are the people from BKC division /area. We are the affected one you all know the present rate of this BKC division /areas land, so our rehabilitation must be done in this area only.	Till today MMRDA has built Rehabilitation Room only at 45 different places. Out of which the nearest & sufficient in quantity are at Wadala Bhakti park & Oshiwara. At present at BKC div. MMRDA Rehabilitation Rooms are not available in sufficient numbers.
2	Only 2 options like / Wadala and Oshiwara are told but there are various other colonies of MMRDA.	Replied as above, however rehabilitation in other colony at various places can be taken into consideration as per the availability of rooms
3	In the list of survey there are mistakes in the names of the slum owners and notices are not yet received and numbered. Such small-small questions need attentions.	Any mistakes in the list of PAP's or numbering on the hutment, the concerned person has to submit an application with proofs/documents attached for his complaint. The complaint shall be investigated and necessary required action shall be taken to make any changes, if complaint found to be correct.
4	MMRDA colonies in Oshiwara and Bhakti Park location are situated, where no facilities are available.	At both the Places the work of basic necessities for development has been taken up by authority / under process. At Oshiwara Road development work is under process. At Wadala Mono Rail / Eastern freeway Projects are going on; Because of this, the different options of transport are being made available. Along with this the basic necessities are being developed here. Similarly at Wadala there's a proposal for development for the Important center like BKC. Complaints connected with MMRDA rehabilitation / resettlement colony are being attended.
5	We must get the Rooms of 269 sq. Feet as per the SRA-Revised Rule.	When MMRDA's Rehabilitation plans were getting Ready at that time SRA's Rule was only for 225 sq. ft. That's why only 225 sq. ft. Area's Rooms are available. In future when 269 sq. ft. size rooms are made available then those size rooms' distributions could be considered.

6	When rehabilitation was done at Aanik Panjrapole, within 2 months notices for vacating of the rooms were issued.	To qualify for resettlement the person for Aanik Panjarapole joint Road project survey was done by deputy Dy. Collector (Encroach & Removal) & this procedure was always delayed. When the project work started his/her Rehabilitation was done on temporary basis but the affected persons didn't submit the necessary documents with in prescribed time & hence the qualifying him /her wasn't done at all. So it was necessary to give notices to such project affected persons for getting them eligible. But in case of Metro-3 Project MUTP's standard would be applied. If the project affected persons names are in the surveyed list, then, there aren't any separate criteria for eligibility for resettlement.
7	In the natural calamities of 2005 many people's Important documents are lost. Now in such cases how could you consider the documents/proofs (of such persons)?	After calamity of 2005 approximately another 10 yrs. have passed & now new documents for this periods must be available. To qualify, the persons, eligibility is decided on the basis of survey. So old documents wouldn't be required. When these cases will be referred to the redressal committee then the available documents would be examined.
8	Give Rehabilitation at SRA at "KURLA PREMIER" site.	The Rehabilitation Rooms are built only for Airport project therefore its availability is uncertain in this present situation. But for Metro project affected people we could try to get those Rooms.
9	We still have many more points, how would we get further information regarding them?	Regarding any question Related to Rehabilitation one can visit / see Addn. Dy. Collector Similarly chief (social development class) could be given visit between 3 pm to 5 pm on Monday. Similarly visit can be given to Addn. Collector (social development cell) on Monday between 3pm to 5pm. Similarly in NAMTREE bldg. on the 1st floor, Public information center has been established and any information regarding Rehabilitation & maps are kept for perusal by the project affected people.

10	Our rehabilitation should be done in a proper way otherwise we may resort to agitation.	The co-operation of project affected person is very good. Do continue your co-operation to complete the Rehabilitation task successfully. Administration will try to solve all the problems in reasonable manner.

The meeting then ended with thanks to all the participants with a request seeking co-operation of residents for timely implementation of the project.

MINUTES OF THE MEETING / PUBLIC CONSULTATION WITH PROJECT AFFECTED PEOPLE OF AGRIPADA (SANTACRUZ) & DHARAVI STATION AREA ON 02/12/2014.

Metro-3 work has been under taken by Metro Rail Corporation Limited (M.M.R.C.L) which is jointly owned by Govt. of India & Govt. of Maharashtra state. State has given the approval for COLABA - BANDRA - SEEPZ - Metro 3 Project. This Project will be implemented, Monitored and financed by Japan International Co-Operative Associations (JICA) and as per their guidelines. Maharashtra State Government has declared Metro-3 project as "an important public project" & "Important City transport project" on 3rd March 2014. The approval is given for the Rehabilitation of the people who are affected by this project, as per Maharashtra Urban Transport Project (MUTP) Resettlement & Rehabilitation policy. As per the JICA Guidelines open public consultation were held and brochures were distributed, specially prepared with full details of the project and resettlement policy; in Marathi, Hindi & English languages to inform them about their rehabilitation from the place that is affected by this public project.

In response to various quarries raised by Project affected persons all information was given to them and their suggestion have been noted down.

Date	Time	Place
02/12/2014	11am to 2 pm.	NAMTREE G - BLOCK BANDRA KURLA COMPLEX BANDRA – (East).

In the public consultation the following officers from the MMRCL had guided the slum dwellers / shop owners (PAP's).

1) Mr. Ramana – Executive director.

2) Mr. Vishram Patil - General Manager (Social Development) M.M.R.C.

3) Mr. G. C. Mangle – Add. Collector (R&R)

4) Mr. Charuhas Jadhav – Dy. General Manager (Tunnel)

5) Mr. Vikas Tondvalkar – Joint Project Director (Environment)

In the beginning a video film of the Metro-3 Project highlighting the importance of this Project, station location and alignment etc., was shown to the projects affected people. Following officers guided the PAP's.

- Mr. Ramana: - He had given the detail information of project alignment, station locations of Metro-3 to the people affected by this project.

- Mr. Vishram Patil: - He had given the detail information about the (MUTP and R&R policy) for those people who are affected by this project. He also had given guidance about the persons those who can take the advantages / benefits of this project. Apart from this he had given very clear idea about survey, FLGRC, SLGRC, Information centers, the distribution of tenements and rooms for the common usage of co-operative housing society & its maintenance fund etc.

- Mr. G. C. Mangle: - He had given the detail information about the details of list of survey of the people affected by this project The name of the person affected, area affected, usage & ownership right etc. he had also given an information about how to give a complaint /Request in writing and also, which officer to be contacted.

In this public consultation 39 people were present who were affected by this project. The list of the persons present is attached as appendix – 1. The details about point raised by the project affected persons and reply to their quarries have been tabulated below:-

Sr. No.	The points that were raised by the PAP's.	The information provided by the officers
1	Hon. MLA. Mr. Parag Alawani: - He said that the development plans could definitely get the co-operation from the leaders of public and he expressed his thoughts about the facts that there are problems that bother these people who suffer from various & serious difficulties of the project affected people. He proposed to find Rehabilitation Place near Milan ROB. He had also put a proposal to include persons of new Aagripada, Santacruz affected by this project in the SRA scheme there.	Hon. MLA's suggestion could be definitely given a thought & then such options could be definitely examined. But in case the option isn't available then PAP's Rehabilitation would be done in the bldg. of MMRDA.
2	We feel that our rehabilitation should be done at SION - DHARAVI, MHADA where Rooms are available.	MHADA is an independent organization and bound by their own policy and rules for allotment of teammates, if Rooms are available under these policy/rules then it may be considered.
3	We feel that all the Rooms /slums which are given I.D. no's should be given Rehabilitated	While making survey a few extra slums are given I.D. no's , but in practice, only required slums/huts that are necessary to be removed for the Engineering work (Project) are only given Resettlement.
4	At Dharavi's in BMC's Buildings few rooms are available for resettlement. We feel that our rehabilitation should be done there.	Your suggestions would be taken into consideration. However BMC has its own Rehabilitation projects. All the project affected people from Dharavi should give joint application and information about the availability of rooms there.

5	Godowns & shops are different. Godowns need more space & shops need less. So what is the provision for that?	As per MUTP Rules of non - Residential purpose the area equivalent to the place in use would be given. If the original area is more than 225 Sq. ft. then 225 Sq. Ft. will be given free of cost and balance area owner has to pay at the rate of ready reckoner. However maximum area 756 Sq. ft. can only be given depending upon the availability.
6	What could be the extra amount that has to be paid?	State announces the ready reckoner rates every year. As per Ready Reckoner, amount is to be

		paid.
7	What area would be given to the persons who have shop of lesser area?	For Example: - Whosesoever's affected structure (Shops) is of 100 Sq. ft., will be given 100 sq. ft. in rehabilitation. If only 125 sq. ft. of non-residential area available in MMRDA then, those who want to accept, they have to pay for extra 25 sq. ft. area. The rate would be charged as per Ready Reckoner.
8	In the natural calamities of 2005 many people's Important documents are lost. Now in such cases what rules will be applicable?	The date on which the survey has been done will be the date of eligibility for resettlement if they are found residing there at the time of survey. More than 10 years have passed after calamity of 2005. Since eligibility is decided on the basis of survey, old records for proof will not be required. All cases of complaints if any given to grievance redressal committee shall be scrutinized based on available records.
9	For rehabilitation you have mentioned only 2 locations – Oshivara & Wadala in the brochure but SRA's rooms are also available at many other places.	With reference to this present location affected by this project the nearest one for Rehabilitation are at Oshiwara & Wadala where ample rooms are available. Apart from this to have Rehabilitation in MMRDA's rooms at other places would be considered only after knowing the availability of rooms.
10	When can we start the Rehabilitation?	In general such Rehabilitation work is likely to start with in next 6 months.
11	It is observed that there are errors in name while making a survey.	To correct the name, affected persons has to give application with documentary proofs. Correction will be made after verification of the submitted documents.

12	We would like to have our rehabilitation in at KURLA – Premier location.	Till today MMRDA has done Rehabilitation of people at various 45 colonies where there are rooms of 225 sq. ft. But except Mahul, Vashi Naka, Mankhurd, Govandi vacant rooms are not available in large number. At present MMRDA's Rooms for rehabilitations are available at Wonderland - Oshiwara & Bhakti park – Wadala. At Kurla Premier rehabilitation rooms are built for airport Project, therefore at present its availability is not decided but we will try to get rooms for this Metro - 3 Project.
13	We must get the rooms of 269 sq. ft. As per the SRA revised rules.	When MMRDA's rehabilitation rooms were getting ready at that time SRA's rule was only for 225sq.ft. That's why only 225 sq. ft. area's rooms

		are available. In future when 269 sq. ft. rooms are made available for distribution it would be considered.
14	There is an independent group of displaced persons. All these affected persons would like to support with unity for rehabilitation.	If this project affected people give the details of their leaders/Representative then our further communication would be with them only in future. Or , even if personal support is likely to be given then concerned officer could be contacted.
15	When could be the next public consultation held?	For that, the information would be provided at the proper time.

This project affected people were given information that if they want to have any further information in addition to the above discussed points they can get it from the branch of Rehabilitation of MMRC.

The meeting then ended with thanks to all the participants with a Request seeking co-operation of Residents in timely implementation of the project.

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MINUTES OF THE MEETING / PUBLIC CONSULTATION WITH PROJECT AFFECTED PEOPLE OF SARIPUT NAGAR (Aarey Colony) on 11-12-2014.

Metro-3 work has been under taken by Metro Rail Corporation Limited (M.M.R.C.L) which is jointly owned by Govt. of India & Govt. of Maharashtra state. State has given the approval COLABA - BANDRA - SEEPZ - Metro 3 Project. This Project will be implemented, Monitored and financed by Japan International Co- Operative Associations (JICA) and as per their guidelines. Maharashtra State Government has declared Metro-3 project as "an important public project" & "Important City transport project" on 3rd March 2014. The approval is given for the Rehabilitation of the people who are affected by this project, as per Maharashtra Urban Transport Project (MUTP) Resettlement & Rehabilitation policy. As per the JICA Guidelines open public consultation were held and brochures were distributed, specially prepared with full details of the project and resettlement policy; in Marathi, Hindi & English languages to inform them about their rehabilitation from the place that is affected by this public project.

In response to various quarries raised by Project affected persons all information was given to them and their suggestion have been noted down.

Date	Time	Place
11/12/2014	11.00 am to 2.00 pm.	COMMUNITY HALL DURGA NAGAR SRA JOGESHWARI-VIKROLI LINK ROAD.

In the public consultation the following officers from the MMRCL had guided the slum dwellers / shop owners (PAP's).

1) Mr. Vishram Patil - General Manager (Social Development) M.M.R.C.

2) Mr. G. C. Mangle – Add. Collector (R&R)

3) Mr. Charuhas Jadhav – Dy. General Manager (Tunnel)

4) Mr. Vikas Tondvalkar – Joint Project Director (Environment)

5) Mr. B. A. Redkar - District Superintendent Land Records

In the beginning a video film of the Metro-3 Project highlighting the importance of this Project, station location and alignment etc., was shown to the projects affected people; following officers guided the PAP's.

- Mr. Charuhas Jadhav: - He had given the detail information of project alignment, station locations of Metro-3 to the people affected by this project.
- Mr. Vishram Patil: - He had given the detail information about the (MUTP and R&R policy) for those people who are affected by this project. He also had given guidance about the persons who can take the advantages / benefits of this project. Apart from this he had given very clear idea about survey, FLGRC, SLGRC, Information centers, the distribution of tenements and rooms for the common usage of co-operative housing society & its maintenance fund etc.
- Mr. G. C. Mangle: - He had given the detail information about the details of list of survey of the people affected by this project the name of the person affected, area affected, usage & ownership right etc. He had also given information about how to give a complaint /Request in writing and also, which officer to be contacted.

In this public consultation 202 people were present who were affected by this project. The list of the persons present is attached as appendix – 1. The details about points raised by the project affected persons and reply to their quarries have been tabulated below:-

Sr. No.	The points that were raised by the PAP's.	The information provided by the officers
1	The rooms you have proposed at Wadala bhakti park & Oshiwara for Rehabilitation are not acceptable by us. Project affected people's Rehabilitation should be done at PMGP colony, Nesco Aajgaonkar plot, Powai.	The rooms at Nesco, Aajgaonkar plot, Nirlon are already handed over to B.M.C. No rooms are available there with SRA. Till today MMRDA has built rehabilitation rooms at 45 various places, out of which the rooms at nearest location are available in sufficient numbers for rehabilitation at Wadala - Bhaktipark & Oshiwara.
2	Most of the project affected people work in the area at M.I.D.C or near Seepz. They could face the problem of their livelihood. Therefore all such people must be given Rehabilitation in the nearby area only.	Your suggestions for rehabilitation are noted down. We would definitely examine the rooms which are available in nearby area for rehabilitation & if you can give information regarding it. Resettlement may be considered in other MMRDA resettlement colonies if rooms are available. MMRC may consider framing the policy for helping poor affected families who may lose their jobs / livelihood due to resettlement.
3	Whether our names are in the survey's list? Is this list available on NET? Which are the proofs/documents required to become eligible?	At this moment rehabilitation dept. has the draft list of PAP's. Applications/representation as per draft survey list is received. All these applications would be examined & then final draft would be made available on NET. The project affected person's name must be in the survey's list & his structure must also be affected by project work, then only that person is eligible for rehabilitation. If there are mistakes in names & if the slum/room has not received ID no's then an application with proper proof(s)/document(s) has to be necessarily given. All such complaints shall be examined thoroughly & then decision will be taken for correction if required.
4	As per SRA revised rules rooms of 269 Sq. ft. are allotted but you have proposed rooms of 225 sq. ft. area.	When MMRDA's rehabilitation rooms were getting ready at that time SRA's rule was only for 225sq.ft. That's why only 225 sq. ft. area's rooms are available. In future when 269 sq. ft. rooms are made available for distribution it would be considered.

5	Will we get allotment letter before the actual work of project begins? In the earlier cases, the project affected persons were first shifted to transit camp & then they were given allotment letter.	Before the displacement of the project affected people the allotment letter would be given. In the earlier case of MUTP project the rooms/builds were not ready so the shifting was done in the transit camp. But here in the case of Metro project for slum owners such things may not require to be done.
6	When the rooms would be allotted?	Unless alternate rooms are allotted existing house will not be demolished. Sufficient time shall be given for shifting. As per the MUTP policy transport charges shall be paid.
7	If rehabilitation is provided in western side, it will be better. We will not go to Wadala or Oshiwara location.	Oshiwara location is in western side only.
8	What would be the method for rehabilitation? Would there be lottery system or rooms will be distributed after calling one by one?	Once the Rehabilitation building is decided, on the ground floor few rooms would be reserved for handicapped & old persons. Thereafter, Rehabilitation would be done by lottery system. If possible we may think of resettling people of same area in the same building.
9	You have said that unless the key of the allotted rooms are handed over demolition of existing structures shall not be done. Whether possession letter shall be given simultaneously?	The passion letter shall be given at the time of rooms' distribution. All rehabilitation shall be done as per government policy.
10	How much area shall be allotted for commercial purpose?	Whatsoever area is affected that same size/area shall be given. For ex: - If the affected area is of 100 sq. ft. Then for rehabilitation 100 sq. ft. Area (gala) will be given. But in case MMRDA's bldg. 125 sq. ft. size non-Residential galas are available and if PAP's wants to accept that, then as per Ready Reckoner rate/price extra 25 sq. ft. charges are required to be paid. As per availability maximum size/area of Commercial galas is 750 sq. ft. which could be given, out of which 225 sq. ft. area would be given free of cost.

This project affected people were given information that if they want to have any further information in addition to the above discussed points they can get it from the branch of Rehabilitation of MMRC.

The meeting then ended with thanks to all the participants with a Request seeking Co-operation of Resident in timely implementation of the project.

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MINUTES OF THE MEETING / PUBLIC CONSULTATION WITH PROJECT AFFECTED PEOPLE OF SARIPUT M.I.D.C. on 26-12-2014.

Metro-3 work has been under taken by Metro Rail Corporation Limited (M.M.R.C.L) which is jointly owned by Govt. of India & Govt. of Maharashtra state. State has given the approval for COLABA - BANDRA - SEEPZ - Metro 3 Project. This Project will be implemented, Monitored and financed by Japan International Co- Operative Associations (JICA) and as per their guidelines. Maharashtra State Government has declared Metro-3 project as "an important public project" & "Important City transport project" on 3rd March 2014. The approval is given for the Rehabilitation of the people who are affected by this project, as per Maharashtra Urban Transport Project (MUTP) Resettlement & Rehabilitation policy. As per the JICA Guidelines open public consultation were held and brochures were distributed, specially prepared with full details of the project and resettlement policy; in Marathi, Hindi & English languages to inform them about their rehabilitation from the place that is affected by this public project.

In response to various quarries raised by Project affected persons all information was given to them and their suggestion have been noted down.

Date	Time	Place
26/12/2014	11.00 am to 2.00 pm.	LABOUR WELFARE CENTRE ANDHERI-(East). Mumbai – 4000096.

In the public consultation the following officers from the MMRCL had guided the slum dwellers / shop owners (PAP's).

1) Mr. Vishram Patil - General Manager (Social Development) M.M.R.C.
2) Mr. G. C. Mangle – Add. Collector (R&R)
3) Mr. Nitin Patil-Upper – Add. Collector MMRC.
4) Mr. Charuhas Jadhav – Dy. General Manager (Tunnel)
5) Mr. Vikas Tondvalkar – Joint Project Director (Environment)

In the beginning a video film of the Metro-3 Project highlighting the importance of this Project, station location and alignment etc., was shown to the projects affected people; following officers guided the PAP's.

- Mr. Charuhas Jadhav: - He had given the detail information of project alignment station locations of Metro - 3 to the people affected by this project.

- Mr. Vishram Patil: - He had given the detail information about the (MUTP and R&R policy) for those people who are affected by this project. He also had given guidance about the persons those who can take the advantages / benefits of this project. Apart from this he had given very clear idea about survey, FLGRC, SLGRC, Information centers, the distribution of tenements and Rooms for the common usage of co-operative housing society & its maintenance fund etc.

- Mr. G. C. Mangle: - He had given the detail information about the details list of survey of the people affected by this project the name of the person affected, area affected, usage & ownership right etc. he had also given an information about how to give a complaint /Request in writing and also, which officer should be contacted.

In this public consultation 307 people were present who were affected by this project. The list of the persons present is attached as appendix – 1. The details about point raised by the project affected persons and reply to their quarries have been tabulated below:-

Sr. No.	The points that were raised by the PAP's.	The information provided by the officers
1	We should get 269 sq. ft. area's rooms as per new SRA rules.	When MMRDA's rehabilitation plans were getting ready at that time SRA's rule was only for 225 sq. ft. That's why only 225 sq. ft. area's rooms are available. If in future when 269 sq. ft. Size rooms are made available, then these size rooms' distribution may be considered.
2	Many homes are not given I.D. no. or homes are two but only one notice is received.	Whatever mistakes in survey are brought to the notice of this office for not giving ID no. etc. shall be examined for which PAP's has to give written application with documents, and decision for correction shall be taken if necessary.
3	We feel that our rehabilitation must be done in the same area. M/s Aakruti developers is implementing an SRA scheme through MMRDA and we should be rehabilitated through this scheme only.	We have to get information of the Metro-3 project affected people included in M/S. Aakruti Developers - SRA scheme. Moreover we do not know as to how many years this project will take to complete. Metro-3's project work can't be delayed till the SRA project is completed. For Metro-3 project the timely Rehabilitation is very essential. After acceptance of rooms allotted by MMRC, at a later stage PAP's can opt for shifting to developers SRA scheme as per the norms for qualifying in SRA scheme. They have to return /surrender already allotted rooms under MUTP scheme. However the criteria for resettlement in the SRA scheme and MUTP scheme are different and the concerned PAP's should take a note of this.
4	In Metro-3 project the local jobless persons should get jobs. Most of the project affected people work in the area at MIDC or near SEEPZ & they would face the problem of their jobs. Therefore all such people must be given rehabilitation in the nearby area only.	The point has been taken into consideration. Policy decision may be taken for helping those who may lose lost their jobs due to displacement & if they are below poverty line.

5	Whosesoever's land is bigger than 225 sq. ft. or whosesoever has private land, what is the actual provision for them as per rule?	Whosesoever's land is private they must submit their ownership documents/poof. Once their documents are examined by authority, proper decision will be taken. When the question of rehabilitation comes the real users would be given homes & the land owners could be offered the compensation for their land value as per the rules & regulations. Even if slum owner's rooms are bigger in area they will be given rooms as per the policy of the resettlement only.
6	The Rehabilitation societies are far away from the present school; therefore school children's journey would be extended. For school going children-long journey is not possible.	We shall examine the possibility of introducing a bus service from the Rehabilitation society to the original place. In near future there could be transport facilities available for connecting all the routes so that journey could be easier. The recommendation letter can be given to the students who are seeking admission in new school and facing any problem.
7	Many of PAP's homes have independent upper floor, where independent family is residing. What sort of solutions/plans is available?	At present there is no provision to provide resettlement for upper floor families as per existing rules of the State government. But if there is a stair case from outside for their residence and documentary proofs for their being independent residence is available, a policy decision may be taken about survey of upper floor structures, their qualifying criteria and benefits to be given for the upper floor rooms.
8	How many sq. ft. non-Residential galas are available in this scheme for Rehabilitation?	For Metro-3 project as per MUTP's Rules Regulations for rehabilitation the project affected persons (Non-residential/commercial) get new area which would be equivalent to the old affected area only for Ex:- If the affected area is of 100 sq. ft. then for rehabilitation, equivalent area of 100 sq. ft. area will be given. But in MMRDA's bldg. if 125 sq. ft. size non-residential shops are available and PAP's wants to accept, then as per Ready Reckoner rate, cost for extra 25 sq. ft. are required to be paid. As per availability maximum area of commercial galas is 750 sq. ft. this could be given out of which 225 sq. ft. area would be given free of cost.

9	Metro - 3 project is at the place where we are residing & our rehabilitation would be at the other place due to which we won't get any benefit out of it.	At Oshiwara & Wadala Bhakti park various transport PROJECT are being undertaken e.g. Monorail, Eastern freeway, Metro-2 etc. At Oshiwara new road development's work is being under taken & at wadala MONORAIL PROJECT has already been started. There is a proposal for Wadala to develop as important center like BKC. Looking at all these factors it is beneficial in future to have rehabilitation at Wadala.

This project affected people were given information that if they want to have any further information in addition to the above discussed points they can get it from the branch of Rehabilitation of MMRC.

The meeting then ended with thanks to all the participants with a Request seeking Co-operation of Resident in timely implementation of the project.

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(Translated copy from Marathi language to English)

REF: VI.ZA.PRU.PRA/Metro-3 line/2015/24 (MMRC LOGO)

To,

Hon. Police commissioner Police
Commissioner Office, Greater
MUMBAI 400001

SUB:- The minutes of the meeting of the proposed Mumbai Metro Line -3 (COLABA – BANDRA – SEPPZ) on dt.13/02/2015 at 6.00pm

Ref :- 1) This office letter no. T&C/MM-3CBS/Police/LA/2014dt.9/01/14
2) Your office letter no.PA /Kaksha-8 (11)30/8/14

With reference to the above subject, it is to inform that due to MUMBAI Metro line 3 (COLABA – BANDRA – SEPPZ) that due to proposed complete underground metro railway alignment which would be affecting police quarters of Maheshwari NAGAR Road no.16; M.I.D.C. police station , MMRCA-officers had arranged a meeting with the actual residents of government bldg.; police officers & authorities as well as their respective family members on 13/2/15, Friday at 6.00 pm. which was held in the premises of present police quarters and discussion was carried out.

The copy of minutes is sent herewith for your reference and for necessary action please.

Sd/-

(Ashwini Bhide)
Administrative Director

Mumbai Metrorail

Copy to: - For information as necessary action

1) Hon. Deputy Police Commissioner (Administrative) Police Commissioner Office, Greater MUMBAI.

2) MR. Prashant Holkar - Deputy Police Commissioner Division-10

3) MR. R. Ramana, Executive Director MMRC

4) MR. Anil Wankhede – DMC - MMRDA (Land Div)

5) MR. G. C. Mangle – Add. Collector (R&R)

6) MR. Pradip Sonawane - Assistance Police Commissioner Andheri (E) Div.

7) MR. Charuhas Jadhav – Dy. General Manager (Depot)

8) Mrs. Sangeeta Varade – Tahsildar MMRC

9) MR. Sanjay Dani - General Manager (Security) MMRC

THE MINUTES OF MEETING DT.13/2/15 AT MAHESHWARI NAGAR ROAD NO.16 M.I.D.C ANDHERI (E) DIVISION WITH FOR POLICE OFFICERS AND THEIR STAFF OF POLICE COLONY.

The metro line-3 project is undertaken by joint venture of Government of India with Maharashtra State Government (COLABA-BANDRA -SEPPZ) is a 33 Kms. complete underground PROJECT which has 27 proposed Railway stations. This project shall be implemented through Mumbai Metro Rail Corporation and is financed by JAPAN International Corporation Agency. (JICA)

This present PROJECT has been approved by from govt. of India and was published in the Gazette on dt.19/11/13 under Metro Act (Alignment). Maharashtra Govt. has declared Metro line 3 PROJECT as an "Important public project" & an "Important city transport project" .In this project police H.Q's state's Residential premises at Maheshwari Nagar Rd.no.16 ,M.I.D.C Andheri (E).are getting affected. In this premises there are 5 bldg, in which there are 16 flats for officers & 48 flats for police staff [Amaldar], a pump house. And a Gymnasium for all the residents of the staff & their family members .In Metro line 3 (COLABA-BANDRA –SEEPZ) out of 27 stations M.I.D.C station is the 25th Railway station for which 97 sq.ms permanently & 785 sq.ms. of temporary land is required .The residents of this police quarters will be required to be shifted temporarily at other locations during execution of the project and it is proposed to resettle them back after completion of the project by constructing new buildings in the balance leftover area.

With reference to the above subject all the officers, staff & their family members participated in the meeting on 13/2/15, Friday @ 6.pm at the police quarter's premises and detail discussion were carried out.

In this above meeting officers of MUMBAI METRO RAIL CORPORATION & following officers from Police Department guided the police officers, Amaldar and their families staying in the police colony

1) Mr. Prashant Holkar- Deputy Police Commissioner Parimandal-10

2) Mr. R. Ramana, Executive Director MMRC

3) Mr. Anil Wankhede – DMC MMRDA -Land Div.

4) Mr. Ghanshyam Mangle – Additional Collector –MMRC (R&R)

5) Mr. Pradip Sonawane –Assistant Police Commissioner Andheri (E) Div.

6) Mr. C. M. Jadhav –Gen. Manager [Depot]

7) Mrs. Sangeeta Borade –Tahsildar MMRC

8) Mr. Sanjay Dani-Deputy General Manager (Security) MMRC

In the beginning Mr. Pradip Sonawane the Dy. Police Commissioner Andheri East –made a preliminary introduction of all the present authorities there. After that Mrs. S. Borde –Tahsildar, welcomed all the police officer, staff(s), Police Amaldars as well as their family members on behalf of Mumbai Metro Rail Corporation & then she requested MR. R. R. Ramana to continue the further guidance. As per her request he had given the primary information about Metro line 3 project to the persons present there. Similarly he had also given information regarding MIDC station that it would need some space initially & mentioned that present residents will need to shift temporarily to some other places. The video of Metro- 3 project was shown to the people present there which actually mentioned the importance of Metro- 3 project & gave further more information.

Following are the points that were raised by the police quarter's residents including Police officers, Police staff, Amaldars, as well as their family members. MMRC's authority /officer replied to the related queries and guided them as follows:-

Sr.no.	The points that were Raised by the persons affected by this PROJECT.	The information provided by the OFFICERs.
1	Instead of giving temporary homes from MMRC, let us get permanent homes of our ownership, for such homes if we need to pay; we are ready to pay that amount.	These homes are GOVT. homes made available by home division for police officers & staff .In the present scenario to give ownership home by MMRC for Govt. officer/staff isn't possible. Regarding this there isn't any govt. policy decision, circular, plan or any standards about it.But regarding this present subject you may put forward a demand to state govt. through Hon. police commissioner.
2	Will it be possible for us to settle down permanently in the homes those will be provided by MMRC on the temporary optional basis?	Homes from MMRC given would be of temporary type optional homes only.in such types of homes one can't stay permanently there. As soon as this PROJECT gets completed /over the homes would be built by MMRDA /MMRC on the earlier govt. land & as when such homes allotment would be given to you then permanent settlement would be possible.
3	Will there be any arrangement done or expenditure paid by MMRDA/MMRC for shifting /transporting the police officers /staff & their members of family from police staff quarters?	Yes .the shifting /transporting expenditures would be paid by MMRDA /MMRC for shifting from police staff quarters
4	Will the fans, lights also be transported at the new govt. homes from old police quarters?	Yes, the fans, lights will also be transported at the new govt. homes from old police quarters.
5	Will the maintenance of the police quarters of state govt.be same [as the old one here]?	Yes, the maintenance of the police quarters of state govt.will be same as the old one here. It is expected because the homes provided by MMRC are for a short period on temporary basis.
6	There are many joint families staying here in police quarters of state govt.so give us larger/bigger homes than the present one	As per the order from the State for the area of homes the homes of similar area would be made available to the police officer /staff [&their members of families.
7	Is the information filled in the question form for homes is for our convenience only or how it is?	Yes, the information filled in the question form for homes is for our convenience only. these proper information would help us to take further decisions.

8	The option should be there with you to take another place instead of Maheshwari Nagar Rd.16, M.I.D.C Andheri (e) police divisional staff quarters.	Any other convenient option for land isn't available & as it is declared by Maharashtra Govt. that Metro-3 project as "Important city transport project .This land is very Important & is necessary for the project. No other suitable alternative land is available.
9	Public work(s) dept. & other Govt. homes must be made available for police officer/staff of police quarters & their family members so that these affected families needn't be re-shifted.	MMRC is ready to provide alternative room at convenient places .If rooms at any other locations are made available by government and residents are ready to shift there, police department can think and decide about it.
10	Is the parking arrangement available there for parking vehicle?	That facility would be given only if there is space availability in the shifted colony.
11	Is water supply available for 24 hrs?	As per the rules of B.M.C. the prescribed schedule water supply would be made available.
12	At present there is space provided for Gymnasium as well as for stage & open ground. Will those facilities be provided?	The space will be provided for Gymnasium in the option homes but the provision of ground, stage etc. Won't be possible at all.
13	Would you inform the Govt. about this present subjects meeting which is held today & the discussion we had?	The Minutes of this today's meeting held & the discussion we had would be given to police department/division along with the demands of the residents.

THE MINUTES OF THE PUBLIC CONSULTATION WITH RESIDENT/COMMERCIAL/NON-RESIDENTIAL PREMISES OWNERS OF KALBADEVI & GIRGAON DT. FROM 02/03/15 TO 04/03/15.

1) Metro-line- 3 (Colaba –Bandra –SEEPZ) project is implemented through Mumbai Metro Rail Corp Ltd which is a joint venture company of Govt. of India & Maharashtra State Government. Its alignment is 32.5 kms. Long and is completely underground which has 27 proposed railway stations. The Kalbadevi & Girgaon stations are proposed to be constructed under the subway /tube at Jagganath Shankar Seth road.

2) In this project the tube /subway is below the ground level at about 20 to 25 meters .Stations will be approximately at a distance of 1km. Though it's a tube /subway line, the passenger's entry /exit & its ancillary bldg. /ventilator shafts etc. would have to be built only above the ground. For which some part of land is required to be used .During construction work some adjoining land area will also be temporarily required (for 3 to 5 yrs.). For Kalbadevi & Girgaon (package-2) stations land admeasuring – 2064.00 sq.m. on temporary basis & 907.00 sq.m. On permanent basis & land admeasuring 1865.00 sq. m. on temporary basis & 787.00 sq. m. (Approximately) on permanent basis respectively are required. As per M.C.G.M plan road's breadth must be 27.4 meters but the present road width at this location is between 12 to 15 meters only. The arrangement s/facilities required for Metro PROJECT are planned as per the width of this road in the map .If the roads widths as shown in the map would have existed then none of the bldg.'s acquisition would have been necessary for this Metro project.

3) This area is always overcrowded and has high density population & there is a lack of open space. Similarly the road's width isn't as per the map .To acquire the necessary land for this project some part of few bldgs. are getting affected and families would need rehabilitation & that's necessary. Therefore in connection with this subject it was necessary to carry out the discussion on the problem of this project with the affected residents/families. So after giving information a few meetings were arranged as follows. The meetings intimations were given by letters to the related /concern persons.

4) These meetings were arranged in Ionox theater.CR-2 bldg. Nariman point, MUMBAI building wise and division wise -

SR. no.	Building's Name	Date	Time	No.of Representatives present
1	Narmada Trust. Kotak bldg. (17, 19) Madina house/Talathi house /Todiwala /Deepak gold /Munnalal Mansion A & B wings.	02/3/15	11.00 to 12.00 Noon	32
2	Mona chambers, fish market, Hem villa, Chhatriwala bldg.	02/03/15	12.30 to 13.30	85
3	Abehant Bldg.-1, Khan House Bldg.No.55/1,55/3 & 55/5 Rajheet, Kapadia Chambers.	2/3/15	15.00 to 16.00	52
4	Chira Bazar bldg.no.606 & 607 Sitapur Bldg.	03/3/15	11am-noon	25
5	Saif Dakshin, Vitthaldas bldg.V.I.P. Luggage	3/3/15	12.30 to 1.30	31

6	The open space between 2 bldg. Bank of India & Waman Hari Pethe jewelers, Shriram Bhavan Swami Niwas.	3/3/15	3 to 4 pm	24
7	Annapurna bldg. Kranti ngr.Ekta Niwas ,Dhaduma pokar	4/3/15	11.00 to 12.00 noon	83
				332 Total present

5) In the beginning of these meetings a briefing was made about MUMBAI Metro line 3, a prestigious project of Central Government and Maharashtra Government and its importance was narrated. Mrs. Ashwini Bhide the Managing Director of Mumbai Metro Rail Corporation & many other senior officers /authorities were present. In each & every meeting the opinions of the representatives of the residents and non-residential commercial shop owners and family details were taken. Their concerns about their rehabilitation were noted down.

6) 1st of all what is the need of this project for MUMBAI was explained. Information about project alignment, Station location, construction methodology was explained. TBM cut & covers stations, NATM station's many technical details were given in short. Many underground digging tests have been carried out. As the safest techniques are going to be used even for hardest rock, there is no fear of any danger in digging so deep at the distance of 20 to 25 mts. below the ground level. The weakest bldgs. Which may crack down anytime was surveyed with all the details. So while the construction work is on, all the safety measures are taken & all the planning's are done for their methodology of working to ensure its ground water level does not go further down .All the service channels /routes & the temporary traffic diversion & their alternative solutions were explained topeople.

7) The details of the land required for this PROJECT on permanent as well as on temporary basis were given. It was most clearly told /said that as the entire Metro Rail /stations are under ground, only very little land is required on permanent basis for entry /exit, for stairs, for ventilation shaft & sub-station. For this project people should not believe in the rumors that about 1000 to 2000 buildings are getting affected & would go for displacement/demolition due to this project .From Girgaon, Kalbadevi & Chira bazaar area. For 2 stations 26 bldgs. are going to get affected. Approximately 777 families would get affected due to this project .All these buildings are getting affected because of their very special type of construction. Though very little land is required on permanent basis for this project & in FSI development plan this much width of the road not being there reconstruction of the bldg. on the balance/remaining land is not possible. For increasing the roads width all the options would be examined & those options have to be accepted. To give rehabilitation to the project affected families in the same vicinity is the mind set of MMRC, for which deep study & its planning is required & MMRC is agreeable and ready to put those planning/proposals before the people. Unless proper plan of affected families rehabilitation is finalized & people give their consent for it, no building would be demolished. This was very clearly told and explained.

8) In this area many bldgs. are very old and about to collapse. Metro project is developing simultaneously which is a very big facility .An opportunity is available to have rehabilitation of the project affected family along with implementation of this Metro Project. Its quiet possible to have many more obstacles in the private plots development, even then due to this Metro PROJECT such obstacles are likely to be solved out to redevelop the project affected building in a "cluster" style for which a details plan has to be prepared & then to get consent from public as well as from state Govt. is the responsibility of MMRC which was expressed very clearly. Temporary redevelopment's ready options would be kept in front of the people very transparently .This was also explained .Co-operation of resident is very much essential and solicited since without their support and co-operation implementation is not

possible.

9) After this in every meeting, the present representative put forward their queries. All these queries were replied by MMRC.

All the points raised in all the meeting which were discussed out in public & the clarification given in the meeting is as follows-

Sr.no.	The points that were raised by the persons affected by this PROJECT.	The information provided by the OFFICERs.
[*]	Kalbadevi & Girgaon are the most Important spots. Here these families are staying since last 50 yrs. Their many generations have been staying there at the same place .Though the tube / subway railway is under the ground but considering the difficulty of rehabilitation & difficulties that we may face now we feel that alignment route should be reconsidered and changed At present these people have sufficient transport facilities so there is no need to displace this people & have this metro project here	This MUMBAI Metro PROJECT is taken in hand just to remove the traffic congestion problems of Mumbai roads .This Metro project is Important from the point of view to reduce road congestion so that in future safe & happy public transport would be easily available for the best transportation Metro line & stations are required where there is dense population so that citizen / traveler can have the facility to travel & the congestion is relieved .With this aim Kalbadevi & Girgaon Metro station are under this plan .Due to these stations nearby area would be developed & even there will be value addition .
[*]	As there is very less distance between Kalbadevi & Girgaon station and just near these stations there is a Western Rly., these stations should be excluded from Metro line.	In the suburban Rly. the local stations are at a distance of 800 mts. to 1 km. As per international guidelines/ rules in. in the thickly populated area it has to be at the distance of 500 mts. so that to no other transport is necessary to reach the stations. If these stations are excluded now, then all the facilities that would be available to the area would be missing forever and the area would be deprived of the new development. Without these stations there would be distance of 2.5 kms. between 2 stations & then no one can deny of the difficulties citizens may have to face. This point doesn't fit well in the Metro plan.
[*]	Do think about making tube /subway Rly. alternatively below Maharshi Karve Road instead of .J .S. Road	Before finalizing Metro -3 line many other options were given studied thoroughly & then only it has been finalized. Due to many more technical difficulties it is impossible to have Metro-3 line under Maharshi Karve Road .Apart from this all other legal facts & many other prescribed procedures are fulfilled & then only based on best option Metro3 line is finalized .It is very Important to note this point

[*]	1st of all construct the Rehabilitation bldgs. In the same area for this project affected families & then only begin the procedure of vacating the premises.	In the opinion of the MMRC that it is possible to have Rehabilitation of this project affected families of Metro -3 line project without changing station locations in the same area. Regarding this the detail study would be made & then final plan would be kept before the affected families'. Unless & until the necessary plan worth implementation isn't finalized for rehabilitation in the nearby area. No bldg. would be demolished.
[*]	While constructing rehabilitation bldgs. Cross maidan, Azad maidan & other open spaces must be taken into consideration.	Open maidan /grounds are very essential for cities and as per development control rules for land proper usage grounds cannot be used. Also considering many Hon. High Court's decisions, rehabilitation homes can't be constructed on open grounds. Since the Rehabilitation is possible in the same vicinity necessary plan shall be prepared.
[*]	Do put forward a detailed plan before the residents about the temporary & permanent rehabilitation after the suitable policy decision by the corporation.	Even if rehabilitation is decided to be in the same vicinity, until the bldg.'s construction works gets completed, the temporary rehabilitation is necessary and MMRC would give its full co-operation in making available the temporary rehabilitation in the same area. The bldgs. of BPT at P'Dmello Road, Back Bay Reclamation and at other locations which are available with MHADA would be checked . .Otherwise to have rehabilitation in the nearby vicinity, rent would be given to the residents.

[*]	Make a policy decision for rehabilitation of the residents like land owners, living with Pagadi systems or tenants ...etc.	If the rehabilitation is in the same /nearby vicinity to be done it shall be as per the development control rules and all shall be accommodated whether land lord or tenants ...etc. during resettlement.
[*]	A few representatives who were present agreed to give their full co-operation if the rehabilitation is in the same vicinity .They requested to produce detail resettlement plan and call them for to discussion again.	On behalf of MMRC thanks were given to those who had co-operated .the very clear idea was given to the people that regarding the rehabilitation in the same vicinity MMRC would make a detail study & then prepare a plan & then that would be represented to the residents. Request seeking co-operation of Resident was made/done.

10) A few people from Chira Bazar's fish market as well as few non-residential but project affected people demanded for the temporary rehabilitation in the same vicinity .The residents of the DHOOT PAPESHWAR bldg. demanded that their bldg. is in very good condition so insisted to find the other option or alternate way. Few residents also said that their bldg.'s were recently repaired & made in good condition either by MHADA or by tenants themselves. A few residents also insisted that temporary rehabilitation must be in the same vicinity only. A few residents also agreed to co-operated for rehabilitation on temporary basis in the other vicinity also but temporary non-residential /commercial shops arrangement must be done in the same vicinity/locality only.

11) After having listened to all the residents it was promised by the MMRC authorities /officers that all your suggestions /objections of project affected people would be definitely considered & the best possible beneficial decision would be taken. In future also the public consultation would go on & the plan for rehabilitation in the same vicinity would be prepared soon and then once again meeting would be held. It was told that today's meeting is not for taking any final decision but for arriving at a beneficial decision for all, after discussion with all affected persons.

The above meeting that was organized by MMRCL ended with the thanks to all the participants with a request seeking co-operation of residents for Metro Project which is an important project.

Nitin Patil
Additional Collector
& Special Land Acquisition Officer M.M.R.C

MINUTES OF THE MEETING / PUBLIC CONSULTATION WITH PROJECT AFFECTED PEOPLE OF SAHAR (SHANTI NAGAR) on 12-03-2015.

Metro-3 work has been undertaken by Metro Rail Corporation Limited (M.M.R.C.L) which is jointly owned by Govt. of India & Govt. of Maharashtra state. State has given the approval COLABA - BANDRA - SEEPZ - Metro 3 Project. This Project will be implemented, Monitored and financed by Japan International Co- Operative Associations (JICA) and as per their guidelines. Maharashtra State Government has declared Metro-3 project as "an important public project" & "Important City transport project" on 3rd March 2014. The approval is given for the Rehabilitation of the people who are affected by this project, as per Maharashtra Urban Transport Project (MUTP) Resettlement & Rehabilitation policy. As per the JICA Guidelines open public consultation were held and brochures were distributed, specially prepared with full details of the project and resettlement policy; in Marathi, Hindi & English languages to inform them about their rehabilitation from the place that is affected by this public project.

In response to various quarries raised by Project affected persons all information was given to them and their suggestion have been noted down.

Date	Time	Place
12/102/2015	11.00 am to 12.30 pm.	NAMTREE GR.FLOOR.M.R.C.BLDG. BANDRA – KURLA COMPLEX BANDRA (EAST)MUMBAI 51

In the public consultation the following officers from the MMRCL had guided the slum dwellers / shop owners (PAP's).

1) Mr. Vishram Patil - General Manager (Social Development) M.M.R.C.

2) Mr. S. K. Gupta - Director (PROJECT) MMRC

3) Mr. Nandargikar - Chief General Manager MMRC

4) Mr. G. C. Mangle – Add. Collector (R&R)

5) Mr. B. A. Redkar - District Superintendent land record

6) MR. Dani – Asst. General Manager MMRCL

In the beginning a video film of the Metro-3 Project highlighting the importance of this Project, station location and alignment etc., was shown to the projects affected people; following officers guided the PAP's.

- Mr. Nandargikar: - He had given the detail information of project alignment station locations of Metro - 3 to the people affected by this project.
- MR. Vishram Patil: - He had given the detail information about the (MUTP and R&R policy) for those people who are affected by this project. He also had given guidance about the persons those who can take the advantages / benefits of this project. Apart from this he had given very clear idea about survey, FLGRC, SLGRC, Information centers, the distribution of tenements and Rooms for the common usage of co-operative housing society & its maintenance fund etc.
- MR. G. C. Mangle: - He had given the detail information about the details list of survey of the people affected by this project the name of the person affected, area affected, usage & ownership right etc. he had also given an information about how to give a complaint /Request in writing and also, which officer should be contacted.

In this public consultation 128 people were present who were affected by this project. The list of the persons present is attached as appendix – 1. The details about point raised by the project affected persons and reply to their quarries have been tabulated below:-

In the beginning Hon. MLA Mr. Alvani presented his own view. Earlier this SAHAR (Shanti Nagar) residential area was not coming in Sahar station of Metro – 3 project, then how this new location has got included in Sahar station of Metro – 3 project. He stated that, it appears this has been done for facilitating Mumbai International Airport LTD. (MIAL) and sought clarification from MMRC officials, similarly he also emphasizes that all PAP's should be given rooms of area 269 sq. ft. and the same locality where they are staying at present. Earlier MMRDA has resettled the PAP's in the same area in Milan subway project and suggested that similar approach should be adopted for resettlement of PAP's affected due to Sahar metro station.

In addition, points raised by other persons who were present are as follows:-

Sr. No.	The points that were raised by the PAP's.	The information provided by the officers
1	Mr. Almeda. Ex- corporator said – 1. For resettlement, rooms of 225 sq. ft. are not acceptable. As per Daravi Patten rooms of 300 sq. ft. should be given. 2. Rehabilitation of PAP's should be done as per National rehabilitation policy 2007 in this matter orders of high court must be obeyed.	1. As per SRA a rule previously 225 sq. ft. was being given. Later on this rule has been change 269 sq. ft. area for SRA projects. For metro project we are making efforts to give rooms of 269 sq. ft. area at Kurla premier (Kurla-West), Kurla (East) & at Chakala. 2. Central Govt. has adopted rule for land acquisition & rehabilitation rule in 2013, in that rule there's no provision made for rehabilitation of slum owner on the public place. 3. However Government of Maharashtra has given approval for resettlement under MUTP policy and we are doing rehabilitation as per this policy.
2	Mr. N. Sureshan said "we are ready to accept rooms of 269 sq. ft. area only at Marol Andheri (East) as stated by you.	Our answer is same as above only.
3	Mr. Makdul Khan said - Earlier rehabilitation has been done at Marol fire brigade therefore Metro-3 project affected people's rehabilitation must be done there only.	Earlier only at Oshiwara / Wadala the rehabilitation was to take place. But now the rooms will be available for rehabilitation at Kurla premier & Marol Andheri (East) also.
4	Mr. Sachin Konde said – 1. For the joint family rooms of 225 sq. ft. are not sufficient for staying so bigger size rooms may be given. 2. Structures (Room) of 1st floor may be considered.	1. About area the clarification has been already been given. 2. The survey of first floor structures (rooms) will also be done. Regarding eligibility, benefits etc. a policy decision will be taken.

5	Mr. Shashikant Shirke- the rehabilitation of the local people must be done in SAHAR village only. What is the distance between every station?	We are making a note of your demand. Every station of Metro is approximately at 1 km. distance.
6	Mr. Almeda: - Till today there aren't basic facilities available at rehabilitation site at Kurla premier division. Even today rehabilitated families are sending their children for schooling at previous/old place only. We want things in writing from you that our rehabilitation would be in the local area only.	Cooperate with us to do survey, by which we would come to know exactly how many homes are getting affected due to this project. On the basis of this information only the rehabilitation plan would be drawn. After the co-op. society's registration by SRA, Bldg's repairing & one time upgradation of basic needs can be undertaken at site.
7	Mr.Makdul Khan:- If any of the N.G.O. interferes here in the work, would the rehabilitation stop? Similarly which rules are applicable for private land?	At present no N.G.O. is participating in rehabilitation work. Pvt. land's affected person's rehabilitation would be done as per land acquisition's rules(s)/with mutual consent.
8	Mr.Almeda:-MMRDA says that the project affected person's rehabilitation would be done in the local area only. Then why in Metro project rehabilitation is shown in other areas?	Earlier for rehabilitation rooms at Oshiwara and Wadala-Bhaktipark area were only available. Now rooms at Kurla–Premier, Kurla (East), Marol Andheri (east) may also become available. All these places are very close &nearby to our local division.
9	Mr.Almeda Airport authority's officers should be called for discussion.	This Metro project-3 is an MMRC's project. Therefore, this project affected peoples rehabilitation responsibility is on MMRC only.
10	We are the people affected on Airport land. So we should get rehabilitation benefit accordingly.	For Metro affected people's rehabilitation is as per MUTP rules. To qualify for airport project, person staying here must be of earlier than 01-01-200. But according to MUTP rules as on the date of BSES survey all the project affected persons found staying there are eligible. Therefore MUTP's rules for rehabilitation are beneficial for project affected people.

The Public Consultation ended with thanks to all the participants with a request seeking co- operation of resident during survey work and in timely implementation of the project.

The Minutes of the meeting with ACTION COMMITTEE of the project METRO LINE-3 affected people staying in bldg. on Dt. 16/03/2015

This meeting was held on 16/03/15 with ACTION COMMITTEE of the project Metro line-3affected people staying in bldg. at Girgaon-Kalbadevi at SRA office CR-2, Nariman point-Mumbai. The summary of the meeting held with KRUTI COMMITTEE is as follows.

1) Kurla Corporation insisted/suggested that the railway of Metro line-3 project must be from Maharshi Karve road rather than J.S. Road.

The lady administrative conductor spoke on this point & gave the information that plan of this project has been made by international consultant keeping in mind all the technical data's details & then this must be very much beneficial to very common man & then the railway path has been selected. During hearing public consultation also such question was raised and then the checking was done by technical experts/consultants whether this project could be passed from MAHARSHI KARVE road or not? There are various/infinite difficulties on Maharshi Karve road. The technical experts/consultants voted for rechecking the rly. path. Looking to all the sides of this situation the path of metro line-3 can't be changed.

2) The Central & Western rly. stn. are very close by Girgaon-Kalbadevi stations, so the residents said that Girgaon-Kalbadevi station aren't required such words were said by Kruti Committee in themeeting.

The lady administrative conductor said while giving can answer to this point she added that the Metro point-3 is for present population of the city & many more persons yet increasing the population in future of this city. Keeping in mind the present transportation of the city and Keeping in mind the next 100 years & the city transport that's available as public transport are being kept in mind.

Metro line-3 project is a plan made after points are being kept in the mind & mainly it's for public welfare/benefits. It's not only for Girgaon-Kalbadevi station but it's for the entire city's benefits, so kindly don't create any such objections in this public project on the contrary put your difficulties & suggestions & see there habilitation & redevelopment that will happen because this project, and all the necessary solutions to the questions would be found out & a full try will be made.

3) This project affected family's rehabilitation must be at the same place at Girgaon- Kalbadevi

Station.

The lady administrative conductor said while giving an answer to this point, the land to its only for entry & exit at metro station or other such related work it may be required. The land required for metro project & to Redevelop the affected bldgs. & similarly to have to have rehabilitation of the affected people at the same place [or in the same vicinity] what can be done.in such matter by consultants/advisors. A plan would be prepared by them & such well-prepared plan would be discussed / approved by affected people & whatsoever approvals that is required to be obtained from the state those all would be requested to state govt. The lady administrative conductor also added that unless until all the above procedures aren't in practice till then no other actions/procedures would be taken on the project affected bldgs. At Girgaon- kalbadevi-station.

4) The temporary transit [camp] of all the affected residents at Girgaon-Kalbadevi must be in the same area/vicinity. The lady administrative conductor said while giving an answer to this point. As mentioned earlier that expert consultants or advisors would be appointed & though would be given to all the possible options there similarly MHADA or other such state bodies would be consulted for the same. The extra confirmed rooms from / different projects for ex: - 337[7] & 33[9]... etc. [would be demanded by us] are demanded by us form MHADA office. Likewise the temporary transit [camp] would be in the same region between 500 to 1000 meters-such try would be done. In case if this isn't possible then the project affected families would be given rent that option would beapplicable.

5) The technical points of/about Metro-line-3:-

Many technical points of/about Metro-line-3Were raised for ex:- Borewell, quality of mountains, the railway path of the project, the techniques that are going to be utilized, similarly the effect[affect] on the old bldg. in this area because of this project work all these facts/factors are studies by MMRC or how about these The lady administrative conductor said while giving an answer to this point.-the world's best techniques would be used to plan & to implement this plan & such world -class consultants/advisors are appointed for his. Even the world- class technical know-how & such machine would be used for this whatsoever points are being raised all were studied in details. And a very brief report would be available for [our] information(s).

As this Metro project is tube/subway so all the construction would be done at around 20 to 25 below the ground/earth level so its construction work wouldn't have any affect in the surrounding bldgs.no danger would be there. Even otherwise a complete care/supervision would be kept on the entire surrounding by a very specially designed technique.

6) The redevelopment of the metro project affected rehabilitation of the affected families of this Girgaon- Kalbadevi have to be done in a very uniform method [in a united way] the lady administrative conductor said while giving an answer to this point. It's the [prime] responsibility of MMRC to have redevelopment of the Metro project affected bldg. Rehabilitation of the affected families of this Girgaon-Kalbadevi area and accordingly the procedures would be adopted.

Similarly Metro project required land & other lands development in the area of Girgaon – Kalbadevi is a public issue too. it's not only in the limitations of MMRC .if the local people give the details point request about this then those points would be definitely put forth to the state govt.to the related dept. and then very proper procedures request can be done.

MAHARASHTRA INDUSTRIAL DEVELOPMENT CORPORATION

(Maharashtra State government undertaking)

Tel.no.25820703/25829569

Fax no.912225821886

off: Add: - Regional office M.I.D.C

Thane Div. office COMPLEX Bldg.1st fl.

wagle estate Thane -400604

Outward Reg. M.I.D.C/Pra.Ka.Tha.1/Marol-2340

Dt. 2/6/15 By.-RPAD

To,
1) M/S E.S.I.C plot no. 23
2) M/S Lalji Gadhu & co. plot no. 53/4
3) M/S Sarju House plot no. 10
4) M/S Ranbaxy Laboratories plot no . 89
5) M/S C.M.S Infosystem Pvt. Ltd. plot no. 91
6) M/S ACME glass seals pvt. ltd. plot no. 92
7) M/S Akruti Nirman O.S 4
8) M/S Slum rehabilitation Authority BANDRA MUM. plot no. AM27
9) M/S Executive Garment processor pvt. Ltd plot no. F-20
10) M/S Bikalane Fabrics plot no.F-21
11) M/S Electronic Regional test laboratory plot no.F7/8
12) M/S Sudha Vihar Restaurant F-6 [Industrial bldg3]
13) M/S Marine Electrical plot no.F-5 & F-6
14) M/S Power grade corp.India ltd.[Vyarvali Project BMC
15) M/S Western Region Electricity board plot no . F-3

Sub: - Marol Ind. Est./Area .About transferring land on temporary & permanent for Mumbai Metro 3 Ref: Mumbai Mahanagar Region Development Authority [M.M.R.D.A.] letter no.09 dt.12/01/15.

Respected sir,

With reference to the above subject you are informed that Metro line3 project is proposed through corporation's Marol industrial area. A few land/plot are affected due to this project. Corporation's representative & M.M.R.D.A-divisions representative have jointly inspected the site with demarcation given & surveyed the location. As per this, some of the areas which are distributed to, are getting affected to some extent on temporary & to some extent on permanent basis. Therefore it has been decided to conduct a hearing on 8/6/15 at 11.30 a.m. in this office for these affected areas. It is requested to all to remain present.

off: Add:- Regional office M.I.D.C Thane Div.
office COMPLEX Bldg. 1st fl. Wagle estate
Thane -400604

Yours faithfully,

Regional officer
M.I.D.C. Regional office.

THE MINUTES OF THE PUBLIC CONSULTATION OF PROJECT AFFECTED PEOPLE OF JANTA/ NAYA NAGAR – MAHIM AREA HELD ON 29/7/15.

Metro-3 work has been under taken by Metro Rail Corporation Limited (M.M.R.C.L) which is jointly owned by Govt. of India & Govt. of Maharashtra state. State has given the approval COLABA - BANDRA - SEEPZ - Metro 3 Project. This Project will be implemented, Monitored and financed by Japan International Co- Operative Associations (JICA) and as per their guidelines. Maharashtra State Government has declared Metro-3 project as "an important public project" & "Important City transport project" on 3rd March 2014. The approval is given for the Rehabilitation of the people who are affected by this project, as per Maharashtra Urban Transport Project (MUTP) Resettlement & Rehabilitation policy. As per the JICA Guidelines open public consultation were held and brochures were distributed, specially prepared with full details of the project and resettlement policy; in Marathi, Hindi & English languages to inform them about their rehabilitation from the place that is affected by this public project.

In response to various quarries raised by Project affected persons all information was given to them and their suggestion have been noted down.

In the PUBLIC CONSULTATION the information was provided to the persons affected by this project & their suggestions were also noted down.

Date	Time	Place
29/07/2015	Morning 11.00am to 1.00 pm.	NAMTREE G- BLOCK BANDRA KURLA COMPLEX BANDRA.

In the public consultation the following OFFICERs / persons from the SRA had guided the slum dwellers / shop owners.

1) Mr. Ramana – Executive Director MMRC

2) Mr. D.C Divate-Chief General Manager (Rly Track] MMRC

3) Mr. Vishram Patil- General manager [Social Development] M.M.R.C.

4) Mr. G.C.Mangle-Additional Collector (Land Acquisition)

5) Mrs. Maya Patole-Dy.Collector (R&R)

6) MR. Dani – State Protocol (Security)] MMRC

In the beginning a video film of the Metro-3 Project highlighting the importance of this Project, station location and alignment etc., was shown to the projects affected people; following officers guided the PAP's.

- Mr. Ramana:- He had given the detail information of projects alignment ,stations locations of METRO 3 PROJECT to the people affected by this project. He explained the need for the lands/plots of Janata Naya Nagar-Mahim area for the project .Likely date for start of project work was explained by him in detail.

- Mr.Vishram Patil:- He had given the detail information about the rehabilitation and resettlement policy of MUTP for those people who are affected by this project. He also had given guidance about the persons who can be eligible to take the advantages / benefits of this PROJECT. Apart from this he had given very clear idea about survey, Redressal committees (FLGRC &.SLGRC) , information centers ,the distribution of tenements/rooms for the common usage of co-operative housing society & its maintenance fund etc.

- Maya Patole:-She had given all the details about the places for rehabilitation available to the project affected people .Public can complain any time regarding the rehabilitation to the concerned person she added in his

information .

Total-231 people affected by this PROJECT were present in this PUBLIC CONSULTATION. The list of the persons present here is attached as appendix-1.The points that were raised by the persons affected by this PROJECT in the PUBLIC CONSULTATION & the related information provided by the officer is given below

Sr.no.	The points that were Raised by the persons affected by this PROJECT.	The information provided by the OFFICERs.
1	Can we have a look at our rehabilitation place available?	Yes, plan in small groups & can see the rehabilitation sites.
2	In case our land / plot is required at an earlier stage then what would be the status of our rehabilitation?	Under Mumbai URBAN transport project (MUTP policy) policy permanent rooms under rehabilitation are given. It is proposed that rehabilitation of Mumbai Metro Rail corporation Naya Nagar –Mahim area's project affected people rehabilitation to be done at BHANDARI Metallurgy-Kurla (East) as the construction work of rehabilitation homes at this location is likely to be completed by December 2015.If before December, Naya Nagar, Mahim's land is required for project then (till the construction work gets completed) on temporary basis, rooms can be allotted at Bhakti park –Wadala or Oshiwara Andheri which are available with MMRDA
3	Can we have rehabilitation anywhere else except Bhandari Metallurgy?	MMRDA has option at Bhakti Park or at Oshiwara, where rehabilitation could be done in groups and can be considered. Area of 269 sq.ft is available at Bhandari Metallurgy whereas at other place it is only 225 sq. ft For any other option they have to apply in groups.
4	Who will pay Rs.20000/- per room towards the maintenance charges to co-op society?	As per rule Rupees.20000/- are received by SRA from the developer for each room. This amount is invested in bank on the name of MMRC & registered co-op society. The obtained interest can be used for the maintenance of the building. After 10 years this entire amount would be transferred in the name of the co-op housing society.

5	SRA scheme is being implemented at Naya nagar Division. If we wish to re-join this scheme can we do that?	The permanent rehabilitation would be done by MMRCL for that METRO-Rail line -3 project affected people .But if project affected. Persons would like to re-join SRA scheme then they must inform MRRCL in writing after returning /paying all the bills of the rooms distributed to them .While giving the allotment letters these all terms & conditions could be included & then on temporary basis possession could be given to them. If the persons are qualified for

		approved SRA scheme then they would be included.
6	Can this present land be re-available in SRA scheme?	At present the land at Naya Nagar area would be used for TBM launching machine. After the work gets over, such land would be returned to the earlier/original condition.
7	Would we have to manage for shifting / transportation?	Shifting/transportation would be done as per MUTP rules & regulations.
8	Will our rehabilitation be on temporary or on permanent basis?	MMRCL affected persons rehabilitation will be on permanent basis but those who would like to join SRA scheme & would like to have temporary rehabilitation would have to give such written application/information.
9	Though persons were present at the time of survey, even then old owner's name has been entered.	Your complaint must be very clear & it must be in writing. Such complaints would be examined properly & then decision would be taken.
10	While giving rehabilitation how the documents /papers would be examined to be eligible?	On each structures /hut ID no. has been given. If the name has been included in the survey list & if the structure is getting affected by the project work, then all such slum owners would be given rehabilitation as per MUTP- R&R policy.
11	What type of documents/papers would be given by you for rehabilitation?	Allotment letter & room's distribution letter will be given.
12	Can we give our property right to our legal heir?	The possession would be given to the person whose name is included in survey draft list. Once co-operative society is registered, and then you may give nomination for room /flat.
13	Can we again do the redevelopment of this bldg after 10 years of rehabilitation?	As per state Govt. rules these rooms can't be transferred till 10 yrs. for redevelopment/rehabilitation of the bldg. the rule & regulation would be applicable as per state govt. laws

The following suggestions/complaints of the affected persons those who were present are noted down which are as follows.

1) We would like to have rehabilitation at Bhandari Metallurgy. We don't want temporary rehabilitation anywhere else.

2) We would not accept 225 sq. ft. area's rooms. Our rehabilitation must be done at KURLA which has 269 sq. ft. size rooms.

3) We would choose our group leader & we would make & represent the special draft /list for rehabilitation to be done in groups

4) If Kurla rehabilitation homes construction work is delayed then other option for rehabilitation could be Oshiwara/Bhakti Park.

The meeting then ended with thanks to all the participants with a request seeking Co-operation of Resident in timely implementation of the project.